

# Pipeline Facility Construction Inspection

API RECOMMENDED PRACTICE 1184  
FIRST EDITION, XXXX 202X

DRAFT

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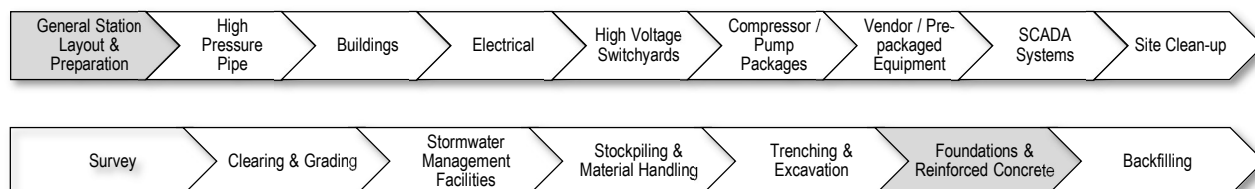
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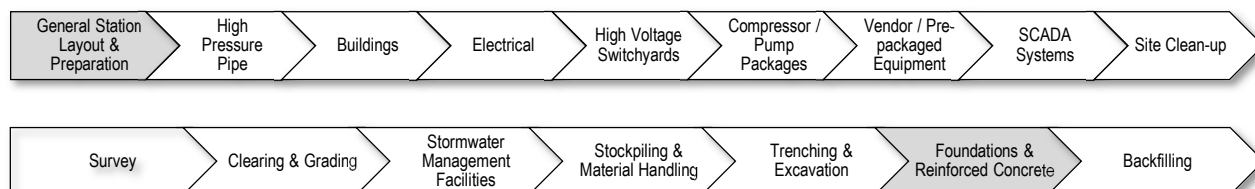
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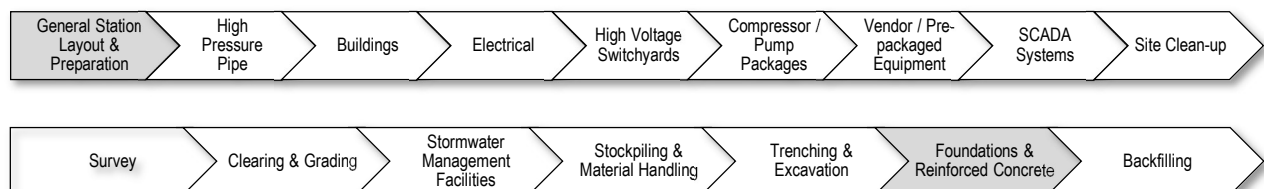
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## Contents

# DRAFT





# Pipeline Facility Construction Inspection

## 1 Scope

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

The scope of this document is limited to gas and liquid pipeline facility construction. Specifically, content is focused on those items that are relevant to the role of an Inspector as it relates to best practices within the industry in the United States and Canada. This document provides Inspectors with background and context, beyond existing regulation, regarding best practices in the industry. Whereas the content is organized in a manner consistent with construction of new facilities, where relevant, the content can also be applied to construction associated with existing facilities (e.g. maintenance-related activities). This document is not intended to be fully comprehensive of all systems which may be located within a pipeline transportation facility.

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

This recommended practice was based on *The Practical Guide for Facilities Construction Inspectors*, developed in partnership by the INGAA Foundation and the CEPA Foundation.

## 2 Normative References

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

API Standard 1104, Welding of Pipelines and Related Facilities

CGA 1, Best Practices

## 3 Terms, Definitions, and Abbreviations

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

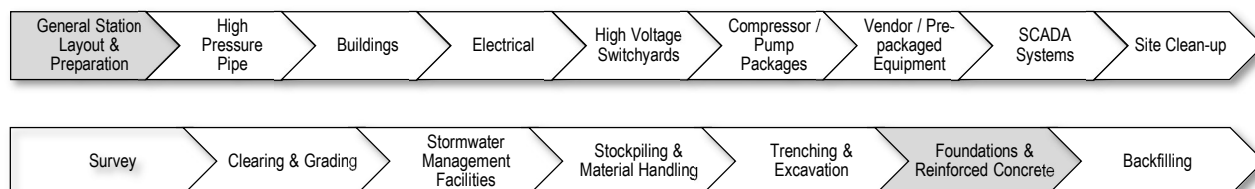
### 3.1 Terms and Definitions

#### 3.1.1

activity quality plan

AQP

<sup>1</sup> Common Ground Alliance, 908 King Street, Suite 330, Alexandria, VA 22314, <https://commongroundalliance.com>.



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

### 3.1.2

#### **chainage**

#### **station numbers**

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

### 3.1.3

#### **confined space**

Any tank or space that meets all three of the following requirements:

- is large enough and so configured that an employee can bodily enter and perform assigned work;
- has limited or restricted means for entry or exit;
- is not designed for or meant to be continuously occupied by employees.

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

### 3.1.4

#### **contractor**

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

### 3.1.5

#### **corrective action**

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

### 3.1.6

#### **ditch plug**

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

### 3.1.7

#### **exclusion zone**

Area where access is controlled due to increased hazard.

### 3.1.8

#### **facility**

All those systems, equipment, and pipe physically located within the confines of a compression, pumping, or meter station usually delineated by fencing and are sites intended to transport, store, measure, or otherwise transform the products moving within the site and may include, for example, meters, pumps, compressors, drivers, tanks, vessels, flares, and pressure vessels.

### 3.1.9

#### **heritage sites**

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

### 3.1.10

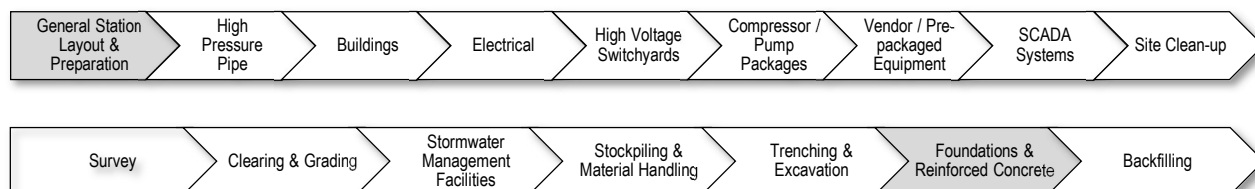
#### **holiday**

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

### 3.1.11

#### **inspection and test plan**

#### **ITP**



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

### 3.1.12

#### **inspector**

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

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

### 3.1.13

#### **material test report**

##### **MTR**

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

### 3.1.14

#### **nonconformance**

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

### 3.1.15

#### **one call**

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

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

### 3.1.16

#### **operator**

Entity that operates a pipeline.

### 3.1.17

#### **permit-required confined space**

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

- contains or has the potential to contain a hazardous atmosphere;
- contains a material with the potential to engulf an entrant;
- has an internal configuration such that an entrant could become trapped or asphyxiated by inwardly converging walls or by bottoms that slope downward, tapering to smaller cross-sections;
- contains any other recognized serious safety or health hazard.

### 3.1.18

#### **quality**

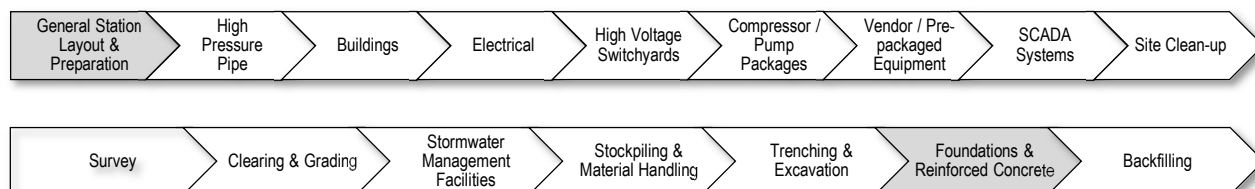
The degree to which requirements are fulfilled by an object's inherent characteristics.

### 3.1.19

#### **quality assurance**

##### **QA**

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



### 3.1.20

#### quality control

##### QC

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

### 3.1.21

#### quality management system

##### QMS

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

### 3.1.22

#### right-of-way

##### ROW

The property in which an operator and a landowner both have a legal interest, usually established through a written document known as an easement.

### 3.1.23

#### safety culture

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

### 3.1.24

#### strength test

A test is used to establish the operating pressure limit of a pipeline segment.

### 3.1.25

#### test bus

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

### 3.1.26

#### tolerance zone

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

### 3.1.27

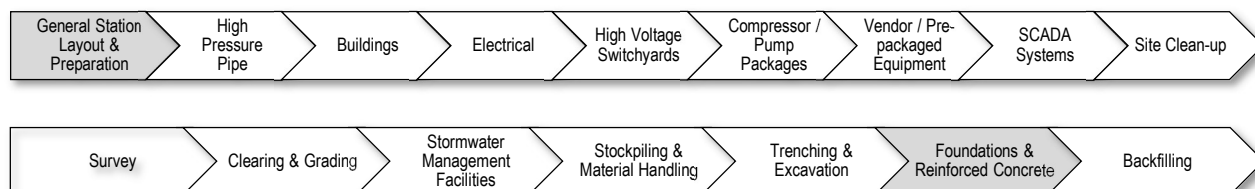
#### weld maps

Drawings indicating pipe and fittings, locating welds, pipe, fitting and heat identifying numbers.

NOTE Jurisdictions often define tolerance zones.

## 3.2 Abbreviations

|        |                                  |
|--------|----------------------------------|
| ALARA  | as low as reasonably achievable  |
| AQP    | activity quality plan            |
| CFR    | code of federal regulations      |
| HAZCOM | hazard communication             |
| HAZMAT | hazardous material               |
| HVAC   | high-voltage alternating current |
| GIS    | geographic information system    |
| GPS    | global positioning system        |



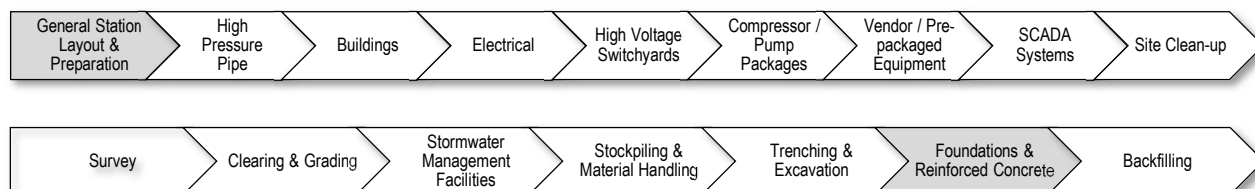
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|        |                                                 |
|--------|-------------------------------------------------|
| IDLH   | immediately dangerous to life and health        |
| ITP    | inspection and test plan                        |
| JSA    | job safety analysis                             |
| LEL    | lower explosive limit                           |
| LFL    | lower flammable limit                           |
| LPG    | liquefied petroleum gas                         |
| LOTO   | lockout/tagout                                  |
| MAOP   | maximum allowable operating pressure            |
| MARSEC | maritime security                               |
| MAWP   | maximum allowable working pressure              |
| MOC    | management of change                            |
| MTR    | mill test report                                |
| NDE    | nondestructive examination                      |
| NDT    | nondestructive testing                          |
| NORM   | naturally occurring radioactive material        |
| OQ     | operator qualification                          |
| OSHA   | Occupational Safety and Health Administration   |
| PEL    | permissible exposure limit                      |
| PPE    | personal protective equipment                   |
| QA     | quality assurance                               |
| QC     | quality control                                 |
| QMS    | quality management system                       |
| ROW    | right-of-way                                    |
| SCBA   | self-contained breathing apparatus              |
| SDS    | safety data sheet                               |
| SWP3   | stormwater pollution prevention plan            |
| TWIC   | Transportation Worker Identification Credential |
| TWS    | temporary workspace                             |

## 4 Pipeline Facility Construction Inspector—Foundational Information

### 4.1 General

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



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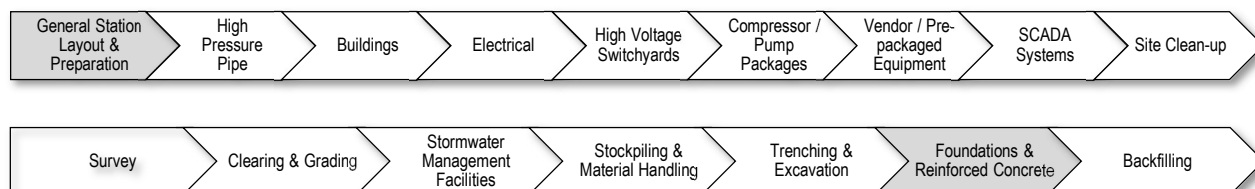
The Inspector acts as the Operator's authorized representative, observes the contractor's progress, and monitors all activities in their assigned areas in accordance with codes and standards; regulatory requirements; Operator safety and environmental requirements, drawings, plans, and specifications;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

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

**Table 1—Main Areas of Inspector Roles and Responsibilities**

| Topic Area                                           | Section Number |
|------------------------------------------------------|----------------|
| Authority                                            | 4.2            |
| Code of conduct                                      | 4.3            |
| Worker, site, and construction safety                | 4.4            |
| Quality, deficiencies, and nonconformance procedures | 4.5            |
| Environmental considerations                         | 4.6            |
| Execution of work                                    | 4.7            |
| Administration of contractual obligations            | 4.8            |
| Records management                                   | 4.9            |
| Personnel qualifications and certifications          | 4.10           |
| Equipment calibration                                | 4.11           |
| Incident reporting                                   | 4.12           |

**Figure 1—Typical Pipeline Facility Construction Phases**



## **4.2 Authority**

### **4.2.1 General**

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

Roles of the contractor and Inspector should be established before performing the tests or measurements to determine whether the work or an item complies with specifications and permit requirements.

The Inspector should be clear about the level and frequency of witnessing required and make sure that the equipment and instruments used by the contractor are correct and properly calibrated.

The Operator should make the contractor aware of the Inspector's duties and authority outlining quality, deficiencies, and nonconformance procedures.

### **4.2.2 Authority to Stop Work**

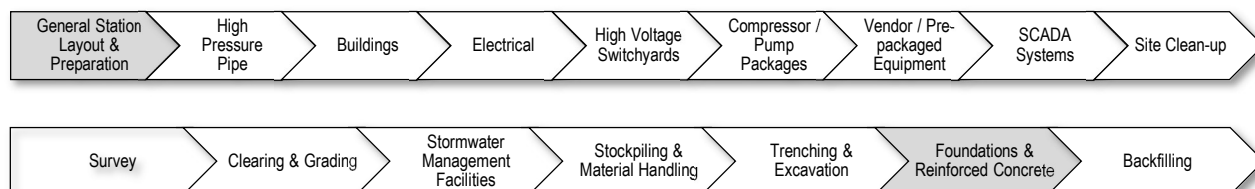
Inspectors are empowered and expected to shut down any work based on, but not limited to, conditions, situations, or activities that have occurred, are occurring, or may occur that could result in:

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

## **4.3 Code of Conduct**

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

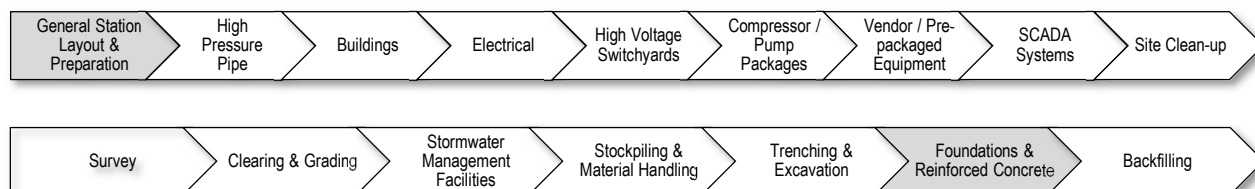
The ethical conduct required from Inspectors is governed by the Operator's Code of Conduct, which can include (but is not limited to) the items identified in Table 2.



**Table 2—Typical Code of Conduct Considerations**

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

#### 4.4 Worker, Site, and Construction Safety





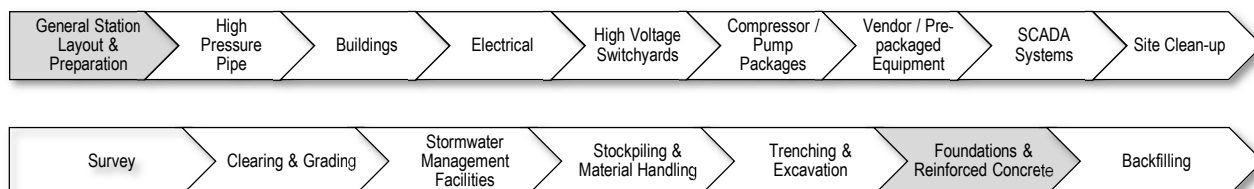
#### 4.4.1 General

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

In addition to safety items detailed in the following sections, the Inspector should keep in mind the overall safety culture and the items identified in Table 3.

**Table 3—Typical Safety Considerations**

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



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

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

| ✓ | Description                                                     |
|---|-----------------------------------------------------------------|
|   | H2S safety                                                      |
|   | Working alone policy                                            |
|   | Fall protection practice                                        |
|   | Restricted work areas policy                                    |
|   | Confined space entry practice                                   |
|   | Hearing conservation practice                                   |
|   | Manual lifting and carrying practice                            |
|   | Lockout/tagout (LOTO) procedure                                 |
|   | Vehicle and equipment safety practice                           |
|   | Drug and alcohol policy                                         |
|   | Job Safety Analysis (JSA)                                       |
|   | Short-service employee policy                                   |
|   | Fatigue management plan                                         |
|   | Incident reporting policy, including for near misses            |
|   | Other Operator- or project-specific requirements, as applicable |

## 4.4.2 Job Safety Analysis

### 4.4.2.1 General

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

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

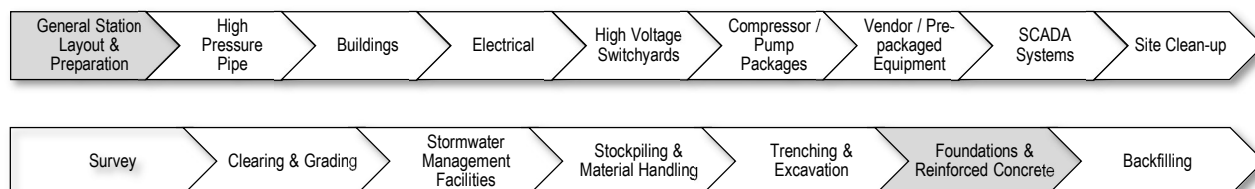
A new JSA should be conducted if conditions change, additional hazards are identified, or there is a change to the project scope.

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

### 4.4.2.2 Hazard Recognition

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

- Job site—Job site incidents, including, but not limited to, slips, trips and falls, pinch points, elevated work surfaces, planned lifts, atmospheric conditions, etc.
- Environmental—Changing environmental conditions, such as flooding, wind, dust, fires, and other potential conditions that could affect personnel and their work performance.
- Site-specific hazards—Physical features, such as terrain, waterway crossings, utilities (including overhead powerlines), general site conditions, and other features the facility construction activities.



- d) Climatic and other work condition hazards—The impact of adverse conditions, such as extremely hot weather (which could cause heat exhaustion and heat stroke) and cold weather (frostbite, hypothermia, encumbrance from extra clothing, etc.) on personnel.
- e) Materials and material handling—Materials, including, but not limited to, their use, movement, and handling within the job site to consider adverse exposure and potential handling incidents. This may include, but not be limited to, pipe, valves, fittings, equipment, and hazardous materials (HAZMAT). Use of safety data sheets (SDS) should be included along with hazard communication (HAZCOM) principles to inform workers of potential hazards and protective measures to be followed. Be aware of HAZMAT exposure during work activities.
- f) Work task review—An overall review of all major tasks to be performed since most construction activities involve moving equipment and lifting and carrying heavy loads in the proximity of personnel, buildings, equipment, utilities, tanks, trenches, holes, welding, metal sparks, and other hazardous activities.
- g) Emergency conditions—Preparation for response to safety-related incidents. Inspectors should be familiar with the emergency response plan, including, but not limited to, emergency phone numbers and locations of response equipment, such as water, fire extinguishers, first aid supplies, etc.
- h) Contractor Requirements—Inspectors should be familiar with the contract provisions regarding contractor(s) and their safety procedures and Operator expectations. The contractor should be monitored for adherence to their internal requirements, and project-specific requirements.

#### 4.4.3 Loss Prevention

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

#### 4.4.4 Occupational Safety

##### 4.4.4.1 Safety Meetings

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

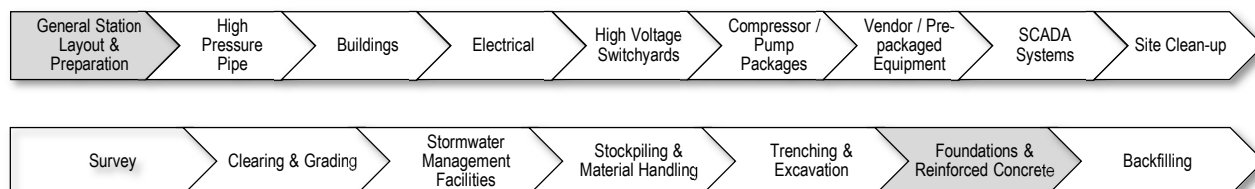
Inspectors should actively participate in all levels of safety planning in which they are engaged. Inspectors should actively participate in all safety meetings.

##### 4.4.4.2 Personal Protective Equipment

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

Inspectors should be knowledgeable about PPE requirements, uses, and limitations. PPE for facility construction activities includes, but is not limited to, approved equipment detailed in Table 5 and is project-specific based on the anticipated hazards (i.e. JSA per Section 4.4.2). Inspectors are expected to intervene when personnel are not wearing appropriate PPE as identified in Table 5.

**Table 5—Typical Examples of Personal Protective Equipment**



|   |                                                                                                                                 |
|---|---------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                     |
|   | Eye Protection                                                                                                                  |
|   | Safety glasses                                                                                                                  |
|   | Safety glasses with rigid side shields, goggles, face shields, and welding goggles and hoods                                    |
|   | Head Protection                                                                                                                 |
|   | Approved hard hats (generally required when injury could occur from impact or electrical shock; normally worn always)           |
|   | Foot Protection                                                                                                                 |
|   | Boots or shoes of leather or leather-type construction that cover the entire foot along with safety toes (normally worn always) |
|   | Hand Protection                                                                                                                 |
|   | Approved gloves (task dependent)                                                                                                |
|   | Hearing Protection (based on noise level survey)                                                                                |
|   | Ear plugs                                                                                                                       |
|   | Ear covers with suitable noise reduction factors                                                                                |
|   | Safety Apparel                                                                                                                  |
|   | Long pants and shirts with sleeves extending over the shoulders                                                                 |
|   | High visibility vest or other outer most high visibility clothing                                                               |
|   | Fire retardant clothing                                                                                                         |
|   | Chemical resistant suits                                                                                                        |
|   | Leather for metal spark protection                                                                                              |
|   | Respiratory Protection (may require specific training)                                                                          |
|   | Dust masks                                                                                                                      |
|   | Air-purifying respirators                                                                                                       |
|   | Air-supplied respirators                                                                                                        |
|   | Self-contained breathing apparatus (SCBA) respirators                                                                           |
|   | Personal gas monitors                                                                                                           |

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

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

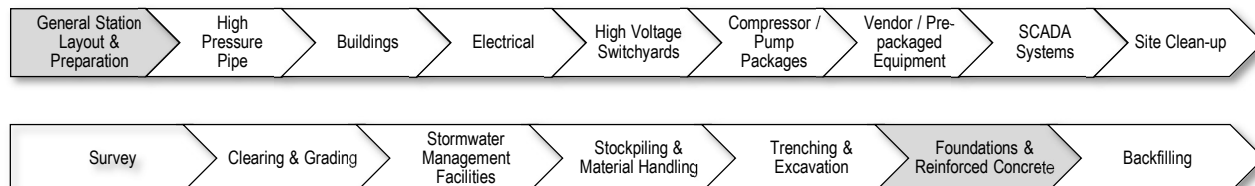
#### 4.4.4.3 Vehicle Operation

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

#### 4.4.4.4 Fatigue and Fitness for Duty

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

#### 4.4.4.5 Near Misses



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

#### 4.4.5 Site and Construction Safety

##### 4.4.5.1 One Call

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

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

##### 4.4.5.2 Site Security

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

- procedures for site security and other safekeeping procedures, including use of surveillance and monitoring devices, security personnel, barriers, locking devices/systems, fencing, and other methods to deny access to materials, supplies, and equipment;
- traffic control, barrier, and marking procedures;
- familiarity with and requirements for Transportation Worker Identification Credential (TWIC) and Maritime Security (MARSEC); this is only necessary when working in facilities covered by these requirements; Operators should provide training on the pertinent requirements;
- Inspectors are responsible for recognizing and reporting security concerns to the operator, including but not limited to:
  - a) terrorist threats;
  - b) threats of sabotage;
  - c) threats of violence, including workplace violence;
  - d) labor disruptions, protests, or work stoppages.

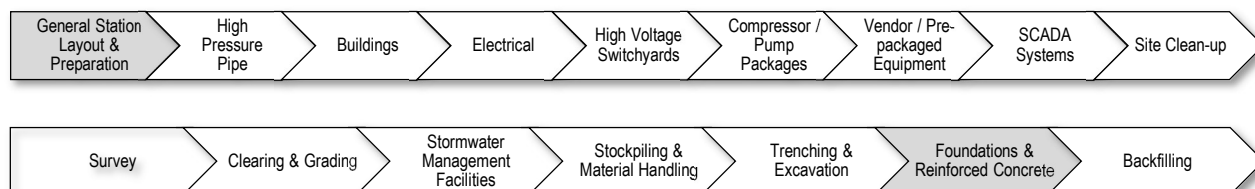
##### 4.4.5.3 Isolation of Hazardous Energy Sources

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

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

##### 4.4.5.4 Safe Use of Tools

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



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

Key factors for avoiding these hazards include:

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

#### **4.4.5.5 Safe Use of Equipment**

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

Safety considerations include:

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

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

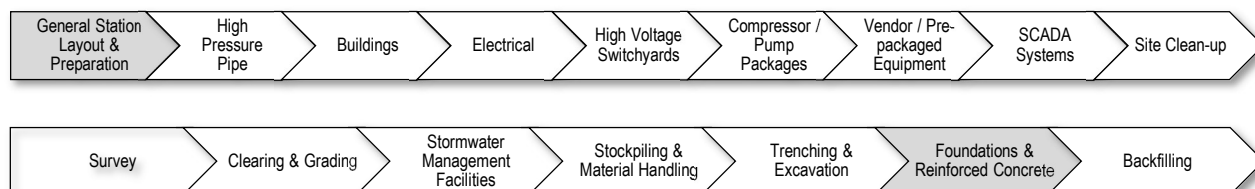
It is a contractor's responsibility to inspect and maintain their equipment. Inspectors should be aware and observant of the movement, storage, condition, and inspection of tools, equipment, and materials being used in facility construction work, even though these materials may be owned and used by the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

#### **4.4.5.7 Confined Space Entry Requirements**

Inspectors should be familiar with the confined space requirements for facility construction. A confined space is a space that can be bodily entered by an individual but is not designed for continuous occupancy and has a limited and restricted means of entrance or egress.

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

Inspectors should also be aware that areas may contain an atmosphere that is hazardous (toxic, explosive, oxygen deficient, or otherwise harmful to personnel). Inspectors should be aware that permits are required for confined space entry when either a hazardous atmosphere exists, it contains material



where an occupant could be engulfed, or is configured where an occupant could be trapped. Permit requirements for confined spaces are determined based on life critical safe work conditions.

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

#### 4.4.5.8 Atmospheric Testing

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

**Table 6—Potential Conditions for Atmospheric Testing**

| ✓ | Description                                                                                                                 |
|---|-----------------------------------------------------------------------------------------------------------------------------|
|   | Flammable gas, vapor, mist, or dust in excess of lower flammable limit (LFL)                                                |
|   | Hydrocarbon gas in excess of permissible lower explosive limit (LEL)                                                        |
|   | Oxygen deficient/excess environments where oxygen levels are immediately dangerous to life and health (IDLH)                |
|   | Other atmospheric conditions or concentrations of toxic contaminants that may be IDLH, such as H <sub>2</sub> S and benzene |

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

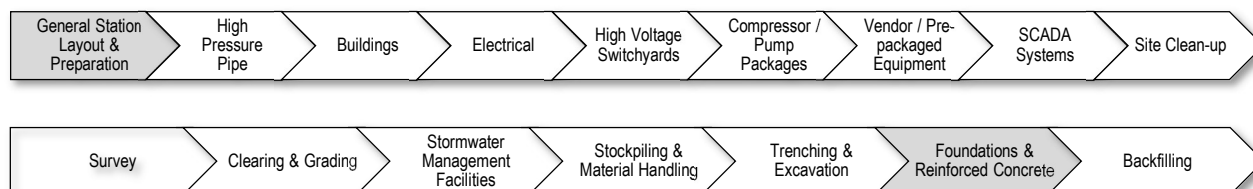
**Table 7—Facets of Atmospheric Testing**

| ✓ | Description                                                                                                                                                     |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | Products and materials (e.g. HAZMAT) being used on the job site that could be exposed during work activities and create hazards to personnel safety             |
|   | Physical properties of toxins (e.g. lighter/heavier than air) and permissible exposure limits (PELs), including use of safety data sheets (SDS) information     |
|   | Measurement and monitoring techniques                                                                                                                           |
|   | Use of testing equipment and procedures to calibrate this equipment, including calibration frequency and verification                                           |
|   | Precautionary measures to be taken (i.e. considering the findings from testing and monitoring) both prior to entry into, or work within, a hazardous atmosphere |

#### 4.4.5.9 Hot Work

Hot work is any task where the potential for a fire hazard is elevated (i.e. the presence of an ignition source and readily combustible material), requiring a permit prior to performing the work. Examples of hot work include, but are not limited to, welding, grinding, torch heating, and oxyacetylene cutting. Vehicles or equipment (i.e. dozer, crane etc.) entering a classified area. Inspectors should be aware of permit requirements and potential mitigation measures associated with hot work.

#### 4.4.5.10 Fall Prevention and Protective Systems



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Facility construction work sites commonly have fall and tripping hazards primarily due to excavations, congested areas with equipment, piping, tanks, vessels, buildings, cable tray etc. Inspectors should be aware of Operator requirements addressing these hazards.

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

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

#### **4.4.5.11 Scaffolding and Ladders**

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

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

#### **4.4.5.12 Protective Measures for Ionizing Radiation**

Inspectors should be aware of valid certification and licensing requirements for non-destructive testing (NDT) personnel handling radioactive sources. Inspectors should also be aware of signage and safety monitoring rules and requirements, and the rules and regulations for the locality that they are working in.

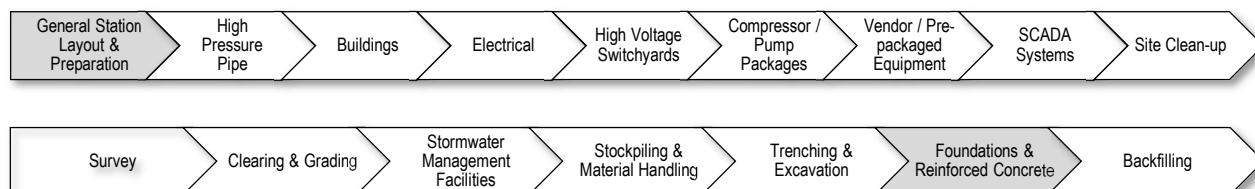
Inspectors should be familiar with and inspect the NDT contractor's conformance with radiation exposure dosage limits, monitoring methods, precautions needed, and documentation of radiation exposure.

#### **4.4.5.13 Protective Measures for Naturally Occurring Radioactive Material**

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

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

- development of written NORM work plan (need for plan determined by hazard assessment, and approved work plan applies to work being performed where NORM is above the exemption limits);
- implementation of training (a NORM training program includes courses on NORM awareness, NORM surveying, and NORM radiation safety officer duties);
- use of engineering controls (preventing human exposure using equipment and systems, such as shielding from piping);
- minimizing exposure to be as low as reasonably achievable (ALARA) (e.g. limiting time spent near NORM, working at maximum possible distance);
- use of PPE.





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

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

Flammable liquids—Liquids having a flashpoint below 100 °F (37.8 °C) are known as Class I liquids. The most common is gasoline.

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

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

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

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

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

All compressed gas cylinders and tanks should be properly secured and labeled when transported and stored with valve protective caps in place when cylinders are not in use. Cylinders, safety release devices, and piping should be regularly inspected to verify that the equipment and its appurtenances are in acceptable condition.

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

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

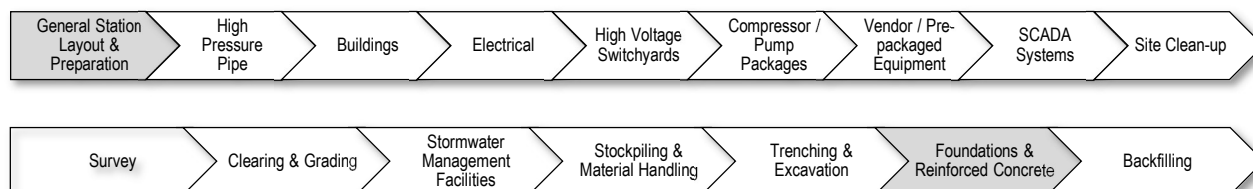
### **4.5 Quality, Deficiencies, and Nonconformance Procedures**

#### **4.5.1 General**

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

**Table 8—List of Typical Operator Quality Documentation**

| ✓ | Description                 |
|---|-----------------------------|
|   | QMS manual                  |
|   | Activity Quality Plan (AQP) |



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

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

#### 4.5.2 Escalation Processes

Since the Inspector monitors facility construction activities and operations for safety, stewardship of the environment, and compliance to project specifications and pertinent regulations, the Operator may 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 nonconformance (a recurring deficiency or major deviation from regulation or Operator specification such that safety, environment, structural integrity, cost, or schedule could be impacted). Any identified nonconformance(s) shall be addressed.

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

- stop work as per Section 4.2.2;
- verbal discussion with third-party representative;
- verbal warning with notification;
- escalation of corrective actions.

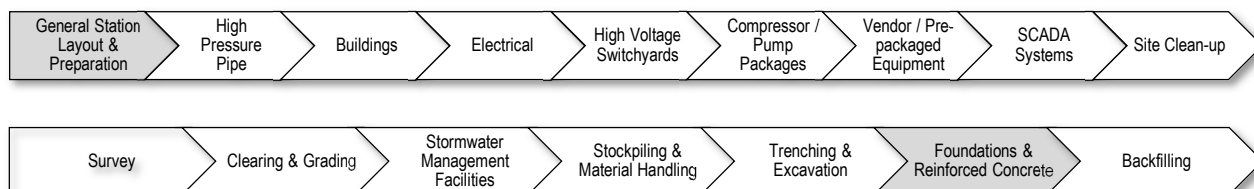
Inspectors are required to reject work, materials, and services that do not meet the standards, contract terms, specifications, drawings, or other requirements of the project. Decisions by the Inspector, inspection team, and/or Operator regarding quality, acceptability, and materials provided are final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

#### 4.5.3 Personal Violations

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

**Table 9—Examples of Personal Violations**

| Type    | Description                                                                                | Potential Consequence/Outcome             |
|---------|--------------------------------------------------------------------------------------------|-------------------------------------------|
| Conduct | Not wearing appropriate PPE                                                                | Removal of worker from worksite           |
|         | Wearing incorrect attire (e.g. muscle shirts, shorts, or clothes made of synthetic fibres) |                                           |
|         | Using headphones for radio/MP3 devices while on duty                                       |                                           |
|         | Roughhousing on the worksite                                                               |                                           |
|         | Not wearing seatbelts                                                                      |                                           |
|         | Not respecting environment or historical resources                                         | Permanent removal of worker from worksite |
|         | Being under the influence of drugs or alcohol                                              |                                           |
|         | Harassment in the workplace                                                                |                                           |
|         | Disregard for health, safety, and environmental procedures                                 |                                           |



| Type     | Description                                                                                                                         | Potential Consequence/<br>Outcome                                      |
|----------|-------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Worksite | Insubordination                                                                                                                     | Stopping use of or removing the vehicle or equipment from the worksite |
|          | Behaving in a manner that can cause serious harm or injury                                                                          |                                                                        |
|          | Not having proper guards or shrouds                                                                                                 |                                                                        |
|          | Not maintaining “safety zones” (i.e. fenced or otherwise marked areas based on the specifics of the project) at hazardous locations |                                                                        |
|          | Non-functional backup alarms on tracked equipment and rubber-tired vehicles                                                         |                                                                        |
|          | Not having canopies for clear operator vision on machinery                                                                          |                                                                        |
|          | Not having fire extinguishers or other required safety equipment                                                                    |                                                                        |
|          | Using defective tools or inappropriate use of tools                                                                                 |                                                                        |
|          | Equipment leaking fluids                                                                                                            |                                                                        |
|          | Any unsafe condition or practice, as determined by Operator or Inspection Resources                                                 | Construction shutdown                                                  |
|          | Construction activities not compliant with applicable safety, contract, procedural, and regulatory requirements                     |                                                                        |

#### 4.5.4 Regulatory Agency Inspections

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

### 4.6 Environmental Considerations

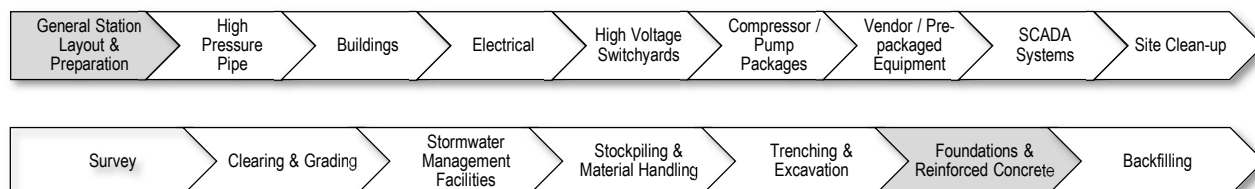
#### 4.6.1 General

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

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

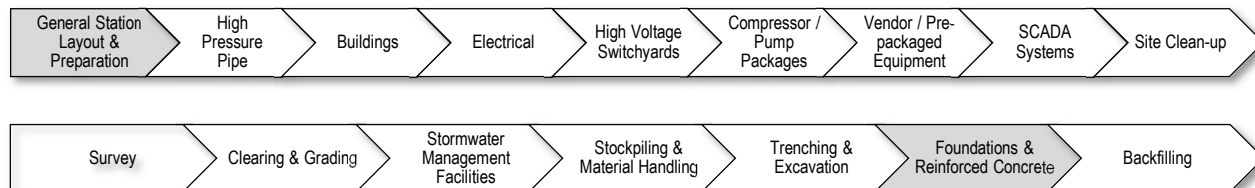
**Table 10—List of Typical Environmental Activities**

| ✓       | Description                                                                                                                                                                                                                                                                                                          |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| General |                                                                                                                                                                                                                                                                                                                      |
|         | Inform and instruct all personnel of environmental concerns, special conditions, regulations, Operator specifications, and specific permit conditions applicable to the construction area and the work itself                                                                                                        |
|         | Maintain contact with the project lead/manager                                                                                                                                                                                                                                                                       |
|         | In case of unanticipated disturbance or damage caused by construction activities, contact the Operator and mitigate as soon as possible to restore affected areas to their original condition (to the extent possible) in a manner satisfactory to the Operator, landowners, land holder, and regulatory authorities |



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

#### 4.6.2 Permits



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

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

- Air Permit
- USACE Permit
- Local Building Permits
- Water discharge permits
- Work Permits on public land;
- Work Permits on Private land;
- Fenced Enclosure Permits;
- Encroachment Permits;
- Water crossing Permits;
- Water Use Permits.

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

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

#### **4.6.3 Site-specific Concerns**

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

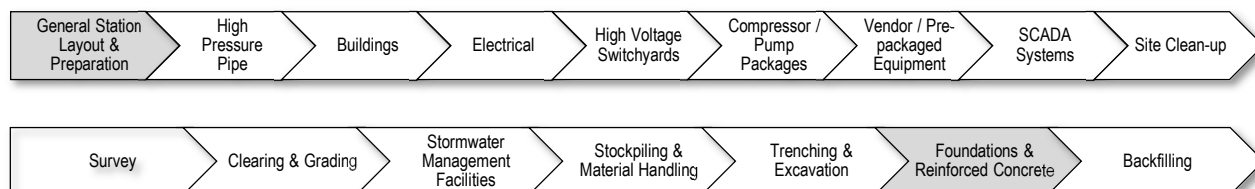
Contract provisions generally highlight those statutes that were considered during the project planning phase. They may be incomplete, and Inspectors should use their judgment to determine the presence or potential of hazards that were not identified to them by the Operator.

#### **4.6.4 Cultural and Heritage Concerns**

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

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

#### **4.6.5 Environmental Contamination**



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

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

- know the procedures to obtain samples, request analytical work, and recognize, handle, and monitor contaminated substances such as soil, coatings, sandblast media, fuels, solvents, and other waste and/or contaminants;
- confirm that waste generation and disposal activities related to the project are performed in accordance with Operator expectations and regulatory and permit requirements;
- check the plan of action for the remediation of suspected or actual contamination; Inspectors should have knowledge of who to contact and what response, if any, the Inspector may need to take in the event of an incident;
- monitor good housekeeping practices to collect and remove waste, including those classified as hazardous, from the work site at regular intervals.

#### **4.6.6 Use of Natural Water Sources**

Inspectors should be knowledgeable of the rules governing water withdrawal from and discharges to any natural water sources for water used in the facility including for hydrostatic test medium.

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

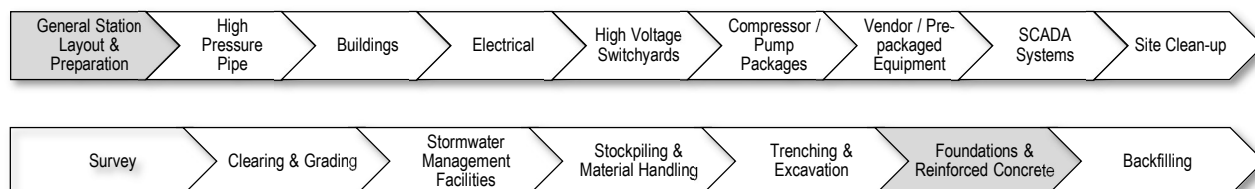
#### **4.6.7 Erosion, Sediment, and Runoff Control on the Pipeline Right-of-Way**

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

- the installation, uses, and maintenance of erosion, sediment, and runoff controls, such as diversion devices, silt fences, and other equipment for control of surface water;
- familiarity with stormwater pollution prevention plans (SWP3), including federal and state plans (where construction is taking place);
- 

#### **4.6.8 Flora and Fauna Concerns**

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



#### **4.6.9 Solid and Hazardous Waste Concerns**

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

#### **4.6.10 Hazardous Materials**

Inspectors should have a general understanding of the following:

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

### **4.7 Execution of Work**

#### **4.7.1 General**

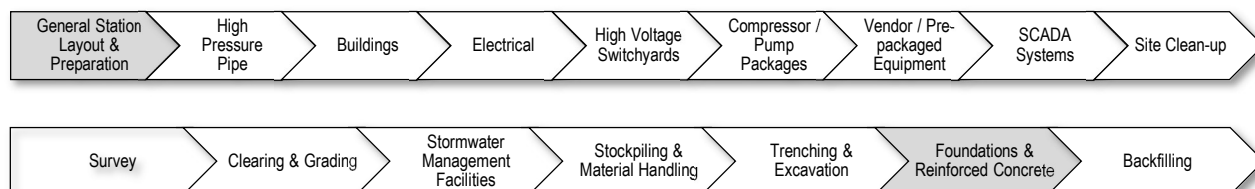
Monitoring work for conformance to Operator specifications is critical for meeting safety and environmental expectations. It is critical for ensuring the quality of construction that is necessary for long-term safety, environmental, and cost-effectiveness of the pipeline asset.

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

- disseminate and explain Operator specifications and project-specific documentation to other Inspectors (where required); it is key that the 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:
  - a) Construction manager / chief inspector (or designate);
  - b) Contractors and subcontractors;
  - c) Landowners (if applicable);
  - d) Land agents (if applicable);
  - e) Third-party representative (where applicable);
  - f) Facility operations personnel;
  - g) Project managers, procurement and engineers;
- follow site-specific communications protocol as defined in the project.

#### **4.7.2 Management of Change**

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



#### 4.7.3 Media Relations

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

### 4.8 Administration of Contractual Obligations

#### 4.8.1 General

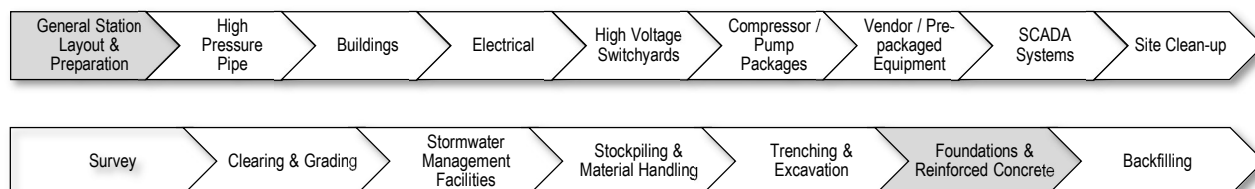
It is part of the Inspector's role to confirm that the contractor is carrying out construction activities/operations according to contractual obligations. The Inspector's role in the administration of contractual obligations is summarized in Table 11 and may include the need to be knowledgeable of the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

**Table 11—Inspector Role in Administration of Contractual Agreements**

| ✓ | Description                                                                                                                                                                                                              |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | Maintain documentation, communicate progress, and provide schedule updates per Operator requirements                                                                                                                     |
|   | Confirm that Operator agreements [e.g. crossing (encroachment) agreements, third-party utilities agreements, landowner agreements], based on the line list, are executed                                                 |
|   | Verify, approve, and forward contractor work items and materials daily to the Operator's authorized representative                                                                                                       |
|   | Perform material take-off and ascertain status of all materials                                                                                                                                                          |
|   | Obtain approval from the Operator's authorized representative or designee prior to commencing any extra work activities                                                                                                  |
|   | Confirm that only the most current revision of Issued for construction (IFC) drawings, approved contract documents, and specifications are referenced for construction                                                   |
|   | Confirm that all proposed deviations from specifications, design changes, or material substitutions are discussed and approved by the Operator's authorized representative or designee prior to proceeding with the work |
|   | Communicate lessons learned and foster an environment of continuous improvement, including participating in post-job review meetings                                                                                     |

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

| Type       | Description                                                                                                                                                                   |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Agreements | Railroad crossing agreements—These agreements are needed to cross any operating or abandoned railroad tracks along the proposed pipeline route                                |
|            | Pipeline crossing agreements—These agreements are needed to cross any existing operating or abandoned underground and aboveground pipelines along the proposed pipeline route |
|            | Utility crossing agreements—Needed to cross any operating or abandoned underground utilities along the proposed pipeline route                                                |
|            | Power line crossing agreements—Needed to cross any overhead power lines along the proposed pipeline route                                                                     |
|            | Road use agreements—Needed to use applicable public or private roads during construction to access pipeline construction sites                                                |





| Type      | Description                                                                                                                                                                                                                                                                                                                        |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           | Road crossing agreements—Required to construct pipeline under public or private roads during construction along the proposed pipeline route                                                                                                                                                                                        |
|           | Land use agreements, which may include provisions for: <ul style="list-style-type: none"> <li>- Facilities use agreement</li> <li>- Pipeline lease agreement</li> <li>- Pipeline installation lease agreement</li> <li>- Material stockpile site</li> <li>- Construction trailer site</li> <li>- Approved working hours</li> </ul> |
| Contracts | Material Stockpiling                                                                                                                                                                                                                                                                                                               |
|           | Construction survey                                                                                                                                                                                                                                                                                                                |
|           | Emergency Medical Service (EMS)                                                                                                                                                                                                                                                                                                    |
|           | Clearing/grading                                                                                                                                                                                                                                                                                                                   |
|           | Pipeline, facility, or integrity construction activities                                                                                                                                                                                                                                                                           |
|           | Non-destructive examination (NDE)                                                                                                                                                                                                                                                                                                  |
|           | Fabrication                                                                                                                                                                                                                                                                                                                        |
|           | Compaction testing                                                                                                                                                                                                                                                                                                                 |
|           | Trenchless crossings                                                                                                                                                                                                                                                                                                               |
|           | Contracts associated with (small) miscellaneous reclamation activities                                                                                                                                                                                                                                                             |

#### 4.8.2 Road and Highway Use

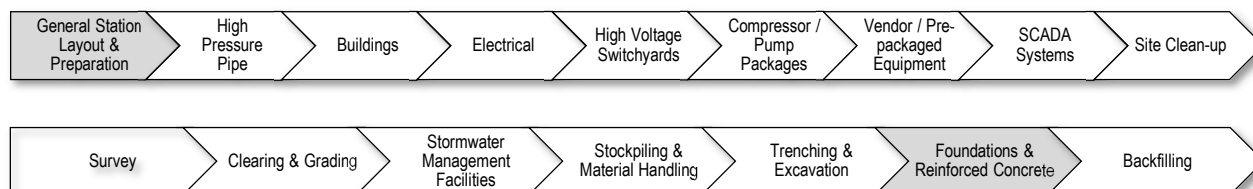
Inspectors should have knowledge of permit requirements and restrictions for transportation of dangerous goods, heavy equipment, trucks, and tracked equipment as to any size and weight restrictions relative to the roads and bridges being used by these types of vehicles.

#### 4.9 Records Management

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

**Table 13—Typical Activities Associated with Supporting Records Management**

| ✓       | Description                                                                                                                                           |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| General |                                                                                                                                                       |
|         | Monitor for timely completion and submission of all required documentation                                                                            |
|         | Confirm that all forms, reports, and submitted data are as complete and accurate as possible                                                          |
|         | Record all as-built information pertaining to the construction progress                                                                               |
|         | Provide information on an ongoing basis that assists in closing contractor claims                                                                     |
|         | When contractor deficiencies and/or nonconformances have been identified, monitor, document, and follow-up on Operator agreed-to actions until closed |
|         | Coordinate project data collection and provide reports to the Operator's authorized representative or designee as per specific timelines              |
|         | Gather data to support a post-construction evaluation and lessons learned document                                                                    |
|         | Review base scope and schedules to actual work performed and provide feedback                                                                         |



| ✓                  | Description                                                                                                                                                                                                                            |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                    | Complete production-related information on inspection forms and reports, and note: <ul style="list-style-type: none"> <li>- Equipment and consumables used by the contractor</li> <li>- Contractor personnel present onsite</li> </ul> |
|                    | Confirm that Near Miss Reports are completed and submitted                                                                                                                                                                             |
|                    | Confirm that Incident Reports are completed and submitted                                                                                                                                                                              |
|                    | Obtain formal approval and written agreement from the Operator's authorized representative or designee prior to commencing any extra work activities                                                                                   |
| <b>Daily</b>       |                                                                                                                                                                                                                                        |
|                    | Complete Inspection reports (e.g. materials, workmanship, areas, areas inspected)                                                                                                                                                      |
|                    | Complete construction progress reports (e.g. materials, workmanship, and areas inspected)                                                                                                                                              |
|                    | Review daily time sheets, where applicable (e.g. typically required on Time and Materials projects)                                                                                                                                    |
| <b>Weekly</b>      |                                                                                                                                                                                                                                        |
|                    | Confirm that Weekly progress reports identify potential cost and schedule issues and safety, environmental, progress, and QC issues                                                                                                    |
|                    | Maintain, coordinate, and communicate weekly progress and schedule on survey activities to the Operator's authorized representative or designee                                                                                        |
| <b>Project End</b> |                                                                                                                                                                                                                                        |
|                    | Prepare an end of project report if required                                                                                                                                                                                           |
|                    | Identify lessons learned and/or participate in sessions in support of lessons learned                                                                                                                                                  |

## 4.10 Personnel Qualifications and Certifications

### 4.10.1 General

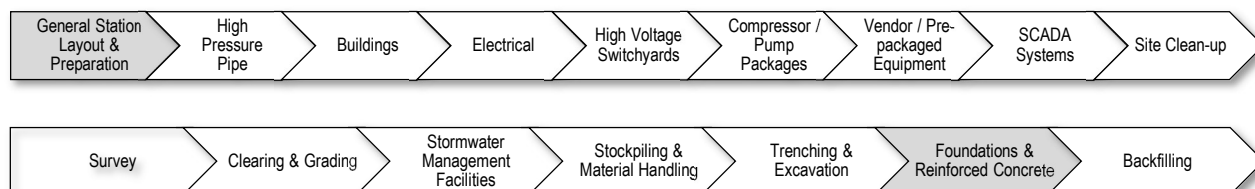
Confirming the qualifications of individuals allowed onsite is an important element of ensuring a safe construction operation as well ensuring that the work meets an acceptable level of quality. For example, welding operations have specific requirements for the qualification of welders and the work they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

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

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

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

### 4.10.2 Operator Qualification



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Inspectors in the United States should be knowledgeable about OQ, including, but not limited to, covered tasks and evaluation of qualifications. The Operator is responsible for communicating the OQ requirements to the Inspector and contractor. Inspectors should know which tasks related to their purview are covered tasks and the required documentation (e.g. inspection activities for tie-ins, application and repair of external coating, line locating, excavation of foreign utilities, backfilling a trench). Inspectors should be aware of Operator procedures related to new and/or short service employees.

#### 4.10.3 Verification of Construction Personnel Qualifications

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

**Table 15—Key Areas to Verify Certification and Qualification**

| ✓ | Description                                                                   |
|---|-------------------------------------------------------------------------------|
|   | Welding personnel                                                             |
|   | Heavy equipment operators                                                     |
|   | Blasting/explosive personnel                                                  |
|   | Excavation (competent personnel)                                              |
|   | Non-destructive examination (NDE) / non-destructive testing (NDT) technicians |
|   | Coating personnel                                                             |
|   | Corrosion control technicians                                                 |
|   | Safety professionals                                                          |
|   | Environmental specialists                                                     |
|   | Rotating equipment specialists                                                |
|   | Foundation and pilings specialists                                            |
|   | Tank, pipe, and vessel specialists                                            |
|   | Electrical and instrumentation personnel                                      |
|   | Pipeline inspectors                                                           |

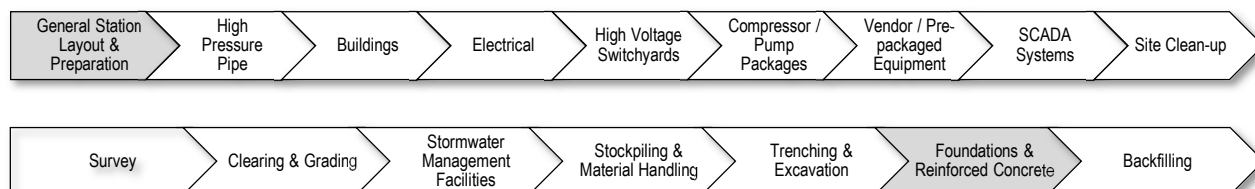
Facility regulation, code, standard, and practice references contain various provisions for use of certified, qualified, and/or competent personnel, including facility construction inspectors.

#### 4.11 Equipment Calibration

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

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

#### 4.12 Incident Reporting



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Should an incident occur, the Inspector is expected to assist the Operator (and where necessary, the local authorities) in conducting a formal and objective Incident Report. The Inspector should keep in mind the items identified in Table 16.

**Table 16—Typical Incident Considerations**

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

#### 4.13 References—Foundational Information

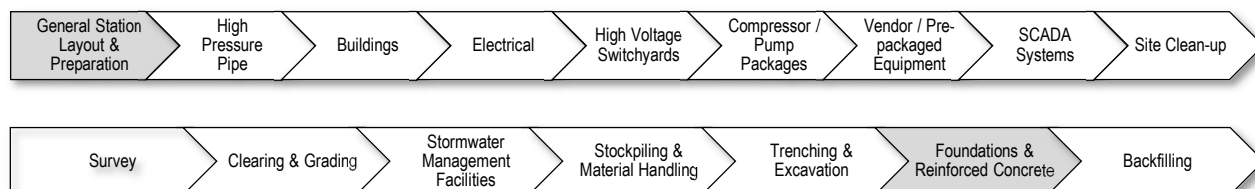
**NOTE** The reference information provided in Table 17 is intended as a guide only (i.e. the list is not exhaustive); documents of this nature are updated frequently, and it remains the responsibility of the user to reference the correct, and most current, documents as appropriate.

**Table 17—List of References—Foundational**

| Document No.                       | Type                 | Title                                                                           |
|------------------------------------|----------------------|---------------------------------------------------------------------------------|
| American Petroleum Institute (API) |                      |                                                                                 |
| API 1104                           | Standard             | Welding of Pipelines and Related Facilities                                     |
| API 1161                           | Recommended Practice | Recommended Practice for Pipeline Operator Qualification (OQ)                   |
| API 500 and 540                    |                      |                                                                                 |
| API 686                            |                      |                                                                                 |
| API 650                            |                      |                                                                                 |
| API 1173                           | Recommended Practice | Pipeline Safety Management Systems                                              |
| API 1177                           | Recommended Practice | Recommended Practice for Steel Pipeline Construction Quality Management Systems |

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

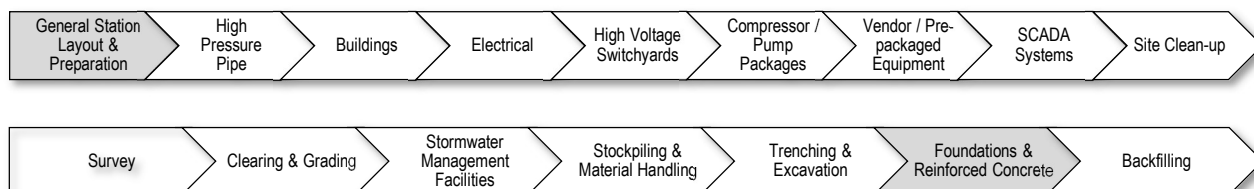
| Document No.                                    | Type       | Title                                                                                  |
|-------------------------------------------------|------------|----------------------------------------------------------------------------------------|
| American Society of Mechanical Engineers (ASME) |            |                                                                                        |
| ASME B31Q                                       | Standard   | Pipeline Personnel Qualification                                                       |
| ASME B31.3                                      |            |                                                                                        |
| ASME B31.4                                      | Standard   | Pipeline Transportation Systems for Liquids and Slurries                               |
| ASME B31.8                                      | Standard   | Gas Transmission and Distribution Piping Systems                                       |
| Canadian Federal Regulations                    |            |                                                                                        |
| N/A                                             | Regulation | Canadian Environmental Protection Act                                                  |
| N/A                                             | Regulation | Fisheries and Oceans—Land Development Guidelines for the Protection of Aquatic Habitat |
| N/A                                             | Regulation | Canada Water Act                                                                       |



|                                             |            |                                                                                       |
|---------------------------------------------|------------|---------------------------------------------------------------------------------------|
| N/A                                         | Regulation | Migratory Birds Convention Act                                                        |
| N/A                                         | Regulation | Canada Occupational Health and Safety Regulations                                     |
| N/A                                         | Regulation | Transport Canada—Transportation of Dangerous Goods Regulations                        |
| N/A                                         | Regulation | Navigation Protection Act                                                             |
| N/A                                         | Regulation | Species at Risk Act                                                                   |
| Canadian Standards Association (CSA)        |            |                                                                                       |
| CSA Z662                                    | Standard   | Oil and Gas Pipeline Systems                                                          |
| Code of Federal Regulations (CFR)           |            |                                                                                       |
| 29 CFR Part 172                             | Regulation | Hazardous Materials Table                                                             |
| 29 CFR Part 1910                            | Regulation | Occupational Safety and Health Standards                                              |
| 29 CFR Part 1926                            | Regulation | Safety and Health Regulations for Construction                                        |
| 33 CFR Part 321                             | Regulation | Permits for Dams and Dikes in Navigable Waters of the United States                   |
| 40 CFR Part 300                             | Regulation | National Oil and Hazardous Substances Pollution Contingency Plan                      |
| 49 CFR Part 192                             | Regulation | Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards |
| 49 CFR Part 195                             | Regulation | Transportation of Hazardous Liquids by Pipeline                                       |
| 50 CFR Part 21                              | Regulation | Migratory Bird Permits                                                                |
| 50 CFR Part 402                             | Regulation | Interagency Cooperation—Endangered Species Act of 1973, as Amended                    |
| Common Ground Alliance (CGA)                |            |                                                                                       |
| CGA Best Practices                          | Guideline  | Chapter 3, One Call Center                                                            |
| Federal Energy Regulatory Commission (FERC) |            |                                                                                       |
| 18 CFR 380.12 (i)                           | Regulation | Upland Erosion control, Revegetation, and Maintenance Plan                            |
| 18 CFR 380.12 (d)                           | Regulation | Wetland and Waterbody Construction and Mitigation procedures                          |

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

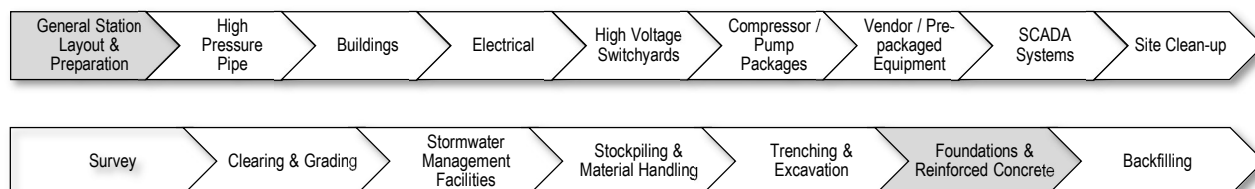
| Document No.                                          | Type      | Title                                                                                                                                                                                               |
|-------------------------------------------------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Interstate Natural Gas Association of America (INGAA) |           |                                                                                                                                                                                                     |
| N/A                                                   | Report    | Safety Every Step of the Way                                                                                                                                                                        |
| INGAA Foundation                                      |           |                                                                                                                                                                                                     |
| CS-G-01                                               | Guideline | Construction Safety & Quality Consensus Guidelines—Basic Personal Protective Equipment (PPE)                                                                                                        |
| CS-H-03                                               | Guideline | Construction Safety & Quality Consensus Guidelines—Naturally Occurring Radioactive Material (NORM) and Technologically Enhanced Naturally Occurring Radioactive Material (TENORM) Safety Guidelines |
| Report 2013.01                                        | Report    | Building Interstate Natural Gas Transmission Pipelines: A Primer                                                                                                                                    |
| N/A                                                   | Report    | Overview of Quality Management Systems—Principles and Practices for Pipeline Construction                                                                                                           |



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|                                                                                                                                                                                                                          |            |                                                                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------------------------------------------------------------------------|
| CS-R-16                                                                                                                                                                                                                  | Guideline  | Construction Safety & Quality Consensus Guidelines—Steep Slope Construction   |
| National Energy Board (NEB)                                                                                                                                                                                              |            |                                                                               |
| OPR-99                                                                                                                                                                                                                   | Regulation | National Energy Board Onshore Pipeline Regulations 1                          |
| United States Code (USC)                                                                                                                                                                                                 |            |                                                                               |
| 16 USC Chapter 35                                                                                                                                                                                                        | Regulation | Endangered Species                                                            |
| 33 USC Chapter 9                                                                                                                                                                                                         | Regulation | Protection of Navigable Waters and of Harbor and River Improvements Generally |
| 1 OPR-99 is the overarching Canadian regulation, but does not include specific instructions for the typical Pipeline Inspector; rather, it incorporates through reference of other documents that are directly relevant. |            |                                                                               |

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## ANNEX A (informative)

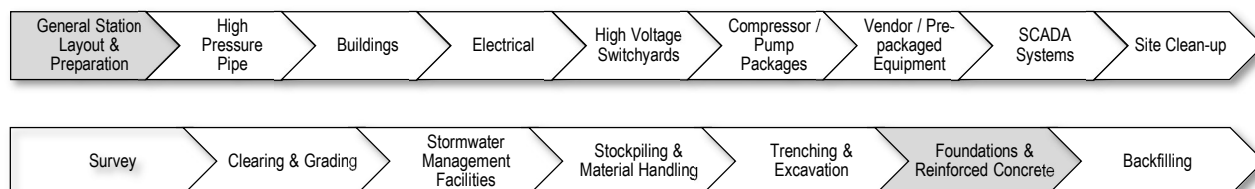
### Pipeline Facility Construction Inspector

#### Organization of this Annex

This annex is organized to reflect the typical construction process for facilities. Foundational information common to all aspects of construction is presented in Section 4, with sections specific to each phase of construction detailed in this annex. Within each section in this annex, five main headings are used consistently.

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

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



## **A.1 General Station Layout and Preparation**

### **A.1.1 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.

#### **A.1.1.1 Survey**

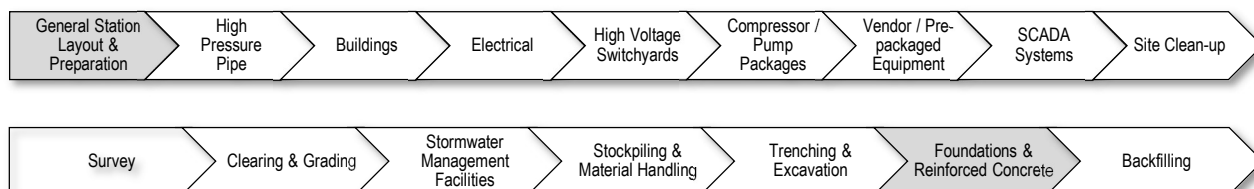
Surveying is an integral part of facilities construction and refers to the installation of visual reference points and markers (e.g., stakes, pins, lath, and hubs) that will define the facility site limits and guide the construction of the facility according to the Issued for Construction (IFC) drawings.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

#### **A.1.1.2 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)





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- Line location of buried utilities (both Operator and foreign)
- Fencing
- Compaction testing

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

#### **A.1.1.3 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 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

#### **A.1.1.4 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 Operator
- Quarantine and return of any materials that are damaged or do not meet specifications according to the Operator's processes
- Storage of materials in accordance with the manufacturer's recommended practices, standards, and / or specifications

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

The Inspector will understand and comply with the Operator's inspection and materials traceability standards and quality control processes and forms.

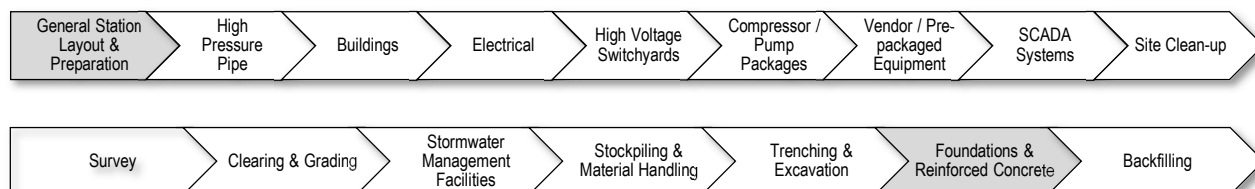
#### **A.1.1.5 Trenching and Excavation**

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 should first be located and exposed prior to any mechanical excavation taking place. Generally, this is done with hydrovac equipment and special conditions should be addressed concerning the disposal of the hydrovac slurry, especially in contaminated soils.

#### **A.1.1.6 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



### A.1.1.7 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 Operator specifications prior to backfilling
- Compaction requirements are met

## A.1.2 Survey

### A.1.2.1 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 Operator technical specifications as identified in Table 19.

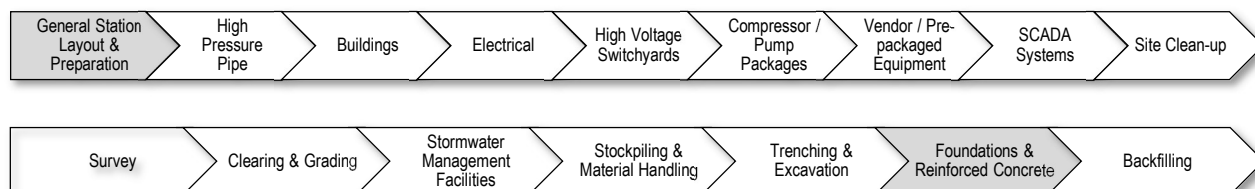
### A.1.2.2 Execution

While the work is being executed, the Inspector should 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 18.

**Table 18—Monitoring Requirements for Survey Inspection – Civil**

| Item                       | Description                                                                                                          | Reference |
|----------------------------|----------------------------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work   | Daily, ensure key issues that have been identified are detailed and addressed                                        | Table 20  |
| Safety                     | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements                  | Table 21  |
| General                    | Identifies general items that should be monitored throughout the construction surveying process                      | Table 22  |
| Buried Facilities Location | Identifies specific survey items that should be monitored at buried facilities locations (both Operator and foreign) | Table 23  |
| Facility Site Limits       | Identifies specific survey items that should be monitored for at facility site limits                                | Table 24  |
| Trench Line                | Identifies specific survey items that should be monitored along the trench line                                      | Table 25  |
| Crossings                  | Identifies specific survey items that should be monitored at crossing locations (e.g., roads, powerlines)            | Table 26  |
| Appurtenances              | Identifies specific survey items that should be monitored at appurtenance locations                                  | Table 27  |
| As-Builts                  | Identifies specific information that should be monitored for collection in support of completing as-builts           | Table 28  |
| Foundations                | Identifies specific survey items that should be monitored for foundation locations                                   | Table 29  |

### A.1.2.3 Outputs



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The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for survey inspection appear in Table 30.

#### A.1.2.4 Detailed Checklists - Surveying

##### A.1.2.4.1 Typical Input Requirements for Survey Inspection

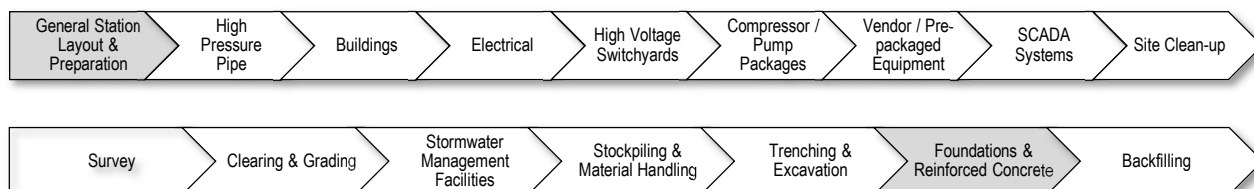
**Table 19—Information Requirements for Survey Inspection**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>All designs, drawings, and specifications developed by the Operator and contractors related to surveying, such as:</p> <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings, including <ul style="list-style-type: none"> <li>o Access road drawings</li> <li>o Line List (e.g., special concerns for each landowner)</li> <li>o GPS or other datum coordinates and elevations for construction control points and benchmark</li> <li>o Site and appurtenance surveys</li> <li>o Boundary surveys</li> <li>o Building Permit surveys</li> <li>o Construction surveys</li> </ul> </li> </ul> |
|   | <p>Contracts and agreements related to:</p> <ul style="list-style-type: none"> <li>- Road use</li> <li>- Crossing for buried facilities</li> <li>- Construction survey</li> <li>- Landowner agreements</li> <li>- Third-party crossing agreements</li> </ul>                                                                                                                                                                                                                                                                                                                                                              |
|   | <p>Operator specific safety plan, including (but not limited to):</p> <ul style="list-style-type: none"> <li>- Traffic control plan</li> <li>- Requirements for Personal Protective Equipment (PPE)</li> <li>- Emergency Medical Services (EMS)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                |
|   | <p>Other project specific plans, which may include:</p> <ul style="list-style-type: none"> <li>- Fire Prevention / firefighting plan</li> <li>- Survey plans</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

##### A.1.2.4.2 Best Practice Items for Inspecting Typical Surveying Operations

**Table 20—Prior to Commencing Work**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                         |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>Participate in daily meetings to address:</p> <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |
|   | <p>Confirm survey crew credentials / qualifications per Operator requirements</p>                                                                                                                                                                                                                                                                                                   |
|   | <p>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</p>                                                                                                                                                  |



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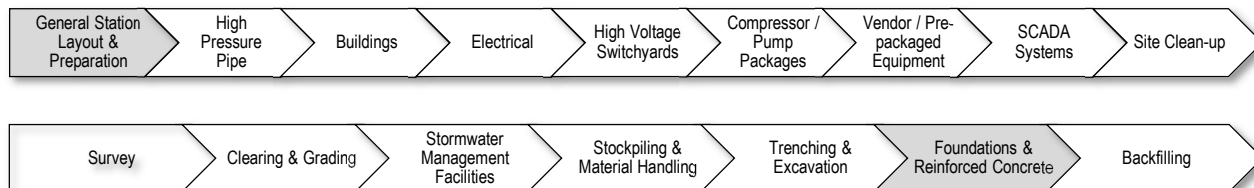
|   |                                                                                                                                                                       |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                           |
|   | 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 Operator's naming convention                                                                             |

**Table 21—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 22—Typical Monitoring Requirements – General**

|   |                                                                                                                                                                                                                                       |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                           |
|   | Ensure construction workspace, adjacent approved temporary workspaces, 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 Operator 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                               |
|   | Ensure that damage or obliteration of any survey references are reported per Operator 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 and valves / fittings nameplates in accordance with Operator 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 benchmark or specified temporary benchmark 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                       |



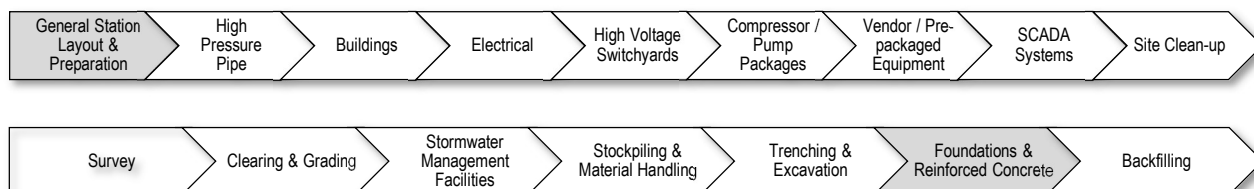
|   |                                                                                                                                                                                                                          |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                              |
|   | 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 23—Typical Monitoring Requirements for Buried Facilities Location**

|   |                                                                                                                                                                                                                                                                                                                                                |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                    |
|   | Consult Operator'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 landowners (if applicable) with surveyors to determine if landowners 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 Operator specific color codes showing the name of the Operator 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                                                                                                                                                                                                                                                |
|   | Confirm locations of existing below grade piping, conduit / cable, tubing, concrete, and miscellaneous facilities by excavation in accordance with Section A.1.6 Trenching and Excavation, as required, and tie in                                                                                                                             |

**Table 24—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 Operator 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                                                                       |



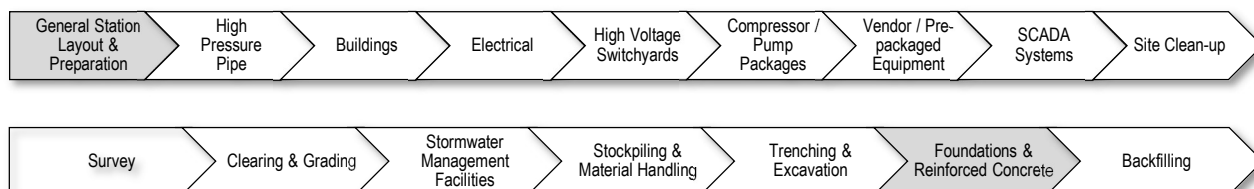
|   |                                                                                                                                                                                                     |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                         |
|   | 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 workspaces (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 25—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 |
|   | Weld mapping                                                                                                                                                |
|   | Document and inform the construction manager / chief inspector (or designate) of any major deviations or necessary changes                                  |

**Table 26—Typical Monitoring Requirements for Crossings**

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|   | Ensure activities are coordinated with the Operator and third-party facilities through One Call                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|   | 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 benchmarks 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 benchmarks 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 Operator and 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: <ul style="list-style-type: none"> <li>- Field sketches showing all buried facilities in relation to new and existing facility boundaries</li> <li>- List of line locating equipment used</li> <li>- Names of surveyors, date, local area conditions, and all correspondence</li> <li>- All visual inspection notes</li> <li>- All drawings referenced</li> <li>- Signature of construction survey contractor and date on all reports</li> </ul> |



**Table 27—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 28—Typical Monitoring Requirements for As-Built**

|   |                                                                                                                                                |
|---|------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | 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                            |
|   | Weld mapping                                                                                                                                   |

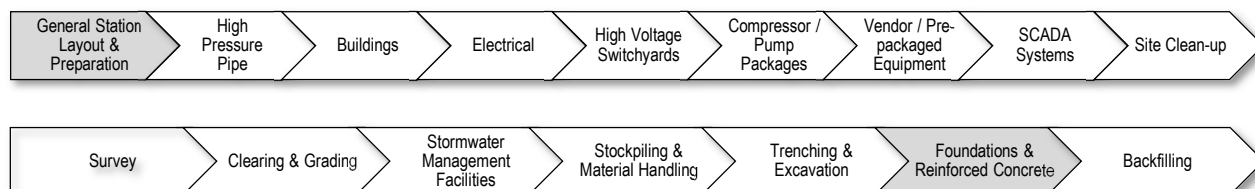
**Table 29—Typical Monitoring Requirements for Foundations**

|   |                                                                                                                                                                                                                                                                                      |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | 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                                                                                                                                                                                               |

#### **A.1.2.4.3 Typical Outputs for Survey Inspection**

**Table 30—Typical Reporting Requirements**

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>General</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                | 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                                                                                                                                                                                                                                                                                                                                     |
| <b>Daily</b>   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                | Complete survey progress reports, including: <ul style="list-style-type: none"> <li>- Weld mapping</li> <li>- 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)</li> <li>- Survey support sketches and data to explain as-built records (where required)</li> <li>- Survey support documentation to field Requests for Information (RFIs)</li> <li>- Document punch list items, as required</li> </ul> |



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### A.1.2.5 References – Survey

NOTE The reference information provided in Table 31 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 31—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                                                                 |
| 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           |

### A.1.3 Clearing and Grading

#### A.1.3.1 Inputs

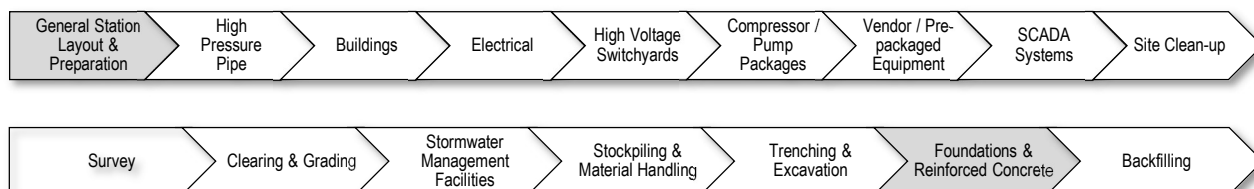
As part of preparing for inspection during the clearing and grading process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Operator technical specifications as identified in Table 33.

#### A.1.3.2 Execution

While the work is being executed, the Inspector should 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 32.

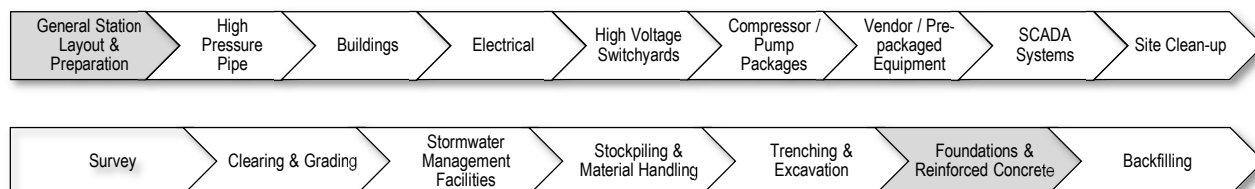
**Table 32—Monitoring Requirements for Clearing and Grading – Civil**

| Item                       | Description                                                                                                                                                                                                                                                                                                                                                       | Reference |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work   | Daily, ensure key issues that have been identified are detailed and addressed                                                                                                                                                                                                                                                                                     | Table 34  |
| Safety                     | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements                                                                                                                                                                                                                                                               | Table 35  |
| Clearing and Grubbing      | Monitor the operations for adherence to relevant Operator- 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), and specific considerations related to creating snow piles, primarily to prevent freezing of areas to be excavated | Table 36  |
| Temporary Workspaces (TWS) | TWS allow for lay down and warehousing of materials in support of facility construction, and temporary decking (i.e., storage) areas for salvaged timber                                                                                                                                                                                                          | Table 37  |





| Item                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Reference |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Site / Access Road Preparation  | <ul style="list-style-type: none"> <li>- 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 (Operator permitting)</li> <li>- It is imperative that all access roads can withstand the loads being transported and the frequency of intended use. When access roads need to be constructed and have been approved, the Inspector will ensure they are constructed as detailed by Operator- and project-specific requirements</li> </ul> | Table 38  |
| Construction Gates and Fences   | <ul style="list-style-type: none"> <li>- Existing structures (e.g., fencing) should be altered to accommodate construction operations, and where possible, returned to their original state after construction is completed</li> <li>- New fencing and structures may be erected to exclude wildlife and livestock, and where possible, restrict access to the facility site</li> </ul>                                                                                                                                                                      | Table 39  |
| Buried Facilities               | <ul style="list-style-type: none"> <li>- In most cases, existing buried facilities (e.g., pipelines or conduits / cables) within facility site limits will require temporary above ground mechanical support</li> <li>- Typically, earthen ramps or mats are installed before construction equipment can cross the surface to prevent undue stress / potential damage to underground facilities</li> </ul>                                                                                                                                                   | Table 40  |
| Timber                          | <ul style="list-style-type: none"> <li>- Incorporates items for removal, salvage, and disposal of timber and brush</li> <li>- Landowner's crop removal requirements (e.g., contractor may cut and remove crops from the facility site limits and store per conditions established between the Operator and the landowner's requirements)</li> </ul>                                                                                                                                                                                                          | Table 41  |
| Grade Rock Blasting and Removal | <ul style="list-style-type: none"> <li>- 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</li> <li>- All requirements as listed in the approved blasting plan should be monitored</li> </ul>                                                                                                                                                                                  | Table 42  |
| Swamps and Muskegs              | Specific considerations relating to land that is particularly sensitive to construction activity                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Table 43  |
| Preliminary Grading             | <ul style="list-style-type: none"> <li>- Preliminary (or rough) grading refers to leveling the facility site so that construction can proceed smoothly and safely within the facility site limits</li> <li>- May involve significant earth moving (cut and fill) to bring the site to the designated rough elevation to begin trenching</li> <li>- Specific grading requirements for containment of surface run-off</li> </ul>                                                                                                                               | Table 44  |



### A.1.3.3 Outputs

The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for clearing and grading appear in Table 45.

### A.1.3.4 Detailed Checklists – Clearing and Grading

#### A.1.3.4.1 Typical Input Requirements for Clearing and Grading Inspection

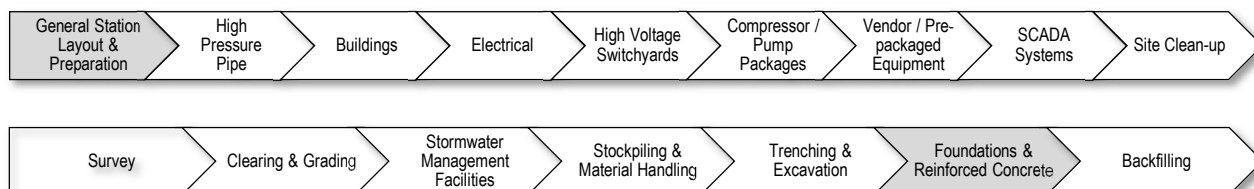
**Table 33—Information Requirements for Clearing and Grading**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>All designs, drawings, and specifications developed by the operator and contractors related to clearing and grading, such as:</p> <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings, including <ul style="list-style-type: none"> <li>o Access road drawings</li> <li>o Grading drawings</li> <li>o Line List (e.g., special concerns for each landowner)</li> <li>o Drawings related to facility site Limits (both permanent and temporary)</li> </ul> </li> </ul> |
|   | <p>Contracts and agreements related to:</p> <ul style="list-style-type: none"> <li>- Clearing</li> <li>- Grading (if required)</li> <li>- Road use</li> <li>- Crossing for buried facilities</li> <li>- Timber salvage (landowner, forestry management, public land holder)</li> <li>- Construction survey</li> <li>- Fencing</li> </ul>                                                                                                                                                             |
|   | <p>Operator specific safety plan, including (but not limited to):</p> <ul style="list-style-type: none"> <li>- Traffic control plan</li> <li>- Requirements for Personal Protective Equipment (PPE)</li> <li>- Procedures for working near overhead powerlines</li> <li>- Emergency Medical Services (EMS)</li> <li>- Blasting safety</li> </ul>                                                                                                                                                     |
|   | <p>Other project specific plans, which may include:</p> <ul style="list-style-type: none"> <li>- Access road plans</li> <li>- Blasting plan</li> <li>- Grading plan</li> <li>- Burn plan</li> <li>- Timber salvage plan</li> <li>- Fire Prevention / firefighting plan</li> <li>- Heritage sites</li> </ul>                                                                                                                                                                                          |

#### A.1.3.4.2 Best Practice Items for Inspecting Typical Clearing and Grading Operations

**Table 34—Prior to Commencing Work**

| ✓ | Description                                                                                                                                                                                                               |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>Participate in daily meetings to address:</p> <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> </ul> |



|   |                                                                                                                                                                                                    |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                        |
|   | <ul style="list-style-type: none"> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |
|   | 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 35—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 36—Typical Monitoring Requirements for Clearing and Grubbing**

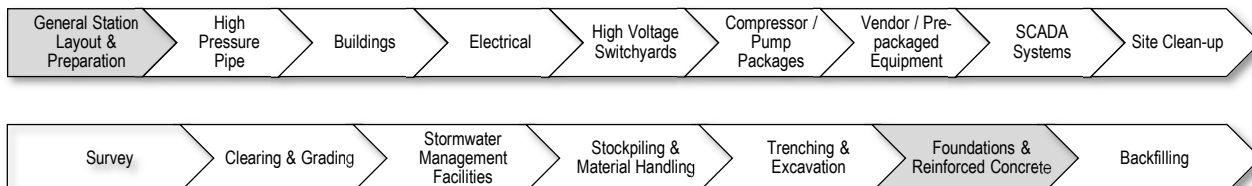
|   |                                                                                                                                                                 |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | 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                                                      |
|   | Ensure snow berms are built to Operator specifications over the areas of excavation immediately after clearing to prevent frost penetration                     |

**Table 37—Typical Monitoring Requirements for Temporary Workspaces (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 38—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 |



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|   |                                                                                                                                          |
|---|------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                              |
|   | 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 39—Typical Monitoring Requirements for Construction Gates and Fences**

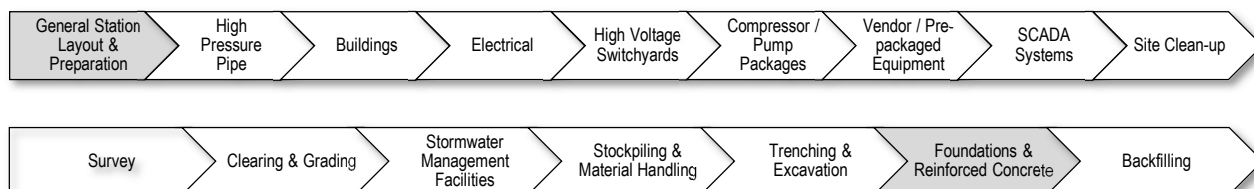
|   |                                                                                                                                                          |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                              |
|   | Ensure contractor installs fences and gates to prevent wildlife and livestock entry and manage security to the facility site per Operator 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 40—Typical Monitoring Requirements for Buried Facilities**

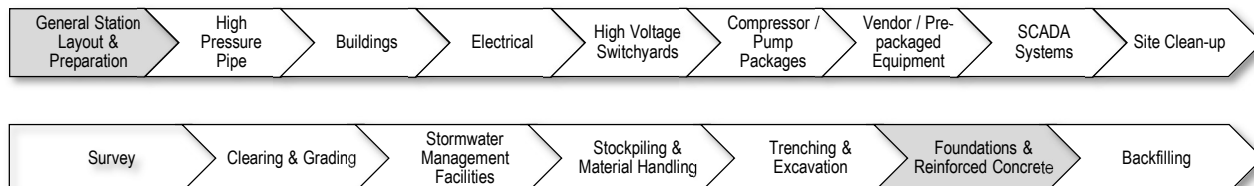
|   |                                                                                                                                                               |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | 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 landowner and third-party utility concerns                                                    |
|   | Confirm all construction activities cease the specified distance away from any unprepared crossings                                                           |

**Table 41—Typical Monitoring Requirements for Timber Processing**

|   |                                                                                                                                                                                                                                     |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                         |
|   | <b>Timber Removal</b>                                                                                                                                                                                                               |
|   | Ensure that only approved equipment is used                                                                                                                                                                                         |
|   | 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 workspaces by an approved method                     |
|   | 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                                                                                                                                |



|   |                                                                                                                                                                                                                                                                                                                                        |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                            |
|   | Monitor for adherence to specific requirements for salvage, storage, and removal associated that may be specific to the landowner                                                                                                                                                                                                      |
|   | 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                                                                                                                                                                                                                                                                                 |
|   | <b>Timber Salvaging</b>                                                                                                                                                                                                                                                                                                                |
|   | Ensure clearing contractor cuts, de-limbs, and stockpiles merchantable timber per Operator specifications, or conditions outlined by the landowner, forest management, or public land holder agreements                                                                                                                                |
|   | Consult with the environmental Inspector and 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): <ul style="list-style-type: none"> <li>- Existing cleared areas</li> <li>- Approved temporary workspaces (TWS)</li> <li>- Areas with non-merchantable timber</li> <li>- Areas with merchantable timber</li> </ul> |
|   | Ensure that decked logs are stacked with butt ends square, facing the same direction and with proper orientation for pickup                                                                                                                                                                                                            |
|   | <b>Timber and Brush Disposal</b>                                                                                                                                                                                                                                                                                                       |
|   | Ensure proper burn permits or other approved disposal techniques are in place                                                                                                                                                                                                                                                          |
|   | Ensure burning activities comply with the burn plan, permit stipulations, landowner requirements, and Environmental Protection Plan (EPP)                                                                                                                                                                                              |
|   | Ensure continuous 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 Operator or project specifications                                                                                                                                                                                         |
|   | Ensure no unburned timber or brush, which can mix with spoil materials, is in the disposal residue                                                                                                                                                                                                                                     |



|   |                                                                                                                                                    |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                        |
|   | 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 42—Typical Monitoring Requirements for Grade Rock Blasting and Removal**

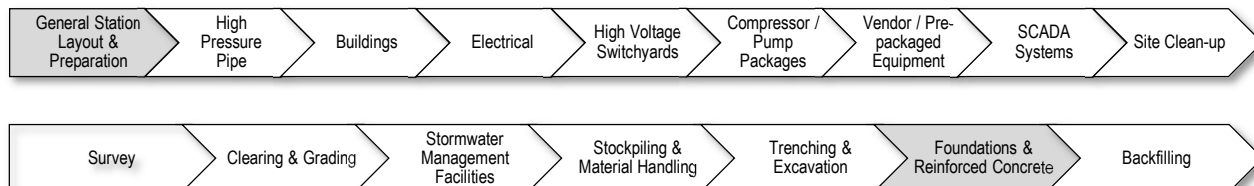
|   |                                                                                                                             |
|---|-----------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                 |
|   | 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            |
|   | 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 around the blast         |
|   | Ensure blasting near 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 43—Typical Monitoring Requirements for Swamps and Muskegs**

|   |                                                                                                                                                   |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                       |
|   | Ensure the clearing contractor clears wetland and muskeg areas using approved Operator 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 44—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 Operator or project specifications and procedures (e.g., verify elevation tolerances are met, topsoil and subsoil are not mixed) |



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|   |                                                                                                                                                                                              |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                  |
|   | Ensure resulting grading meets alignment and widths specified on drawings                                                                                                                    |
|   | Check line list for special requirements of landowners                                                                                                                                       |
|   | Monitor temporary fencing requirements                                                                                                                                                       |
|   | Ensure buried facilities have been properly located and ramped to Operator 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 Operator or project specifications (requirements may differ between site and access roads) |
|   | Ensure excess graded material is placed at Operator 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                                                                                                                                |

#### A.1.3.4.3 Typical Outputs for Clearing and Grading Inspection

**Table 45—Typical Reporting Requirements**

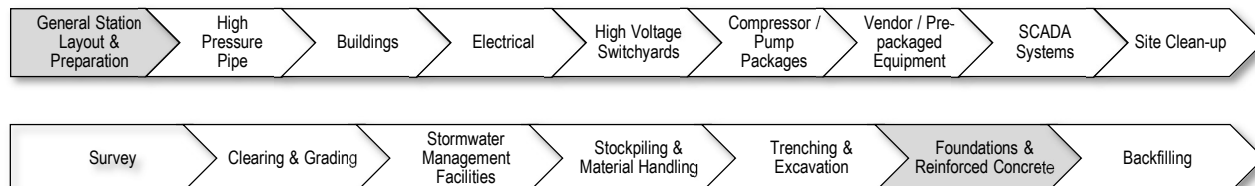
|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|   | General                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|   | Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information.                                                                                                                                                                                                                                                                                                                                                     |
|   | Daily                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|   | Complete clearing and grading progress reports, including: <ul style="list-style-type: none"> <li>- Record lengths and locations of temporary fencing</li> <li>- Record estimated areas of grubbing, topsoil stripping, grading, and rock grade activities</li> <li>- Record stripping depths</li> <li>- Detailed records (per Operator forms) of blasting activity</li> <li>- Records of compaction testing</li> <li>- Records of materials removed or brought to site (e.g., select fill)</li> <li>- Document punch list items, as required</li> </ul> |

#### A.1.3.5 References – Clearing and Grading

**NOTE** The reference information provided in Table 46 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 46—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 |



## **A.1.4 Stormwater Management Facilities**

### **A.1.4.1 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 Operator technical specifications as identified in Table 48.

### **A.1.4.2 Execution**

While the work is being executed, the Inspector should 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 47.

**Table 47—Monitoring Requirements for Stormwater Management Facilities Construction – Civil**

| Item                                          | Description                                                                                                                | Reference |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work                      | Daily, ensure key issues that have been identified are detailed and addressed                                              | Table 49  |
| Safety                                        | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements                        | Table 50  |
| Stormwater Management Facilities Construction | Monitoring requirements associated with stormwater management facilities, ensuring the installation conforms to the design | Table 51  |

### **A.1.4.3 Outputs**

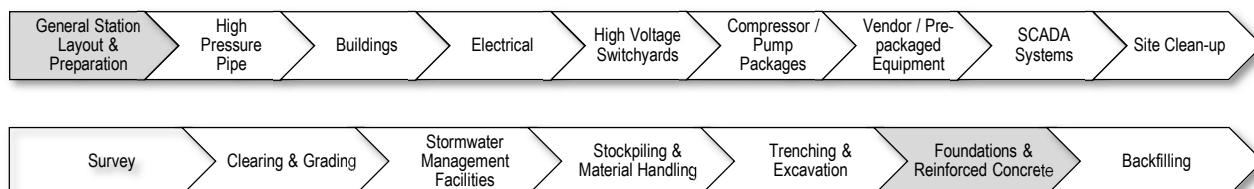
The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for stormwater management facilities inspection appear in Table 52.

## **A.1.4.4 Detailed Checklists – Stormwater Management Facilities**

### **A.1.4.4.1 Typical Input Requirements for Stormwater Management Facilities Inspection**

**Table 48—Information Requirements for Stormwater Management Facilities Inspection**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                      |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | All designs, drawings, and specifications developed by the Operator and contractors related to stormwater management facilities construction, such as: <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings (including those related to catch basin locations, pipe invert elevations, and proper sloping)</li> </ul> |
|   | Contracts and agreements related to: <ul style="list-style-type: none"> <li>- Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information</li> </ul>                                                     |
|   | Operator specific safety plan, including (but not limited to): <ul style="list-style-type: none"> <li>- Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information</li> </ul>                           |
|   | Other project specific plans, which may include:                                                                                                                                                                                                                                                                                                 |





|   |                                                                                                                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                           |
|   | - Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information |

#### A.1.4.4.2 Best Practice Items for Inspecting Typical Stormwater Management Facilities Construction

**Table 49—Prior to Commencing Work**

|   |                                                                                                                                                                                                                                                                                                                                                                              |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                  |
|   | Participate in daily meetings to address: <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |
|   | Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Operator or project specifications and Issued for Construction (IFC) drawings per Section A.1.5 Stockpiling and Material Handling                                                                                                                        |

**Table 50—Safety Concerns for Stormwater Management Facilities Construction**

|   |                                                                                                                                                                                                     |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                         |
|   | Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information |

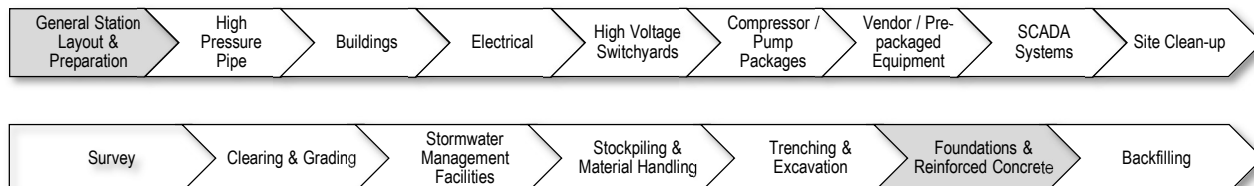
**Table 51—Typical Monitoring Requirements for Stormwater Management Facilities Construction**

|   |                                                                          |
|---|--------------------------------------------------------------------------|
| ✓ | 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 |

#### A.1.4.4.3 Typical Outputs for Stormwater Management Facilities Inspection

**Table 52—Typical Reporting Requirements**

|   |                                                                                                                                                                                                                                                                                                                     |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                         |
|   | <b>General</b>                                                                                                                                                                                                                                                                                                      |
|   | Ensure completion of as-built, red-lined drawings                                                                                                                                                                                                                                                                   |
|   | <b>Daily</b>                                                                                                                                                                                                                                                                                                        |
|   | Complete stormwater management facilities construction progress reports, including: <ul style="list-style-type: none"> <li>- Quantity of catch basins / drain structures and manholes installed</li> <li>- Length and diameter of sewer drainpipe installed</li> <li>- Backfill placement and compaction</li> </ul> |



- Document punch list items, as required

#### A.1.4.5 References – Stormwater Management Facilities

NOTE The reference information provided in Table 53 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 53—List of References – Stormwater Management Facilities**

| Document No.                                                                                                                                                                                        | Type | Title |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|
| Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information |      |       |

### A.1.5 Stockpiling and Material Handling

#### A.1.5.1 Inputs

As part of preparing for inspection during the stockpiling and material handling process, the Inspector will be familiar with relevant aspects of key Operator documents, drawings, and materials technical specifications as identified in Table 55.

#### A.1.5.2 Execution

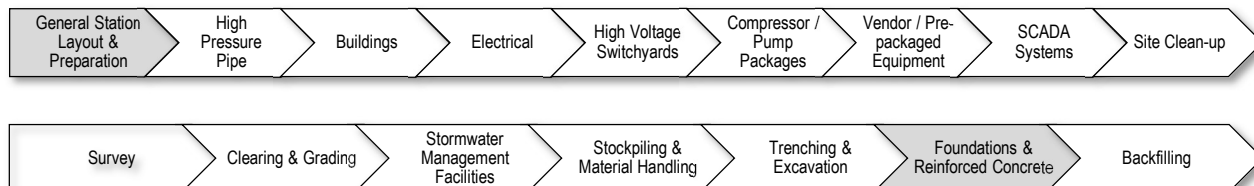
While the work is being executed, Inspectors are required to monitor workmanship and report on progress on a periodic basis. Typical items that Inspectors will monitor for during the stockpiling and material handling process are identified in Table 54.

**Table 54—Monitoring Requirements for Stockpiling and Material Handling – Civil, Mechanical, Electrical (All Disciplines)**

| Item                                                   | Description                                                                                                                                                                                                             | Reference |
|--------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work                               | Daily, ensure key issues that have been identified are detailed and addressed                                                                                                                                           | Table 56  |
| Safety                                                 | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements                                                                                                                     | Table 57  |
| 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 58  |
| Transport and Material Handling                        | Use of cranes, rigging and lifting, load handling, and signaling procedures to ensure safety and preserve material integrity                                                                                            | Table 59  |
| Storage / Stockpiling                                  | Proper storage of materials (e.g., sensitive materials stored indoors)                                                                                                                                                  | Table 60  |
| Identifying and Addressing Equipment / Material Damage | Inspection and repair of any damaged equipment or materials<br>Damaged or otherwise unfit materials (manufacturer's defects) are identified and quarantined until approved for use, repaired, or removed from site      | Table 61  |

#### A.1.5.3 Outputs

The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for stockpiling and material handling inspection appear in Table 62.



#### **A.1.5.4 Detailed Checklists – Stockpiling and Material Handling**

##### **A.1.5.4.1 Typical Inputs for Stockpiling and Material Handling Inspection**

**Table 55—Information Requirements for Stockpiling and Material Handling**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | All designs, drawings, and specifications developed by the Operator and contractors related to stockpiling and material handling, such as: <ul style="list-style-type: none"> <li>- Bill of Materials (BOM)</li> <li>- Purchase Orders (PO)</li> <li>- Mill or material certifications</li> <li>- Fabrication shop drawings</li> <li>- Manufacturer specifications</li> <li>- Material handling specifications</li> <li>- Operator specific custody transfer forms, material transfer reports (or equivalent)</li> </ul> |
|   | Contracts and agreements related to: <ul style="list-style-type: none"> <li>- Transport and handling of materials</li> <li>- Inspection of materials</li> <li>- Materials storage and preservation</li> </ul>                                                                                                                                                                                                                                                                                                            |
|   | Operator specific safety plan, including (but not limited to): <ul style="list-style-type: none"> <li>- Equipment transport</li> <li>- Equipment loading / unloading</li> <li>- Equipment and materials storage</li> <li>- Handling of materials</li> </ul>                                                                                                                                                                                                                                                              |
|   | Other project specific plans, which may include: <ul style="list-style-type: none"> <li>- Traffic control plan</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                |

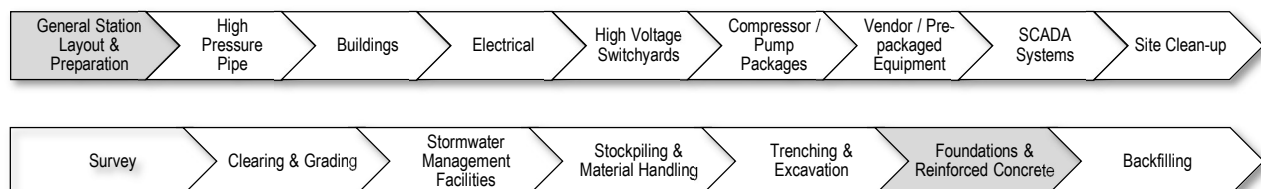
##### **A.1.5.4.2 Best Practices for Typical Stockpiling and Material Handling Inspection**

**Table 56—Prior to Commencing Work**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                         |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | Participate in daily meetings to address: <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul>        |
|   | Equipment: <ul style="list-style-type: none"> <li>- Confirm all equipment operators have appropriate certification / ticket(s)</li> <li>- Confirm contractor possesses manufacturer information / manual of the machinery operated</li> <li>- Ensure that all lifting equipment is inspected (e.g., slings and cables) for damage and all findings documented before use</li> </ul> |

**Table 57—Safety Concerns for Stockpiling and Material Handling**

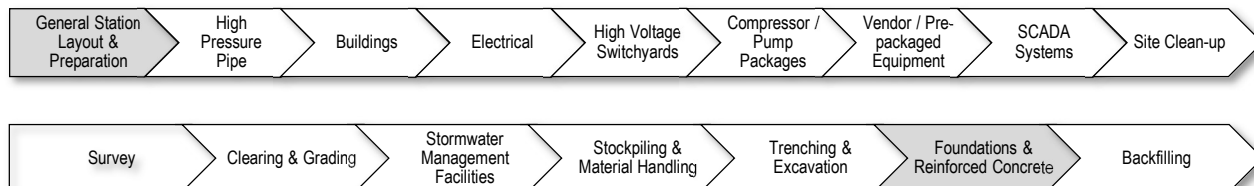
| ✓ | Description                                                                                     |
|---|-------------------------------------------------------------------------------------------------|
|   | Monitor for individuals standing between a suspended load and equipment or materials            |
|   | Ensure spotter is used as specified by Operator or contractor to assist with equipment movement |
|   | Ensure that workers are not standing under or near a suspended load                             |



|   |                                                                                                                                                                                                  |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                      |
|   | 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 equipment operator's signal before proceeding |
|   | Monitor and be aware of other vehicles moving in the lay down or warehousing area                                                                                                                |
|   | Ensure lift plan is followed for large, complicated lifts.                                                                                                                                       |
|   | Understand equipment limitations related to weather, such as vac-lifts and frost                                                                                                                 |

**Table 58—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 Operator specifications)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|   | Confirm all material is clearly marked as required. Illustrative example for pipe follows:<br><br>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: <ul style="list-style-type: none"> <li>- Size</li> <li>- Wall Thickness</li> <li>- Nominal Outside Diameter (OD)</li> <li>- Grade</li> <li>- Manufacturer</li> <li>- Coating vendor</li> <li>- Thickness of the Coating in Mills</li> <li>- Heat Number</li> <li>- Applicable specification (e.g., API 5L)</li> <li>- Customer's purchase order (if mill purchased)</li> <li>- Date of manufacture</li> <li>- Date of coating</li> <li>- Ensure QR code or barcode is present (if required by Operator)</li> </ul> |
|   | 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, poor workmanship defects, 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

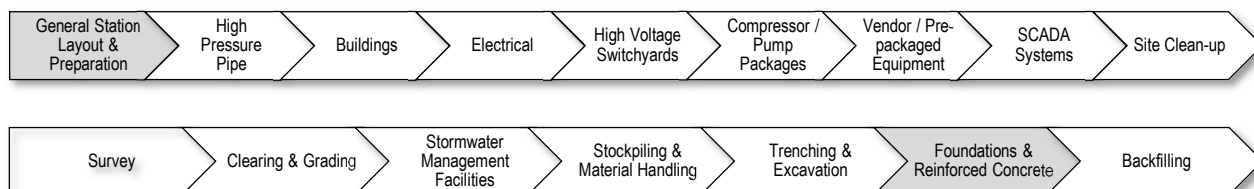


|   |                                                                                                                                                                                                                                                                                             |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                 |
|   | 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 59—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: <ul style="list-style-type: none"> <li>- Check that the center of balance of the machine and the center of weight of the load are balanced</li> <li>- 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)</li> </ul> |
|   | 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 always used if a load is suspended for an extended period                                                                                                                                                                                                                                                                                                                                                                              |
|   | 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 60—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                                                                         |
|   | Ensure pipe is stored with end caps (as required by Operator 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 Operator and / or manufacturer are identified and followed                                                 |

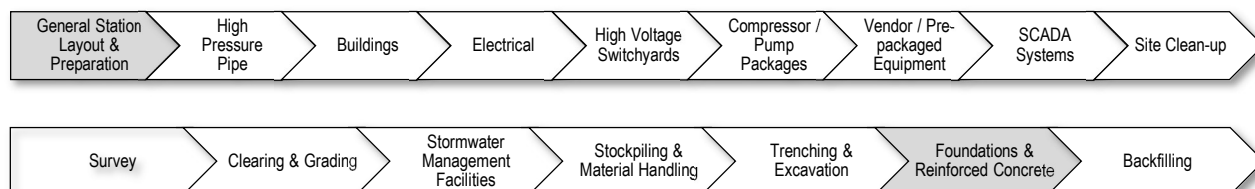
**Table 61—Typical Monitoring Requirements for Identifying and Addressing Equipment / Material Damage**

|   |                                                                                                                                                                                                                                                                                                                                                                                                      |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                          |
|   | Ensure pipe is inspected for damage per Operator specifications prior to unloading, including (but not limited to): <ul style="list-style-type: none"> <li>- Beveled ends</li> <li>- External pipe body for ovality, dents, gouges, and scratches</li> <li>- Internal pipe body for ovality, dents, gouges, scratches, and debris</li> <li>- Damage due to objects falling between joints</li> </ul> |
|   | Check crating or packaging for indications of material shipping and handling damage and ensure damage is documented                                                                                                                                                                                                                                                                                  |
|   | Confirm that all damaged pipe is either: <ul style="list-style-type: none"> <li>- Repaired per Operator specifications using Operator approved techniques, or</li> <li>- Marked as damaged goods and stored separately in the marshalling area for disposition</li> </ul>                                                                                                                            |

#### A.1.5.4.3 Typical Outputs for Stockpiling and Material Handling Inspection

**Table 62—Typical Reporting Requirements**

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                             |
|   | <b>General</b>                                                                                                                                                                                                                                                                                                                                                                                                                          |
|   | Record any site weather or other logistical conditions that caused either an increase or decrease in expected progress                                                                                                                                                                                                                                                                                                                  |
|   | <b>Daily</b>                                                                                                                                                                                                                                                                                                                                                                                                                            |
|   | Complete stockpiling and material handling progress reports, including: <ul style="list-style-type: none"> <li>- Actual hours of work utilized for labor and equipment</li> <li>- Number of transport loads received</li> <li>- Conditions that enhanced or delayed the planned progress of the day</li> <li>- Custody transfer forms, material transfer reports (or equivalent)</li> <li>- Material Receiving Reports (MRR)</li> </ul> |



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|   |                                                                                                                                                                           |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                               |
|   | <ul style="list-style-type: none"> <li>- Material Exception Reports (MER)</li> <li>- Material damage reports</li> <li>- Document punch list items, as required</li> </ul> |

#### A.1.5.5 References – Stockpiling and Material Handling

NOTE The reference information provided in Table 63 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 63—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)                                               |

#### A.1.6 Trenching and Excavation

##### A.1.6.1 Inputs

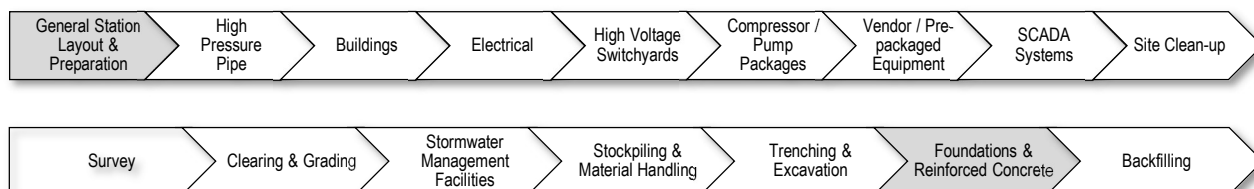
As part of preparing for inspection during the trenching and excavation process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Operator technical specifications as identified in Table 65.

##### A.1.6.2 Execution

While the work is being executed, the Inspector should 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 64.

**Table 64—Monitoring Requirements for Trenching and Excavation – Civil**

| Item                     | Description                                                                                         | Reference |
|--------------------------|-----------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work | Daily, ensure key issues that have been identified are detailed and addressed                       | Table 66  |
| Safety                   | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements | Table 67  |



| Item                                      | Description                                                                                                                                                                                                                                                                                                                 | Reference |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Excavation Equipment                      | Monitor the operations for adherence to relevant Operator- and project-specific requirements; in particular, ensure that equipment does not damage pipe, buried facilities, or roadways in any way                                                                                                                          | Table 68  |
| Trenching and Excavation                  | Ensure that the trench is excavated to project requirements, including: <ul style="list-style-type: none"> <li>- Specifications for alignment of centerline and dimensions of slope of sides, width, and depth</li> <li>- Installation of padding and buoyancy controls in preparation for lowering-in</li> </ul>           | Table 69  |
| Trenching through Rock                    | In rocky areas, blasting breaks and loosens 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 to the use of explosives; Inspectors will ensure that the blasting plan is followed without exception | Table 70  |
| 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 71  |
| 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 Operator specifications                   | Table 72  |
| Seasonal (Winter) Considerations          | Itemizes considerations that are specific to the construction season                                                                                                                                                                                                                                                        | Table 73  |
| Addressing Additional Work                | Identifies items of note during this phase of the operation that can result in additional work                                                                                                                                                                                                                              | Table 74  |
| 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 Operator to recommence construction                                                                                                     | Table 75  |

### A.1.6.3 Outputs

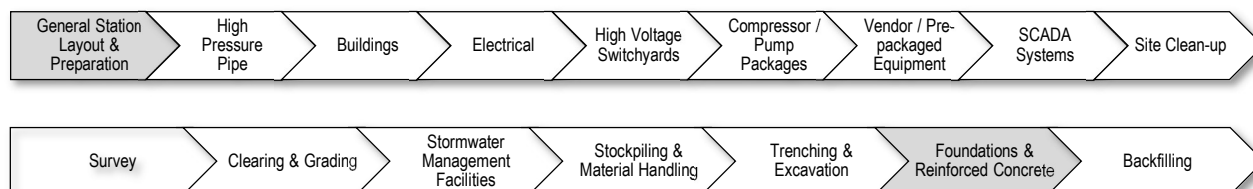
The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for trenching and excavation inspection appear in Table 76.

### A.1.6.4 Detailed Checklists – Trenching and Excavation

#### A.1.6.4.1 Typical Input Requirements for Trenching and Excavation Inspection

**Table 65—Information Requirements for Trenching and Excavation**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                               |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>All designs, drawings, and specifications developed by the Operator and contractors related to trenching and excavation, such as:</p> <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings, including <ul style="list-style-type: none"> <li>o Access road drawings</li> <li>o Line list (e.g., special concerns for each landowner)</li> </ul> </li> </ul> |



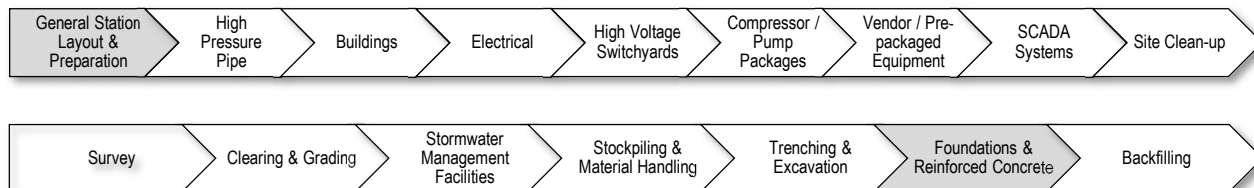


|   |                                                                                                                                                                                                                                                                                                                                                          |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                              |
|   | <ul style="list-style-type: none"> <li>○ Underground conduit / cable routing plan</li> <li>○ Grounding plan</li> <li>○ Trenching specifications and procedures</li> <li>○ Topsoil segregation requirements</li> <li>○ Depth of cover requirements</li> <li>○ Blasting specification (if required)</li> <li>○ Ground disturbance documentation</li> </ul> |
|   | <p>Contracts and agreements related to:</p> <ul style="list-style-type: none"> <li>- Road use</li> <li>- Crossings for buried facilities</li> <li>- Construction survey</li> </ul>                                                                                                                                                                       |
|   | <p>Operator specific safety plan, including (but not limited to):</p> <ul style="list-style-type: none"> <li>- Excavation plan</li> <li>- Traffic control plan</li> <li>- Requirements for Personal Protective Equipment (PPE)</li> <li>- Emergency Medical Services (EMS)</li> </ul>                                                                    |
|   | <p>Other project specific plans, which may include:</p> <ul style="list-style-type: none"> <li>- Blasting plan</li> <li>- Fire prevention / firefighting plan</li> <li>- Heritage sites</li> <li>- Engineered shoring and dewatering plans (as required)</li> </ul>                                                                                      |

#### **A.1.6.4.2 Best Practice Items for Inspecting Typical Trenching and Excavation Operations**

**Table 66—Prior to Commencing Work**

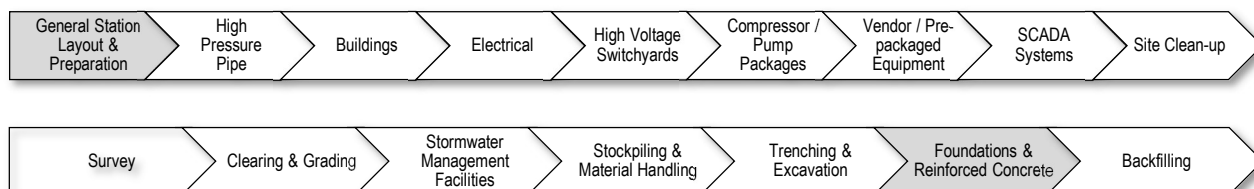
|   |                                                                                                                                                                                                                                                                                                                                                                                     |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                         |
|   | <p>Participate in daily meetings to address:</p> <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |
|   | 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 Operator of a third-party facility may locate, expose, and excavate the facility themselves or allow the contractor to do so (according to the Operator's procedures, specifications, and the crossing agreement); before the crossing construction begins, the existing buried utilities should be positively located                                                          |
|   | <p>Equipment:</p> <ul style="list-style-type: none"> <li>- Confirm all equipment operators have appropriate certification(s) / ticket(s)</li> <li>- Confirm contractor possesses manufacturer information / manual of the machinery operated</li> </ul>                                                                                                                             |



|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|   | <p>Work area:</p> <ul style="list-style-type: none"> <li>- Check that third-party pipeline crossing ramps have been built</li> <li>- Check that warning signs and temporary fencing are installed on open excavations where required</li> <li>- Ensure that all necessary hand or hydrovac excavations of buried facilities and third-party pipelines have been carried out in advance of trenching activities</li> <li>- 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)</li> </ul> |
|   | Ensure an approved plan is in place to manage disposal of hydrovac slurry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

**Table 67—Safety Concerns for Trenching and Excavation**

|   |                                                                                                                                                                                                 |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                     |
|   | Ensure One Calls for underground facilities are made by the contractor and ensure that a valid One 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                                                                                                                                   |
|   | Ensure that signage, barriers, warning flashers, or fencing are erected and maintained around excavations left overnight or for an extended period in accordance with applicable regulations    |
|   | <b>Blasting</b>                                                                                                                                                                                 |
|   | 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                                                                                                                   |



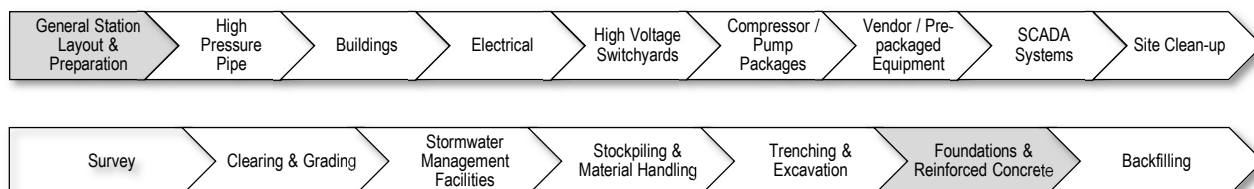
|   |                                                                                                                             |
|---|-----------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                 |
|   | 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            |
|   | 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 near 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 68—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 Operator 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 69—Typical Monitoring Requirements for Trenching and Excavation**

|   |                                                                                                                                                                                                                                                  |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                      |
|   | <b>Trench Dimensions</b>                                                                                                                                                                                                                         |
|   | 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 duct banks and foundations (including over-excavation and select fill as indicated on the Issued for Construction (IFC) drawings, including listed specifications and notes)   |
|   | <b>Open Trench Considerations</b>                                                                                                                                                                                                                |
|   | 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: <ul style="list-style-type: none"> <li>- Safety concerns for workers and the public</li> <li>- Large accumulations of water</li> </ul> |



|   |                                                                                                                                                               |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                   |
|   | <ul style="list-style-type: none"> <li>- Excavated soil becoming frozen in winter</li> <li>- Snow and ice accumulation</li> <li>- Foreign material</li> </ul> |

**Table 70—Typical Monitoring Requirements for Trenching through Rock**

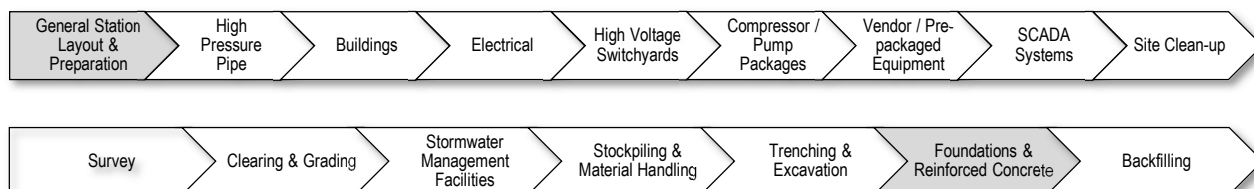
|   |                                                                                                                                                                                                     |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | 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 Operator specifications (i.e., greater than the minimum trench depth shown on the drawings) to allow for trench bottom padding |

**Table 71—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 Operator's specification, the construction contract, or the crossing agreement, the most stringent requirements will apply) |

**Table 72—Typical Monitoring Requirements for Trench Plugs and Sub-drains / Drain Tiles**

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|   | Trench plugs and sub-drains may be constructed based on construction drawings; in some cases the quantity and their location are best determined in the field after the trench is excavated.<br>Monitor for: <ul style="list-style-type: none"> <li>- Specific terrain features / drainage patterns</li> <li>- 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</li> <li>- Locations where water can enter the trench and flow downhill through the backfill</li> <li>- Trench water encountered on slopes and hills</li> </ul> |
|   | Ensure Operator 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 Operator drawings and specifications or as required                                                                                                                                                                                                                                                                                                                                                                                                      |
|   | <b>Sub-drains / Drain Tiles</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|   | If drain tiles are cut: <ul style="list-style-type: none"> <li>- Ensure location is marked</li> <li>- Confirm ends are capped to prevent clogging from dirt or debris</li> <li>- Ensure temporary flumes are installed to maintain drainage</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                         |



|   |                                                                                                                                                                                                                   |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                       |
|   | If unmarked utilities are discovered or damaged, ensure the contractor contacts the facility Owner for approval and requirements for the repair                                                                   |
|   | 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 73—Typical Monitoring Requirements for Seasonal (Winter) Considerations**

|   |                                                                                                                                                                                                                                |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                    |
|   | Ensure contractor blades a berm of loose material or snow to Operator 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 74—Typical Monitoring Requirements for Additional Work Items**

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|   | Monitor and record the following additional work items: <ul style="list-style-type: none"> <li>- Extra-depth trench</li> <li>- Rock-trench excavation by specialized mechanical excavation techniques</li> <li>- Rock-trench excavation by blasting techniques</li> <li>- Quantity of rock excavation</li> <li>- Fabricated blasting mats used to contain fly-rock (where required by permit)</li> <li>- Use of timber mats for equipment support in areas of weak and saturated soils</li> <li>- Third-party utility crossings</li> </ul> |

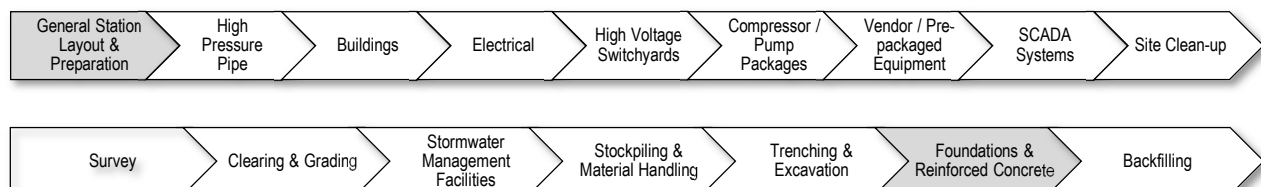
**Table 75—Typical Monitoring Requirements for Historic Sites**

|   |                                                                                                                                                               |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | 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)                                  |

#### **A.1.6.4.3 Typical Outputs for Trenching and Excavation Inspection**

**Table 76—Typical Reporting Requirements**

|                |                                                                                                                        |
|----------------|------------------------------------------------------------------------------------------------------------------------|
| ✓              | Description                                                                                                            |
| <b>General</b> |                                                                                                                        |
|                | 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: <ul style="list-style-type: none"> <li>- Record the quantities of any rock excavation</li> <li>- Record the trench depths and widths</li> <li>- Detailed records (per Operator forms) of blasting activity</li> <li>- Document punch list items, as required</li> </ul> |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### A.1.6.5 References – Trenching and Excavation

**NOTE** The reference information provided in Table 77 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 77—List of References – Trenching and Excavation**

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

## A.1.7 Foundations and Reinforced Concrete

### A.1.7.1 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 Operator technical specifications as identified in Table 79.

### A.1.7.2 Execution

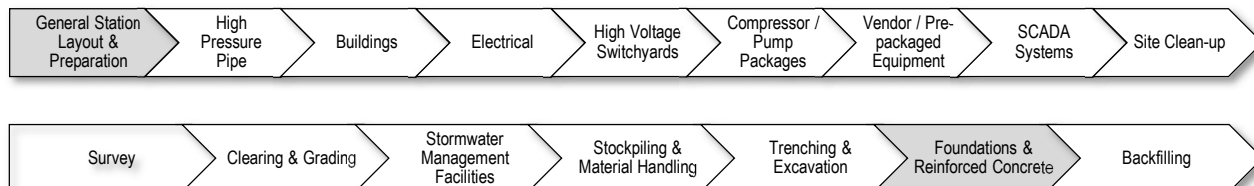
While the work is being executed, the Inspector should monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the foundations and reinforced concrete construction process are identified in a series of checklists as detailed in Table 78.

**Table 78—Monitoring Requirements for Foundations and Reinforced Concrete Construction – Civil**

| Item                                             | Description                                                                                                                   | Reference |
|--------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work                         | Daily, ensure key issues that have been identified are detailed and addressed                                                 | Table 80  |
| Safety                                           | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements                           | Table 81  |
| Foundations and Reinforced Concrete Construction | Monitoring requirements associated with foundations and reinforced concrete, ensuring the installation conforms to the design | Table 82  |

### A.1.7.3 Outputs

The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for foundations and reinforced concrete inspection appear in Table 83.



#### **A.1.7.4 Detailed Checklists – Foundations and Reinforced Concrete**

##### **A.1.7.4.1 Typical Input Requirements for Foundations and Reinforced Concrete Inspection**

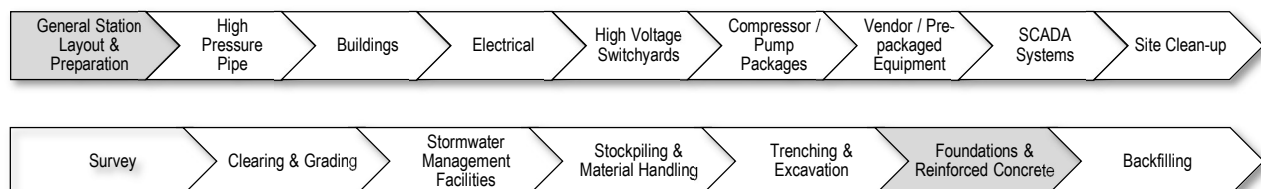
**Table 79—Information Requirements for Foundations and Reinforced Concrete Inspection**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>All designs, drawings, and specifications developed by the Operator and contractors related to foundations and reinforced concrete, such as:</p> <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings, including</li> <li>- Plans, Sections, and details</li> <li>- Pile schedules (including electrical grounding plans and details)</li> <li>- Rebar drawings</li> <li>- Formwork drawings</li> </ul> <p>Foundation specifications, including:</p> <ul style="list-style-type: none"> <li>- Plain and Reinforced Concrete, including Concrete Mix Design</li> <li>- Embedded steel</li> <li>- Anchor bolts (including allowable use of post-installed adhesive (epoxy) anchors)</li> <li>- Grout</li> <li>- Manufacturer specifications (including additives)</li> </ul> |
|   | <p>Contracts and agreements related to:</p> <ul style="list-style-type: none"> <li>- Technical advisors / vendor representatives</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|   | Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|   | <p>Other project specific plans, which may include:</p> <ul style="list-style-type: none"> <li>- Concrete production facilities certification</li> <li>- 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</li> <li>- Coordination for embedded water and / or sewer pipe, conduits / cables, and grounding</li> <li>- Methods for protection of anchor bolt threads</li> <li>- Reciprocating compressor package grout plan</li> <li>- Hot / cold weather concrete plans</li> </ul>                                                                                                                                               |

##### **A.1.7.4.2 Best Practice Items for Inspecting Typical Foundations and Reinforced Concrete Construction**

**Table 80—Prior to Commencing Work**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                         |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>Participate in daily meetings to address:</p> <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |
|   | 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 Operator or project specifications and IFC drawings per Section A.1.1.4 Stockpiling and Material Handling                                                                                                                                                       |



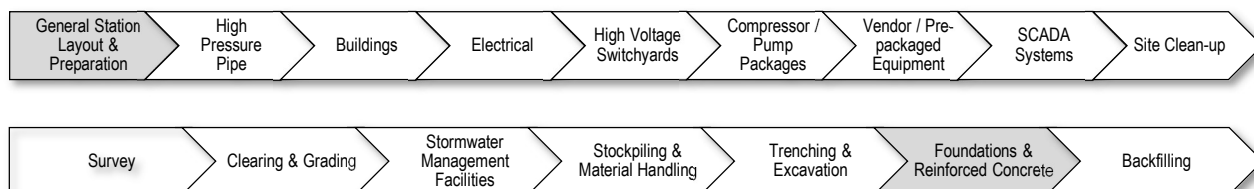
|   |                                                                                                                                                                                                   |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                       |
|   | Ensure excavations are complete per Section A.1.6 Trenching and Excavation                                                                                                                        |
|   | Verify electrical inspection is complete per Section A.4 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 81—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 82—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 A.2.4 Welding and Joining, if required |
|   | Ensure reinforcing steel is properly grounded in accordance with Section A.4.4 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 Operator                                                                                                |
|   | Ensure concrete materials, including cement, fly ash, mixing water, and aggregate, are in accordance with concrete mix design and Operator or project specifications                                                                                        |
|   | Ensure concrete mix proportions (e.g., water-cement ratio) are in accordance with concrete mix design and Operator or project specifications                                                                                                                |
|   | Ensure high early strength cement is only used with Operator 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                                                                                                                                     |





|   |                                                                                                                                                                  |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                      |
|   | 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                                                       |

#### A.1.7.4.3 Typical Outputs for Foundations and Reinforced Concrete Inspection

**Table 83—Typical Reporting Requirements**

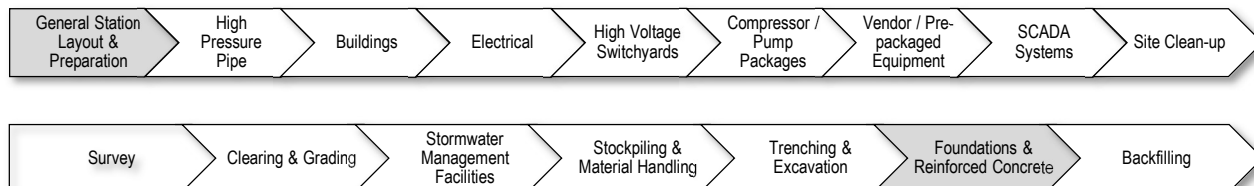
|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| General     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|             | Ensure completion of as-built, red-lined drawings                                                                                                                                                                                                                                                                                                                                                                                                               |
|             | Ensure survey of top of concrete elevations prior to backfill in accordance with Section A.1.8                                                                                                                                                                                                                                                                                                                                                                  |
| Backfilling |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Daily       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|             | Complete foundations and reinforced concrete progress reports, including: <ul style="list-style-type: none"> <li>- Concrete cylinder field and laboratory reports</li> <li>- Mass concrete temperature reports (if required by Operator)</li> <li>- Concrete pour release forms</li> <li>- Daily concrete placement reports</li> <li>- Piling logs</li> <li>- Concrete batch tickets for each pour</li> <li>- Document punch list items, as required</li> </ul> |

#### A.1.7.5 References – Foundations and Reinforced Concrete

NOTE The reference information provided in Table 84 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.

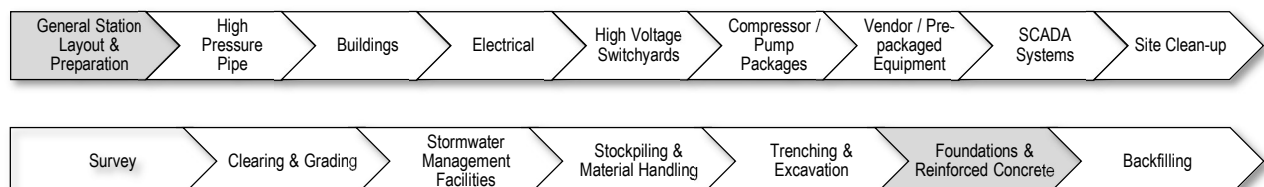
**Table 84—List of References – Foundations and Reinforced Concrete**

| Document No.                      | Type | Title |
|-----------------------------------|------|-------|
| American Concrete Institute (ACI) |      |       |

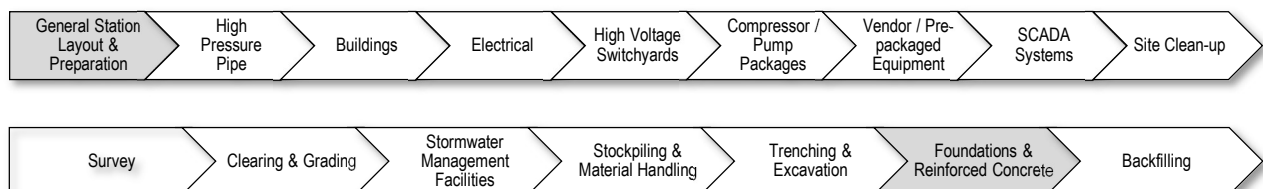


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| Document No.                           | Type                 | Title                                                                                 |
|----------------------------------------|----------------------|---------------------------------------------------------------------------------------|
| 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                                                         |
| 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                                          |



# DRAFT



## A.1.8 Backfilling

### A.1.8.1 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 Operator technical specifications as identified in Table 86.

### A.1.8.2 Execution

While the work is being executed, the Inspector should 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 85.

**Table 85—Monitoring Requirements for Backfilling – Civil**

| Item                           | Description                                                                                                                                                                                                                                      | Reference |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work       | Daily, ensure key issues that have been identified are detailed and addressed                                                                                                                                                                    | Table 87  |
| Safety                         | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements                                                                                                                                              | Table 88  |
| General Backfilling Operations | Identifies overall items that Inspectors should monitor during backfilling operations                                                                                                                                                            | Table 89  |
| 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 Operator specifications to prevent damage to the pipe | Table 90  |

### A.1.8.3 Outputs

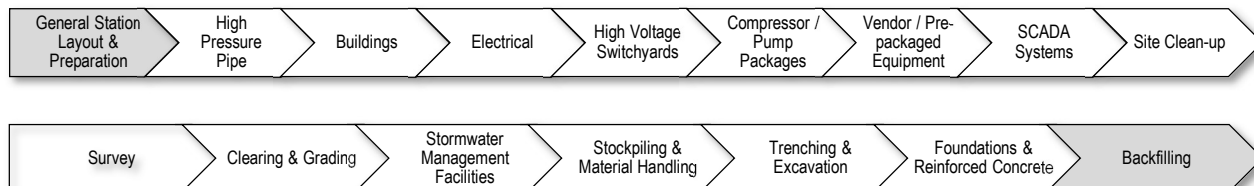
The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for backfilling inspection appear in Table 91.

### A.1.8.4 Detailed Checklists – Backfilling

#### A.1.8.4.1 Typical Inputs for Backfilling Inspection

**Table 86—Information Requirements for Backfilling**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                           |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>All designs, drawings, and specifications developed by the Operator and contractors related to backfilling, such as:</p> <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings, including</li> <li>- Access road drawings</li> <li>- Line list (e.g., special concerns for each landowner)</li> <li>- Backfill specifications</li> </ul> |
|   | <p>Contracts and agreements related to:</p> <ul style="list-style-type: none"> <li>- Road use</li> <li>- Crossing for buried facilities</li> <li>- Construction survey</li> </ul>                                                                                                                                                                                     |



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|   |                                                                                                                                                                                                                                                                                                                                                           |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                               |
|   | Permits related to: <ul style="list-style-type: none"> <li>- Environmental</li> <li>- Road use</li> </ul>                                                                                                                                                                                                                                                 |
|   | Operator specific safety plan, including (but not limited to): <ul style="list-style-type: none"> <li>- Traffic control plan</li> <li>- Requirements for Personal Protective Equipment (PPE)</li> <li>- Procedures for working around overhead powerlines</li> <li>- Emergency Medical Services (EMS)</li> <li>- Trenching and Excavation plan</li> </ul> |
|   | Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information                                                                                                                                                       |

#### A.1.8.4.2 Best Practice Items for Inspecting Typical Backfilling Operations

**Table 87—Prior to Commencing Work**

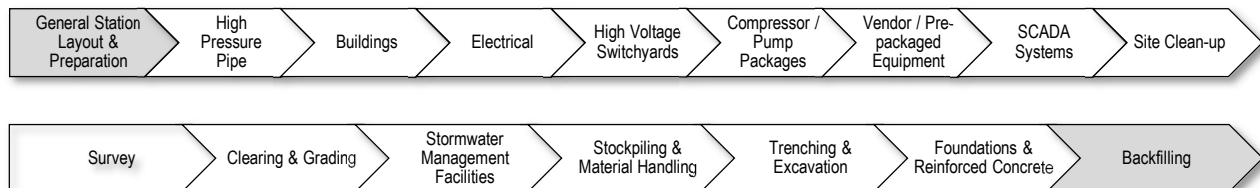
|   |                                                                                                                                                                                                                                                                                                                                                                              |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                  |
|   | Participate in daily meetings to address: <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |
|   | Ensure that the Operator witnesses and acquires approval before commencing the backfilling operation                                                                                                                                                                                                                                                                         |
|   | 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 88—Safety Concerns for Backfilling**

|   |                                                                                                                                                                                                     |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                         |
|   | Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information |

**Table 89—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 Operator approved select / imported bedding and backfill      |



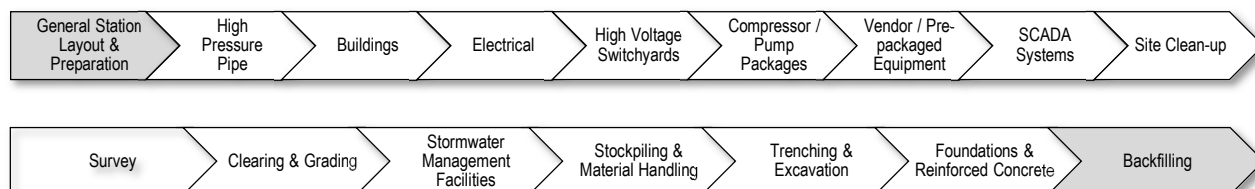
|   |                                                                                                                                                                                                                                                         |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                             |
|   | 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 Operator 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                                                                                                                                                                                              |
|   | <b>Winter Construction</b>                                                                                                                                                                                                                              |
|   | Confirm that during winter construction, trench excavation, assembly installation, and backfilling are completed by the contractor as agreed with the Operator                                                                                          |
|   | Ensure that any snow or ice is removed from the compacted layer prior to placement of subsequent layers                                                                                                                                                 |

**Table 90—Typical Monitoring Requirements for Backfilling Materials**

|   |                                                                                                                                                                                                |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                    |
|   | Ensure that topsoil 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, Operator 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           |
|   | <b>Padding</b>                                                                                                                                                                                 |
|   | 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 Operator or project specifications, construction drawings, and agreements  |

#### **A.1.8.4.3 Typical Outputs for Backfilling Inspection**

**Table 91—Typical Reporting Requirements**



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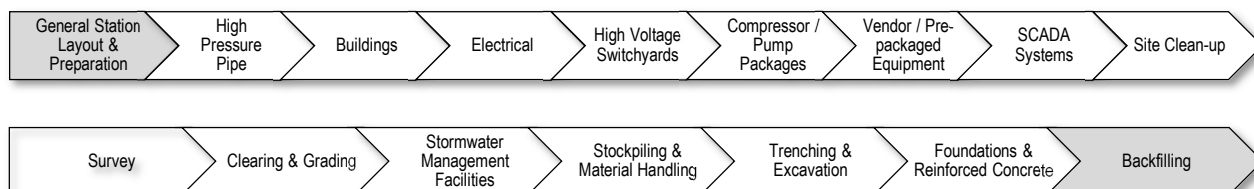
|         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓       | 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: <ul style="list-style-type: none"> <li>- Minimum cover obtained</li> <li>- Description of the areas backfilled</li> <li>- Description of compaction equipment and methods used, including test results</li> <li>- Schedule changes including any delay or acceleration and reasons</li> <li>- As-built alignment (or weld maps) and profile of installed pipe</li> <li>- Holiday detector settings and calibration</li> <li>- Locations of damaged drain tiles for repair</li> <li>- Locations and type of pipe protection materials installed</li> <li>- Document punch list items, as required</li> </ul> |

#### A.1.8.5 References – Backfilling

NOTE The reference information provided in Table 92 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 92—List of References – Backfilling**

| Document No.                                                                                                                                                                                        | Type | Title |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|
| Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information |      |       |



## **A.2 High Pressure Pipe**

### **A.2.1 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.

High pressure pipe construction activities consist of the following major items during the construction of a facility:

- Pipe Inspection
- Lifting and Setting
- Welding and Joining
- Coating / Painting
- Hydrostatic Testing
- Cathodic Protection

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

#### **A.2.1.1 Pipe Inspection**

Steel pipe is inspected prior to construction or installation. This activity requires comparing material in the field to construction documents.

#### **A.2.1.2 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.

#### **A.2.1.3 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 inspectors 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.

#### **A.2.1.4 Coating / Painting**

Coating of the pipe sections and equipment assemblies provides a protective barrier against damage (e.g., corrosion). Most 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.





### A.2.1.5 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. Operators 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 than 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.

### A.2.1.6 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.



## A.2.2 Pipe Inspection

### A.2.2.1 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 Operator technical specifications as identified in Table 94.

### A.2.2.2 Execution

While the work is being executed, the Inspector should 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 93.

**Table 93—Monitoring Requirements for Structural Steel Construction – Civil**

| Item                                             | Description                                                                                                   | Reference     |
|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------|---------------|
| Prior to Commencing Work                         | Daily, ensure key issues that have been identified are detailed and addressed                                 | Table 95      |
| Safety                                           | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements           | Table 96      |
| Trenching and Excavation Operations              | Previously discussed monitoring requirements associated with trenching and excavation operations              | Section A.1.6 |
| Foundations and Reinforced Concrete Construction | Previously discussed monitoring requirements associated with foundations and reinforced concrete construction | Section A.1.7 |
| Structural Steel Construction                    | Monitoring requirements associated with structural steel, ensuring the installation conforms to the design    | Table 97      |

### A.2.2.3 Outputs

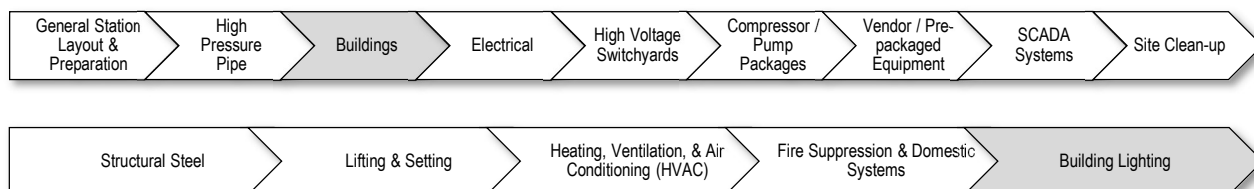
The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for structural steel inspection appear in Table 98.

### A.2.2.4 Detailed Checklists – Structural Steel

#### A.2.2.4.1 Typical Input Requirements for Structural Steel Inspection

**Table 94—Information Requirements for Structural Steel Inspection**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>All designs, drawings, and specifications developed by the Operator and contractors related to structural steel, such as:</p> <p>Issued for Construction (IFC) drawings, including</p> <ul style="list-style-type: none"> <li>- Pipe support drawings</li> <li>- Vent support drawings</li> <li>- Fabrication shop drawings</li> <li>- Structural steel specifications</li> <li>- Construction specifications</li> <li>- Manufacturer specifications and drawings</li> </ul> |



|   |                                                                                                                                                                                                                                                                                              |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                  |
|   | Contracts and agreements related to: <ul style="list-style-type: none"> <li>- Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information</li> </ul> |
|   | Operator specific safety plan, which may include: <ul style="list-style-type: none"> <li>- Working at elevations</li> <li>- Lift plan</li> </ul>                                                                                                                                             |
|   | Other project specific plans, which may include: <ul style="list-style-type: none"> <li>- Traffic Management plan</li> </ul>                                                                                                                                                                 |

#### A.2.2.4.2 Best Practice Items for Inspecting Typical Structural Steel Construction

**Table 95—Prior to Commencing Work**

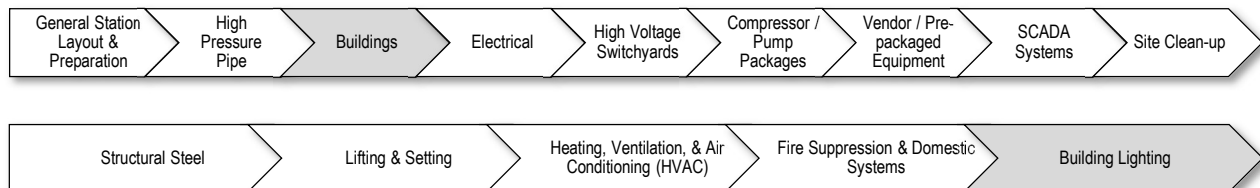
|   |                                                                                                                                                                                                                                                                                                                                                                              |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                  |
|   | Participate in daily meetings to address: <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |
|   | Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Operator or project specifications and IFC drawings per Section A.1.5 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                                                                                                                                                                                                                                   |
|   | Ensure contractor is familiar with and competent in the proper joining method (e.g., bolt torquing values, turn-of-nut bolting method)                                                                                                                                                                                                                                       |

**Table 96—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 97—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 Operator 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                                                  |



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|   |                                                                                  |
|---|----------------------------------------------------------------------------------|
| ✓ | Description                                                                      |
|   | Ensure welding is completed in accordance with Section A.2.4 Welding and Joining |

#### A.2.2.4.3 Typical Outputs for Structural Steel Inspection

**Table 98—Typical Reporting Requirements**

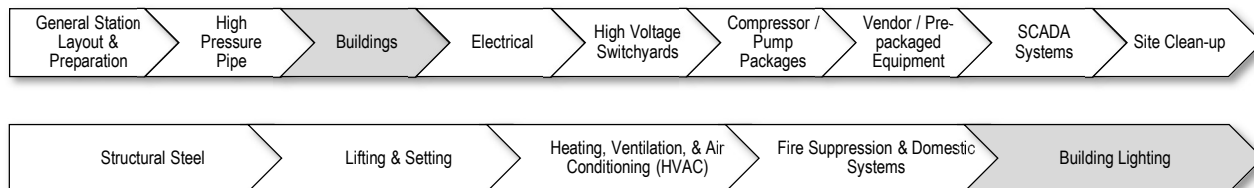
|                |                                                                                                                                                                                                                                                                                     |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓              | Description                                                                                                                                                                                                                                                                         |
| <b>General</b> |                                                                                                                                                                                                                                                                                     |
|                | Ensure completion of as-built, red-lined drawings and MTRs as required by Operator                                                                                                                                                                                                  |
| <b>Daily</b>   |                                                                                                                                                                                                                                                                                     |
|                | Complete structural steel progress reports, including: <ul style="list-style-type: none"> <li>- Number and location of structural steel members erected</li> <li>- Description and location of placed structural steel</li> <li>- Document punch list items, as required</li> </ul> |

#### A.2.2.5 References – Structural Steel

**NOTE** The reference information provided in Table 99 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 99—List of References – Structural Steel**

| Document No.                                                                                          | Type          | Title                                                                                              |
|-------------------------------------------------------------------------------------------------------|---------------|----------------------------------------------------------------------------------------------------|
| <b>American Institute of Steel Construction (AISC)</b>                                                |               |                                                                                                    |
| 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                                                                          |
| <b>American National Standards Institute (ANSI) / American Institute of Steel Construction (AISC)</b> |               |                                                                                                    |
| ANSI / AISC 303                                                                                       | Standard      | Code of Standard Practice for Steel Buildings and Bridges                                          |
| ANSI / AISC 360                                                                                       | Specification | Specification for Structural Steel Buildings                                                       |
| <b>American Society for Testing and Materials (ASTM)</b>                                              |               |                                                                                                    |
| 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                                             |



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

## A.2.3 Lifting and Setting

### A.2.3.1 Inputs

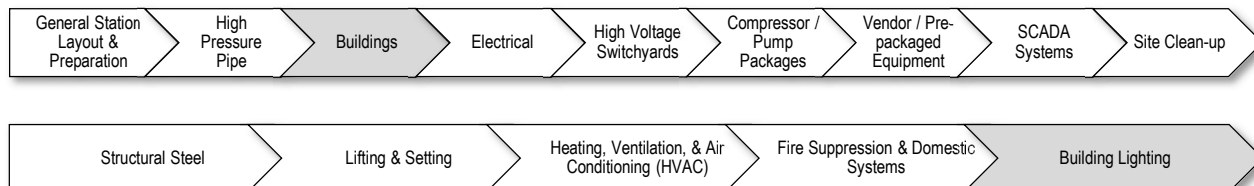
As part of preparing for inspection during the lifting and setting process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Operator technical specifications as identified in Table 101.

### A.2.3.2 Execution

While the work is being executed, the Inspector should 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 100.

**Table 100—Monitoring Requirements for Lifting and Setting – Mechanical**

| Item                     | Description                                                                   | Reference |
|--------------------------|-------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work | Daily, ensure key issues that have been identified are detailed and addressed | Table 102 |



| Item                | Description                                                                                                | Reference |
|---------------------|------------------------------------------------------------------------------------------------------------|-----------|
| Safety              | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements        | Table 103 |
| Lifting and Setting | Monitor lifting and setting operations for safety and ensure that no damage occurs to the pipe and coating | Table 104 |

### A.2.3.3 Outputs

The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for lifting and setting inspection appear in Table 105.

### A.2.3.4 Detailed Checklists – Lifting and Setting

#### A.2.3.4.1 Typical Input Requirements for Lifting and Setting Inspection

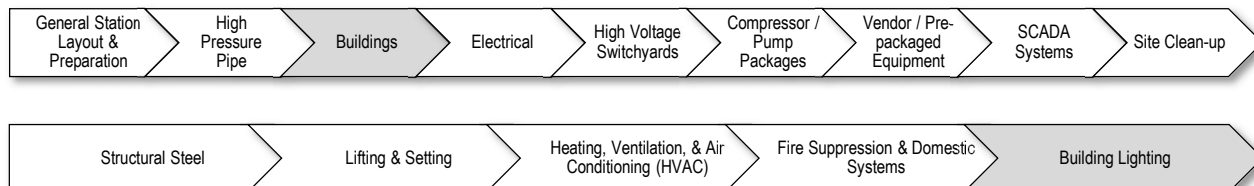
**Table 101—Information Requirements for Lifting and Setting**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>All designs, drawings, and specifications developed by the Operator and contractors related to lifting and setting, such as:</p> <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings, including <ul style="list-style-type: none"> <li>o Piping and Instrumentation Diagrams (P&amp;IDs)</li> <li>o Equipment manufacturer specifications and drawings</li> <li>o Lifting equipment specifications and drawings, including maximum allowed equipment spacing for material</li> </ul> </li> </ul> |
|   | <p>Contracts and agreements related to:</p> <ul style="list-style-type: none"> <li>- Road use</li> <li>- Crossing for buried facilities</li> <li>- Construction survey</li> </ul>                                                                                                                                                                                                                                                                                                                                               |
|   | <p>Operator specific safety plan, including (but not limited to):</p> <ul style="list-style-type: none"> <li>- Traffic control plan</li> <li>- Requirements for Personal Protective Equipment (PPE)</li> <li>- Emergency Medical Services (EMS)</li> <li>- Heavy lift plan</li> <li>- Lock-out / Tag-out procedures</li> </ul>                                                                                                                                                                                                  |
|   | <p>Other project specific plans, which may include:</p> <ul style="list-style-type: none"> <li>- Fire prevention / firefighting plan</li> <li>- Relevant contingency plans</li> <li>- Loading, securing, and rigging practices</li> </ul>                                                                                                                                                                                                                                                                                       |

#### A.2.3.4.2 Best Practice Items for Inspecting Typical Lifting and Setting Operations

**Table 102—Prior to Commencing Work**

| ✓ | Description                                                                                                                                                                                                                                                                                          |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>Participate in daily meetings to address:</p> <ul style="list-style-type: none"> <li>- Job safety analysis (JSA) and hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> </ul> |



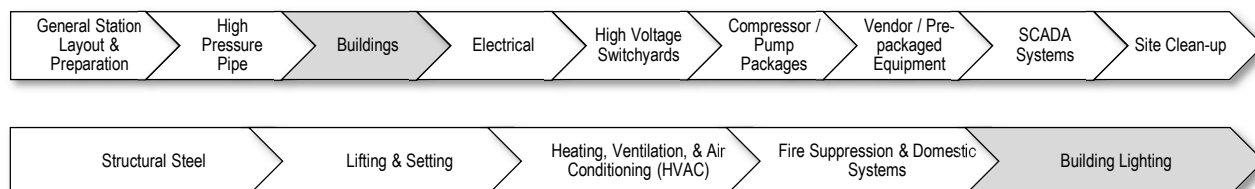
|   |                                                                                                                                                                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                           |
|   | - 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 / pipe damage |
|   | Inspect spreader bars, slings, belts, cradles, etc. visually for damage                                                                                                                                                                               |

**Table 103—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 104—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                                                          |



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|   |                                                                                                                                                                                                                                                                                                                                                                                                              |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | 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 A.2.5 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                                                                                                                                                                                                                                                                                 |

#### A.2.3.4.3 Typical Outputs for Lifting and Setting Inspection

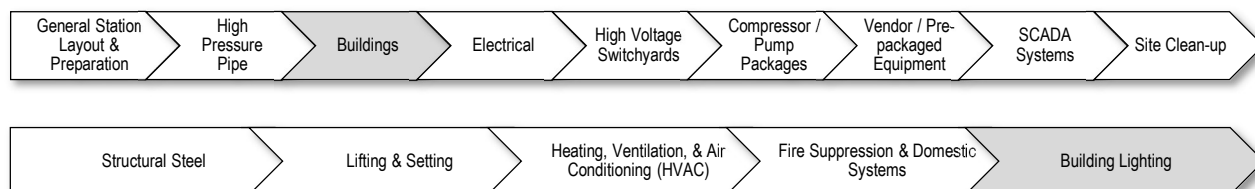
**Table 105—Typical Reporting Requirements**

|                |                                                                                                                                                                                                                                                                                       |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓              | Description                                                                                                                                                                                                                                                                           |
| <b>General</b> |                                                                                                                                                                                                                                                                                       |
|                | Ensure completion of as-built, red-lined drawings                                                                                                                                                                                                                                     |
| <b>Daily</b>   |                                                                                                                                                                                                                                                                                       |
|                | Complete lifting and setting progress reports, including: <ul style="list-style-type: none"> <li>- Description and location of placed pipe or structural steel</li> <li>- Any damage incurred during lifting and setting</li> <li>- Document punch list items, as required</li> </ul> |

#### A.2.3.5 References – Lifting and Setting

**NOTE** The reference information provided in Table 106 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 106—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                                     |

## A.2.4 Welding and Joining

### A.2.4.1 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 108.

### A.2.4.2 Execution

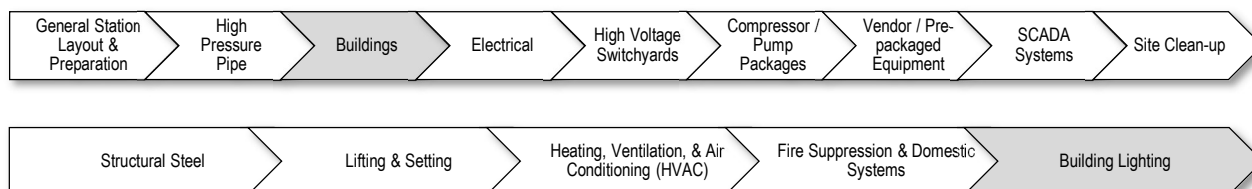
While the work is being executed, the Inspector should monitor workmanship and report on progress on a periodic basis. Since welding inspection is a specialized role, the listing provided in this section is focused on items that would typically require specialized welding expertise (i.e., indication 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 107.

**Table 107—Monitoring Requirements for Welding and Joining**

| Item                                            | Description                                                                                                                                                                                                                                                                      | Reference |
|-------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work                        | Daily, ensure key issues that have been identified are detailed and addressed                                                                                                                                                                                                    | Table 109 |
| Safety                                          | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements                                                                                                                                                                              | Table 110 |
| 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 111 |
| Mechanical                                      |                                                                                                                                                                                                                                                                                  |           |
| Joining Operations                              | Monitoring requirements associated with joining (e.g., bolting of pipe flanges), ensuring the installation conforms to the design. Note that it is important to identify those situations that require a specialized inspector for rotating and stationary equipment and piping. | Table 112 |



### A.2.4.3 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 113.

### A.2.4.4 Detailed Checklists – Welding and Joining

#### A.2.4.4.1 Typical Input Requirements for Welding and Joining Inspection

**Table 108—Information Requirements for Welding and Joining**

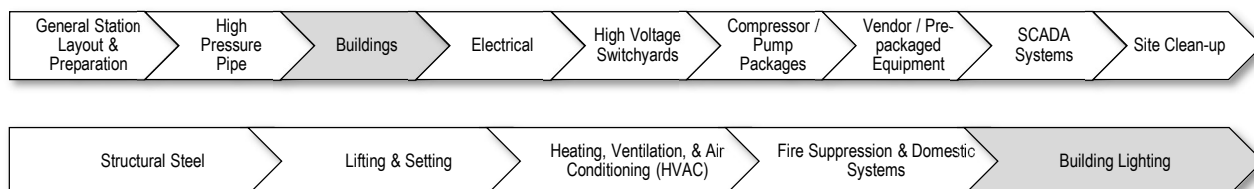
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>All designs, drawings, and specifications developed by the Operator and contractors related to welding and joining, such as:</p> <ul style="list-style-type: none"> <li>- All applicable Welding Procedure Specifications (WPS)</li> <li>- All applicable Operator's welding standards</li> <li>- Issued for Construction (IFC) drawings, including:                     <ul style="list-style-type: none"> <li>Piping and Instrumentation Diagrams (P&amp;IDs)</li> <li>Bills of Materials (BOMs)</li> </ul> </li> </ul> |
|   | <p>Contracts and agreements related to:</p> <ul style="list-style-type: none"> <li>- Welding</li> <li>- All welders' qualifications records to specific applicable processes and WPS</li> <li>- Non-destructive Examination (NDE)</li> <li>- Construction survey</li> </ul>                                                                                                                                                                                                                                                  |
|   | <p>Operator specific safety plan, including (but not limited to):</p> <ul style="list-style-type: none"> <li>- Requirements for Personal Protective Equipment (PPE)</li> <li>- Emergency Medical Services (EMS)</li> </ul>                                                                                                                                                                                                                                                                                                   |
|   | <p>Other project specific plans, which may include:</p> <ul style="list-style-type: none"> <li>- Welding plan</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                     |

#### A.2.4.4.2 Best Practice Items for Inspecting Typical Welding and Joining Operations

**Table 109—Prior to Commencing Work**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>Participate in daily meetings to address:</p> <ul style="list-style-type: none"> <li>- Ensure all welders have welding qualifications on hand for the process and specified WPS. Ensure WPS matches materials being welded. Ensure bolting procedure matches the bolted connection being assembled.</li> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> <li>- Conduct and record tailgate meetings with welders to ensure they clearly understand the Operator Quality, safety, welding standards, and Welding Procedure Specifications (WPS)</li> <li>- Communicate and monitor all hold points prior to start of welding operations</li> <li>- Ensure every new welder to site is briefed on the above points during onboarding</li> </ul> |
|   | Ensure torquing or bolt tensioning equipment calibration has been verified                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

**Table 110—Safety Concerns for Welding and Joining**



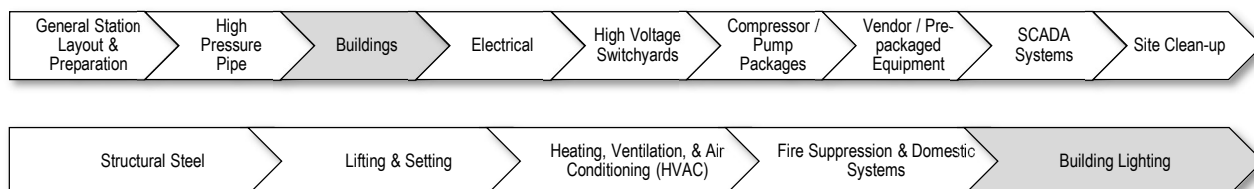
|   |                                                                                                                                                                                                                                                                                                                                                                                                |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | 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 111—Typical Monitoring Requirements for Welding Operations**

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|   | Ensure all materials are inspected for compliance with Operator 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: <ul style="list-style-type: none"> <li>- Confirmation of appropriate welding equipment</li> <li>- Confirmation of appropriate handling and storage of welding materials</li> <li>- Confirmation of qualifications of tackers, welders, and welding operators</li> <li>- Identification of substandard quality of work</li> <li>- Examination of finished work for compliance of code, standards, specifications, and drawings</li> <li>- Confirmation of any issues related to weld repair</li> <li>- Conformance to WPS (e.g., volts, amps, travel speed, pre-heat, post-weld heat maintenance, post-weld heat treatment)</li> </ul> |

**Table 112—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                                                                                                                                                                                                       |
|   | 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 A.2.5 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 A.2.5 Coating / Painting, and hydrostatic testing in accordance with Section A.2.6 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 torquing or tensioning                                            |

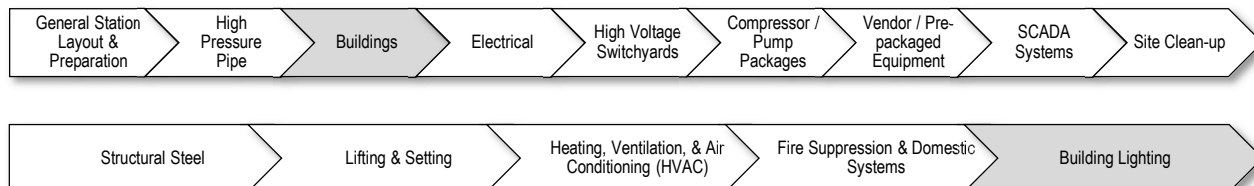


| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | Ensure flange fit-ups and screwed connections are properly installed, including verification of the following: <ul style="list-style-type: none"> <li>- Torque / tension requirements</li> <li>- Proper support and torqueing / tensioning per Operator specifications</li> <li>- Flange is clean and free of any debris</li> <li>- Connection to the proper piece of equipment</li> <li>- Location</li> <li>- Equipment / device needed to be used (e.g., standard gasket, CGI gasket, insulation kit)</li> <li>- Correct vessel</li> <li>- Screwed connections are properly installed without cross-threading</li> </ul> |
|   | Ensure special bolting requirements, if any, including specific fasteners, installation order and location, and coating or protective cover, are met                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|   | <b>Main Process Piping and Inlet Gas Filter Separators</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|   | Check horizontal vessels and pipe to ensure that sliding end is free to slide, as required                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|   | <b>Fuel Gas Systems</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|   | Ensure correct installation of filter elements in fuel gas filter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|   | Verify odorant level in gas odorant, as required                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

#### A.2.4.4.3 Typical Outputs for Welding and Joining Inspection

**Table 113—Typical Reporting Requirements**

| ✓ | Description                                                                                                                            |
|---|----------------------------------------------------------------------------------------------------------------------------------------|
|   | <b>General</b>                                                                                                                         |
|   | Safety hazard observation report                                                                                                       |
|   | Job Safety Analysis (JSA) / hazard identification report                                                                               |
|   | Ensure completion of as-built, red-lined drawings                                                                                      |
|   | <b>Non-destructive Examination (NDE)</b>                                                                                               |
|   | 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                                                                                                    |
|   | <b>Welding</b>                                                                                                                         |
|   | 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                                                                                                                           |
|   | Operator specific requirements, (e.g., heat mapping)                                                                                   |
|   | <b>Joining</b>                                                                                                                         |
|   | Flanged torque / tension report (including size, class, bolt size, torque / tension value)                                             |
|   | <b>Other</b>                                                                                                                           |
|   | Damaged Pipe Report                                                                                                                    |
|   | Non-pipe Material / Equipment Damage Report                                                                                            |



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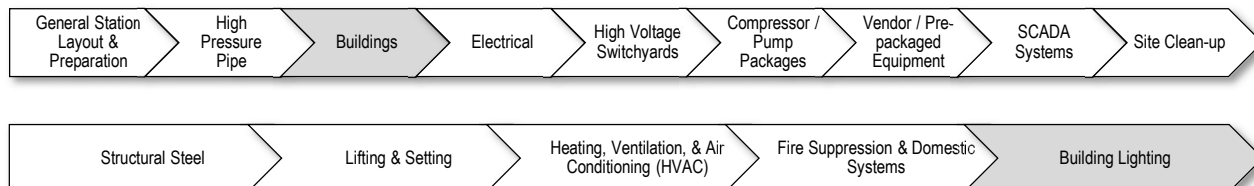
| ✓     | Description                                                                                                                                                                                                                                                                                                                                                       |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Daily | Complete welding and joining progress reports, including: <ul style="list-style-type: none"> <li>- Number of welds completed, and the number of welds rejected on a daily basis</li> <li>- Operator specific welding inspection forms</li> <li>- All specific daily reports required by the Operator</li> <li>- Document punch list items, as required</li> </ul> |

#### A.2.4.5 References – Welding and Joining

NOTE The reference information provided in Table 114 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 114—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                                    |



| Document No.                     | Type                        | Title                                          |
|----------------------------------|-----------------------------|------------------------------------------------|
| 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  |

## A.2.5 Coating / Painting

### A.2.5.1 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 116.

### A.2.5.2 Execution

While the work is being executed, the Inspector should 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 115.

**Table 115—Monitoring Requirements for Coating / Painting – Civil, Mechanical, Electrical (All Disciplines)**

| Item                                                               | Description                                                                                                                                                                                                                                                                                                                                         | Reference |
|--------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work                                           | Daily, ensure key issues that have been identified are detailed and addressed                                                                                                                                                                                                                                                                       | Table 117 |
| Safety                                                             | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements                                                                                                                                                                                                                                                 | Table 118 |
| General Pipe Surface Preparation and Coating / Painting Operations | <ul style="list-style-type: none"> <li>- Typical monitoring requirements for a non-specialized Inspector. Note that it is important to identify those situations that require a specialized coating inspector</li> <li>- Ensure that all pipe coating damage has been identified and repaired prior to the physical installation of pipe</li> </ul> | Table 119 |

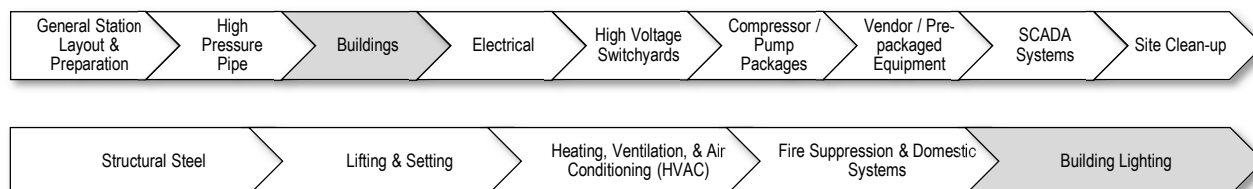
### A.2.5.3 Outputs

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 120.

### A.2.5.4 Detailed Checklists – Coating / Painting

#### A.2.5.4.1 Typical Input Requirements for Coating / Painting Inspection

**Table 116—Information Requirements for Coating / Painting**



|   |                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                          |
|   | All designs, drawings, and specifications developed by the Operator and contractors related to coating / painting, such as: <ul style="list-style-type: none"> <li>- Coating / painting procedures</li> <li>- Coating / painting specifications</li> <li>- Manufacturer supplied information (e.g., storage and handling requirements)</li> <li>- Safety Data Sheet (SDS) for Coating / painting material</li> </ul> |
|   | Contracts and agreements related to: <ul style="list-style-type: none"> <li>- Coating / painting application</li> <li>- Handling and disposal of waste</li> </ul>                                                                                                                                                                                                                                                    |
|   | Operator specific safety plan, including (but not limited to): <ul style="list-style-type: none"> <li>- Requirements for Personal Protective Equipment (PPE)</li> <li>- Emergency Medical Services (EMS)</li> </ul>                                                                                                                                                                                                  |
|   | Other project specific plans, which may include: <ul style="list-style-type: none"> <li>- Coating / painting plan</li> </ul>                                                                                                                                                                                                                                                                                         |

#### A.2.5.4.2 Best Practice Items for Inspecting Typical Coating / Painting Operations

**Table 117—Prior to Commencing Work**

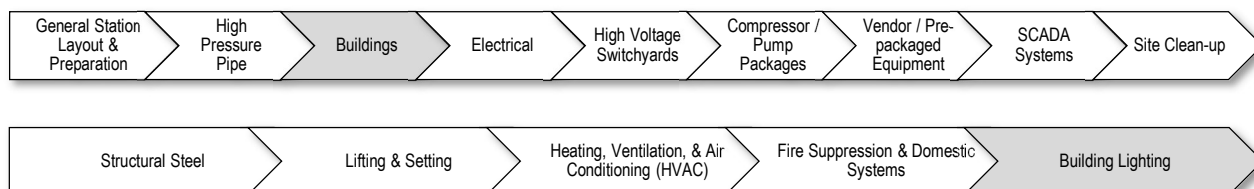
|   |                                                                                                                                                                                                                                                                                                                                                                              |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                  |
|   | Participate in daily meetings to address: <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |
|   | Verify that blasting medium and coating / painting materials are approved                                                                                                                                                                                                                                                                                                    |
|   | Verify product quantities, batch numbers, expiry dates, and types                                                                                                                                                                                                                                                                                                            |

**Table 118—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 |
|   | Ensure specialized coating inspector is engaged to identify additional safety requirements                   |
|   | Ensure adequate ventilation and / or PPE                                                                     |

**Table 119—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 Operator specifications |
|   | Ensure all materials being used (e.g., paint system, primer, topcoat) match Operator 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            |

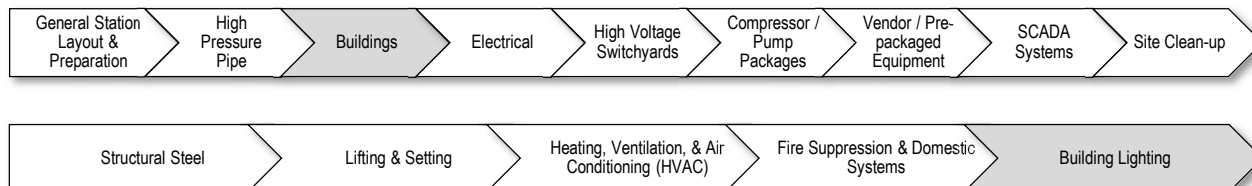


|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|   | 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 Operator 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: <ul style="list-style-type: none"> <li>- Confirmation of qualifications of coating applicators</li> <li>- Confirmation of appropriate pre-heat temperatures around circumference of pipe</li> <li>- Confirmation that coatings are only applied within the surface, weather, and atmospheric requirements of Operator specifications and the manufacturer's specifications</li> <li>- Confirm that surface cleanliness requirements are met prior to applying coating</li> <li>- Ensure that surface profile is checked for compliance with Operator specifications and recorded (i.e., anchor profile specifications (pipe surface roughness / pattern that achieves maximum coating adhesion))</li> <li>- Identification of substandard quality of work</li> <li>- Examination of finished work for compliance with code, standards, specifications, and drawings</li> <li>- Interpretation of specifications and codes</li> <li>- Confirmation of any issues related to coating repair</li> </ul> |
|   | 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 Operator or project specifications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|   | Ensure minimum paint coverage and mill thickness is obtained                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|   | Verify shelf life of materials used is documented                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|   | Verify dew point and ambient temperatures are measured and documented                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|   | Verify stripe coating is completed, if required                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

#### A.2.5.4.3 Typical Outputs for Coating / Painting Inspection

**Table 120—Typical Reporting Requirements**

|   |                                                                                                                        |
|---|------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                            |
|   | <b>General</b>                                                                                                         |
|   | 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 Operator forms                                            |
|   | Ensure completion of as-built, red-lined drawings                                                                      |





#### Daily

Complete coating / painting progress reports, including:

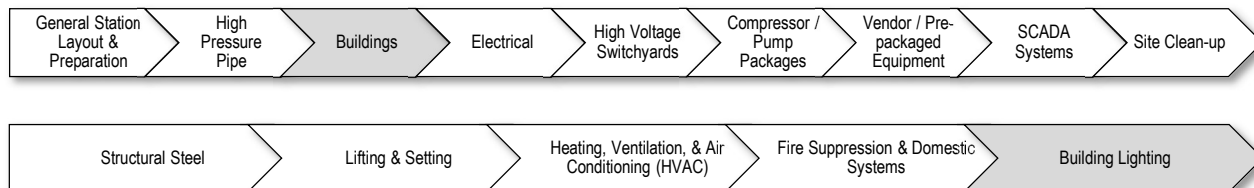
- Coating / painting inspection report, including:
- Conditions of the coating / painting product containers
- Number and types of coating / painting products
- Names of the manufacturers of coating / painting products
- Color of coating / painting products
- Batch and / or lot numbers of coating / painting 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
- Operator specific coating / painting inspection forms
- All specific daily reports required by the Operator
- Document punch list items, as required

#### A.2.5.5 References – Coating / Painting

NOTE The reference information provided in Table 121 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 121—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  |



| Document No.                                      | Type     | Title                                                                                           |
|---------------------------------------------------|----------|-------------------------------------------------------------------------------------------------|
| 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)        |
| <b>The Society for Protective Coatings (SSPC)</b> |          |                                                                                                 |
| 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                                                                  |

## A.2.6 Hydrostatic Testing

### A.2.6.1 Inputs

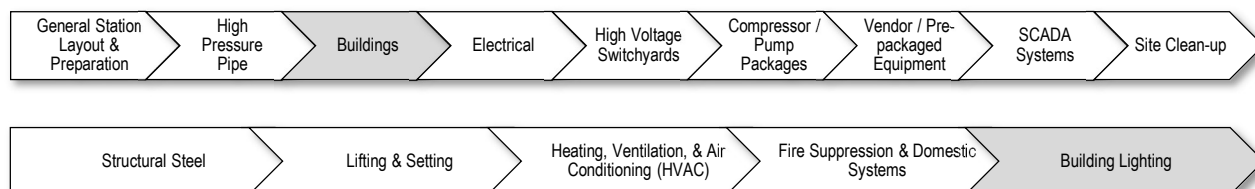
As part of preparing for inspection during the hydrostatic testing process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Operator technical specifications as identified in Table 123.

### A.2.6.2 Execution

While the work is being executed, the Inspector should monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector should monitor for during the hydrostatic testing process are identified in a series of checklists, organized around the typical sequence of events during hydrostatic testing, as detailed in Table 122.

**Table 122—Monitoring Requirements for Hydrostatic Testing – Mechanical**

| Item                     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                               | Reference |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work | <ul style="list-style-type: none"> <li>Daily, ensure key issues that have been identified are detailed and addressed</li> <li>Review and confirm all testing equipment has been certified as fully functional in advance of the testing operations</li> <li>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 Operator specifications</li> </ul> | Table 124 |
| Safety                   | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements                                                                                                                                                                                                                                                                                                                                                       | Table 125 |



| Item                                        |               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Reference |
|---------------------------------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Preparing for Pressure Test                 |               | Ensure all required permits, plans, and calculations are approved and in place prior to commencing hydrostatic test operation. Ensure test pressure is appropriate for pipe included in test.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Table 126 |
| Filling the Pipe                            |               | Confirm pipe is filled as per hydrostatic test plan                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Table 127 |
| Preparing for Pressurization                |               | Ensure all instrumentation and equipment is in place prior to pressuring the test section, including setting up a “Test Vehicle”                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Table 128 |
| Pressurization                              | Strength Test | Proof of strength of installed pipe as per hydrostatic test plan                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Table 129 |
|                                             | Leak Test     | Follow controlled depressurization process from strength test to leak test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Table 130 |
| Leak or Failure Investigation (if required) |               | <ul style="list-style-type: none"> <li>- 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 Operator of further action</li> <li>- 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</li> </ul> | Table 131 |
| Depressurizing                              |               | Ensure depressurizing happens safely in preparation for dewatering and drying                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Table 132 |
| Dewatering                                  |               | Confirm dewatering happens in a manner consistent with environmental permits and approvals, paying specific attention to draining water out of valve bodies and low points.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Table 133 |
| Test Head Removal / Replacement             |               | The contractor will supply all materials, equipment, and personnel to remove test heads                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Table 134 |
| Drying                                      |               | To prevent internal corrosion, one of three methods of drying should be undertaken to the Operator’s specifications (i.e., use of drying pigs, air drying, or methanol)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Table 135 |

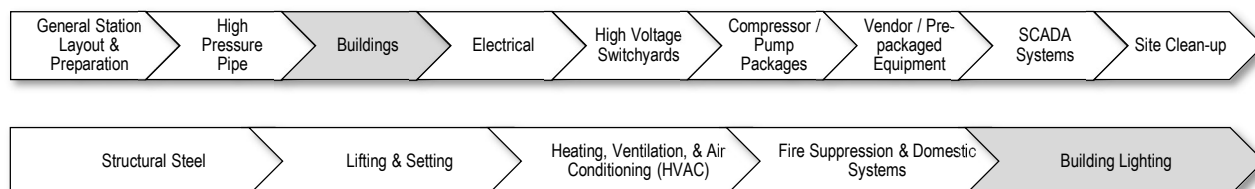
### A.2.6.3 Outputs

The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for hydrostatic testing inspection appear in Table 136.

### A.2.6.4 Detailed Checklists – Hydrostatic Testing

#### A.2.6.4.1 Typical Input Requirements for Hydrostatic Testing Inspection

**Table 123—Information Requirements for Hydrostatic Testing**

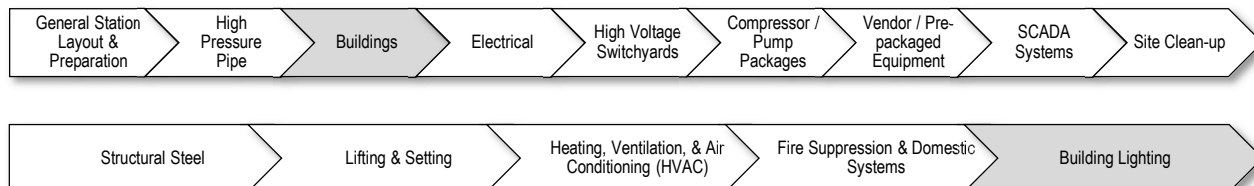


|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|   | <p>All designs, drawings, and specifications developed by the Operator and contractors related to hydrostatic testing, such as:</p> <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings, including <ul style="list-style-type: none"> <li>o Piping and Instrumentation Diagrams (P&amp;IDs)</li> <li>o Isometric drawings</li> <li>o Line List (e.g., special concerns for each landowner); for facility piping, should include tabulated test pressures, duration, and radiography requirements</li> <li>o Pipeline facility drawings</li> <li>o Hydrostatic test specification</li> <li>o Drawings specific to hydrostatic test</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|   | <p>Contracts and agreements related to:</p> <ul style="list-style-type: none"> <li>- Road use</li> <li>- Crossing for buried facilities</li> <li>- Construction survey</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|   | <p>Operator specific safety plan, including (but not limited to):</p> <ul style="list-style-type: none"> <li>- Traffic control plan</li> <li>- Specified minimum setback distance for personnel and testing equipment</li> <li>- Requirements for Personal Protective Equipment (PPE)</li> <li>- Emergency Medical Services (EMS)</li> <li>- Emergency contact list</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|   | <p>Other project specific plans, which may include:</p> <ul style="list-style-type: none"> <li>- Hydrostatic test plan addressing (but not limited to) the following items:</li> <li>- Number of hydrostatic tests required</li> <li>- Site-specific safety / hazards and appropriate analysis</li> <li>- Emergency response plan in the event of a rupture during the test</li> <li>- Testing personnel emergency contact list</li> <li>- Location of testing equipment</li> <li>- Types of discharge structures to be built and used</li> <li>- Volume of water required for each test</li> <li>- Test water sourcing, filling, pressurizing, depressurizing, and dewatering</li> <li>- Signage</li> <li>- The sequencing of hydrostatic tests</li> <li>- Test pressure calculations (i.e., test letter)</li> <li>- Minimum test head rating</li> <li>- Testing crew credentials</li> <li>- Test equipment list and capacities</li> <li>- Test schedule and sequence of tests</li> <li>- Instrumentation and their certification</li> <li>- Provision of protective berms around fuel storage used to supply fuel-driven line fill pumps (as required)</li> <li>- Leak Detection Mechanism / plan (if required)</li> </ul> |

#### A.2.6.4.2 Best Practice Items for Inspecting Typical Hydrostatic Testing Operations

**Table 124—Prior to Commencing Work**

|   |                                                                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                           |
|   | <p>Participate in daily meetings to address:</p> <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> </ul> |



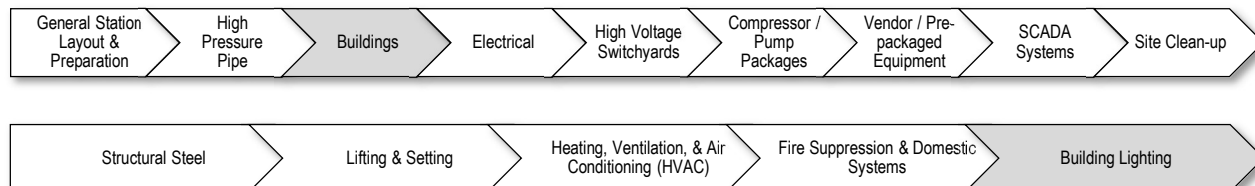
|   |                                                                                                                                                                                                                                                                        |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                            |
|   | <ul style="list-style-type: none"> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |
|   | 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 125—Safety Concerns for Hydrostatic Testing**

|   |                                                                                                           |
|---|-----------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                               |
|   | Confirm comprehensive safety / hazard requirements are covered in detail within the hydrostatic test plan |

**Table 126—Typical Monitoring Requirements for Preparing for Pressure Test**

|   |              |
|---|--------------|
| ✓ | Description  |
|   | Test Section |



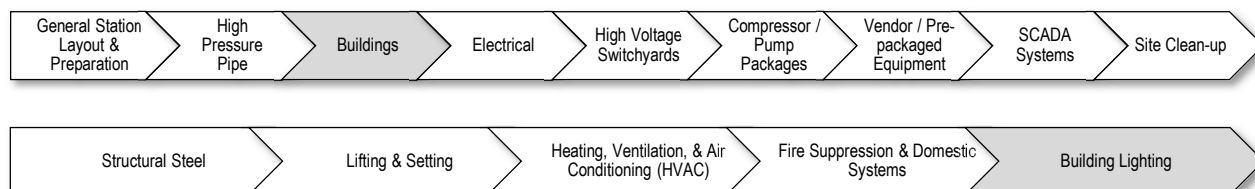
|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|   | Ensure that the final test pressure calculation sheet is signed and dated by the Operator designate and available                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|   | Check that water tanks have sufficient capacity to complete the test section before running out of water                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|   | Check that pumps have the correct capacities (pressure delivery and volumetric flow rate)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|   | Check that water hoses for fill and squeeze activities have the correct ratings                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|   | Check that water heating boilers (for hydrostatic testing in 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)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|   | <b>Mobile Test Vehicle</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|   | Ensure that the test vehicle is supplied with the following: <ul style="list-style-type: none"> <li>- Basic first aid supplies</li> <li>- Tables, chairs, lights, and heaters</li> <li>- Pressure charts and temperature charts</li> <li>- Pressure recorder (either hydraulic dead weights and / or electronic recorders)</li> <li>- Flow totalizer (shows the total volume of water injected into the test section)</li> <li>- Thermometers (ambient and / or alternate)</li> <li>- Test instrument certificates</li> <li>- Verify the serial numbers correspond to that identified on the certifications</li> <li>- Test system spare parts</li> </ul> |
|   | Ensure the contractor will install a thermometer outside the test vehicle in the shade to measure the ambient temperatures during pressure testing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

**Table 127—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                                                                 |
|   | Monitor to ensure that the filling procedure, as specified in the hydrostatic test plan, is followed                            |

**Table 128—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: <ul style="list-style-type: none"> <li>- Final validated calculation sheets that are stamped, signed, and dated by Operator designate</li> <li>- Mechanical pencil, pen, eraser, ruler, and calculator</li> </ul> |



|   |                                                                                                                                                                                                                                                     |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                         |
|   | <ul style="list-style-type: none"> <li>- Writing pad, graph paper, and envelopes</li> <li>- Operator hydrostatic test forms and logs</li> <li>- Unit conversion table</li> <li>- Watch, cell phone, cell phone charger, and water / food</li> </ul> |

**Table 129—Typical Monitoring Requirements for Strength Test**

|   |                                                                                                                                                                                     |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                         |
|   | Ensure all instrument and equipment is installed and set as per 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 Operator                                                                                                                         |
|   | Accept the strength test by signing and dating the log if the pressure remains above the minimum value as specified by the hydrostatic test plan                                    |
|   | If the pressure drops below the minimum test pressure, proceed to investigate, and resolve as per the hydrostatic test plan                                                         |

**Table 130—Typical Monitoring Requirements for Leak Test**

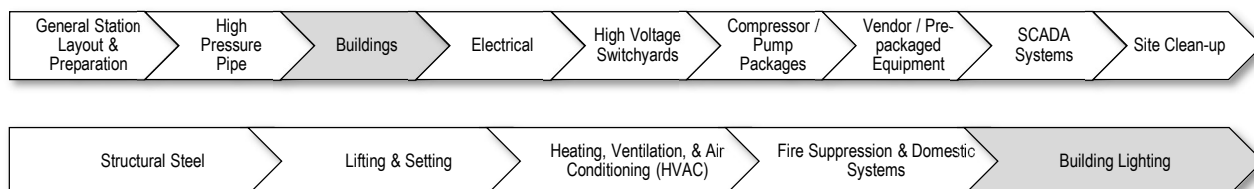
|   |                                                                                                                                      |
|---|--------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                          |
|   | 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 129                                                         |

**Table 131—Typical Monitoring Requirements for Leak or Failure Investigation**

|   |                                                                                                                                                                                                 |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                     |
|   | Advise the Operator of further action if the contractor cannot locate a pipe leak or determine the cause of failure during hydrostatic testing through visual inspection                        |
|   | Notify the 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 Operator specifications and other portions of this document are referenced prior to conducting the hydrostatic test again |

**Table 132—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 133—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 dewater 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 134—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                               |

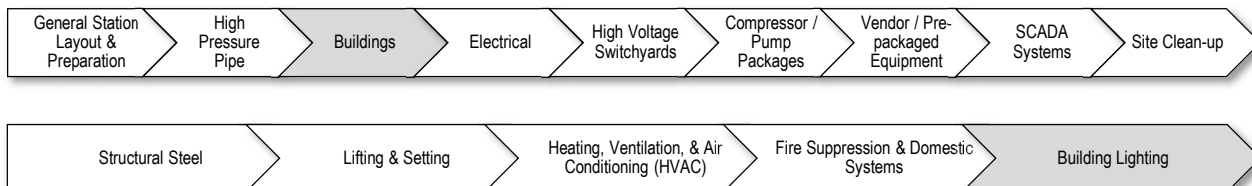
**Table 135—Typical Monitoring Requirements for Drying**

|                      |                                                                                                                                                   |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓                    | Description                                                                                                                                       |
| <b>General</b>       |                                                                                                                                                   |
|                      | Confirm that drying method used by contractor is consistent with hydrostatic test plan requirements                                               |
|                      | Ensure that Operator 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 Operator specifications               |
| <b>Air Drying</b>    |                                                                                                                                                   |
|                      | Ensure injected dried air relative humidity readings meet specifications                                                                          |
| <b>Methanol Wash</b> |                                                                                                                                                   |
|                      | If Operator has specified methanol wash as the acceptable drying method, ensure specifications for injection, recovery, and disposal are followed |

#### **A.2.6.4.3 Typical Outputs for Hydrostatic Testing Inspection**

**Table 136—Typical Reporting Requirements**

|                |                                                                         |
|----------------|-------------------------------------------------------------------------|
| ✓              | Description                                                             |
| <b>General</b> |                                                                         |
|                | 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 |





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|       |                                                                                                                                                                                                                                                                                                                                                          |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|       | Leak Check – Record results                                                                                                                                                                                                                                                                                                                              |
|       | Strength Test – Fill out the strength test data log as required by Operator                                                                                                                                                                                                                                                                              |
| Daily | Complete hydrostatic testing progress reports, including: <ul style="list-style-type: none"> <li>- All the monitoring and inspection items as defined in previous tables within Section A.2.6</li> <li>- Hydrostatic Testing</li> <li>- All specific daily reports required by the Operator</li> <li>- Document punch list items, as required</li> </ul> |

#### A.2.6.5 References – Hydrostatic Testing

**NOTE** The reference information provided in Table 137 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 137—List of References – Hydrostatic Testing**

| Document No.                                      | Type                 | Title                                                                                                                                           |
|---------------------------------------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| American Petroleum Institute (API)<br>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<br>CS-S-9                        | Guideline            | Construction Safety Consensus Guidelines – Pressure Testing (Hydrostatic / Pneumatic) Safety Guidelines                                         |

### A.2.7 Cathodic Protection

#### A.2.7.1 Inputs

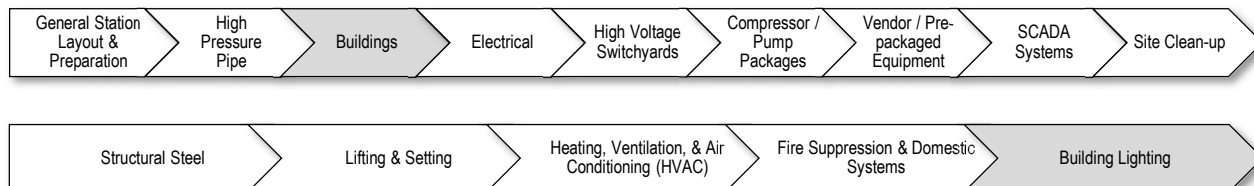
As part of preparing for inspection during the cathodic protection process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Operator technical specifications as identified in Table 139.

#### A.2.7.2 Execution

While the work is being executed, the Inspector should 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 138.

**Table 138—Monitoring Requirements for Cathodic Protection – Electrical**

| Item                     | Description                                                                                         | Reference |
|--------------------------|-----------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work | Daily, ensure key issues that have been identified are detailed and addressed                       | Table 140 |
| Safety                   | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements | Table 141 |



| Item                             | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Reference |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Cathodic Protection Installation | <p>Monitor the installation of cathodic protection systems for safety and adherence to Operator specifications. Incorporate considerations for locating cathodic protection test stations such as:</p> <ul style="list-style-type: none"> <li>- Ease of accessibility of proposed installation location</li> <li>- Use of existing facilities (e.g., valve or scraper trap locations)</li> <li>- Work with electrical and instrumentation personnel, and stationary and rotating equipment inspectors to ensure the integrity of cathodic protection measures throughout the construction process</li> </ul> | Table 142 |

### A.2.7.3 Outputs

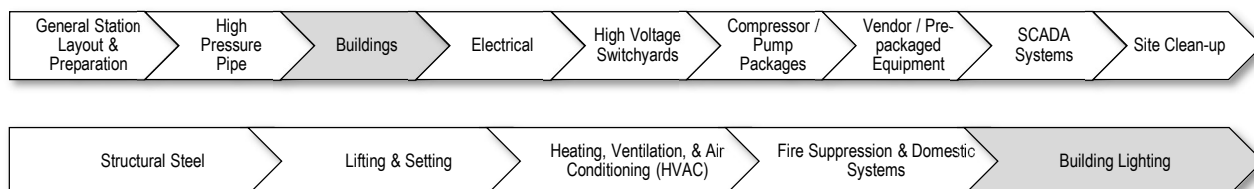
The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for cathodic protection inspection appear in Table 143.

### A.2.7.4 Detailed Checklists – Cathodic Protection

#### A.2.7.4.1 Typical Input Requirements for Cathodic Protection Inspection

**Table 139—Information Requirements for Cathodic Protection**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>All designs, drawings, and specifications developed by the Operator and contractors related to cathodic protection, such as:</p> <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings, including</li> <li>- Access road drawings</li> <li>- Line List (e.g., special concerns for each landowner)</li> <li>- Ground bed installation details</li> <li>- Rectifier installation details</li> <li>- Isolation kit installation details</li> <li>- Cathodic protection installation specifications</li> <li>- Cathodic protection testing specifications</li> <li>- Third-party utility locations where CP connections are required</li> <li>- Locations and types of ground beds and anodes</li> </ul> |
|   | <p>Contracts and agreements related to:</p> <ul style="list-style-type: none"> <li>- Road use</li> <li>- Crossing for buried facilities</li> <li>- Crossing agreements</li> <li>- Cathodic protection installation</li> <li>- Construction survey</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|   | <p>Operator specific safety plan, including (but not limited to):</p> <ul style="list-style-type: none"> <li>- Traffic control plan</li> <li>- Requirements for Personal Protective Equipment (PPE)</li> <li>- Emergency Medical Services (EMS)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|   | <p>Other project specific plans, which may include:</p> <ul style="list-style-type: none"> <li>- Cathodic protection and installation</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |



#### **A.2.7.4.2 Best Practice Items for Inspecting Typical Cathodic Protection Operations**

**Table 140—Prior to Commencing Work**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | Participate in daily meetings to address: <ul style="list-style-type: none"> <li>- Cathodic protection requirements as per Operator specifications</li> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |

**Table 141—Safety Concerns for Cathodic Protection Installation**

| ✓ | Description                                                                          |
|---|--------------------------------------------------------------------------------------|
|   | Confirm that manufacturer's instructions are followed in the use of thermite devices |

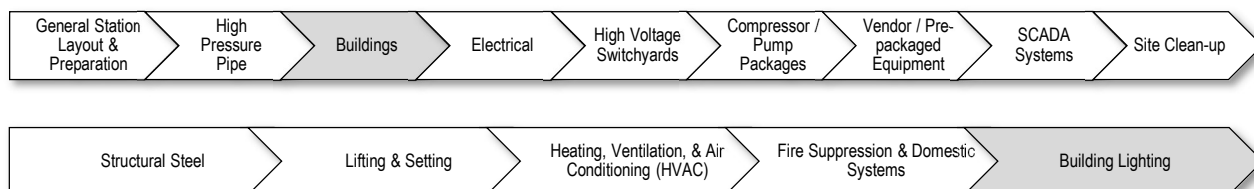
**Table 142—Typical Monitoring Requirements for Cathodic Protection Installation**

| ✓ | 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                                                                                                          |

#### **A.2.7.4.3 Typical Outputs for Cathodic Protection Inspection**

**Table 143—Typical Reporting Requirements**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <b>General</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|   | Ensure completion of as-built, red-lined drawings                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|   | Complete cathodic protection (CP) installation / test station report, including: <ul style="list-style-type: none"> <li>- Number and location of test station installations</li> <li>- Continuity test results (i.e., upon backfilling to ensure test leads have not broken)</li> </ul>                                                                                                                                                                                                                                                                     |
|   | Complete third-party pipeline crossing report, including: <ul style="list-style-type: none"> <li>- Survey station numbers at crossings</li> <li>- Name of third-party pipelines</li> <li>- Pipeline size and use</li> <li>- Type and condition of coating</li> <li>- Clearance above or below pipeline</li> <li>- Distance from nearest third-party rectifier</li> <li>- Type and output from third-party rectifier</li> <li>- Pipe to soil readings at crossing for both parties</li> <li>- If test leads are installed, size and color of wire</li> </ul> |



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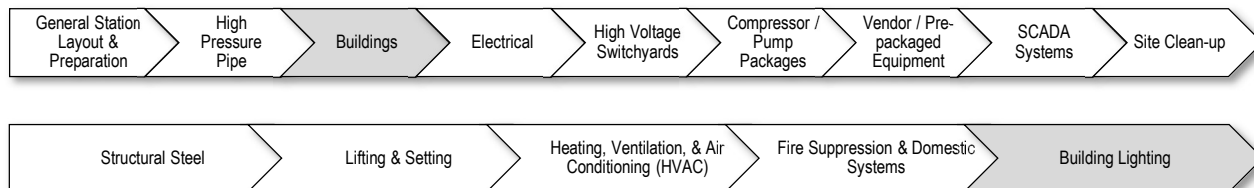
|       |                                                                                                                                                                                                                                 |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓     | Description                                                                                                                                                                                                                     |
|       | <ul style="list-style-type: none"> <li>- Description of location; Township, Range, Section, and landowner (tract number from alignment sheet)</li> <li>- Sketch of the pipeline crossing showing available landmarks</li> </ul> |
| Daily |                                                                                                                                                                                                                                 |
|       | Complete CP progress reports, including:<br>Document punch list items, as required                                                                                                                                              |

#### A.2.7.5 References – Cathodic Protection

NOTE The reference information provided in Table 144 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 144—List of References – Cathodic Protection**

| Document No.                            | Type     | Title                                                                                                                              |
|-----------------------------------------|----------|------------------------------------------------------------------------------------------------------------------------------------|
| Canadian Gas Association (CGA)<br>OCC-1 | Standard | Recommended Practices for Control of External Corrosion on Buried or Submerged Metallic Piping Systems                             |
| NACE International<br>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                          |



## **A.3 Buildings**

### **A.3.1 Overview**

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

General building construction consists of the following major items during the construction of a facility:

- Structural Steel
- Lifting and Setting
- 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.

#### **A.3.1.1 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.

#### **A.3.1.2 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.

#### **A.3.1.3 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.

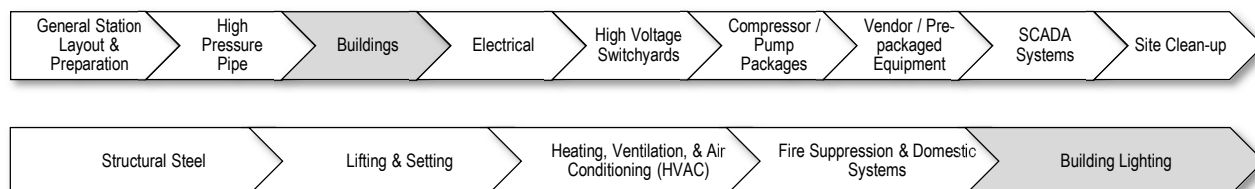
#### **A.3.1.4 Fire Suppression and Domestic Systems**

Fire suppression and domestic systems are typically some of the last items installed during building construction. Fire suppression systems are installed 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).

#### **A.3.1.5 Building Lighting**

Building and yard lighting provide adequate illumination to perform tasks safely in hazardous and non-hazardous environments. If 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.



## A.3.2 Structural Steel

### A.3.2.1 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 Operator technical specifications as identified in Table 146.

### A.3.2.2 Execution

While the work is being executed, the Inspector should 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 145.

**Table 145—Monitoring Requirements for Structural Steel**

| Item                                             | Description                                                                                                   | Reference     |
|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------|---------------|
| Prior to Commencing Work                         | Daily, ensure key issues that have been identified are detailed and addressed                                 | Table 147     |
| Safety                                           | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements           | Table 148     |
| Civil                                            |                                                                                                               |               |
| Foundations and Reinforced Concrete Construction | Previously discussed monitoring requirements associated with foundations and reinforced concrete construction | Section A.1.7 |
| Structural Steel Construction                    | Monitoring requirements associated with structural steel, ensuring the installation conforms to the design    | Table 149     |
| Civil, Mechanical, Electrical (All Disciplines)  |                                                                                                               |               |
| Welding and Joining Operations                   | Previously discussed monitoring requirements associated with welding and joining operations                   | Section A.2.4 |
| Coating / Painting Operations                    | Previously discussed monitoring requirements associated with coating / painting operations                    | Section A.2.5 |

### A.3.2.3 Outputs

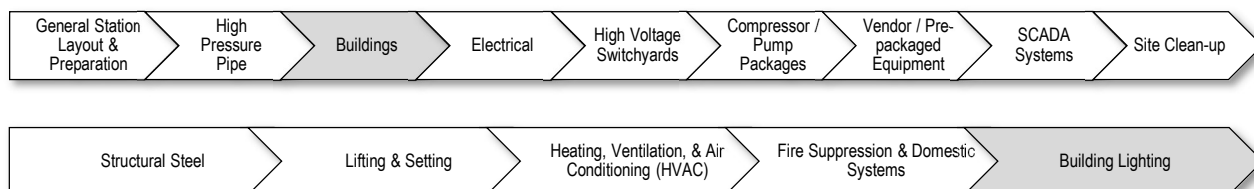
The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for structural steel inspection appear in Table 150.

### A.3.2.4 Detailed Checklists – Structural Steel

#### A.3.2.4.1 Typical Input Requirements for Structural Steel Inspection

**Table 146—Information Requirements for Structural Steel Inspection**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                    |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>All designs, drawings, and specifications developed by the Operator and contractors related to structural steel, such as:</p> <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings</li> <li>- Fabrication shop drawings</li> <li>- Structural steel specifications</li> <li>- Building specifications</li> </ul> |



|   |                                                                                                                                                                                                      |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                          |
|   | <ul style="list-style-type: none"> <li>- Construction specifications</li> <li>- Manufacturer specifications and drawings</li> </ul>                                                                  |
|   | Contracts and agreements related to: <ul style="list-style-type: none"> <li>- Fabrication and erection of buildings</li> <li>- Municipal / county permits and inspections (if applicable)</li> </ul> |
|   | Operator specific safety plan, including (but not limited to): <ul style="list-style-type: none"> <li>- Working at elevations</li> <li>- Lift plan</li> </ul>                                        |
|   | Other project specific plans, which may include: <ul style="list-style-type: none"> <li>- Traffic management plan</li> </ul>                                                                         |

#### **A.3.2.4.2 Best Practice Items for Inspecting Typical Structural Steel Construction**

**Table 147—Prior to Commencing Work**

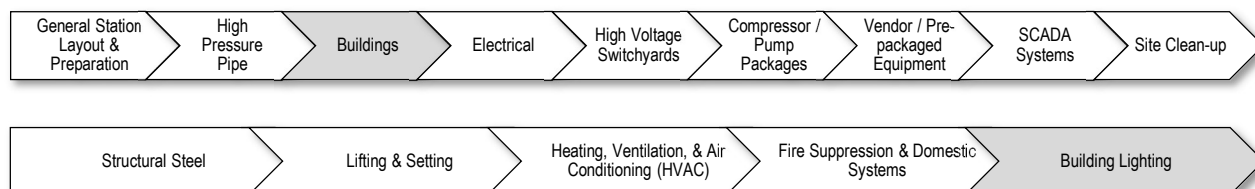
|   |                                                                                                                                                                                                                                                                                                                                                                              |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                  |
|   | Participate in daily meetings to address: <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |
|   | Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Operator or project specifications and Issued for Construction (IFC) drawings per Section A.1.5 Stockpiling and Material Handling                                                                                                                        |
|   | Ensure all structural steel members are piece marked in accordance with fabrication shop drawings                                                                                                                                                                                                                                                                            |

**Table 148—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 149—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 Operator 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                                                                     |



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| ✓ | Description                                                                                                                                                                                                                |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | 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 Operator'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                                                                                                                                                          |
|   | Ensure platforms and elevated structures are properly installed                                                                                                                                                            |
|   | Ensure welding is completed in accordance with Section A.2.4 Welding and Joining                                                                                                                                           |

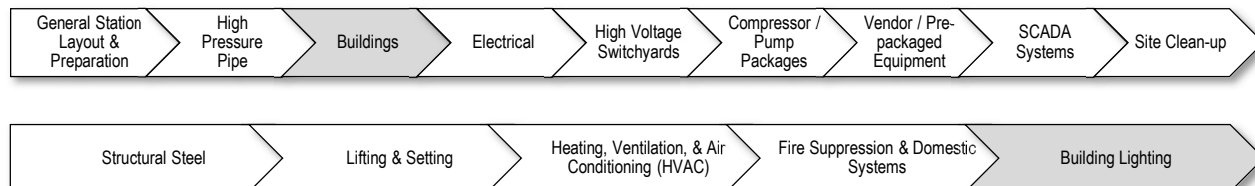
#### A.3.2.4.3 Typical Outputs for Structural Steel Inspection

**Table 150—Typical Reporting Requirements**

| ✓              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>General</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                | Ensure completion of as-built, red-lined drawings                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Daily</b>   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                | Complete structural steel progress reports, including: <ul style="list-style-type: none"> <li>- Number and location of structural steel members erected</li> <li>- Description and location of placed structural steel</li> <li>- Progress on installation of internal and external cladding</li> <li>- Progress on installation of doors and windows</li> <li>- Descriptions of buildings set on foundations (e.g., metering building / skid)</li> <li>- Descriptions of facilities where vent bracing has been installed</li> <li>- Document punch list items, as required</li> </ul> |

#### A.3.2.5 References – Structural Steel

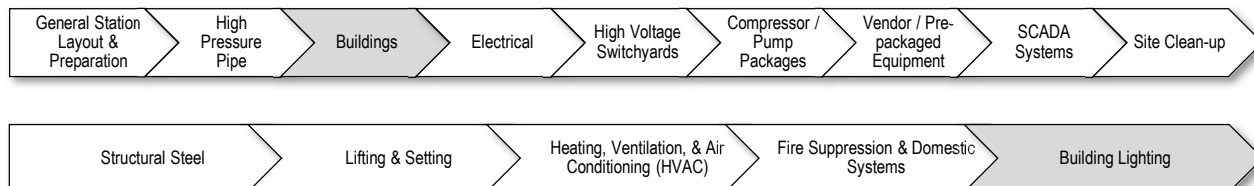
**NOTE** The reference information provided in Table 151 is intended as a guide only (i.e., the list is not exhaustive); documents of this nature are updated frequently, and it remains the responsibility of the user to ensure that the correct, and most current, documents are referenced as appropriate.





**Table 151—List of References – Structural Steel**

| Document No.                                                                                          | Type                 | Title                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>American Institute of Steel Construction (AISC)</b>                                                |                      |                                                                                                                                                                   |
| 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                                                                                                                                         |
| <b>American National Standards Institute (ANSI) / American Institute of Steel Construction (AISC)</b> |                      |                                                                                                                                                                   |
| ANSI / AISC 303                                                                                       | Standard             | Code of Standard Practice for Steel Buildings and Bridges                                                                                                         |
| ANSI / AISC 360                                                                                       | Specification        | Specification for Structural Steel Buildings                                                                                                                      |
| <b>American Society for Testing and Materials (ASTM)</b>                                              |                      |                                                                                                                                                                   |
| 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                                                                                                          |
| <b>American Society of Civil Engineers (ASCE)</b>                                                     |                      |                                                                                                                                                                   |
| ASCE 7                                                                                                | Standard             | Minimum Design Loads for Buildings and Other Structures                                                                                                           |
| <b>Canadian Institute of Steel Construction (CISC)</b>                                                |                      |                                                                                                                                                                   |
| N/A                                                                                                   | Recommended Practice | Code of Standard Practice                                                                                                                                         |
| N/A                                                                                                   | Handbook             | Handbook of Steel Construction                                                                                                                                    |
| <b>Canadian Standards Association (CSA)</b>                                                           |                      |                                                                                                                                                                   |
| 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                                                                               |



| Document No.                                      | Type          | Title                                                         |
|---------------------------------------------------|---------------|---------------------------------------------------------------|
| 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 |

### A.3.3 Lifting and Setting

#### A.3.3.1 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 Operator technical specifications as identified in Table 153.

#### A.3.3.2 Execution

While the work is being executed, the Inspector should 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 152.

**Table 152—Monitoring Requirements for Lifting and Setting – Mechanical**

| Item                     | Description                                                                                                             | Reference |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work | Daily, ensure key issues that have been identified are detailed and addressed                                           | Table 154 |
| Safety                   | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements                     | Table 155 |
| Lifting and Setting      | Monitor lifting and setting operations for safety and ensure that no damage occurs to the buildings or structural steel | Table 156 |

#### A.3.3.3 Outputs

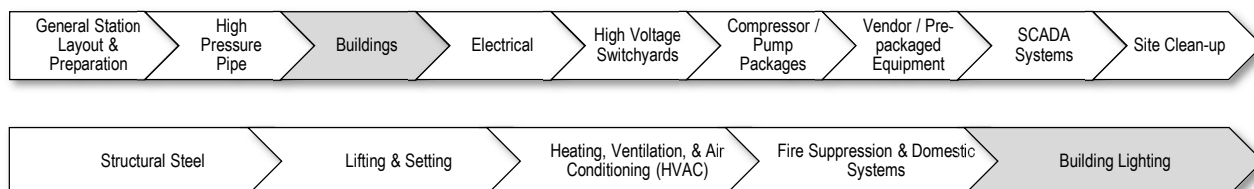
The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for lifting and setting inspection appear in Table 157.

#### A.3.3.4 Detailed Checklists – Lifting and Setting

##### A.3.3.4.1 Typical Input Requirements for Lifting and Setting Inspection

**Table 153—Information Requirements for Lifting and Setting**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                           |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>All designs, drawings, and specifications developed by the Operator and contractors related to lifting and setting, such as:</p> <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings</li> <li>- Equipment manufacturer specifications and drawings</li> <li>- Lifting Equipment specifications and drawings</li> </ul> |



|   |                                                                                                                                                                                                                                                                                                                         |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                             |
|   | Contracts and agreements related to: <ul style="list-style-type: none"> <li>- Road use</li> <li>- Crossing for buried facilities</li> <li>- Construction survey</li> </ul>                                                                                                                                              |
|   | Operator specific safety plan, including (but not limited to): <ul style="list-style-type: none"> <li>- Traffic control plan</li> <li>- Requirements for Personal Protective Equipment (PPE)</li> <li>- Emergency Medical Services (EMS)</li> <li>- Heavy lift plan</li> <li>- Lock-out / Tag-out procedures</li> </ul> |
|   | Other project specific plans, which may include: <ul style="list-style-type: none"> <li>- Fire prevention / firefighting plan</li> <li>- Relevant contingency plans</li> <li>- Loading, securing, and rigging practices</li> </ul>                                                                                      |

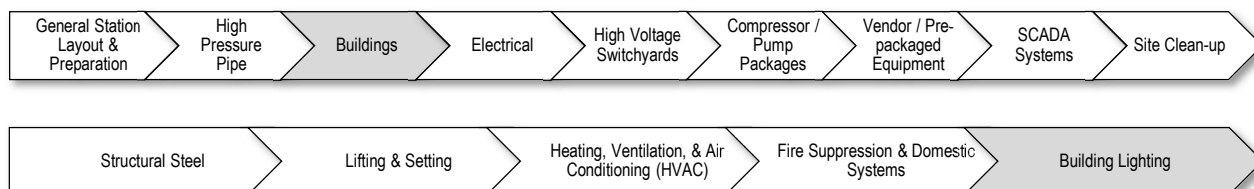
#### A.3.3.4.2 Best Practice Items for Inspecting Typical Lifting and Setting Operations

**Table 154—Prior to Commencing Work**

|   |                                                                                                                                                                                                                                                                                                                                                                                             |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                 |
|   | Participate in daily meetings to address: <ul style="list-style-type: none"> <li>- Job safety analysis (JSA) and hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul>      |
|   | Conduct planning and tailgate meetings before the start of lifting and setting to make sure all personnel involved are aware of: <ul style="list-style-type: none"> <li>- Lifting sequence</li> <li>- Critical lift circumstances</li> <li>- Equipment size and numbers</li> <li>- Individual roles and responsibilities</li> <li>- Weather restrictions (e.g., wind, lightning)</li> </ul> |
|   | 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                                                                                                                                                                                                                                                                                                                     |
|   | 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

**Table 155—Safety Concerns for Lifting and Setting**



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|   |                                                                                                                                       |
|---|---------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | 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)                       |

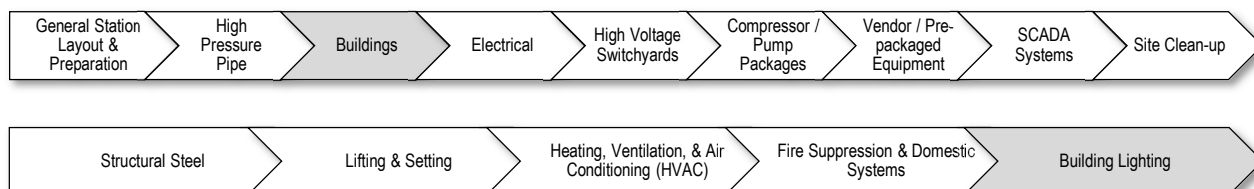
**Table 156—Typical Monitoring Requirements for Lifting and Setting**

|   |                                                                                                                                                                                                                                                                                                                                                                                                              |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | 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                                                                                                                                                                                                                                                                  |

#### A.3.3.4.3 Typical Outputs for Lifting and Setting Inspection

**Table 157—Typical Reporting Requirements**

|                |                                                                                                                                                                                                                                                                                            |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓              | Description                                                                                                                                                                                                                                                                                |
| <b>General</b> |                                                                                                                                                                                                                                                                                            |
|                | Ensure completion of as-built, red-lined drawings                                                                                                                                                                                                                                          |
| <b>Daily</b>   |                                                                                                                                                                                                                                                                                            |
|                | Complete lifting and setting progress reports, including: <ul style="list-style-type: none"> <li>- Description and location of placed buildings or structural steel</li> <li>- Any damage incurred during lifting and setting</li> <li>- Document punch list items, as required</li> </ul> |



### A.3.3.5 References – Lifting and Setting

NOTE The reference information provided in Table 158 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 158—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                                     |

### A.3.4 Heating, Ventilation, and Air Conditioning (HVAC)

#### A.3.4.1 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 Operator technical specifications as identified in Table 160.

#### A.3.4.2 Execution

While the work is being executed, the Inspector should 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 159.

**Table 159—Monitoring Requirements for HVAC – Mechanical**

| Item                     | Description                                                                                         | Reference |
|--------------------------|-----------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work | Daily, ensure key issues that have been identified are detailed and addressed                       | Table 161 |
| Safety                   | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements | Table 162 |
| HVAC Installation        | Monitoring requirements associated with HVAC, ensuring the installation conforms to the design      | Table 163 |

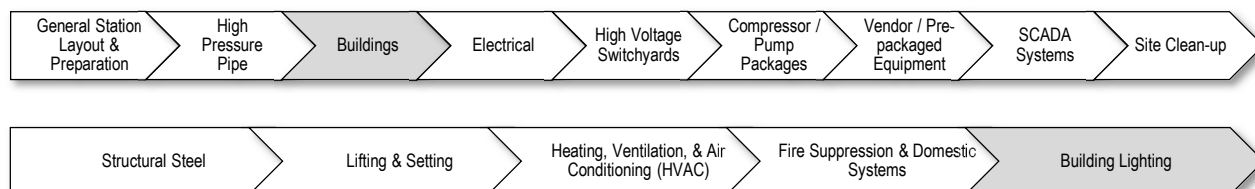
#### A.3.4.3 Outputs

The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for HVAC inspection appear in Table 164.

#### A.3.4.4 Detailed Checklists – HVAC

##### A.3.4.4.1 Typical Input Requirements for HVAC Inspection

**Table 160—Information Requirements for HVAC Inspection**



|   |                                                                                                                                                                                                                                                 |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                     |
|   | All designs, drawings, and specifications developed by the Operator and contractors related to HVAC, such as: <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings</li> <li>- Manufacturer specifications</li> </ul> |
|   | Contracts and agreements related to: <ul style="list-style-type: none"> <li>- HVAC performance standards</li> <li>- Municipal / county Permits and Inspection (if applicable)</li> </ul>                                                        |
|   | Operator specific safety plan, including (but not limited to): <ul style="list-style-type: none"> <li>- Lock-out / Tag-out procedures</li> </ul>                                                                                                |
|   | Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information                                             |

#### A.3.4.4.2 Best Practice Items for Inspecting Typical HVAC Installation

**Table 161—Prior to Commencing Work**

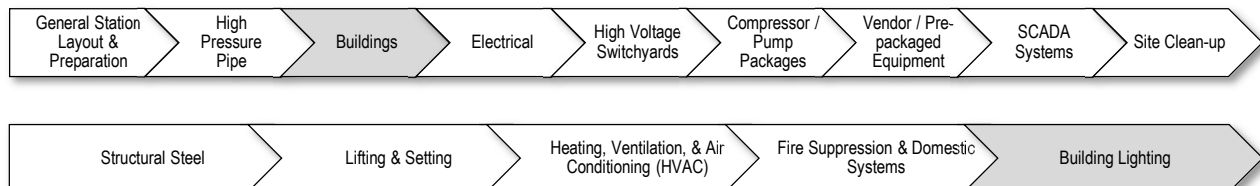
|   |                                                                                                                                                                                                                                                                                                                                                                              |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                  |
|   | Participate in daily meetings to address: <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |
|   | Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Operator or project specifications and IFC drawings per Section A.1.5 Stockpiling and Material Handling                                                                                                                                                  |

**Table 162—Safety Concerns for HVAC Installation**

|   |                                                                                                                                                                                                     |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                         |
|   | Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information |

**Table 163—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                                            |

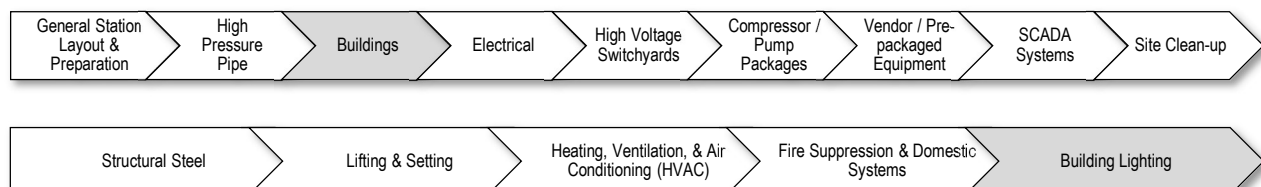


| ✓ | Description                                                                                                                                           |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | 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 drainpipe 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                                                                                                 |

#### A.3.4.4.3 Typical Outputs for HVAC Inspection

**Table 164—Typical Reporting Requirements**

| ✓              | Description                                       |
|----------------|---------------------------------------------------|
| <b>General</b> |                                                   |
|                | Ensure completion of as-built, red-lined drawings |
|                | Complete HVAC test reports, including:            |
|                | - Leak / pressure test records                    |



|       |                                                                                                                                                                               |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|       | <ul style="list-style-type: none"> <li>- Air flow test records</li> <li>- Temperature control calibration and test records</li> </ul>                                         |
| Daily | Complete HVAC progress reports, including: <ul style="list-style-type: none"> <li>- System performance standards</li> <li>- Document punch list items, as required</li> </ul> |

#### A.3.4.5 References – HVAC

**NOTE** The reference information provided in Table 165 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 165—List of References – HVAC**

| Document No.                                                                                                                                                                                        | Type | Title |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|
| Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information |      |       |

### A.3.5 Fire Suppression and Domestic Systems

#### A.3.5.1 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 Operator technical specifications as identified in Table 167.

#### A.3.5.2 Execution

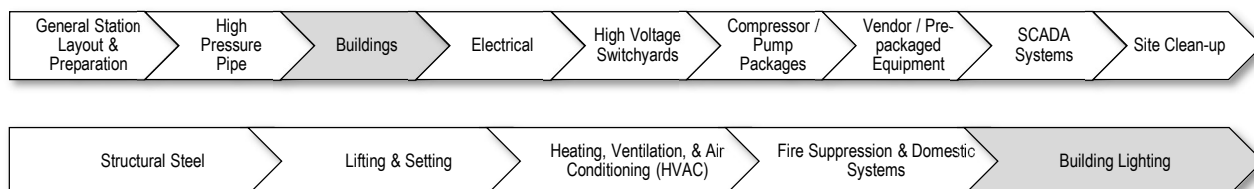
While the work is being executed, the Inspector should monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the fire suppression and domestic systems installation process are identified in a series of checklists as detailed in Table 166.

**Table 166—Monitoring Requirements for Fire Suppression and Domestic Systems**

| Item                                  | Description                                                                                                        | Reference |
|---------------------------------------|--------------------------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work              | Daily, ensure key issues that have been identified are detailed and addressed                                      | Table 168 |
| Safety                                | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements                | Table 169 |
| <b>Mechanical</b>                     |                                                                                                                    |           |
| Domestic Water Installation           | Monitoring requirements associated with domestic water, ensuring the installation conforms to the design           | Table 170 |
| Sanitary Sewer Systems Installation   | Monitoring requirements associated with sanitary sewer systems, ensuring the installation conforms to the design   | Table 171 |
| <b>Electrical</b>                     |                                                                                                                    |           |
| Fire Suppression Systems Installation | Monitoring requirements associated with fire suppression systems, ensuring the installation conforms to the design | Table 172 |

#### A.3.5.3 Outputs

The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting





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processes are Operator- and project-specific; best practices for reporting requirements for fire suppression and domestic systems inspection appear in Table 173.

#### A.3.5.4 Detailed Checklists – Fire Suppression and Domestic Systems

##### A.3.5.4.1 Typical Input Requirements for Fire Suppression and Domestic Systems Inspection

**Table 167—Information Requirements for Fire Suppression and Domestic Systems Inspection**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>All designs, drawings, and specifications developed by the Operator and contractors related to fire suppression and domestic systems, such as:</p> <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings, including</li> <li>- Plot plans</li> <li>- Line List (e.g., special concerns for each landowner)</li> <li>- Fire and gas plans and details</li> <li>- Piping specifications</li> <li>- Electrical specifications</li> </ul> |
|   | <p>Contracts and agreements related to:</p> <ul style="list-style-type: none"> <li>- Water utility Requirements</li> <li>- Potable Water Standards</li> <li>- Municipal / County Codes and Requirements (e.g., for drilling wells)</li> <li>- Municipal / County Permits and Inspection (if applicable)</li> </ul>                                                                                                                                                 |
|   | <p>Operator specific safety plan, including (but not limited to):<br/>Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information</p>                                                                                                                                                                                      |
|   | <p>Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information</p>                                                                                                                                                                                                                                                         |

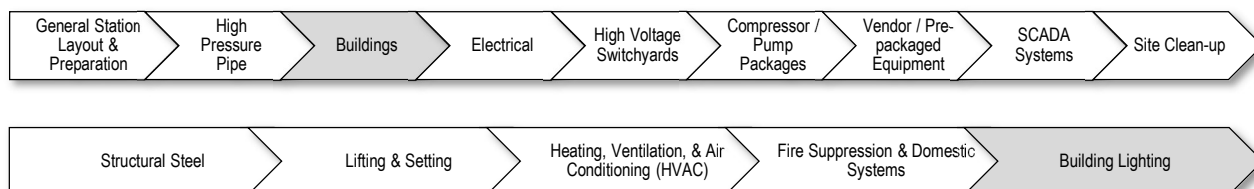
##### A.3.5.4.2 Best Practice Items for Inspecting Typical Fire Suppression and Domestic Systems Installation

**Table 168—Prior to Commencing Work**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                         |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>Participate in daily meetings to address:</p> <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |
|   | <p>Ensure local jurisdictional inspections are completed in accordance with permit requirements</p>                                                                                                                                                                                                                                                                                 |
|   | <p>Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Operator or project specifications and IFC drawings per Section A.1.5 Stockpiling and Material Handling</p>                                                                                                                                                  |

**Table 169—Safety Concerns for Fire Suppression and Domestic Systems Installation**

| ✓ | Description                                                                                                 |
|---|-------------------------------------------------------------------------------------------------------------|
|   | <p>Identify and monitor hazardous situations associated with installation of oxygen suppression systems</p> |



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**Table 170—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 171—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 A.1.8 Backfilling) |

**Table 172—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                                  |

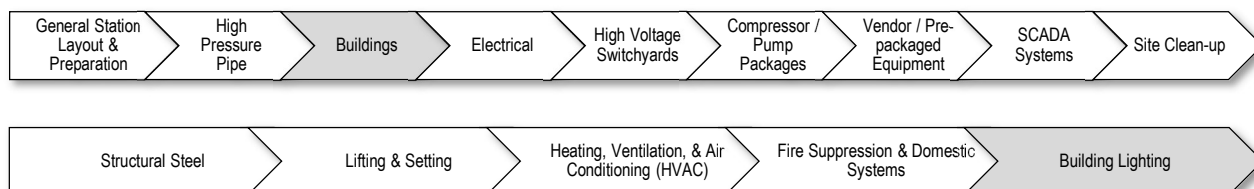
#### **A.3.5.4.3 Typical Outputs for Fire Suppression and Domestic Systems Inspection**

**Table 173—Typical Reporting Requirements**

| ✓              | Description                                                                                                                                                                                                                                                                             |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>General</b> |                                                                                                                                                                                                                                                                                         |
|                | Ensure completion of as-built, red-lined drawings                                                                                                                                                                                                                                       |
|                | Complete Water Quality Report                                                                                                                                                                                                                                                           |
| <b>Daily</b>   |                                                                                                                                                                                                                                                                                         |
|                | Complete fire suppression and domestic systems progress reports, including: <ul style="list-style-type: none"> <li>- Domestic Water leak test records</li> <li>- Fire suppression instrumentation calibration record forms</li> <li>- Document punch list items, as required</li> </ul> |

#### **A.3.5.5 References – Fire Suppression and Domestic Systems**

**NOTE** The reference information provided in Table 174 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 174—List of References – Fire Suppression and Domestic Systems**

| Document No.                                       | Type     | Title                                                                                        |
|----------------------------------------------------|----------|----------------------------------------------------------------------------------------------|
| <b>National Fire Protection Association (NFPA)</b> |          |                                                                                              |
| 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 |

### **A.3.6 Building Lighting**

#### **A.3.6.1 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 Operator technical specifications as identified in Table 176.

#### **A.3.6.2 Execution**

While the work is being executed, the Inspector should 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 175.

**Table 175—Monitoring Requirements for Building Lighting – Electrical**

| Item                           | Description                                                                                                 | Reference |
|--------------------------------|-------------------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work       | Daily, ensure key issues that have been identified are detailed and addressed                               | Table 177 |
| Safety                         | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements         | Table 178 |
| Building Lighting Installation | Monitoring requirements associated with building lighting, ensuring the installation conforms to the design | Table 179 |

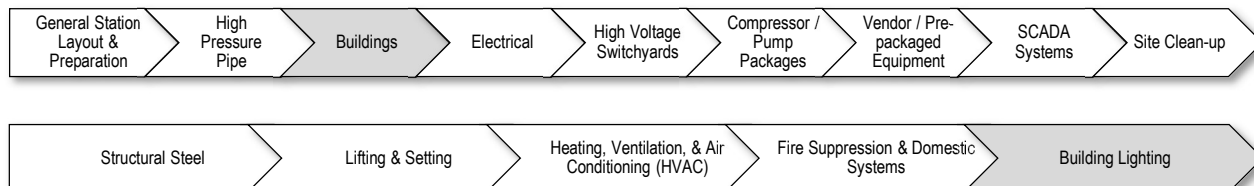
#### **A.3.6.3 Outputs**

The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for building lighting inspection appear in Table 180.

#### **A.3.6.4 Detailed Checklists – Building Lighting**

##### **A.3.6.4.1 Typical Input Requirements for Building Lighting Inspection**

**Table 176—Information Requirements for Building Lighting Inspection**



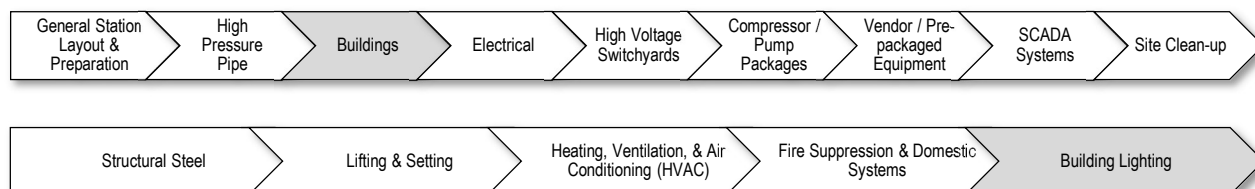
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>All designs, drawings, and specifications developed by the Operator and contractors related to building lighting, such as:</p> <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings, including <ul style="list-style-type: none"> <li>o Single line diagrams</li> <li>o Panel schedules</li> <li>o Panel assemblies</li> <li>o Wiring diagrams</li> <li>o Lighting plans, sections, and details</li> <li>o Conduit / cable schedules</li> <li>o Electrical specifications</li> <li>o Lighting specifications</li> <li>o Electrical vendor drawings</li> <li>o Manufacturer specifications</li> <li>o Routing plans</li> </ul> </li> </ul> |
|   | <p>Contracts and agreements related to:</p> <ul style="list-style-type: none"> <li>- Electrical work</li> <li>- All electricians' qualifications records to specific applicable processes</li> <li>- Building lighting installation</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                          |
|   | <p>Operator specific safety plan, including (but not limited to):</p> <ul style="list-style-type: none"> <li>- Requirements for Personal Protective Equipment (PPE)</li> <li>- Lock-out / Tag-out procedures</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|   | <p>Other project specific plans, which may include:</p> <ul style="list-style-type: none"> <li>- Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information</li> </ul>                                                                                                                                                                                                                                                                                                                                                         |

#### A.3.6.4.2 Best Practice Items for Inspecting Typical Building Lighting Installation

**Table 177—Prior to Commencing Work**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                         |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>Participate in daily meetings to address:</p> <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |
|   | <p>Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Operator or project specifications and Issued for Construction (IFC) drawings per Section A.1.5 Stockpiling and Material Handling</p>                                                                                                                        |
|   | <p>Ensure all material markings and tag numbers are in accordance with Operator or project specifications and IFC drawings per Section A.1.5 Stockpiling and Material Handling</p>                                                                                                                                                                                                  |
|   | <p>Ensure all conduits / cables, fuses, switch boxes, equipment, and other electrical fittings bear electrical capacity data and manufacturer's name</p>                                                                                                                                                                                                                            |

**Table 178—Safety Concerns for Building Lighting Installation**



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|   |                                                                                                                                                                                                     |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                         |
|   | Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information |

**Table 179—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                                                                                   |

#### A.3.6.4.3 Typical Outputs for Building Lighting Inspection

**Table 180—Typical Reporting Requirements**

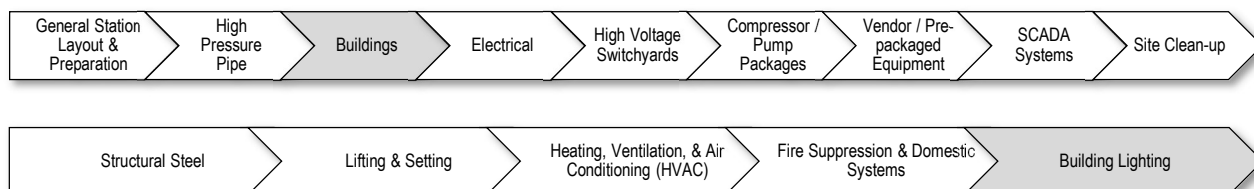
|         |                                                                                                                                                                                                               |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓       | Description                                                                                                                                                                                                   |
| General |                                                                                                                                                                                                               |
|         | Ensure completion of as-built, red-lined drawings                                                                                                                                                             |
| Daily   |                                                                                                                                                                                                               |
|         | Complete building lighting progress reports, including: <ul style="list-style-type: none"> <li>- Number and Location of Light Fixtures Installed</li> <li>- Document punch list items, as required</li> </ul> |

#### A.3.6.5 References – Building Lighting

NOTE The reference information provided in Table 181 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 181—List of References – Building Lighting**

| Document No. | Type | Title                                                                                                                                                                                               |
|--------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|              |      | Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information |



## **A.4 Electrical**

### **A.4.1 Overview**

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

General electrical system and control installation consists of the following major items during the construction of a facility:

- AC electrical systems
- Electrical controls and instrumentation
- Grounding

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

#### **A.4.1.1 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

#### **A.4.1.2 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.

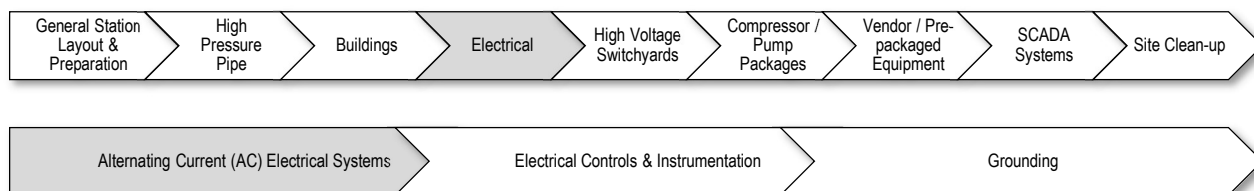
#### **A.4.1.3 Grounding**

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.

### **A.4.2 Alternating Current (AC) Electrical Systems**

#### **A.4.2.1 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 Operator technical specifications as identified in Table 183.



#### **A.4.2.2 Execution**

While the work is being executed, the Inspector should 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 182.

**Table 182—Monitoring Requirements for AC Electrical Systems – Electrical**

| Item                               | Description                                                                                                           | Reference |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work           | Daily, ensure key issues that have been identified are detailed and addressed                                         | Table 184 |
| Safety                             | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements                   | Table 185 |
| Distribution Panels                | Monitoring requirements associated with distribution panels, ensuring the installation conforms to the design         | Table 186 |
| Transformers                       | Monitoring requirements associated with transformers, ensuring the installation conforms to the design                | Table 187 |
| Motor Control Centers (MCCs)       | Monitoring requirements associated with MCCs, ensuring the installation conforms to the design                        | Table 188 |
| Automatic Transfer Switches        | Monitoring requirements associated with automatic transfer switches, ensuring the installation conforms to the design | Table 189 |
| Uninterruptible Power Supply (UPS) | Monitoring requirements associated with UPS, ensuring the installation conforms to the design                         | Table 190 |
| Motors                             | Monitoring requirements associated with motors, ensuring the installation conforms to the design                      | Table 191 |
| Standby Generators                 | Monitoring requirements associated with standby generators, ensuring the installation conforms to the design          | Table 192 |
| Lighting                           | Monitoring requirements associated with lighting, ensuring the installation conforms to the design                    | Table 193 |
| Utility Power                      | Monitoring requirements associated with utility power, ensuring the installation conforms to the design               | Table 194 |

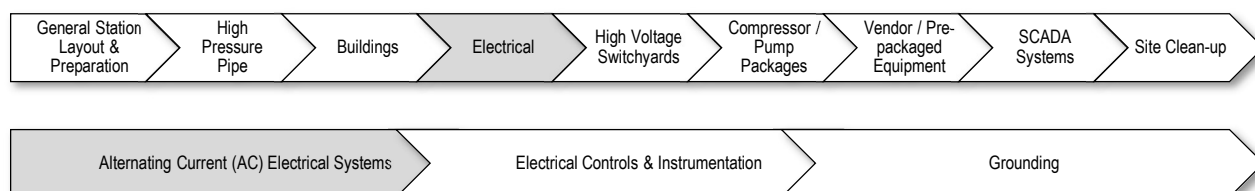
#### **A.4.2.3 Outputs**

The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for AC electrical systems inspection appear in Table 195.

#### **A.4.2.4 Detailed Checklists – AC Electrical Systems**

##### **A.4.2.4.1 Typical Input Requirements for AC Electrical Systems Inspection**

**Table 183—Information Requirements for AC Electrical Systems Inspection**

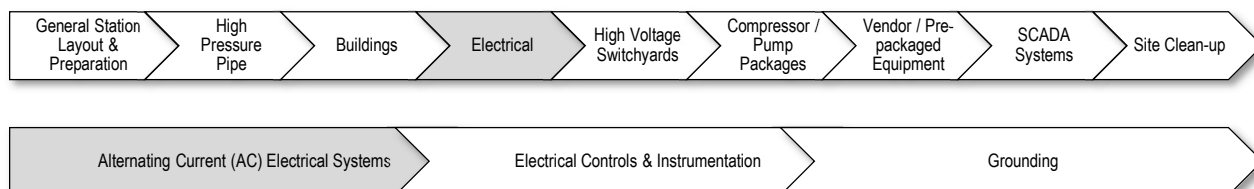


| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>All designs, drawings, and specifications developed by the Operator and contractors related to AC electrical systems, such as:</p> <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings, including <ul style="list-style-type: none"> <li>o Piping and Instrumentation Diagrams (P&amp;IDs)</li> <li>o Electrical details and wiring</li> <li>o Network wiring diagrams</li> <li>o Equipment arrangement plans</li> <li>o Single line diagrams</li> <li>o Lighting plans, sections, and details</li> <li>o Panel assemblies</li> <li>o Panel schedules</li> <li>o Conduit / cable schedules</li> <li>o Conduit / cable routing plans</li> <li>o Loop drawings</li> <li>o Termination schedules</li> <li>o Wiring diagrams</li> <li>o Hazardous area classification plans and details</li> <li>o Electrical specifications</li> <li>o Electrical manufacturer drawings and specifications</li> <li>o Conduit / cable / cable tray placements</li> </ul> </li> </ul> |
|   | <p>Contracts and agreements related to:</p> <ul style="list-style-type: none"> <li>- Electrical work</li> <li>- All electricians' qualifications records to specific applicable processes</li> <li>- Technical advisors / vendor representatives</li> <li>- Municipal / County permits and inspection (if applicable)</li> <li>- Electric utility company specifications and requirements</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|   | <p>Operator specific safety plan, including (but not limited to):</p> <ul style="list-style-type: none"> <li>- Lock-out / Tag-out procedures</li> <li>- Electrical safety (e.g., arc flash)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|   | <p>Other project specific plans, which may include:</p> <ul style="list-style-type: none"> <li>- Working at elevations</li> <li>- Ladder safety</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

#### A.4.2.4.2 Best Practice Items for Inspecting Typical AC Electrical Systems Installation

**Table 184—Prior to Commencing Work**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                         |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>Participate in daily meetings to address:</p> <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |
|   | <p>Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Operator- or project-specifications and Issued for Construction (IFC) drawings per Section A.1.5 Stockpiling and Material Handling</p>                                                                                                                       |





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|   |                                                                                                                                                                             |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                 |
|   | Ensure all material markings and tag numbers are in accordance with Operator or project specifications and IFC drawings per Section A.1.5 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 185—Safety Concerns for AC Electrical Systems Installation**

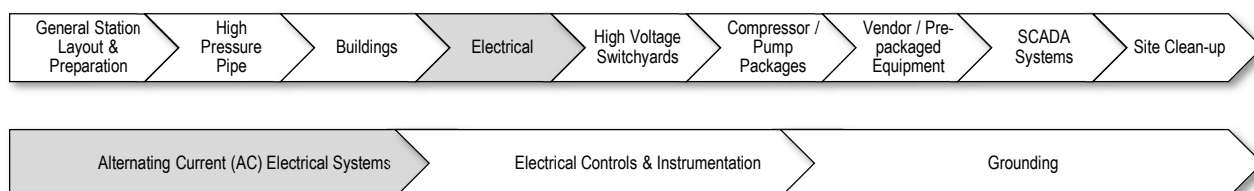
|   |                                                                                                                         |
|---|-------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                             |
|   | 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 186—Typical Monitoring Requirements for Distribution Panels**

|   |                                                                                               |
|---|-----------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                   |
|   | Ensure assembly is checked for any missing parts                                              |
|   | Ensure panel board 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 panel board 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                                        |

**Table 187—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                             |



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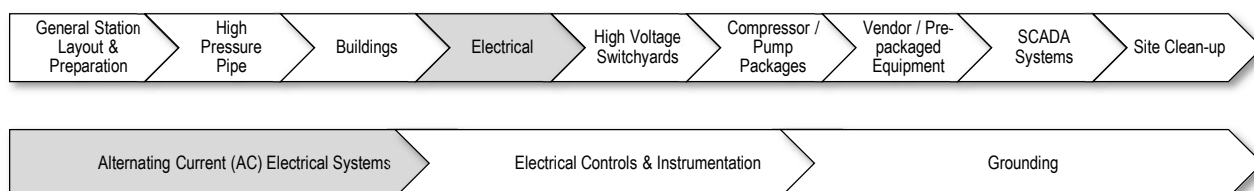
|   |                                                                                                                      |
|---|----------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                          |
|   | 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 Operator or project specifications and Issued for Construction (IFC) drawings |
|   | Verify proper operation of transformer protective relays and metering circuits                                       |

**Table 188—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 189—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         |



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|   |                                                                      |
|---|----------------------------------------------------------------------|
| ✓ | Description                                                          |
|   | 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 190—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 and restoration            |
|   | Ensure ventilation requirements are functional prior to charging any batteries, if required |

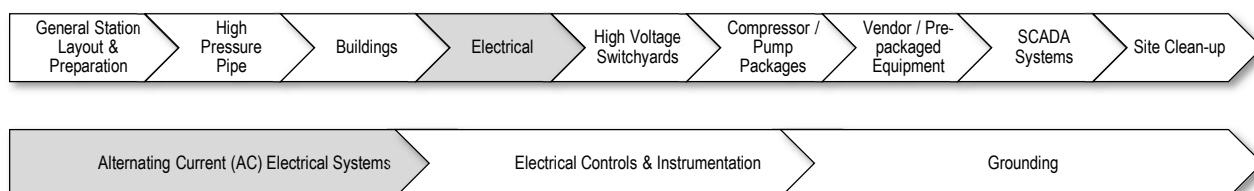
**Table 191—Typical Monitoring Requirements for Motors**

|   |                                                                                       |
|---|---------------------------------------------------------------------------------------|
| ✓ | 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 192—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 193—Typical Monitoring Requirements for Lighting**



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| ✓ | 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 Operator or project specifications                            |
|   | Check for proper orientation of floodlights                                                         |
|   | Check for proper orientation of photocell and ensure correct operation of photocell                 |

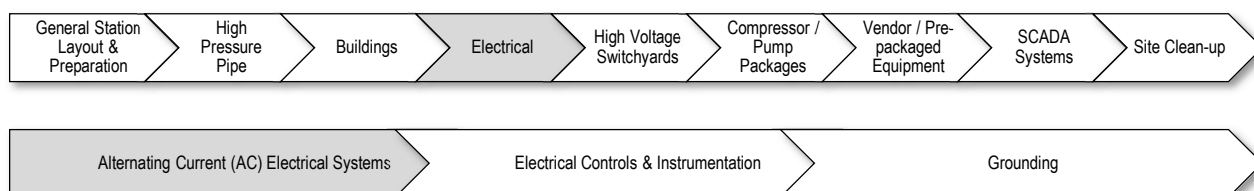
**Table 194—Typical Monitoring Requirements for Utility Power**

| ✓ | Description                                                                                                                                         |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------|
|   | Verify installation meets electric utility company specifications and Operator 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                                                                                                  |

#### **A.4.2.4.3 Typical Outputs for AC Electrical Systems Inspection**

**Table 195—Typical Reporting Requirements**

| ✓              | Description                                                                                                                                                                                                                                                                                                                       |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>General</b> |                                                                                                                                                                                                                                                                                                                                   |
|                | Ensure completion of as-built, red-lined drawings                                                                                                                                                                                                                                                                                 |
|                | Complete AC electrical systems test reports, including: <ul style="list-style-type: none"> <li>- Instrument calibration record forms</li> <li>- Megger test records</li> </ul>                                                                                                                                                    |
| <b>Daily</b>   |                                                                                                                                                                                                                                                                                                                                   |
|                | Complete AC electrical systems progress reports, including: <ul style="list-style-type: none"> <li>- Length and locations of conduits / cables installed</li> <li>- Conduits / cables installed by conduit / cable number</li> <li>- Progress of specific activities</li> <li>- Document punch list items, as required</li> </ul> |



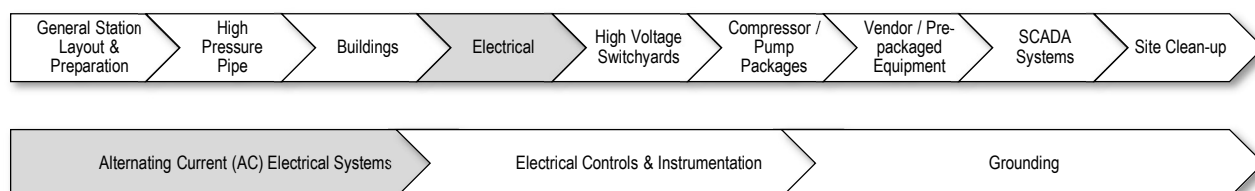
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#### **A.4.2.5 References – AC Electrical Systems**

**NOTE** The reference information provided in Table 196 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 196—List of References – AC Electrical Systems**

| Document No.                                       | Type                 | Title                                                                                                                                                      |
|----------------------------------------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>American Gas Association (AGA)</b>              |                      |                                                                                                                                                            |
| AGA XL1001                                         | Recommended Practice | Classifications of Locations for Electrical Installations in Gas Utility Areas                                                                             |
| <b>American Petroleum Institute (API)</b>          |                      |                                                                                                                                                            |
| 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 |
| <b>Canadian Standards Association (CSA)</b>        |                      |                                                                                                                                                            |
| 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                                                                                                                          |
| <b>National Fire Protection Association (NFPA)</b> |                      |                                                                                                                                                            |
| 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                                                                                                                    |



### A.4.3 Electrical Controls and Instrumentation

#### A.4.3.1 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 Operator technical specifications as identified in Table 198.

#### A.4.3.2 Execution

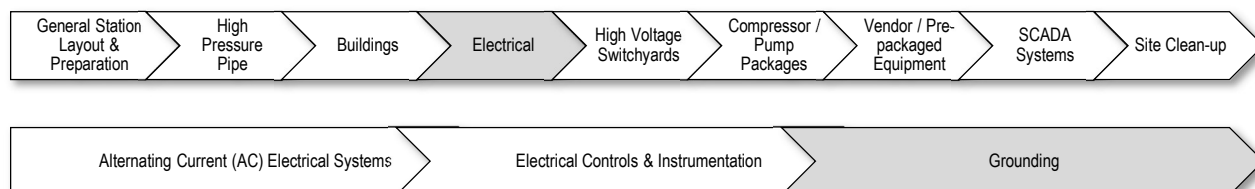
While the work is being executed, the Inspector should monitor workmanship and report on progress on a periodic basis. Typical items that the Inspector will monitor for during the electrical controls and instrumentation installation process are identified in a series of checklists as detailed in Table 197.

**Table 197—Monitoring Requirements for Electrical Controls and Instrumentation – Electrical**

| Item                                                         | Description                                                                                                                               | Reference |
|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work                                     | Daily, ensure key issues that have been identified are detailed and addressed                                                             | Table 199 |
| Safety                                                       | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements                                       | Table 200 |
| General Electrical Controls and Instrumentation Installation | Monitoring requirements associated with electrical controls and instrumentation, ensuring the installation conforms to the design         | Table 201 |
| Tubing                                                       | Monitoring requirements associated with tubing, ensuring the installation conforms to the design                                          | Table 202 |
| Conduits / Cables                                            | Monitoring requirements associated with conduits / cables, ensuring the installation conforms to the design                               | Table 203 |
| Boxes and Fittings                                           | Monitoring requirements associated with boxes and fittings, ensuring the installation conforms to the design                              | Table 204 |
| Wiring                                                       | Monitoring requirements associated with wiring, ensuring the installation conforms to the design                                          | Table 205 |
| 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 206 |
| Conduit / Cable Trays                                        | Monitoring requirements associated with cable trays, ensuring the installation conforms to the design                                     | Table 207 |
| Relays and Protective Devices                                | Monitoring requirements associated with relays and protective devices, ensuring the installation conforms to the design                   | Table 208 |

#### A.4.3.3 Outputs

The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for electrical controls and instrumentation inspection appear in Table 209.



#### **A.4.3.4 Detailed Checklists – Electrical Controls and Instrumentation**

##### **A.4.3.4.1 Typical Input Requirements for Electrical Controls and Instrumentation Inspection**

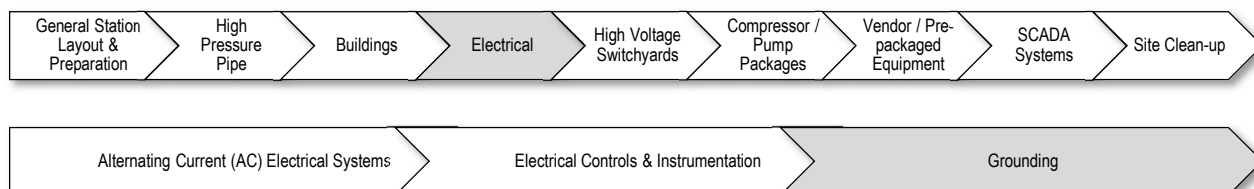
**Table 198—Information Requirements for Electrical Controls and Instrumentation Inspection**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>All designs, drawings, and specifications developed by the Operator and Contractors related to electrical controls and instrumentation, such as:</p> <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings, including <ul style="list-style-type: none"> <li>o Piping and Instrumentation Diagrams (P&amp;IDs)</li> <li>o Electrical details and wiring</li> <li>o Network wiring diagrams</li> <li>o Equipment arrangement plans</li> <li>o Single line diagrams</li> <li>o Lighting plans, sections, and details</li> <li>o Panel assemblies</li> <li>o Panel schedules</li> <li>o Conduit / cable schedules</li> <li>o Termination schedules</li> <li>o Interconnect listings</li> <li>o Wiring diagrams</li> <li>o Routing plans</li> <li>o Loop diagrams</li> <li>o Cause and effect diagrams</li> <li>o Electrical specifications, including operations philosophy</li> <li>o Electrical manufacturer drawings and specifications</li> </ul> </li> </ul> |
|   | <p>Contracts and agreements related to:</p> <ul style="list-style-type: none"> <li>- Electrical work</li> <li>- All electricians' qualifications records to specific applicable processes</li> <li>- Technical advisors / vendor representatives</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|   | <p>Operator specific safety plan, including (but not limited to):</p> <ul style="list-style-type: none"> <li>- Lock-out / Tag-out procedures</li> <li>- Electrical safety (e.g., arc flash)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|   | <p>Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

##### **A.4.3.4.2 Best Practice Items for Inspecting Typical Electrical Controls and Instrumentation Installation**

**Table 199—Prior to Commencing Work**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                         |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>Participate in daily meetings to address:</p> <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |
|   | <p>Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Operator or project specifications and IFC drawings per Section A.1.5 Stockpiling and Material Handling</p>                                                                                                                                                  |



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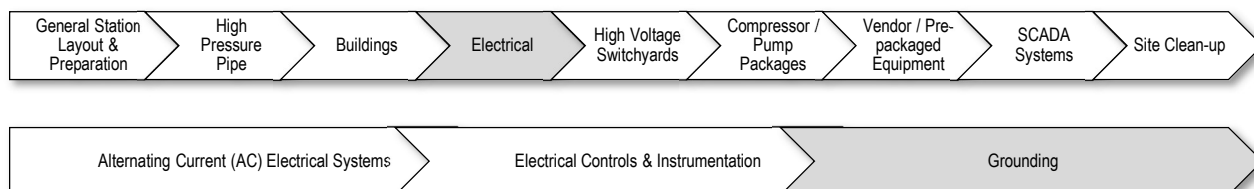
|   |                                                                                                                                                                             |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                 |
|   | Ensure all material markings and tag numbers are in accordance with Operator or project specifications and IFC drawings per Section A.1.5 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 200—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 201—Typical Monitoring Requirements for General Electrical Controls and Instrumentation Installation**

|   |                                                                                                                                                                           |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                               |
|   | Ensure all panels are properly labelled and identified                                                                                                                    |
|   | 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 Operator    |
|   | Ensure that electrical equipment is free of dust, moisture, oil, chemicals, or other harmful matter, such as airborne particles, trimmings, and other construction debris |



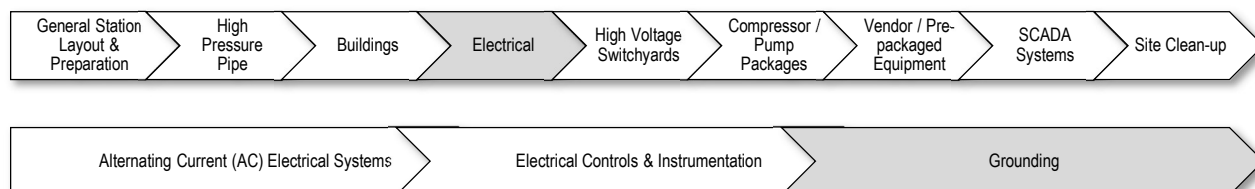


|   |                                                                                                                                                                         |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                             |
|   | 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          |
|   | 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                                                                                                        |

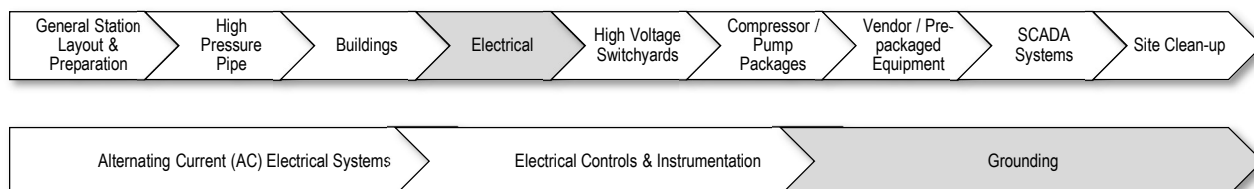
**Table 202—Typical Monitoring Requirements for Tubing**

|   |                                                                                                                                                                                                                         |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | 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, and 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 203—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 watertight                                                                                                                            |
|                                 | Ensure that a protective bushing is installed on all conduit / cable ends before any wire or conduit / cable is pulled                                                                                       |
|                                 | 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 duct banks                                                                                                                                                |
|                                 | 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                                                                           |



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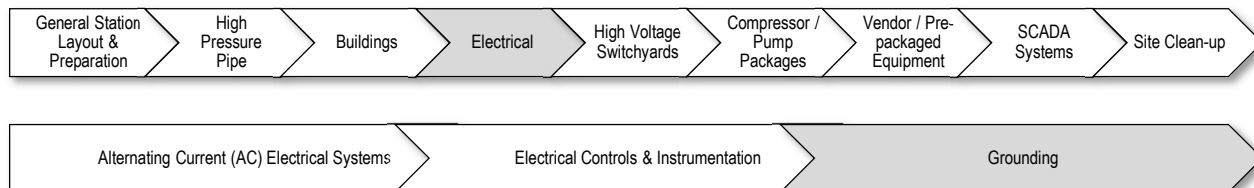
|                              |                                                                                                                                                      |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓                            | Description                                                                                                                                          |
|                              | 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 |
|                              | 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                         |
| <b>Conduit / Cable Seals</b> |                                                                                                                                                      |
|                              | 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 204—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 205—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                                                   |
|   | 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                                                                                                                  |



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**Table 206—Typical Monitoring Requirements for Connections and Terminations 600 Volts and Less**

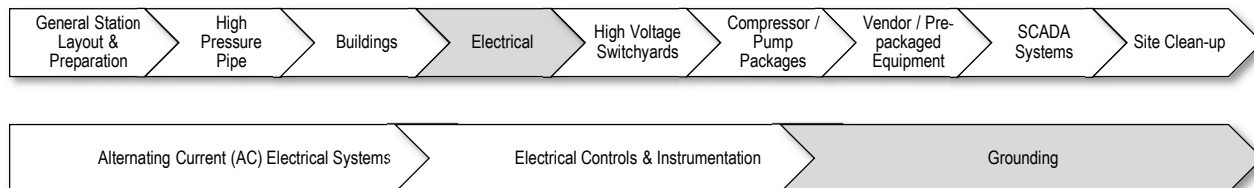
| ✓ | Description                                                                                                                                                                                                           |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | 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 207—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 208—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 |



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|   |                                                                                                                                                                                  |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                      |
|   | 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) |

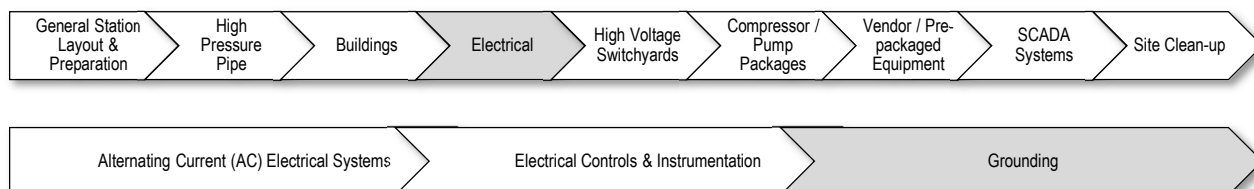
#### A.4.3.4.3 Typical Outputs for Electrical Controls and Instrumentation Inspection

**Table 209—Typical Reporting Requirements**

|   |                                                                                                                                                                                                                                                                                      |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                          |
|   | General                                                                                                                                                                                                                                                                              |
|   | Ensure completion of as-built, red-lined drawings                                                                                                                                                                                                                                    |
|   | Complete electrical controls and instrumentation test reports, including:                                                                                                                                                                                                            |
|   | <ul style="list-style-type: none"> <li>- Instrument calibration record forms</li> <li>- Instrument check sheets</li> <li>- Loop test record forms</li> </ul>                                                                                                                         |
|   | Daily                                                                                                                                                                                                                                                                                |
|   | Complete electrical controls and instrumentation progress reports, including:                                                                                                                                                                                                        |
|   | <ul style="list-style-type: none"> <li>- Length and locations of conduits / cables installed</li> <li>- Conduits / cables installed by conduit / cable number</li> <li>- Instrumentation installed by instrument number</li> <li>- Document punch list items, as required</li> </ul> |

#### A.4.3.5 References – Electrical Controls and Instrumentation

**NOTE** The reference information provided in Table 210 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 210—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                                                                                                                    |

## A.4.4 Grounding

### A.4.4.1 Inputs

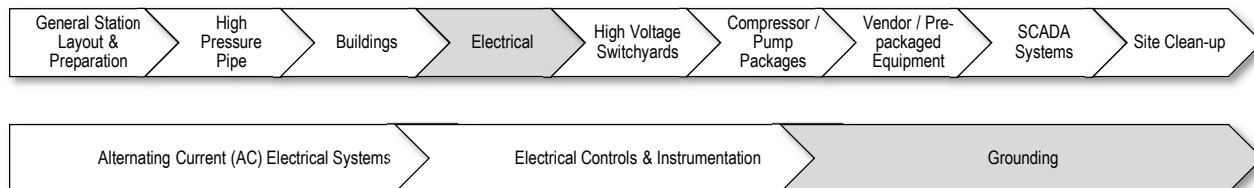
As part of preparing for inspection during the grounding process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Operator technical specifications as identified in Table 212.

### A.4.4.2 Execution

While the work is being executed, the Inspector should 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 211.

**Table 211—Monitoring Requirements for Grounding – Electrical**

| Item                     | Description                                                                                         | Reference |
|--------------------------|-----------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work | Daily, ensure key issues that have been identified are detailed and addressed                       | Table 213 |
| Safety                   | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements | Table 214 |
| Grounding Installation   | Monitoring requirements associated with grounding, ensuring the installation conforms to the design | Table 215 |



#### **A.4.4.3 Outputs**

The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for grounding inspection appear in Table 216.

#### **A.4.4.4 Detailed Checklists – Grounding**

##### **A.4.4.4.1 Typical Input Requirements for Grounding Inspection**

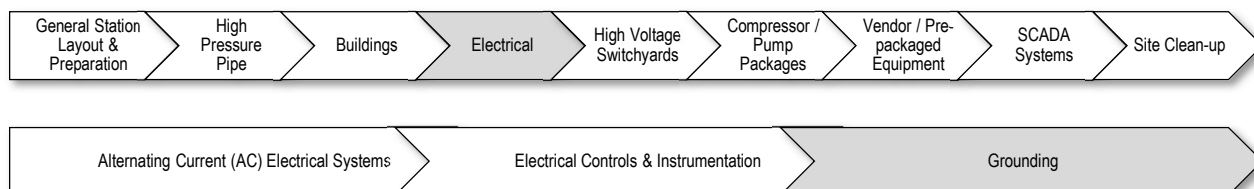
**Table 212—Information Requirements for Grounding Inspection**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>All designs, drawings, and specifications developed by the Operator and contractors related to grounding, such as:</p> <ul style="list-style-type: none"> <li>- Issued for construction (IFC) drawings, including: <ul style="list-style-type: none"> <li>o Piping and instrumentation diagrams (P&amp;IDs)</li> <li>o Electrical details and wiring</li> <li>o Network wiring diagrams</li> <li>o Equipment arrangement plans</li> <li>o Single line diagrams</li> <li>o Lighting plans, sections, and details</li> <li>o Panel assemblies</li> <li>o Panel schedules</li> <li>o Conduit / cable schedules</li> <li>o Wiring diagrams</li> <li>o Grounding drawings</li> <li>o Routing plans</li> <li>o Electrical specifications, including grounding specifications</li> <li>o Electrical manufacturer drawings and specifications</li> </ul> </li> </ul> |
|   | <p>Contracts and agreements related to:</p> <ul style="list-style-type: none"> <li>- Electrical Work</li> <li>- All electricians' qualifications records to specific applicable processes</li> <li>- Technical advisors / vendor representatives</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|   | <p>Operator specific safety plan, including (but not limited to):</p> <ul style="list-style-type: none"> <li>- Lock-out / Tag-out procedures</li> <li>- Electrical safety (e.g., arc flash)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|   | <p>Other project specific plans, which may include:</p> <ul style="list-style-type: none"> <li>- Site security</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

##### **A.4.4.4.2 Best Practice Items for Inspecting Typical Grounding Installation**

**Table 213—Prior to Commencing Work**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                         |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>Participate in daily meetings to address:</p> <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |



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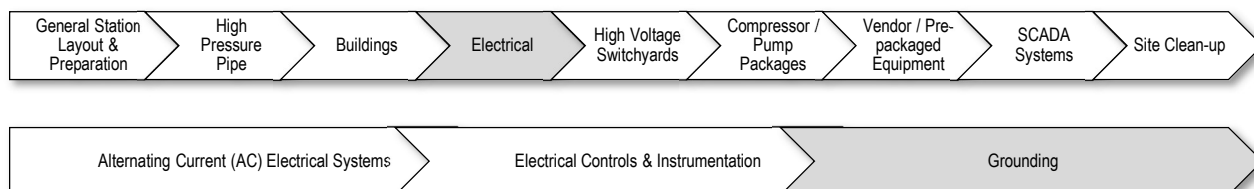
|   |                                                                                                                                                                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                           |
|   | Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Operator or project specifications and Issued for Construction (IFC) drawings per Section A.1.5 Stockpiling and Material Handling |
|   | Ensure all material markings and tag numbers are in accordance with Operator or project specifications and IFC drawings per Section A.1.5 Stockpiling and Material Handling                                                                           |

**Table 214—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 215—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                                                                                                                                                                                                                                                                                                                       |





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|   |                                                                                                              |
|---|--------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                  |
|   | 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 Operator or project specifications |
|   | Ensure lightning protection is properly installed                                                            |

#### A.4.4.4.3 Typical Outputs for Grounding Inspection

**Table 216—Typical Reporting Requirements**

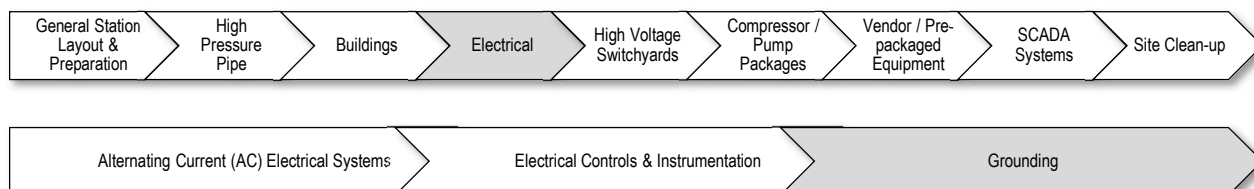
|         |                                                   |
|---------|---------------------------------------------------|
| ✓       | Description                                       |
| General |                                                   |
|         | Ensure completion of as-built, red-lined 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          |

#### A.4.4.5 References – Grounding

**NOTE** The reference information provided in Table 217 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 217—List of References – Grounding**

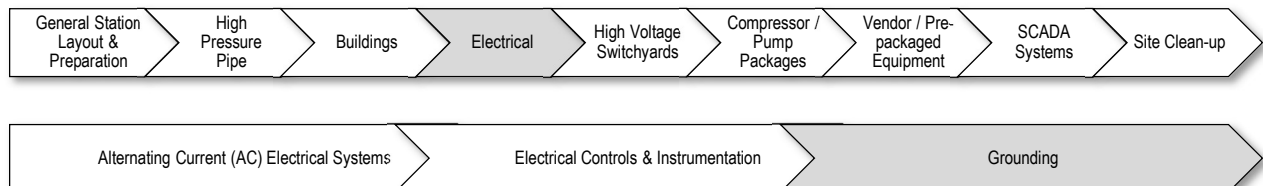
| Document No.                                | Type                 | Title                                                                                                                                                      |
|---------------------------------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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) |                      |                                                                                                                                                            |
| NFPA 70                                     | Standard             | National Electrical Code (NEC)                                                                                                                             |
| NFPA 70E                                    | Standard             | Standard for Electrical Safety in the Workplace                                                                                                            |



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| Document No. | Type     | Title                                   |
|--------------|----------|-----------------------------------------|
| N/A          | Handbook | National Electrical Code (NEC) Handbook |

DRAFT



## A.5 High Voltage Switchyards

### A.5.1 Overview

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

High voltage switchyard installation consists of the following major items during the construction of a facility:

- Structural Steel
- Lifting and Setting
- Switchgear

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

#### A.5.1.1 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.

#### A.5.1.2 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.

#### A.5.1.3 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.

### A.5.2 Structural Steel

#### A.5.2.1 Inputs

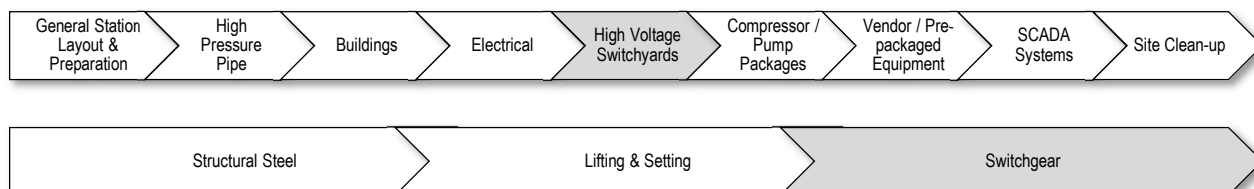
As part of preparing for inspection during the structural steel construction process, the Inspector will continually familiarize themselves with relevant aspects of key documents, drawings, and Operator technical specifications as identified in Table 219.

#### A.5.2.2 Execution

While the work is being executed, the Inspector should 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 218.

**Table 218—Monitoring Requirements for Structural Steel**

| Item                     | Description                                                                                         | Reference |
|--------------------------|-----------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work | Daily, ensure key issues that have been identified are detailed and addressed                       | Table 220 |
| Safety                   | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements | Table 221 |
| Civil                    |                                                                                                     |           |



| Item                                             | Description                                                                                                   | Reference     |
|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------|---------------|
| Foundations and Reinforced Concrete Construction | Previously discussed monitoring requirements associated with foundations and reinforced concrete construction | Section A.1.7 |
| Structural Steel Construction                    | Monitoring requirements associated with structural steel, ensuring the installation conforms to the design    | Table 222     |
| Civil, Mechanical, Electrical (All Disciplines)  |                                                                                                               |               |
| Welding and Joining Operations                   | Previously discussed monitoring requirements associated with welding and joining operations                   | Section A.2.4 |
| Coating / Painting Operations                    | Previously discussed monitoring requirements associated with coating / painting operations                    | Section A.2.5 |

### A.5.2.3 Outputs

The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for structural steel inspection appear in Table 223.

### A.5.2.4 Detailed Checklists – Structural Steel

#### A.5.2.4.1 Typical Input Requirements for Structural Steel Inspection

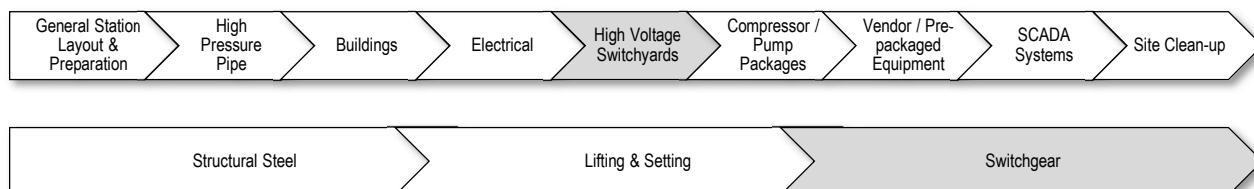
**Table 219—Information Requirements for Structural Steel Inspection**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                     |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | All designs, drawings, and specifications developed by the Operator and contractors related to structural steel, such as: <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) Drawings</li> <li>- Fabrication shop drawings</li> <li>- Structural steel specifications</li> <li>- Construction specifications</li> <li>- Manufacturer specifications and drawings</li> </ul> |
|   | Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information                                                                                                                                                                                             |
|   | Operator specific safety plan, including (but not limited to): <ul style="list-style-type: none"> <li>- Working at elevations</li> <li>- Lift plan</li> </ul>                                                                                                                                                                                                                                   |
|   | Other project specific plans, which may include: <ul style="list-style-type: none"> <li>- Traffic management plan</li> </ul>                                                                                                                                                                                                                                                                    |

#### A.5.2.4.2 Best Practice Items for Inspecting Typical Structural Steel Construction

**Table 220—Prior to Commencing Work**

| ✓ | Description                                                                                                                                                                                                        |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | Participate in daily meetings to address: <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> </ul> |



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|   |                                                                                                                                                                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                           |
|   | <ul style="list-style-type: none"> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul>                                                    |
|   | Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Operator or project specifications and Issued for Construction (IFC) drawings per Section A.1.5 Stockpiling and Material Handling |
|   | Ensure all structural steel members are piece marked in accordance with fabrication shop drawings                                                                                                                                                     |

**Table 221—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 222—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 Operator 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 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 A.2.4 Welding and Joining                                                      |

#### A.5.2.4.3 Typical Outputs for Structural Steel Inspection

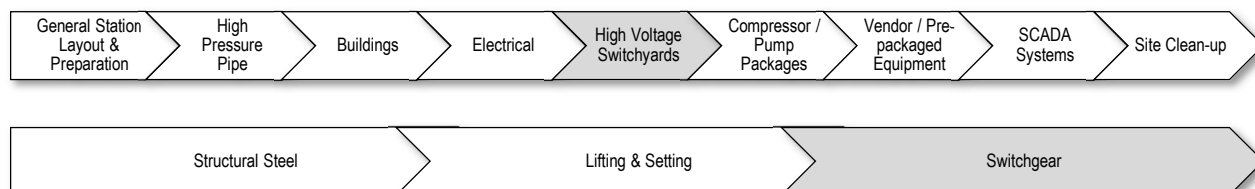
**Table 223—Typical Reporting Requirements**

|   |                                                                                                                                                                                                                                                                                     |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                         |
|   | General                                                                                                                                                                                                                                                                             |
|   | Ensure completion of as-built, red-lined drawings                                                                                                                                                                                                                                   |
|   | Daily                                                                                                                                                                                                                                                                               |
|   | Complete structural steel progress reports, including: <ul style="list-style-type: none"> <li>- Number and location of structural steel members erected</li> <li>- Description and location of placed structural steel</li> <li>- Document punch list items, as required</li> </ul> |

#### A.5.2.5 References – Structural Steel

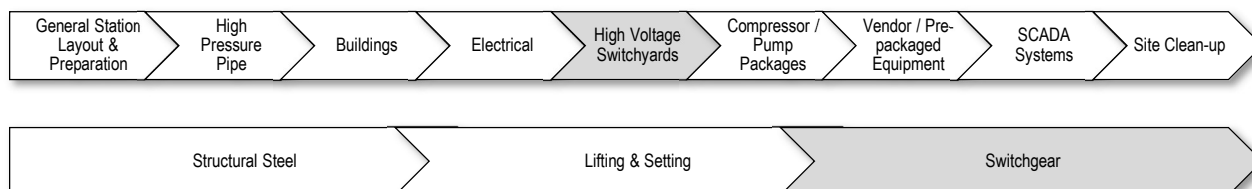
**NOTE** The reference information provided in Table 224 is intended as a guide only (i.e., the list is not exhaustive); documents of this nature are updated frequently, and it remains the responsibility of the user to ensure that the correct, and most current, documents are referenced as appropriate.

**Table 224—List of References – Structural Steel**



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| Document No.                                                                                          | Type                 | Title                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>American Institute of Steel Construction (AISC)</b>                                                |                      |                                                                                                                                                                   |
| 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                                                                                                                                         |
| <b>American National Standards Institute (ANSI) / American Institute of Steel Construction (AISC)</b> |                      |                                                                                                                                                                   |
| ANSI / AISC 303                                                                                       | Standard             | Code of Standard Practice for Steel Buildings and Bridges                                                                                                         |
| ANSI / AISC 360                                                                                       | Specification        | Specification for Structural Steel Buildings                                                                                                                      |
| <b>American Society for Testing and Materials (ASTM)</b>                                              |                      |                                                                                                                                                                   |
| 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                                                                                                          |
| <b>American Society of Civil Engineers (ASCE)</b>                                                     |                      |                                                                                                                                                                   |
| ASCE 7                                                                                                | Standard             | Minimum Design Loads for Buildings and Other Structures                                                                                                           |
| <b>Canadian Institute of Steel Construction (CISC)</b>                                                |                      |                                                                                                                                                                   |
| N/A                                                                                                   | Recommended Practice | Code of Standard Practice                                                                                                                                         |
| N/A                                                                                                   | Handbook             | Handbook of Steel Construction                                                                                                                                    |
| <b>Canadian Standards Association (CSA)</b>                                                           |                      |                                                                                                                                                                   |
| 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                                                                               |
| <b>International Code Council (ICC)</b>                                                               |                      |                                                                                                                                                                   |
| N/A                                                                                                   | Standard             | The International Building Code (IBC) 1                                                                                                                           |



| Document No.                                      | Type          | Title                                                         |
|---------------------------------------------------|---------------|---------------------------------------------------------------|
| 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 |

### A.5.3 Lifting and Setting

#### A.5.3.1 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 Operator technical specifications as identified in Table 226.

#### A.5.3.2 Execution

While the work is being executed, the Inspector should 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 225.

**Table 225—Monitoring Requirements for Lifting and Setting – Mechanical**

| Item                     | Description                                                                                         | Reference |
|--------------------------|-----------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work | Daily, ensure key issues that have been identified are detailed and addressed                       | Table 227 |
| Safety                   | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements | Table 228 |
| Lifting and Setting      | Monitor lifting and setting operations for safety and ensure that no damage occurs to the equipment | Table 229 |

#### A.5.3.3 Outputs

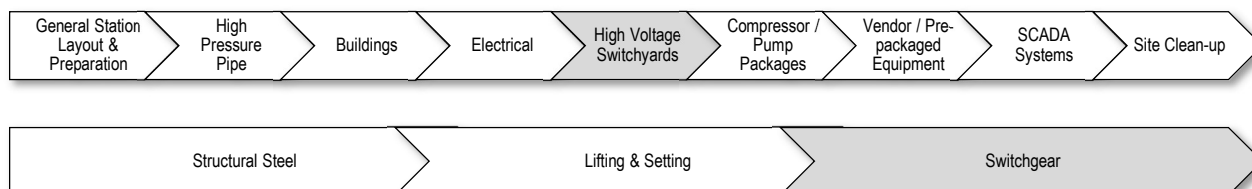
The Inspector should report on workmanship and progress on a periodic basis (e.g., daily, or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for lifting and setting inspection appear in Table 230.

#### A.5.3.4 Detailed Checklists – Lifting and Setting

##### A.5.3.4.1 Typical Input Requirements for Lifting and Setting Inspection

**Table 226—Information Requirements for Lifting and Setting**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                    |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | All designs, drawings, and specifications developed by the Operator and contractors related to lifting and setting, such as: <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings</li> <li>- Equipment manufacturer specifications and drawings</li> <li>- Lifting Equipment specifications and drawings</li> </ul> |
|   | Contracts and agreements related to: <ul style="list-style-type: none"> <li>- Road use</li> <li>- Crossing for buried facilities</li> </ul>                                                                                                                                                                                                    |



|   |                                                                |
|---|----------------------------------------------------------------|
| ✓ | Description                                                    |
|   | - Construction survey                                          |
|   | Operator 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                     |

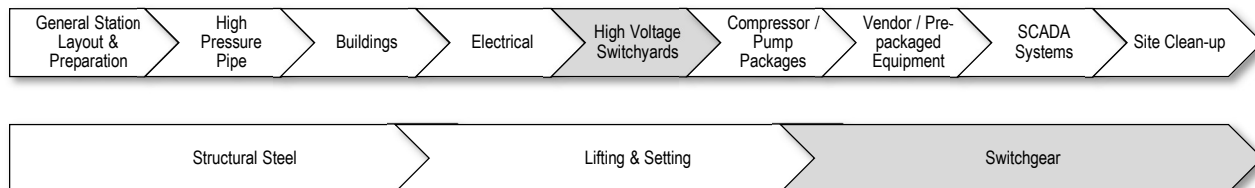
#### A.5.3.4.2 Best Practice Items for Inspecting Typical Lifting and Setting Operations

**Table 227—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 |
|   | 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 228—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 |





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|   |                                                                                                                                       |
|---|---------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                           |
|   | 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 229—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                                                                                                                                                                                                                                                                                                                              |

#### **A.5.3.4.3 Typical Outputs for Lifting and Setting Inspection**

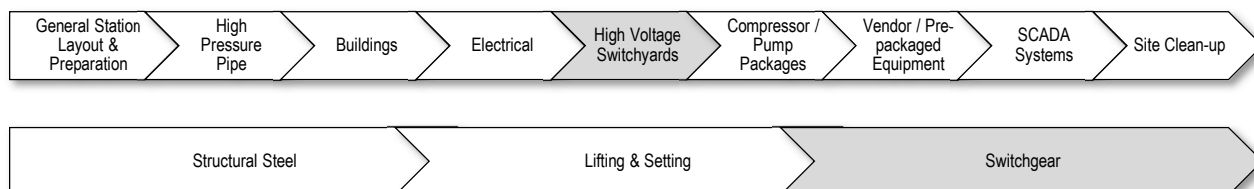
**Table 230—Typical Reporting Requirements**

|         |                                                                                                                                                                                                                                                                                            |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓       | Description                                                                                                                                                                                                                                                                                |
| General |                                                                                                                                                                                                                                                                                            |
|         | Ensure completion of as-built, red-lined drawings                                                                                                                                                                                                                                          |
| Daily   |                                                                                                                                                                                                                                                                                            |
|         | Complete lifting and setting progress reports, including: <ul style="list-style-type: none"> <li>- Description and location of placed equipment or structural steel</li> <li>- Any damage incurred during lifting and setting</li> <li>- Document punch list items, as required</li> </ul> |

#### **A.5.3.5 References – Lifting and Setting**

**NOTE** The reference information provided in Table 231 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 231—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                                     |

## A.5.4 Switchgear

### A.5.4.1 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 Operator technical specifications as identified in Table 233.

### A.5.4.2 Execution

While the work is being executed, the Inspector should 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 232.

**Table 232—Monitoring Requirements for Switchgear – Electrical**

| Item                     | Description                                                                                          | Reference |
|--------------------------|------------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work | Daily, ensure key issues that have been identified are detailed and addressed                        | Table 234 |
| Safety                   | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements  | Table 235 |
| Switchgear Installation  | Monitoring requirements associated with switchgear, ensuring the installation conforms to the design | Table 236 |

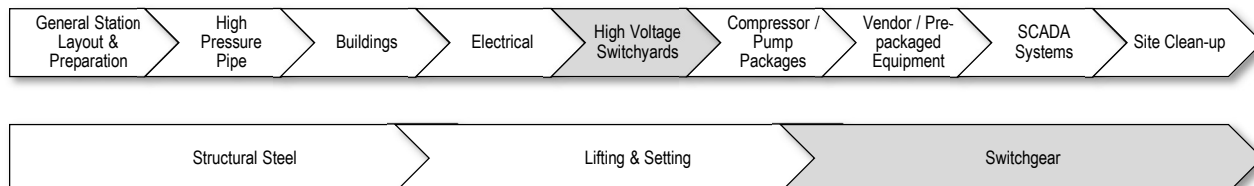
### A.5.4.3 Outputs

The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for switchgear inspection appear in Table 237.

### A.5.4.4 Detailed Checklists – Switchgear

#### A.5.4.4.1 Typical Input Requirements for Switchgear Inspection

**Table 233—Information Requirements for Switchgear**



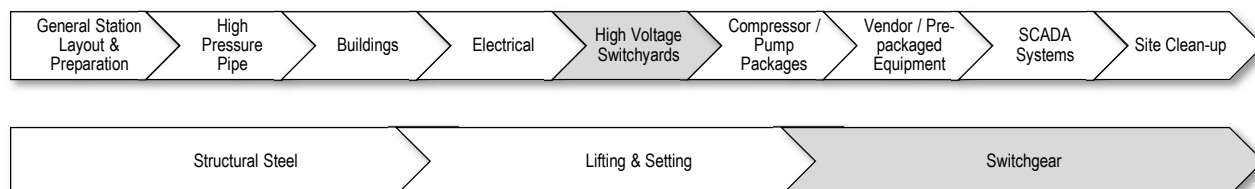
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>All designs, drawings, and specifications developed by the Operator and contractors related to switchgear, such as:</p> <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings, including</li> <li>- Piping and Instrumentation Diagrams (P&amp;IDs)</li> <li>- Electrical details and wiring</li> <li>- Network wiring diagrams</li> <li>- Equipment arrangement plans</li> <li>- Single line diagrams</li> <li>- Lighting plans, sections, and details</li> <li>- Panel assemblies</li> <li>- Panel schedules</li> <li>- Conduit / cable schedules</li> <li>- Wiring diagrams</li> <li>- Routing plans</li> <li>- Electrical specifications</li> <li>- Electrical manufacturer drawings and specifications</li> </ul> |
|   | <p>Contracts and agreements related to:</p> <ul style="list-style-type: none"> <li>- Electrical work</li> <li>- All electricians' qualifications records to specific applicable processes</li> <li>- Technical advisors / vendor representatives</li> <li>- Electric utility company specifications and requirements</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                     |
|   | <p>Operator specific safety plan, including (but not limited to):</p> <ul style="list-style-type: none"> <li>- Lock-out / Tag-out procedures</li> <li>- Electrical safety (e.g., arc flash)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|   | <p>Other project specific Plans, which may include:</p> <ul style="list-style-type: none"> <li>- Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                     |

#### A.5.4.4.2 Best Practice Items for Inspecting Typical Switchgear Installation

**Table 234—Prior to Commencing Work**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                   |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>Participate in daily meetings to address:</p> <ul style="list-style-type: none"> <li>- Job safety analysis (JSA) and hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |
|   | <p>Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Operator or project specifications and Issued for Construction (IFC) drawings per Section A.1.5 Stockpiling and Material Handling</p>                                                                                                                                  |
|   | <p>Ensure all material markings and tag numbers are in accordance with Operator or project specifications and IFC drawings per Section A.1.5 Stockpiling and Material Handling</p>                                                                                                                                                                                                            |
|   | <p>Ensure all conduits / cables, fuses, switch boxes, equipment, and other electrical fittings bear electrical capacity data and manufacturer's name</p>                                                                                                                                                                                                                                      |
|   | <p>Ensure procedures are available for all instrumentation requiring field calibrations</p>                                                                                                                                                                                                                                                                                                   |

**Table 235—Safety Concerns for Switchgear Installation**



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|   |                                                                                                                                       |
|---|---------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | 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                                                                  |

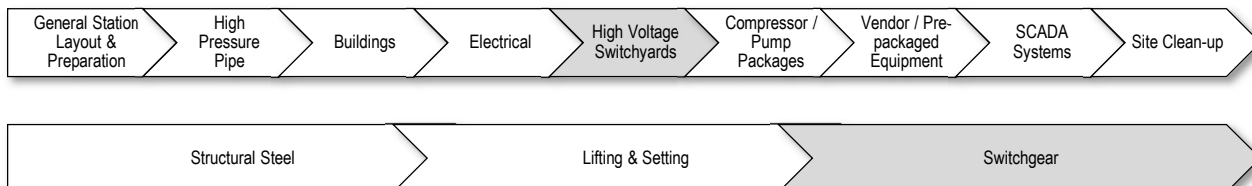
**Table 236—Typical Monitoring Requirements for Switchgear Installation**

|   |                                                                                                                                         |
|---|-----------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | 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                                                                                 |

#### A.5.4.4.3 Typical Outputs for Switchgear Inspection

**Table 237—Typical Reporting Requirements**

|         |                                                                                                                                                                                                                                                                                                                                                          |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓       | Description                                                                                                                                                                                                                                                                                                                                              |
| General |                                                                                                                                                                                                                                                                                                                                                          |
|         | Ensure completion of as-built, red-lined drawings                                                                                                                                                                                                                                                                                                        |
|         | Complete switchgear test reports, including: <ul style="list-style-type: none"> <li>- Instrument calibration record forms</li> <li>- Megger test records</li> <li>- Ground bus resistance values</li> <li>- Insulation resistance test record forms</li> <li>- Distribution panel test records</li> <li>- Bus connection verification reports</li> </ul> |
| Daily   |                                                                                                                                                                                                                                                                                                                                                          |



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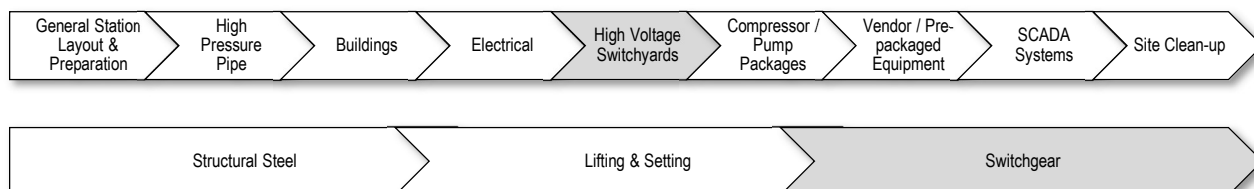
|   |                                                                                                                                                                               |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                   |
|   | Complete switchgear progress reports, including: <ul style="list-style-type: none"> <li>- Work completed to date</li> <li>- Document punch list items, as required</li> </ul> |

#### A.5.4.5 References – Switchgear

NOTE The reference information provided in Table 238 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 238—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                                                                                                                    |



## **A.6 Compressor / Pump Packages**

### **A.6.1 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.

Connections to compressor / pump packages are within the scope of this document; connections for components within these packages are typically inspected by the vendor and therefore outside the scope of this document.

Compressor / pump package installation consists of the following major items during the construction of a facility:

- Lifting and Setting

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

### **A.6.2 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 should be given during the lifting and setting phase to ensure that the equipment is not damaged, which may cause delays to the project.

#### **A.6.2.1 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 Operator technical specifications as identified in Table 240.

#### **A.6.2.2 Execution**

While the work is being executed, the Inspector should 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 239.

**Table 239—Monitoring Requirements for Compressor / Pump Packages**

| Item                                             | Description                                                                                                   | Reference     |
|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------|---------------|
| Prior to Commencing Work                         | Daily, ensure key issues that have been identified are detailed and addressed                                 | Table 241     |
| Safety                                           | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements           | Table 242     |
| Civil, Mechanical, Electrical (All Disciplines)  |                                                                                                               |               |
| High Pressure Pipe Construction                  | Previously discussed monitoring requirements associated with high pressure pipe construction                  | Section A.2   |
| Civil                                            |                                                                                                               |               |
| Foundations and Reinforced Concrete Construction | Previously discussed monitoring requirements associated with foundations and reinforced concrete construction | Section A.1.7 |



| Item                                                 | Description                                                                                                       | Reference                                                   |
|------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| Structural Steel Construction                        | Previously discussed monitoring requirements associated with structural steel construction                        | <b>Section Error!</b><br><b>Reference source not found.</b> |
| <b>Mechanical</b>                                    |                                                                                                                   |                                                             |
| Lifting and Setting                                  | Monitoring requirements associated with lifting and setting, ensuring the installation conforms to the design     | Table 243                                                   |
| <b>Electrical</b>                                    |                                                                                                                   |                                                             |
| Electrical Controls and Instrumentation Installation | Previously discussed monitoring requirements associated with electrical controls and instrumentation installation | Section A.4.3                                               |

### A.6.2.3 Outputs

The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for compressor / pump packages installation inspection appear in Table 244.

### A.6.2.4 Detailed Checklists – Compressor / Pump Packages

#### A.6.2.4.1 Typical Input Requirements for Compressor / Pump Packages Inspection

**Table 240—Information Requirements for Compressor / Pump Packages Inspection**

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|   | <p>All designs, drawings, and specifications developed by the Operator and contractors related to compressor / pump packages, such as:</p> <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings</li> <li>- Equipment manufacturer specifications and drawings</li> <li>- Lifting equipment specifications and drawings</li> <li>- Leveling and alignment procedures</li> <li>- Long-term storage procedures (i.e., to prevent corrosion)</li> </ul>                                   |
|   | <p>Contracts and agreements related to:</p> <ul style="list-style-type: none"> <li>- Road use</li> <li>- Crossing for buried facilities</li> <li>- Construction survey</li> </ul>                                                                                                                                                                                                                                                                                                                                |
|   | <p>Operator specific safety plan, including (but not limited to):</p> <ul style="list-style-type: none"> <li>- Traffic control plan</li> <li>- Requirements for Personal Protective Equipment (PPE)</li> <li>- Emergency Medical Services (EMS)</li> <li>- Heavy lift plan (including equipment manufacturer information on weights, center of gravity, dimensions, lift points, spreader bars, slings, etc.)</li> <li>- Lock-out / Tag-out procedures</li> <li>- Electrical safety (e.g., arc flash)</li> </ul> |
|   | <p>Other project specific plans, which may include:</p> <ul style="list-style-type: none"> <li>- Fire prevention / firefighting plan</li> <li>- Relevant contingency plans</li> <li>- Loading, securing, and rigging practices</li> </ul>                                                                                                                                                                                                                                                                        |

#### A.6.2.4.2 Best Practice Items for Inspecting Typical Compressor / Pump Packages Installation

**Table 241—Prior to Commencing Work**



| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                        |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>Participate in daily meetings to address:</p> <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul>                |
|   | <p>Conduct planning and tailgate meetings before the start of lifting and setting to make sure all personnel involved are aware of:</p> <ul style="list-style-type: none"> <li>- Lifting sequence</li> <li>- Critical lift circumstances</li> <li>- Equipment size and numbers</li> <li>- Individual roles and responsibilities</li> <li>- Weather restrictions (e.g., wind, lightning)</li> </ul> |
|   | 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

**Table 242—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                                                                        |





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|   |                                                                                                                                       |
|---|---------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                           |
|   | 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 243—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*

#### **A.6.2.4.3 Typical Outputs for Compressor / Pump Packages Inspection**

**Table 244—Typical Reporting Requirements**

|   |             |
|---|-------------|
| ✓ | Description |
|   | General     |



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|       |                                                                                                                                                                                                                                                                               |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|       | Ensure completion of as-built, red-lined drawings                                                                                                                                                                                                                             |
| Daily |                                                                                                                                                                                                                                                                               |
|       | Complete compressor / pump packages progress reports, including: <ul style="list-style-type: none"> <li>- Description and location of placed equipment</li> <li>- Any damage incurred during lifting and setting</li> <li>- Document punch list items, as required</li> </ul> |

#### A.6.2.5 References – Compressor / Pump Packages

NOTE The reference information provided in Table 245 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 245—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                                     |



## A.7 Vendor / Pre-packaged Equipment

### A.7.1 Overview

Vendor / pre-packaged equipment is installed to support the primary compressor or pump package.

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.

### A.7.2 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 Operator technical specifications as identified in Table 247.

### A.7.3 Execution

While the work is being executed, the Inspector should 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 246.

**Table 246—Monitoring Requirements for Vendor / Pre-packaged Equipment**

| Item                     | Description                                                                   | Reference |
|--------------------------|-------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work | Daily, ensure key issues that have been identified are detailed and addressed | Table 248 |



| Item                                             | Description                                                                                                               | Reference     |
|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|---------------|
| Safety                                           | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements                       | Table 249     |
| Civil                                            |                                                                                                                           |               |
| Foundations and Reinforced Concrete Construction | Previously discussed monitoring requirements associated with foundations and reinforced concrete construction             | Section A.1.7 |
| Vendor / Pre-packaged Equipment Installation     | Monitoring requirements associated with vendor / pre-packaged equipment, ensuring the installation conforms to the design | Table 250     |
| Mechanical                                       |                                                                                                                           |               |
| Lifting and Setting Operations                   | Previously discussed monitoring requirements associated with lifting and setting operations                               | Section A.2.3 |
| Vendor / Pre-packaged Equipment Installation     | Monitoring requirements associated with vendor / pre-packaged equipment, ensuring the installation conforms to the design | Table 251     |
| Electrical                                       |                                                                                                                           |               |
| Vendor / Pre-packaged Equipment Installation     | Monitoring requirements associated with vendor / pre-packaged equipment, ensuring the installation conforms to the design | Table 252     |

#### A.7.4 Outputs

The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for vendor / pre-packaged equipment installation inspection appear in Table 253.

#### A.7.5 Detailed Checklists – Vendor / Pre-packaged Equipment

##### A.7.5.1 Typical Input Requirements for Vendor / Pre-packaged Equipment Inspection

**Table 247—Information Requirements for Vendor / Pre-packaged Equipment Inspection**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>All designs, drawings, and specifications developed by the Operator and contractors related to vendor / pre-packaged equipment, such as:</p> <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings, including: <ul style="list-style-type: none"> <li>o Piping and Instrumentation Diagrams (P&amp;IDs)</li> <li>o Process Flow Diagrams (PFDs)</li> <li>o Isometric drawings</li> <li>o Electrical line lists and drawings</li> <li>o Equipment vendor drawings and specifications</li> <li>o Long-term storage procedures (i.e., to prevent corrosion)</li> </ul> </li> </ul> |
|   | <p>Contracts and agreements related to:</p> <ul style="list-style-type: none"> <li>- Procurement of equipment (e.g., purchase orders)</li> <li>- Technical advisors / vendor representatives</li> <li>- Utility power</li> <li>- First Fill</li> </ul>                                                                                                                                                                                                                                                                                                                                                       |
|   | <p>Operator specific safety plan, including (but not limited to):</p> <ul style="list-style-type: none"> <li>- Requirements for Personal Protective Equipment (PPE)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                               |



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|   |                                                                                                                                                                                                                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                           |
|   | <ul style="list-style-type: none"> <li>- Emergency Medical Services (EMS)</li> <li>- Lock-out / Tag-out procedures</li> <li>- Electrical safety (e.g., arc flash)</li> <li>- Working at elevations</li> <li>- Working with Medium voltage devices</li> <li>- Physical Containment of leaks</li> </ul> |
|   | Other project specific plans, which may include: <ul style="list-style-type: none"> <li>- Fire Prevention / firefighting plan</li> <li>- Relevant contingency plans</li> </ul>                                                                                                                        |

#### A.7.5.2 Best Practice Items for Inspecting Typical Vendor / Pre-packaged Equipment Installation

**Table 248—Prior to Commencing Work**

|   |                                                                                                                                                                                                                                                                                                                                                                              |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                  |
|   | Participate in daily meetings to address: <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |
|   | Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Operator or project specifications and Issued for Construction (IFC) drawings per Section A.1.5 Stockpiling and Material Handling                                                                                                                        |
|   | Ensure tag numbers are in accordance with IFC drawings                                                                                                                                                                                                                                                                                                                       |
|   | Verify nameplate data against IFC drawings                                                                                                                                                                                                                                                                                                                                   |

**Table 249—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 250—Typical Monitoring Requirements for Vendor / Pre-packaged Equipment Installation – Civil**

|   |                                                                                |
|---|--------------------------------------------------------------------------------|
| ✓ | Description                                                                    |
|   | Ensure elevations of foundations have been verified prior to setting equipment |



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|   |                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                           |
|   | Ensure the installation is undertaken in accordance with equipment vendor procedures and requirements |

**Table 251—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 A.2.6 Hydrostatic Testing) of the pipe is completed                                  |
|   | 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 252—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 A.4.4 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                                                                                                              |
|   | 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, rigidly supported, and properly routed, including loops to account for vibration or thermal differentials |



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|   |                                                                                                                                                                                                                                                |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                    |
|   | Ensure the installation is undertaken in accordance with equipment vendor procedures and requirements                                                                                                                                          |
|   | 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, and 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                                                                                                                                                                         |

#### A.7.5.3 Typical Outputs for Vendor / Pre-packaged Equipment Inspection

**Table 253—Typical Reporting Requirements**

|         |                                                                                                                                                                                                                                                                                                                              |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓       | Description                                                                                                                                                                                                                                                                                                                  |
| General |                                                                                                                                                                                                                                                                                                                              |
|         | Complete vendor / pre-packaged equipment test reports, including vendor checklists                                                                                                                                                                                                                                           |
| Daily   |                                                                                                                                                                                                                                                                                                                              |
|         | Complete vendor / pre-packaged equipment progress reports, including: <ul style="list-style-type: none"> <li>- Vendor equipment mounted</li> <li>- Description and location of pipe or tubing installed</li> <li>- Identification of instrumentation terminated</li> <li>- Document punch list items, as required</li> </ul> |

#### A.7.6 References – Vendor / Pre-packaged Equipment

**NOTE** The reference information provided in Table 254 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 254—List of References—Vendor / Pre-packaged Equipment**

| Document No. | Type | Title                                                                                                                                                                                               |
|--------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|              |      | Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information |



## **A.8 Supervisory Control and Data Acquisition (SCADA) Systems**

### **A.8.1 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; emergency shutdown systems are within the scope of this document.

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

### **A.8.2 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 Operator technical specifications as identified in Table 256.

### **A.8.3 Execution**

While the work is being executed, the Inspector should 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 255.

**Table 255—Monitoring Requirements for SCADA Systems – Electrical**

| Item                                    | Description                                                                                                          | Reference |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work                | Daily, ensure key issues that have been identified are detailed and addressed                                        | Table 257 |
| Safety                                  | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements                  | Table 258 |
| Emergency Shutdown Systems Installation | Monitoring requirements associated with emergency shutdown systems, ensuring the installation conforms to the design | Table 259 |

### **A.8.4 Outputs**

The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for SCADA systems inspection appear in Table 260.

### **A.8.5 Detailed Checklists – SCADA Systems**

#### **A.8.5.1 Typical Input Requirements for SCADA Systems Inspection**

**Table 256—Information Requirements for SCADA Systems Inspection**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>All designs, drawings, and specifications developed by the Operator and contractors related to SCADA systems, such as:</p> <ul style="list-style-type: none"> <li>- Issued for Construction (IFC) drawings, including: <ul style="list-style-type: none"> <li>- Piping and Instrumentation Diagrams (P&amp;IDs) including instrument index</li> <li>- Panel assemblies</li> <li>- Wiring diagrams</li> <li>- Network wiring diagrams</li> </ul> </li> </ul> |





| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <ul style="list-style-type: none"> <li>- Schematic diagrams</li> <li>- Lighting details</li> <li>- Fire and gas plans and details</li> <li>- Electrical details</li> <li>- Power distribution drawings</li> <li>- Nameplate schedules</li> <li>- Input / output list (including calibration range, alarms, and set points)</li> <li>- Vendor drawings and specifications, including: <ul style="list-style-type: none"> <li>- Operating and maintenance manuals and test procedures)</li> <li>- SCADA test documentation</li> <li>- Telecommunication test documentation</li> <li>- System software design documentation</li> <li>- Factory acceptance test procedures</li> <li>- Site acceptance test procedures</li> </ul> </li> </ul> |
|   | <p>Contracts and agreements related to:</p> <ul style="list-style-type: none"> <li>- Third-party support for installation (may be included in commissioning support contract)</li> <li>- Interconnect agreements</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|   | <p>Operator specific safety plan, including (but not limited to):</p> <ul style="list-style-type: none"> <li>- Lock-out / Tag-out procedures</li> <li>- Electrical safety (e.g., arc flash)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|   | <p>Other project specific plans, which may include:</p> <ul style="list-style-type: none"> <li>- Operations philosophy</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

#### **A.8.5.2 Best Practice Items for Inspecting Typical SCADA Systems Installation**

**Table 257—Prior to Commencing Work**

| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                         |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>Participate in daily meetings to address:</p> <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |
|   | <p>Ensure all materials required for anticipated work are available, free of defects or damage, and in accordance with Operator or project specifications and IFC drawings per Section A.1.5 Stockpiling and Material Handling</p>                                                                                                                                                  |

**Table 258—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 259—Typical Monitoring Requirements for Emergency Shutdown Systems Installation**



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|   |                                                                       |
|---|-----------------------------------------------------------------------|
| ✓ | 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                   |

### A.8.5.3 Typical Outputs for SCADA Systems Inspection

**Table 260—Typical Reporting Requirements**

|   |                                                                                                                                                                                                                                                                    |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                        |
|   | General                                                                                                                                                                                                                                                            |
|   | Ensure completion of as-built, red-lined drawings                                                                                                                                                                                                                  |
|   | Daily                                                                                                                                                                                                                                                              |
|   | Complete SCADA systems progress reports, including: <ul style="list-style-type: none"> <li>- Instrument calibration record forms</li> <li>- Instrument check sheets</li> <li>- Loop test record forms</li> <li>- Document punch list items, as required</li> </ul> |

### A.8.6 References – SCADA Systems

**NOTE** The reference information provided in Table 261 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 261—List of References – SCADA Systems**

| Document No.                                                                                                                                                                                        | Type | Title |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|
| Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information |      |       |



## A.9 Site Clean-up

### A.9.1 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.

During summer construction, the contractor will do both machine and final clean-up immediately after the end of construction and return to the site later for additional restoration work.

### A.9.2 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 Operator technical specifications as identified in Table 263.

### A.9.3 Execution

While the work is being executed, the Inspector should 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 262.

**Table 262—Monitoring Requirements for Site Clean-up – Civil**

| Item                     | Description                                                                                                                                               | Reference |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Prior to Commencing Work | Daily, ensure key issues that have been identified are detailed and addressed                                                                             | Table 264 |
| Safety                   | Monitor the operations for adherence to relevant Operator- and project-specific safety requirements                                                       | Table 265 |
| 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 266 |
| Fencing                  | Confirm that fencing has been installed as per Operator specifications and landowner agreements                                                           | Table 267 |

### A.9.4 Outputs

The Inspector should report on workmanship and progress on a periodic basis (e.g., daily or weekly) by completing various reports on each workday and end of week. Report requirements and reporting processes are Operator- and project-specific; best practices for reporting requirements for site clean-up inspection appear in Table 268.

### A.9.5 Detailed Checklists – Site Clean-up

#### A.9.5.1 Typical Input Requirements for Site Clean-up Inspection

**Table 263—Information Requirements for Site Clean-up**

| ✓ | Description                                                                                                                                                                                                                                                                                                                  |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | All designs, drawings, and specifications developed by the Operator and contractors related to site clean-up, such as: <ul style="list-style-type: none"><li>- Issued for Construction (IFC) drawings, including:<ul style="list-style-type: none"><li>o Access road drawings</li><li>o Grading drawings</li></ul></li></ul> |

|   |                                                                                                                                                                                                                                                                                                                  |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                      |
|   | <ul style="list-style-type: none"> <li>○ Line List (e.g., special concerns for each landowner)</li> <li>○ Surface Treatment drawings (e.g., surface gravel placement)</li> <li>○ Fencing drawings</li> </ul>                                                                                                     |
|   | Contracts and agreements related to: <ul style="list-style-type: none"> <li>- Road use</li> <li>- Crossing for buried facilities</li> <li>- Construction survey</li> <li>- Municipal / County Codes and Requirements (e.g., for road repair in rural areas)</li> </ul>                                           |
|   | Operator specific safety plan, including (but not limited to): <ul style="list-style-type: none"> <li>- Traffic control plan</li> <li>- Requirements for Personal Protective Equipment (PPE)</li> <li>- Procedures for working around overhead powerlines</li> <li>- Emergency Medical Services (EMS)</li> </ul> |
|   | Other project specific plans, which may include: <ul style="list-style-type: none"> <li>- Approved grading plan</li> </ul>                                                                                                                                                                                       |

#### A.9.5.2 Best Practice Items for Inspecting Typical Site Clean-up Operations

**Table 264—Prior to Commencing Work**

|   |                                                                                                                                                                                                                                                                                                                                                                              |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                                                                                                                                                                                  |
|   | Participate in daily meetings to address: <ul style="list-style-type: none"> <li>- Job safety and / or hazard identification issues</li> <li>- Environmental concerns</li> <li>- Duties of Inspector(s)</li> <li>- Facility contractor's tailgate meetings (as required)</li> <li>- Ad-hoc meetings with contractors to discuss and clarify questions or concerns</li> </ul> |

**Table 265—Safety Concerns for Site Clean-up**

|   |                                                                                                                                                                                                     |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                         |
|   | Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information |

**Table 266—Typical Monitoring Requirements for General Site Clean-up**

|   |                                                                                                                                                                                                                       |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                           |
|   | Liaise with land agent on any special restoration requirements of landowners                                                                                                                                          |
|   | Ensure complete removal of debris (e.g., general construction debris, rocks, boulders)                                                                                                                                |
|   | Check placement of erosion control measures for compliance with Operator 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 Operator 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 Operator 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                                                                                                 |

|   |                                                                                                                                                                                                                      |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓ | Description                                                                                                                                                                                                          |
|   | 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 Operator specifications and landowner agreements |
|   | Verify final grade and drainage requirements are met                                                                                                                                                                 |

**Table 267—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 |

#### **A.9.5.3 Typical Outputs for Site Clean-up Inspection**

**Table 268—Typical Reporting Requirements**

|                |                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ✓              | Description                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>General</b> |                                                                                                                                                                                                                                                                                                                                                                                             |
|                | 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                                                                                                                                                                                                                                                                      |
| <b>Daily</b>   |                                                                                                                                                                                                                                                                                                                                                                                             |
|                | Complete site clean-up progress reports, including: <ul style="list-style-type: none"> <li>- Daily progress of the contractor's clean-up activities</li> <li>- Temporary / permanent repairs performed</li> <li>- Location and type of sediment control measures installed</li> <li>- Installation of additional warning signs</li> <li>- Document punch list items, as required</li> </ul> |

#### **A.9.6 References – Site Clean-up**

NOTE The reference information provided in Table 269 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 269—List of References – Site Clean-up**

| Document No.                                                                                                                                                                                        | Type | Title |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|
| Refer to Operator specific plans, procedures, and specifications for additional requirements beyond those identified in Section 4 Pipeline Facility Construction Inspector—Foundational Information |      |       |