

National Occupational Standard

Residential GeoExchange Heat Pump System Designer

Electricity Human Resources Canada is a non-profit organization supporting the human resources needs of the Canadian electricity sector.

Our Vision

Keeping the lights on in Canada by preparing and empowering a world-class workforce for the entire electricity industry.

Our Mission

Working to strengthen the ability of the Canadian electricity industry in meeting current and future needs for their workforce—one that is safety-focused, highly skilled, diverse and productive.

Our Values

We are a values-driven organization, committed to the improvement of our sector, the growth of Canada's economy, and the stability of our power grid. Our core values are:

Collaboration

Working with all stakeholders in Canada's electricity sector for our mutual benefit.

Trust

Forging relationships and products built on unwavering integrity.

Innovation

Leading the industry to be future-ready.

National Occupational Standards (NOS)

NOS are voluntary guidelines that have been developed to provide businesses, educators, trainers, and job seekers with practical guidance.

How are NOS used?

Employers, employees, and educational institutions can put NOS to a wide variety of uses supporting effective workforce planning:

- Support personnel certification or accreditation programs.
- Inform curricula for colleges and apprenticeships.
- Assist recruitment by informing job descriptions and providing a benchmark for employee appraisals.
- Identify career paths in order to promote employee retention.
- Help employers evaluate and determine the competencies of potential employees, including Internationally Trained Workers (ITWs).

Electricity Human Resources Canada has developed National Occupational Standards for a range of in-demand occupations.

Visit electricityhr.ca for more information.

Key Terms within the National Occupational Standard:

Major Category	A general functional area within the industry
Competency Area	A specific area of responsibility within a Major Category
Competency Unit	A specific task that contains a description of the knowledge and performance components that are needed for successful, safe and effective completion

Each Competency within the National Occupational Standard is made up of (some or all of) the following elements:

- **Purpose:** A statement that describes what the competency is, and why it is important.
- **Performance:** What a job incumbent must be able to do to perform the competency.
- **Knowledge:** What a job incumbent must know to perform the competency.
- **Glossary:** Definitions for key terms used in the competency.
- **Range of Context:** Specific variables or situations that may impact the way that the competency is performed.
- **Level of Practice:** The level of job incumbent that typically performs the competency.
- **Adapted Bloom's Taxonomy:** The level of cognitive performance required for the competency (of particular interest to trainers/educators).
- **RWATEM:** The Requisite Work Aids, Tools, Equipment and Materials used by job incumbents to perform the competency.

Chart of Competency: Residential GeoExchange Heat Pump System Designer

This Chart outlines the competencies (also known as skills and knowledge) that are performed by Residential GeoExchange Heat Pump System Designers.

Occupational Definition:

Residential GeoExchange Heat Pump System Designers design systems that transfer energy between ground or water and residential buildings for the purposes of heating and cooling. Their design responsibilities include assessing the single-family house and site, determining the optimal equipment and configuration for the system, and collaborating with project-related occupations to ensure quality designs and installations. The authority and limitations of designers of GeoExchange heat pump systems for single-family houses differ among and within provinces/territories according to the authority having jurisdiction.

GeoExchange heat pump systems are also referred to as ground source heat pump systems, ground-coupled heat pump systems, earth-energy systems and geothermal systems. The term “geothermal” can be confused with utility operations that produce electricity using heat generated in the earth’s core. “GeoExchange” is the preferred term going forward as it reflects industry’s efforts to professionalize and communicate what quality work is to clients.

Major Category	Competency Area	Competency Unit					
Design	Conduct Pre-Design Activities	Consult with external/internal client	Consult with stakeholders	Coordinate site visit	Conduct site visit		
	Design Residential GeoExchange Heat Pump Systems	Analyze building and site	Determine type and capacity of heat pump	Determine type of heat exchanger	Design vertical closed-loop heat exchanger	Design horizontal closed-loop heat exchanger	Design submerged closed-loop heat exchanger
		Design open-loop heat exchanger	Design integration of GeoExchange system with distribution system				
	Produce Design Drawings and Construction Documentation	Produce construction/installation drawings and diagrams	Produce materials lists of suppliers, and pricing based on system specifications				
	Produce Quote for Client	Produce quote for client					
	Provide Post-Design Support	Provide technical expertise	Assist with utility and regulatory permitting applications	Prepare tender package			
Safety	Maintain a Safe Working Environment	Follow safe work practices	Use personal protective equipment (PPE)	Participate in safety meetings and emergency drills	Work in confined spaces		
	Maintain a Sustainable Environment	Follow sustainable work practices					
	Respond to Emergencies	Respond to non-electrical emergencies	Participate in incident and accident investigations				
Security	Follow Security Practices	Follow security practices for physical work environment	Follow cybersecurity procedures				
Organizational Policies and Procedures	Follow Organizational Policies and Procedures	Follow organizational policies and procedures					
Information/Record Management	Complete Information/Record Management Tasks	Maintain technical information and data					
Information and Communication Technology Foundations	Use Digital Technology	Use communication applications	Use common software applications	Use navigation and mapping applications	Use digital mobile radios		
	Use Organization’s ICT System	Use organization’s ICT system					
Personal Competencies	Demonstrate Professionalism	Work as member of a team	Develop professionally	Demonstrate professional and ethical conduct	Mentor/coach others	Manage stress	Manage time
	Communicate Effectively	Use active listening skills	Use speaking skills	Use writing skills	Negotiate with internal and external stakeholders	Conduct meetings and presentations	Exchange information with internal and external stakeholders

Major Category

Design

Competency Area

Conduct Pre-Design Activities

Competency Unit

Consult with external/internal client

Purpose

Understanding the client's concept requirements, scope and limitations is necessary to inform the project design. Consultation with the client may occur several times over the course of the design process in order to keep the client informed and to obtain decisions on options and strategies.

Performance/Abilities

- P1** Conduct research on client, if applicable, for example:
 - access website to identify corporate history and philosophy
 - review previous project outcomes provided by client
- P2** Set up meeting time, date and location
- P3** Prepare for meeting:
 - obtain documents related to project, e.g. topographical maps, legal maps, site plan
 - visit site, if applicable
- P4** Meet with client:
 - meet on site, if required
 - include project engineer or project manager, as required
- P5** Discuss project, including:
 - goal/purpose of project
 - uses
 - scope
 - budget
 - financing, if applicable
 - activities completed to date, e.g. zoning, land acquisition, purchase of water rights, approvals
 - timelines for completion, e.g. start and finish dates
- P6** Provide advice and guidance, e.g. suitability of client's concept for end use
- P7** Request follow up information from client based on discussions, e.g. historic utility costs
- P8** Document client discussion and decisions
- P9** Inform client of project requirements for approvals based on previous experience with similar projects, e.g. hydrology assessment, soil testing, environmental assessment:
 - confirm when approvals and permits will be obtained
 - confirm who will be responsible for meeting approval requirements and obtaining permits
- P10** Inform clients of potential costs, e.g. cost of permits, required deposits, costs of consultants
- P11** Consult with client and project manager throughout design process to address issues, changes, and obtain approvals

Knowledge

- K1** Organization policies, procedures and plans, e.g. communication protocols
- K2** Organizational document management system
- K3** Jurisdictional and regulatory requirements based on location, scope and type of project

K4 Government incentive programs for energy producers and consumers

K5 Organizational customer credit/grant programs

Contextual Variables

Range of Context

- Pre-design activities may be combined and may occur several times.
- Consultation meetings with clients may also include other stakeholders.
- Size and scope of project may impact role and responsibilities of practitioner.
- Individual completing the actual design may or may not consult with the client. Client information may be provided to person completing the design by an intermediary such as a sales representative.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Relevant project documentation, e.g. maps

Major Category

Design

Competency Area

Conduct Pre-Design Activities

Competency Unit

Consult with stakeholders

Purpose

Consultation with other stakeholders, including external stakeholders (e.g. regulatory agencies, architects, contractors, suppliers) and internal stakeholders (e.g. finance and asset maintenance departments) is necessary to identify issues and requirements that may need to be considered during the design process. It is important to ensure the design process meets stakeholder requirements, mitigates issues, and realizes the client’s concept. Stakeholder consultations may occur several times during the design process.

Performance/Abilities

- P1** Identify relevant stakeholders based on:
 - previous experience with similar projects
 - client requirements
- P2** Set up meeting time and location with stakeholders, e.g. project site
- P3** Meet with stakeholders:
 - individually or as group
 - on site, if appropriate
- P4** Present project to stakeholders:
 - use document(s) from client meeting, if appropriate
 - describe relevant client information, e.g. historic utility costs, current transmission loads, zoning applications
- P5** Discuss project requirements or issues with stakeholders, e.g. permitting, access, agreements, zoning, approvals
- P6** Determine requirements for specialized assessment/testing, for example:
 - geological testing, e.g. geophysical, geotechnical assessments
 - hydrological assessment, e.g. hydrogeological testing, water quality, flow rates, water temperature
 - soil testing
 - meteorological assessment, e.g. solar aspects, prevailing winds, wind speed, temperature and temperature fluctuations
 - archeological/paleontological assessments, e.g. indigenous sacred sites, fossils
- P7** Document stakeholders’ comments and required follow-up
- P8** Obtain relevant information for client, e.g. costs and return on investment, required assessment/testing
- P9** Inform client and project manager of stakeholders’ discussions for example:
 - issues and testing/assessment requirements
 - information required by stakeholders from client
- P10** Update project documentation, as required
- P11** Consult with project manager to determine when specialized assessment/testing reports will be available, as required

Knowledge

- K1** Organization policies, procedures and plans, e.g. communication protocols
- K2** Organizational document management system
- K3** Client concept

- K4** Potential stakeholders, e.g. neighbourhood associations, provincial/territorial, federal agencies, First Nations
- K5** Regulatory requirements for approvals

Contextual Variables

Range of Context

- Pre-design activities may be combined and may occur several times.
- Initial meetings with stakeholders may also include clients.
- Stakeholders may be aware of client’s intentions, based on preliminary work carried out by client.
- Stakeholders may have supporting approval documentation that may be required for design, e.g. geotechnical reports.
- Individual completing the actual design may or may not consult with the stakeholders. Stakeholder information may be provided to person completing the design by an intermediary such as a sales representative.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom’s Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Contact information for stakeholders
- Relevant project documentation, e.g. client concept, maps

Major Category	Design
Competency Area	Conduct Pre-Design Activities
Competency Unit	Coordinate site visit

Purpose

Depending on the scope and location of the project, it may be necessary to organize site visits to ensure the client is kept informed of project activities and to maximize the use of resources.

Performance/Abilities

- P1** Obtain permission for visits to site on specified dates:
 - inform client of who will be on site and type of activity that will occur
- P2** Arrange to meet with client or stakeholders, if required
- P3** Schedule visits of specialized consultants, e.g. biologist, hydrologist, geologist, as required, for example:
 - sequence visits based on types of activities, e.g. environmental assessment before drilling
 - allow required time between visits to complete assessment activities
 - provide information on access to site, e.g. access location, roadways
- P4** Collect relevant documentation:
 - provide to stakeholders, as required

Knowledge

- K1** Organization policies, procedures and plans, e.g. communication protocols
- K2** Organizational document management system
- K3** Site location and access information

Contextual Variables

Range of Context

- Different testing/assessments may require a specific sequence to provide accurate data that may inform design.
- Sites may be remote, requiring coordination to ensure best use of transportation resources, e.g. ATVs, helicopters.
- Responsibility for this competency may be assigned to another person on behalf of the design practitioner.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Relevant project documentation, e.g. maps
- Documentation from client and/or stakeholder consultation
- Site access information if required, e.g. lock keys/codes
- Specialist consultants' contact information

Major Category	Design
Competency Area	Conduct Pre-Design Activities
Competency Unit	Conduct site visit

Purpose

It is important to visit the site with the client and relevant stakeholders to ensure that critical information related to the site can be identified and addressed in the project design.

Performance/Abilities

- P1** Conduct pre-visit research, e.g. previous and current uses, for example, access:
 - archival records
 - cadastral/legal maps
 - land lease(s)
 - land title, e.g. availability of easements
 - water rights license
- P2** Organize materials to bring to site, e.g. maps, notebook, measuring tools, camera
- P3** Wear appropriate PPE, e.g. sturdy boots, reflective vest
- P4** Access site using appropriate protocols, e.g. communicate arrival, use passcode
- P5** Identify relevant aspects of site, for example:
 - location of existing utilities, e.g. electrical power, gas, sewer, water, irrigation lines
 - site safety hazards, e.g. buried and overhead utility lines, slumping terrain
 - condition and features of existing structures, e.g. occupied buildings, abandoned mine or well shafts, archeological sites
 - location of significant stands of vegetation, e.g. large trees
 - elevations/topography
 - location of site access points
 - available footprint for construction, as required
- P6** Take measurements, e.g. structure dimensions, depth of water body, sun shadow path and tracking
- P7** Ask questions of on-site individuals, as required, e.g. client, project manager
- P8** Document observations, e.g. take photographs, make notations on maps, take field notes

Knowledge

- K1** Organization policies, procedures and plans, e.g. communication protocols
- K2** Organizational document management system
- K3** Sources for research documentation, e.g. Land Titles office
- K4** Information provided by different types of documents
- K5** Client's design concept
- K6** Site features that impact design feasibility, requirements and safety
- K7** Types of measurements for different site features, measuring procedures and required calculations
- K8** Use and care of measurement tools and equipment

Glossary

- **Cadastral map:** a graphic representation of a parcel of land that describes property boundaries, and may include other information such as building footprints, public easements, ownership, rights, restrictions and other responsibilities. Each parcel of property has a unique identifier, address and coordinates and is part of a larger system of mapping of a given region. May be considered a legal document.

Contextual Variables

Range of Context

- Pre-design activities may be combined and may occur several times.
- Location of site varies which could impact how this competency is conducted, e.g. access limitations, public scrutiny.
- Type, size, and scope of project may impact what needs to be identified and measured for the design process and document management.
- Site features are variable and may or may not be able to be ignored, used, or mitigated by design.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Relevant project documentation, e.g. maps identifying existing assets, letter of permission to be on-site, site survey
- Digital camera or video recorder with extra battery
- Measuring equipment, e.g. survey tape, tape measure/measuring wheel, azimuth measuring tool
- Writing materials, e.g. field notebook, pencil
- PPE for site
- Computer and relevant software, e.g. GIS

Major Category

Design

Competency Area

Design Residential GeoExchange Heat Pump Systems

Competency Unit

Analyze building and site

Purpose

Collecting required information and conducting a thorough analysis of the building and site is crucial to designing a residential GeoExchange heat pump system that is economical, sustainable and meets the client's needs. Identification of design opportunities results in reduced costs related to construction and operation. An inadequate analysis of the heating and cooling loads will likely result in a system with operational issues, dissatisfied clients, and damage to the reputations of the involved organizations.

Performance/Abilities

- P1** Review information about building in site visit report:
- size of building
 - occupancy and building use
 - historical energy consumption
 - design of internal distribution system:
 - determine feasibility of connecting GeoExchange system to existing or planned distribution system
- P2** Calculate heating and cooling loads:
- base calculations on peak and annual heat supplied to and removed from building
 - consider energy balance and need for domestic hot water load on GeoExchange system
 - consider energy use and heat loss/gains in building, including:
 - building construction details, e.g. insulation levels in roof, basement and walls, type of glass in windows
 - type and amount of supplemental heat to be used
 - occupancy of building, i.e. number of people and activities that will generate heat
 - variables of air exchange with outdoors, e.g. infiltration and leakage
- P3** Review information about site in site visit report:
- site geology:
 - formation characteristics, e.g. sandy, gravel, bedrock
 - thermal properties, e.g. conductivity, diffusivity and temperature, moisture content
 - site hydrology:
 - availability of groundwater of sufficient quantity and quality
 - aquifer's characteristics, e.g. confined, unconfined, flowing
 - availability of sink location
 - availability of surface water of sufficient size and depth
 - characteristics of surface water, e.g. freezing patterns
 - results of subgrade locates
 - size of land area for trenching, boreholes and wells
 - site access for drilling or excavation equipment
 - preservation of existing landscape, if required
 - environmental considerations
- P4** Identify additional information needed that site visit report does not cover:
- conduct research to obtain additional information, e.g. provincial water well database
 - use data collected from similar systems that organization has designed, if available
- P5** Engage local contractors (e.g. drillers, system installers) to provide:
- indication of local geological conditions

- information on drilling feasibility
- budget estimates

P6 Identify feasible system options for site by considering:

- heating and cooling loads
- heat pump options
- existing or planned distribution system
- different types of heat exchangers

P7 Review client's goals and plans for building and site:

- consider opportunities for efficiencies in client's energy use
- consider client's reasons for selecting GeoExchange system, e.g. reduced environmental impact, greater energy independence
- consider client's plans for changes to construction and occupancy of building

P8 Discuss opportunities with client to reduce heating/cooling loads and optimize system, for example:

- changing how fresh air is provided to building
- adding insulation to attic or basement

P9 Manage clients' expectations:

- explain how GeoExchange systems perform differently than fossil fuel systems and how to maximize their benefits
- inform clients that their electricity bill will be higher with GeoExchange system but fuel costs will be lower
- clarify what must be done to comply with code, e.g. system must have capacity to maintain 22°C (71°F) room temperature

Knowledge

- K1** Organization policies, procedures and plans, e.g. communication protocols
- K2** Organizational document management system
- K3** Jurisdictional requirements, e.g. codes, regulations, standards
- K4** Load calculation methods accepted as industry best practices and by regulating authorities, e.g. CAN/CSA F280
- K5** Residential GeoExchange design specifications and guidelines provided in ANSI/CSA/IGSHPA C448 Bi-National Standard
- K6** Local ground water quality protection and preservation requirements
- K7** Manufacturers' specifications
- K8** Residential design principles, e.g. envelope thermal properties, construction characteristics
- K9** Basic principles of heat transfer, fluid dynamics, electricity, vapour-compression refrigeration, and HVAC systems
- K10** Relationship between building distribution system and GeoExchange system, and their impact on one another
- K11** Software used to design GeoExchange systems, e.g. loop design, load calculations
- K12** Benefits of using design software, e.g. speed and accuracy of calculations, design adjustments
- K13** Ground thermal properties
- K14** Sources of information about geology and hydrology of site, e.g. water well records
- K15** Importance of determining accurate heating and cooling loads
- K16** Importance of exploring opportunistic designs
- K17** Importance of sharing information with clients and managing their expectations
- K18** Local energy costs
- K19** Government incentive programs for reducing impact on environment
- K20** Terminology related to GeoExchange heat pump and traditional HVAC systems

Glossary

- **Opportunistic design:** design that reflect a designer's ability to identify potential synergies between existing and planned elements in a site/building energy system, to identify ways to reduce heat loss/gain in building, and to optimize energy use.

Contextual Variables

Range of Context

- Practitioners may contract out portions of a design to an engineer depending on their own level of proficiency in different aspects of the design and requirements of the authority having jurisdiction.
- Practitioners may deal with clients directly or with a client's builder.
- In larger organizations, information sharing with clients and managing their expectations may be the responsibility of salespeople.
- Data monitoring capabilities of GeoExchange heat pump systems are increasing, as are their contributions to informing future designs and promoting the benefits of GeoExchange systems based on real data, e.g. electrical consumption, earth loop temperatures and flow, refrigeration system operation.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Site visit report
- Plot plan or site survey
- ANSI/CSA/IGSHPA C448 Bi-National Standard
- Manufacturers' specifications
- Other information sources, e.g. provincial records, local drillers and excavation contractors
- Software used to design GeoExchange systems, e.g. loop design, load calculations

Major Category	Design
Competency Area	Design Residential GeoExchange Heat Pump Systems
Competency Unit	Determine type and capacity of heat pump

Purpose

The type and capacity of the heat pump needs to be determined in order to properly design the heat exchanger and the connection to the building's distribution system. Proper sizing of the heat pump based on accurate calculations of heating and cooling loads increases the system's effectiveness, efficiency and economies. It also improves the level of heating and cooling comfort for residents.

Performance/Abilities

- P1** Refer to specifications of distribution system that heat pump will connect to, e.g. water-to-air or water-to-water
- P2** Determine heat pump's performance requirements according to manufacturers' specifications:
 - adjust performance requirements according to type of heat exchanger system, e.g. open or closed loop
- P3** Confirm heating and cooling loads:
 - use larger of two loads to determine required capacity of pump
- P4** Provide heat pump specifications:
 - minimum design heating and cooling capacity:
 - do not neglect use of duct heater as per CSA version 16 clause 7.6.1.
 - necessity for desuperheater
 - source and sink entering and exiting fluid temperatures and flow rate
 - load side entering and exiting fluid temperature and flow rate
 - electrical feeder details
- P5** Engage heat pump vendor:
 - distribute specifications
 - receive vendor's specification sheet
 - select heat pump based on design criteria and goals of client, e.g. reduced upfront or operational costs
- P6** Determine if data monitoring is desired by client, and if so:
 - determine whether data monitoring is available from manufacturer of heat pump or if third-party monitoring is required
 - determine what data elements client wishes to monitor, for example:
 - power consumption, e.g. current and annual
 - fluid flow rate through loop field
 - temperatures, e.g. loop field, air, indoor hydronics, domestic hot water
 - efficiencies
 - select appropriate monitoring solution

Knowledge

- K1** Organization policies, procedures and plans, e.g. communication protocols
- K2** Organizational document management system
- K3** Jurisdictional requirements, e.g. codes, regulations, standards
- K4** Residential GeoExchange design specifications and guidelines provided in ANSI/CSA/IGSHPA C448 Bi-National Standard
- K5** Manufacturers' specifications

- K6** Industry best practices for selecting and installing heat pumps
- K7** Heating and cooling loads for building
- K8** Importance of accurate heating and cooling loads
- K9** Relationship between building distribution system and GeoExchange system, and their impact on one another
- K10** Software used to design GeoExchange systems, e.g. loop design, load calculations
- K11** Benefits of using design software, e.g. speed and accuracy of calculations, ease of design adjustments
- K12** Basic principles of heat transfer, fluid dynamics, electricity, vapour-compression refrigeration, and HVAC systems
- K13** Principles of source flow, load flow and refrigerant flow
- K14** Capabilities of planned or existing distribution system
- K15** Design challenges that heat pump selection could overcome, e.g. zoning
- K16** Features and advantages/disadvantages of different types of heat pumps, e.g. liquid-to-liquid, liquid-to-air, variable refrigerant flow
- K17** Consequences of inappropriate heat pump selection, e.g. cycles frequently for short periods of time which causes undue stress on system and reduces efficiency
- K18** Impact of entering water temperature and flow rate on heat pump performance in terms of capacity (kW) and input power
- K19** Consequences of condensate build-up
- K20** GeoExchange system data that can be monitored and interpreted for clients
- K21** Terminology related to GeoExchange heat pump and traditional HVAC systems

Contextual Variables

Range of Context

- Practitioners may contract out portions of a design to an engineer depending on their own level of proficiency in different aspects of the design and requirements of the authority having jurisdiction.
- Practitioners may deal with clients directly or with a client's builder.
- Data monitoring capabilities of GeoExchange heat pump systems are increasing, as are their contributions to informing future designs and promoting the benefits of GeoExchange systems based on real data, e.g. electrical consumption, earth loop temperatures and flow, refrigeration system.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Site visit report
- Plot plan or site survey
- ANSI/CSA/IGSHPA C448 Bi-National Standard
- Manufacturers' specifications
- Other information sources, e.g. provincial records, local drillers and excavation contractors
- Software used to design GeoExchange systems, e.g. loop design, load calculations

Major Category	Design
Competency Area	Design Residential GeoExchange Heat Pump Systems
Competency Unit	Determine type of heat exchanger

Purpose

Analyzing heat exchanger options enables designers to select the one best suited to the site and the building's heating/ cooling load. By identifying the most suitable option, designers are able to create a sustainable system that performs well and avoids unnecessary costs. The installation of heat exchangers is a significant cost component of the GeoExchange system and is also the most difficult and expensive to correct if designed improperly.

Performance/Abilities

- P1** Refer to site visit report and assessment of building and site:
- obtain additional information, as required
- P2** Determine which types of heat exchanger systems are permitted on site according to authority having jurisdiction
- P3** If considering using ground as heat source and sink:
- determine if ground conditions and land area available are suitable
 - consider configuration of loop and depth at which loop would be installed
 - consider soil conditions, including moisture level
 - consider climate
- P4** If considering using surface water as heat source and sink:
- confirm that client owns body of water or has access to it
 - determine if development will include creation of body of water, e.g. reflection pond, retention pond
 - determine if depth and surface area of body of water are sufficient
 - confirm water temperature is sufficient
- P5** If considering using groundwater, ocean water or lake water as heat source and sink:
- consider approvals, permits and reporting required for open system
 - confirm groundwater is available in sufficient quantities and is of satisfactory quality:
 - access well water records, if available
 - test water quality and quantity if water records are not available, i.e. where test wells are permitted
 - confirm availability of used-water sink
 - confirm aquifer characteristics
 - determine minimum water temperature that will enter system, i.e. worst-case scenario
- P6** Select type of heat exchanger that best meets requirements of project

Knowledge

- K1** Organization policies, procedures and plans, e.g. communication protocols
- K2** Organizational document management system
- K3** Jurisdictional requirements, e.g. codes, regulations, standards
- K4** Residential GeoExchange design specifications and guidelines provided in ANSI/CSA/IGSHPA C448 Bi-National Standard
- K5** Manufacturers' specifications
- K6** Basic principles of heat transfer and fluid dynamics
- K7** Software used to design GeoExchange systems, e.g. loop design, load calculations

- K8** Benefits of using design software, e.g. speed and accuracy of calculations and design adjustments
- K9** Heating and cooling loads for building
- K10** Importance of accurate heating and cooling loads
- K11** Relationship between building distribution system and GeoExchange system, and their impact on one another
- K12** Peak and annual ground loads
- K13** Ground conditions, e.g. thermal conductivity and diffusivity, ground temperature
- K14** Fluid properties and dynamics
- K15** Types of antifreeze used in industry
- K16** Different types of heat exchangers including features, advantages/disadvantages, relative cost of installation
- K17** Variables included in calculations for ground heat exchangers
- K18** Consequences of inappropriately designed heat exchanger
- K19** Terminology related to GeoExchange heat pump systems

Contextual Variables

Range of Context

- Practitioners may contract out portions of a design to an engineer depending on their own level of proficiency in different aspects of the design and requirements of the authority having jurisdiction.
- Practitioners may deal with clients directly or with a client's builder.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Site visit report
- Plot plan or site survey
- ANSI/CSA/IGSHPA C448 Bi-National Standard
- Manufacturers' specifications
- Other information sources
- Software used to design GeoExchange systems, e.g. loop design, load calculations

Purpose

A well designed vertical closed-loop heat exchanger results in a configuration that reflects the site's assets and that operates efficiently. Heat exchangers that are not properly sized and laid out can result in a failed system, dissatisfied clients, and a damage to the reputation of involved organizations.

Performance/Abilities

- P1** Determine loop length for heating and cooling situations considering relevant parameters:
- peak and annual ground loads
 - undisturbed earth temperatures at proposed heat exchanger depth
 - thermal conductivity and diffusivity of soil
 - maximum and minimum acceptable entering water temperature
 - long-term ground effects, including thermal interference
 - earth to loop temperature difference
 - pipe resistance to heat transfer
- P2** Determine loop layout:
- select number and depth of boreholes according to:
 - requirements of total loop length
 - drilling conditions and associated costs
 - space available on site
 - determine pipe diameter for well and header configuration:
 - consider flow rate requirements
 - consider pumping power
 - consider purge ability of field
 - select series or parallel layout
 - minimize thermal interference among boreholes by using sufficient spacing
- P3** Design pumping system:
- perform calculations that consider:
 - flow rates required by heat pump
 - pressure drop in heat pump, heat exchanger and supply/return headers
 - flow rates to obtain transitional or turbulent flow
 - interpret pump curves
 - determine optimal size of circulating pump:
 - select minimum size that meets required flow rate, overcomes pressure drop, and maintains turbulent or transitional flow
- P4** Select suitable heat transfer fluid
- P5** Optimize design:
- explore different ways to make design more cost effective
 - use design software to facilitate calculations and adjustments, and improve their accuracy
- P6** Provide specifications for vertical closed loop including:
- placement, depth and diameter of boreholes
 - pipe sizing for circuits and runouts

- type of pipe, fittings, joints and connection methods
- backfill materials and grouting
- access ports
- heat transfer fluids, e.g. type and amount of antifreeze
- building penetration
- circulating pump
- mechanical room headers
- purging, evaluating and charging of piping
- site reclamation

Knowledge

- K1** Organization policies, procedures and plans, e.g. communication protocols
- K2** Organizational document management system
- K3** Jurisdictional requirements, e.g. codes, regulations, standards
- K4** Residential GeoExchange design specifications and guidelines provided in ANSI/CSA/IGSHPA C448 Bi-National Standard
- K5** Manufacturer's specifications
- K6** Basic principles of heat transfer and fluid dynamics
- K7** Software used to design GeoExchange systems, e.g. loop design, load calculations
- K8** Benefits of using software, e.g. adjusting parameters in unique circumstances
- K9** Heating and cooling loads for building
- K10** Importance of accurate heating and cooling loads
- K11** Calculations used to determine size and layout of vertical closed-loop heat exchangers
- K12** Ground conditions, e.g. thermal conductivity and diffusivity, ground temperature, depth of bedrock
- K13** Borehole field design
- K14** Drilling methods
- K15** Types of grouting materials and their advantages/disadvantages, e.g. thermal conductivity, cost
- K16** Distance specifications, e.g. from building, site boundaries, septic tanks
- K17** Actual energy loss and behaviours in building that impact heat loss/gain calculations and need to be considered when determining size of heat exchanger
- K18** Types of equipment and materials required for vertical closed loops, e.g. piping with thermally fused joints, antifreeze, circulating pump, grouting
- K19** Backfilling best practices
- K20** Pumping strategies
- K21** Consequences of inadequately designed vertical closed-loop heat exchanger
- K22** Strategies to optimize efficiency of heat exchanger design and cost effectiveness
- K23** Terminology related to GeoExchange heat pump systems

Contextual Variables

Range of Context

- Practitioners may contract out portions of a design to an engineer depending on their own level of proficiency in different aspects of the design and requirements of the authority having jurisdiction.
- Practitioners may deal with clients directly or with a client's builder.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- | | |
|-------------------------------------------|---------------------------------------------|
| <input type="checkbox"/> Recall, Remember | <input checked="" type="checkbox"/> Analyze |
| <input type="checkbox"/> Understand | <input type="checkbox"/> Evaluate |
| <input type="checkbox"/> Apply | <input type="checkbox"/> Create/Transform |

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Site visit report
- Plot plan or site survey
- ANSI/CSA/IGSHPA C448 Bi-National Standard
- Manufacturers' specifications
- Other information sources, e.g. provincial well water records, local drillers and excavation contractors
- Software used to design GeoExchange systems, e.g. loop design, load calculations

Major Category

Design

Competency Area

Design Residential GeoExchange Heat Pump Systems

Competency Unit

Design horizontal closed-loop heat exchanger

Purpose

A well designed horizontal closed-loop heat exchanger results in a configuration that reflects the site's assets and that operates efficiently. Loop configurations that are not properly sized and laid out can result in a failed system, dissatisfied clients, and damage to the reputations of the involved organizations.

Performance/Abilities

- P1** Determine loop length for heating and cooling situations considering relevant parameters:
- peak and annual ground loads
 - maximum and minimum earth temperatures at proposed heat exchanger depth
 - thermal conductivity and diffusivity of soil
 - maximum and minimum acceptable entering water temperature
 - earth to loop temperature difference
 - pipe resistance to heat transfer
- P2** Determine loop layout:
- determine number and configuration of pipes, e.g. straight, spiraled or slinky coiled
 - determine number, depth and length of horizontal trenches
 - select layout that considers:
 - requirements of total loop length
 - excavating conditions and costs
 - space available on site
 - how to minimize amount of pumping power required
 - how to avoid sharp bends
 - determine pipe diameter for individual trench and header configuration that considers:
 - flow rate requirements
 - pumping power
 - purge ability of field
- P3** Design pumping system:
- perform calculations:
 - consider flow rate required by heat pump
 - consider pressure drop in heat pump, heat exchanger and supply/return headers
 - consider flow rate required to obtain turbulent or transitional flow
 - interpret pump curves
 - determine optimal size of circulating pump:
 - select minimum size that meets required flow rate, overcomes pressure drop and maintains turbulent or transitional flow
- P4** Select suitable heat transfer fluid
- P5** Optimize design:
- explore ways to make design more cost effective
 - use design software to facilitate calculations and adjustments and improve their accuracy
- P6** Provide specifications for horizontal closed loop including:
- depth and location of trenching
 - pipe sizing for circuits and runouts

- type of pipe, fittings, joints and connection methods
- loop configuration
- horizontal directional drilling and grouting
- backfill materials
- heat transfer fluid
- building penetration
- circulating pump
- mechanical room headers
- purging, evacuating and charging of piping
- site reclamation

Knowledge

- K1** Organization policies, procedures and plans, e.g. communication protocols
- K2** Organizational document management system
- K3** Jurisdictional requirements, e.g. codes, regulations, standards
- K4** Residential GeoExchange design specifications and guidelines provided in ANSI/CSA/IGSHPA C448 Bi-National Standard
- K5** Manufacturers' specifications
- K6** Basic principles of heat transfer and fluid dynamics
- K7** Software used to design GeoExchange systems, e.g. loop design, load calculations
- K8** Benefits of using software, e.g. speed and accuracy of calculations, design adjustments
- K9** Calculations used to determine size and layout of horizontal closed-loop heat exchangers
- K10** Heating and cooling loads for building
- K11** Importance of accurate heating and cooling loads
- K12** Local average and minimum/maximum air temperature data
- K13** Ground conditions, e.g. thermal conductivity and diffusivity, ground temperature
- K14** Peak and annual ground loads
- K15** Trenching methods
- K16** Distance specifications to maintain, e.g. from building, site boundaries, septic tanks
- K17** Actual energy loss and behaviours in building that impact heat loss/gain calculations and need to be considered when determining size of heat exchanger
- K18** Types of equipment and materials required for horizontal closed loops, e.g. piping with thermally fused joints, antifreeze, circulating pump, grouting
- K19** Backfilling best practices
- K20** Consequences of inadequately designed horizontal closed-loop heat exchanger
- K21** Strategies to optimize efficiency of heat exchanger design and cost effectiveness
- K22** Terminology related to GeoExchange heat pump systems

Contextual Variables

Range of Context

- Practitioners may contract out portions of a design to an engineer depending on their own level of proficiency in different aspects of the design and requirements of the authority having jurisdiction.
- Practitioners may deal with clients directly or with a client's builder.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Site visit report
- Plot plan or site survey
- ANSI/CSA/IGSHPA C448 Bi-National Standard
- Manufacturers' specifications
- Other information sources, e.g. provincial well water records, local drillers and excavation contractors
- Software used to design GeoExchange systems, e.g. loop design, load calculations

Major Category	Design
Competency Area	Design Residential GeoExchange Heat Pump Systems
Competency Unit	Design submerged closed-loop heat exchanger

Purpose

A well designed submerged closed-loop heat exchanger provides good economic value for clients by taking advantage of energy stored in a body of water. A submerged closed-looped heat exchanger that is not properly designed can result in a failed system, dissatisfied clients, and a damage to the reputations of involved organizations.

Performance/Abilities

- P1** Determine total loop length required for heating and cooling situations considering related variables:
- temperature of surface water
 - amount of winter ice cover
 - maximum heat rejected to loop during cooling design hour
 - maximum heat extracted from loop during heating design hour
 - spool length/ton of unit capacity
- P2** Determine submerged closed-loop layout:
- conduct site visit to determine best location for loop in body of water
 - select methods for securing pipe to bottom of body of water, e.g. cable ties fastened to sides of concrete blocks
 - select location for pipe that will avoid ice damage
- P3** Design pumping system:
- perform calculations:
 - consider flow rates required by heat pump
 - consider pressure drop in heat pump, heat exchanger and supply/return headers
 - consider flow rates to obtain turbulent or transitional flow
 - interpret pump curves
 - determine optimal size of circulating pump:
 - select minimum size that meets required flow rate, overcomes pressure drop and maintains turbulent or transitional flow
- P4** Select suitable heat transfer fluid, e.g. type and amount of antifreeze
- P5** Optimize design:
- explore different ways to make design more energy efficient and cost effective
 - use design software to facilitate calculations and design adjustments, and improve their accuracy
 - minimize fittings that increase equivalent length
- P6** Provide specifications for submerged closed loop including:
- trench for return and supply runouts
 - pipe, fittings, joints and connection methods
 - backfill materials
 - circulating pump
 - heat transfer fluid
 - purging, evacuating and charging of piping
 - building penetration
 - mechanical room headers
 - site reclamation

Knowledge

- K1** Organization policies, procedures and plans, e.g. communication protocols
- K2** Organizational document management system
- K3** Jurisdictional requirements, e.g. codes, regulations, standards
- K4** Residential GeoExchange design specifications and guidelines provided in ANSI/CSA/IGSHPA C448 Bi-National Standard
- K5** Manufacturers' specifications
- K6** Basic principles of heat transfer and fluid dynamics
- K7** Software used to design GeoExchange systems, e.g. loop design, load calculations
- K8** Benefits of using software, e.g. speed and accuracy of calculations, design adjustments
- K9** Calculations used to determine size and layout of submerged closed-loop heat exchangers
- K10** Heating and cooling loads for building
- K11** Importance of accurate heating and cooling loads
- K12** Ground conditions, e.g. thermal conductivity and diffusivity, ground temperature
- K13** Trenching methods
- K14** Distance specifications to maintain, e.g. from building, site boundaries, septic tanks
- K15** Backfilling best practices
- K16** Methods for calculating head loss in circulator pumps
- K17** Factors to include in calculation of acceptable pipe length
- K18** Actual energy loss and behaviours in building that impact heat loss/gain calculations and need to be considered when determining size of heat exchanger
- K19** Consequences of inadequately sized submerged heat exchanger
- K20** Types of equipment and materials required for submerged closed loops, e.g. piping with thermally fused joints, approved plate heat exchangers, antifreeze, circulating pump
- K21** Strategies to optimize efficiency of heat exchanger design and cost effectiveness
- K22** Terminology related to GeoExchange heat pump systems

Contextual Variables

Range of Context

- Practitioners may contract out portions of a design to an engineer depending on their own level of proficiency in different aspects of the design and requirements of the authority having jurisdiction.
- Practitioners may deal with clients directly or with a client's builder.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Site visit report
- Plot plan or site survey
- ANSI/CSA/IGSHPA C448 Bi-National Standard
- Manufacturers' specifications
- Other information sources, e.g. provincial records, local excavation contractors
- Design software, e.g. loop design, load calculations
- Equipment and tools for site visit, e.g. scuba gear, boat, underwater camera

Major Category

Design

Competency Area

Design Residential GeoExchange Heat Pump Systems

Competency Unit

Design open-loop heat exchanger

Purpose

A well designed open-loop heat exchanger reflects the capacity of the available water supply well, local code requirements, site geology, and system performance requirements. This type of heat exchanger takes advantage of ground water to serve as a heat source and sink. An open-loop heat exchanger that is not properly designed can result in a failed system, dissatisfied clients, and a damage to the reputations of involved organizations.

Performance/Abilities

- P1** Determine amount of ground water required
- P2** Determine water rejection method:
- use existing or create new rejection well ensuring that it has enough capacity to dispose of water that passes through heat pump
 - determine local jurisdiction's requirements for water rejection
- P3** Determine optimal size of submersible pump in supply well:
- interpret pump curves
 - identify minimum size of pump that can:
 - provide flow rate required by heat pump
 - meet heat pump's required entering water temperature
 - overcome pressure drop in heat pump and supply/return headers
 - supply enough water for heat pump as well as domestic water requirements
- P4** Determine need to enlarge pressure tank or modify plumbing to supply water to heat pump:
- confirm suitability of existing well pump and pressure tank based on energy consumption and gallons per minute (GPM)
- P5** Provide design specifications:
- consult with client to determine suitable locations for wells
 - specify number of wells and minimum spacing between them
 - specify casing requirements, i.e. sealed with cement rather than bentonite
 - for rejection wells:
 - ensure water draw and discharge comply with authority having jurisdiction
 - ensure discharge piping able to maintain positive pressure thereby excluding air and reducing noise
 - ensure total yield exceeds sum of peak potable water system and peak GeoExchange heat pump system requirements
- P6** Obtain specifications from driller related to drilled wells, including:
- GPM of supply well
 - depth and diameter of wells
 - size, location and orientation of pick-up/discharge points, if applicable

Knowledge

- K1** Organization policies, procedures and plans, e.g. communication protocols
- K2** Organizational document management system
- K3** Jurisdictional requirements, e.g. codes, regulations, standards

- K4** Reporting requirements of jurisdiction having authority
- K5** Residential GeoExchange design specifications and guidelines provided in ANSI/CSA/IGSHPA C448 Bi-National Standard
- K6** Manufacturers' specifications
- K7** Basic principles of heat transfer and fluid dynamics
- K8** Heating and cooling loads for building
- K9** Importance of accurate heating and cooling loads
- K10** Aquifer characteristics, e.g. confined, unconfined, flowing
- K11** Calculations used to determine size and layout of open-loop heat exchanger
- K12** Importance of pipe sizing between supply and rejection well according to required GPM
- K13** Consequences of inadequately designed open-loop heat exchanger
- K14** Terminology related to GeoExchange systems

Contextual Variables

Range of Context

- Practitioners may contract out portions of a design to an engineer depending on their own level of proficiency in different aspects of the design and requirements of the authority having jurisdiction.
- Practitioners may deal with clients directly or with a client's builder.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Site visit report
- Plot plan or site survey
- ANSI/CSA/IGSHPA C448 Bi-National Standard
- Manufacturers' specifications
- Other information sources, e.g. provincial well water records, local drillers and excavation contractors

Purpose

A properly designed integration allows for optimal performance of both the GeoExchange heat pump system and the distribution system. This provides a sustainable system and other long-term benefits for the client. An inadequate integration design can result in a system with operational issues, dissatisfied clients, and a damage to the reputations of the involved organizations.

Performance/Abilities

- P1** Highlight differences in operation of GeoExchange heat pump system versus conventional heating and cooling equipment to project's HVAC contractor, for example:
- water-to-air system has increased cubic feet per minute (CFM) at lower air temperatures
 - water-to-water is typically limited to lower water temperatures than boiler
- P2** Design layout of mechanical room:
- select location for heat pump:
 - consider distribution system efficiency
 - consider ease of access to filters and access panels
 - strive for balance between efficiency in system and convenience of operation and maintenance
 - provide sufficient space for water, electrical and duct connections
 - determine location of pump module:
 - typically placed between ground loop and heat pump
- P3** For water-to-air integration:
- note location of condensate outlets in relation to floor drain
 - include mechanism for collecting and draining condensate, e.g. condensate overflow protection drain pan
 - add inlet and outlet pipe connections to heat pump to connect to hot water tank, if using desuperheater:
 - use single- or dual-tank system, as appropriate
 - discuss use of heat recovery ventilators with builder and HVAC contractor
 - confirm adequate thermostat wiring with builder and electrical contractor
 - for new builds:
 - increase size of air ducts as air temperature coming out of heat pump is lower than conventional HVAC system and therefore greater air flow rates are needed
 - confirm with builder and HVAC contractor use of acoustic insulation in ducts
 - for retrofits:
 - discuss increased air flow and subsequent noise and whether client wants to replace existing main and room ducts
- P4** For water-to-water integration:
- design integration system to minimize annual average lift condition of heat pump and thereby maximize seasonal coefficient of performance (COP):
 - minimize hot water heating temperatures on design
 - implement outdoor air temperature setback schedule
 - ensure adequate flow through heat pump:
 - include properly sized mass tank if there are multiple heating zones
 - specify settings for start-up and shutdown temperatures of compressor
 - consider piping arrangements and reversing valve function to adapt to heating/cooling sources

- P5** Optimize design:
- collaborate with builder and HVAC contractor designing new or retrofit distribution system
 - explore different ways to make design more cost effective and energy efficient, for example:
 - serve multiple purposes such as heat domestic hot water, heat pool or hot tub, and snow melt
 - find other heat sources or useful heat sinks, e.g. heat from cooling building is rejected directly to pool or domestic hot water
 - use design software to facilitate and improve accuracy of calculations and adjustments
- P6** Provide specifications for integration of systems:
- installation requirements for heat pump
 - insulation requirements for piping, e.g. supply and return lines, flow centres, hot water lines
 - control system requirements, e.g. system and equipment sequence of operation, control algorithms
 - pressure management requirements, e.g. air relief valves, expansion tanks
 - HVAC, electrical and plumbing requirements to be determined in collaboration with specialists in those fields

Knowledge

- K1** Organization policies, procedures and plans, e.g. communication protocols
- K2** Organizational document management system
- K3** Jurisdictional requirements, e.g. codes, regulations, standards
- K4** GeoExchange residential design specifications and guidelines provided in ANSI/CSA/IGSHPA C448 Bi-National Standard
- K5** Manufacturer's specifications
- K6** General residential design principles, e.g. envelope thermal properties, construction characteristics
- K7** Duct and hydronic design and installation principles
- K8** Basic principles of heat transfer, fluid dynamics, electricity, vapour-compression refrigeration and HVAC systems
- K9** Software used to design GeoExchange systems, e.g. loop design, load calculations
- K10** Benefits of using software, e.g. speed and accuracy of calculations, design adjustments
- K11** Heating and cooling loads for building
- K12** Importance of accurate heating and cooling loads
- K13** Relationship between building distribution system and GeoExchange system, and their impact on one another
- K14** Disadvantages and advantages of water-to-water and water-to-air systems
- K15** Minimum required operating flow and temperature range of heat pump
- K16** Impact of temperature changes in heat source and sink on heating/cooling capacity and efficiency of heat pump
- K17** System controls
- K18** Traditional HVAC equipment
- K19** Elements of HVAC interface design including:
- piping manifold (supply and return)
 - filtration
 - heat exchanger
 - flow control and balance
 - bleed option
- K20** Zoning characteristics
- K21** Piping connections required for different types of distribution systems
- K22** Terminology related to GeoExchange heat pump and traditional HVAC systems

Contextual Variables

Range of Context

- Practitioners may contract out portions of a design to an engineer depending on their own level of proficiency in different aspects of the design and requirements of the authority having jurisdiction.
- In some cases, the design of the duct work and/or in-floor radiant heating may be part of the GeoExchange system contract.
- Practitioners may deal with clients directly, or with a client's builder.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Site visit report
- ANSI/CSA/IGSHPA C448 Bi-National Standard
- Manufacturers' specifications
- Other information sources, e.g. provincial records, local drillers and excavation contractors
- Software used to design GeoExchange systems, e.g. loop design, load calculations

Major Category

Design

Competency Area

Produce Design Drawings and Construction Documentation

Competency Unit

Produce construction/installation drawings and diagrams

Purpose

Construction and installation drawings direct the work of builders and installers to ensure that the design is carried out to the clients' specifications. They accurately translate what the design is and how it should be built. Incorrect construction and installation drawings can result in issues throughout a construction process, including incorrect materials lists and inaccurate estimates of cost and timelines.

Performance/Abilities

- P1** Identify required equipment components
- P2** Determine:
 - installation steps
 - construction phases, as required
 - required construction equipment and components
- P3** Determine types of shop drawings required by project, e.g. mechanical, electrical, plumbing
- P4** Determine regulatory requirements for construction drawings, for example:
 - scale
 - standardized symbols
 - format
 - types of drawings
 - number of drawings
- P5** Use standardized architectural symbols and drawing views
- P6** Ensure drawings contain accurate measurements for:
 - dimensions of required components
 - dimensions of existing components
 - placement of components
 - runs and placement of materials
 - specifications, e.g. type or size of component, type of material
- P7** Submit drawings to regulatory agency for approval, if required:
 - provide supporting documentation
 - respond to questions from agency
- P8** Provide drawings to relevant personnel, e.g. installers, project manager, client, contractors
- P9** Follow organizational document management protocols for naming and storage of drawings and diagrams

Knowledge

- K1** Organization policies, procedures and plans, e.g. communication protocols
- K2** Organizational document management system
- K3** Relevant CSA Standards, e.g. Canadian Electrical Code (CE code)
- K4** Jurisdictional requirements including permit requirements, e.g. Building Code
- K5** Construction document standards
- K6** Design drawings and specifications
- K7** Construction/installation process

- K8** End use of drawings e.g. tender process, in-house build, permit approval
- K9** Standardized symbols for construction components
- K10** Common issues with installations and construction documentation
- K11** Manufacturer's specifications for equipment and system being installed

Major Category	Design
Competency Area	Produce Design Drawings and Construction Documentation
Competency Unit	Produce materials lists of suppliers and pricing based on system specifications

Contextual Variables

Range of Context

- Construction drawings for tender bids may have different requirements.
- Construction drawing types will vary depending on type and scope of project.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Documentation relevant to jurisdictional requirements, e.g. Canadian Electrical Code, Building Code
- Design drawings
- Approving authority drawing standards
- Drafting software, e.g. AutoCAD

Purpose

The materials list is important in the development of a final cost estimate for the construction/installation of a project. An accurate materials list ensures that the correct type and amount of equipment and materials are ordered to prevent project delays, waste and extra cost.

Performance/Abilities

- P1** Review construction/installation drawings, to identify required:
 - equipment, e.g. PV panels, wood poles, heat pump
 - equipment components, e.g. fasteners, brackets, valves, switches
 - construction materials, e.g. grout, concrete
- P2** Calculate required quantities, for example:
 - number of 4x8 plywood sheets required for specified roof area
 - number of bags of grout required for 4 - 10ft deep x 8" diameter bore holes
 - length of cable for distance from building to power pole
- P3** Develop itemized list of materials based on construction/installation drawings:
 - specify items in descriptive terms, e.g. lumber 2x4s, 2x2s, 2.0 inch-diameter high density polyethylene hose
 - specify quantity relevant to material, for example:
 - length requirement, e.g. lumber, cable, hose, pipe
 - volume, e.g. concrete, grout
 - square footage, e.g. panels
 - simple count for prefabricated items, e.g. number of switches
- P4** Add to estimated quantities to account for wastage
- P5** Select suppliers for each item, as required, for example:
 - reference list of preferred suppliers
 - research suppliers as needed, check:
 - prices
 - reviews
 - proximity to project site
 - availability of required quantities
 - issue request for bids from materials vendors
- P6** Develop corresponding cost list:
 - check suppliers' lists for latest prices
 - estimate potential future cost estimates, as required
- P7** Compile materials, suppliers and costs into single document, e.g. spreadsheet, table, as required
- P8** Provide list to others, as required, e.g. client:
 - answer questions
 - provide supporting documentation, if requested

Knowledge

- K1** Organization policies, procedures and plans, e.g. communication protocols
- K2** Organizational document management system
- K3** Sources of supplier price lists
- K4** Measurement conversions, e.g. length, volume, area
- K5** Construction/installation process
- K6** Preferred suppliers
- K7** Client's design concept

Contextual Variables

Range of Context

- Depending on size and scope of project, materials list can be prepared digitally using construction takeoff software, which can read construction and installation documentation, generate lists and make calculations to generate required materials and quantities. This software may also be integrated with construction cost estimating software which accesses multiple databases to determine material prices of suppliers in general location of project. Digital materials list generation is much faster than lists generated manually.
- Depending on the size of the project and the organization, an estimator may be used to generate the materials list.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Supplier price lists
- Construction/installation drawings
- Equipment and component specifications
- Computer and relevant software, may include construction takeoff software

Major Category

Design

Competency Area

Produce Quote for Client

Competency Unit

Produce quote for client

Purpose

Producing the quote helps to ensure expectations are clear for all stakeholders involved in a project. If this competency is performed poorly or incorrectly, it can cause project delays, client dissatisfaction and financial loss.

Performance/Abilities

- P1** Refer to design drawings and diagrams
- P2** Determine all activities needed to complete the project
- P3** Review previous similar projects' outcomes and lessons learned, as applicable
- P4** Refer to material lists of suppliers/supplies, as required
- P5** Estimate time required to complete each activity
- P6** Estimate labour required to complete each activity
- P7** Estimate contingency, as required
- P8** Assign resources to activities:
 - define resources needed, e.g. internal human resources, contractors, materials and equipment
 - consider availability of each required resource
 - consider constraints and restraints, e.g. weather, site availability
- P9** Assign dollar amounts to resources
- P10** Create draft quote:
 - use organizational templates, as required
 - include terms and conditions
- P11** Circulate draft quote to other relevant parties, as required, e.g. team members, management, contractors:
 - facilitate consensus, as required
 - obtain approval, as required
- P12** Finalize quote:
 - communicate to client and other all relevant parties, e.g. contractors, team members, management

Knowledge

- K1** Organization policies, procedures and plans
- K2** Organization/project goals, vision and status
- K3** Organizational document management system
- K4** Skills and abilities of project personnel
- K5** Contract strategy, e.g. internal versus external as required
- K6** Procurement strategy, as required

Glossary

- **Lessons learned:** learning gained from the process of performing the project. Formally conducted lessons learned sessions are traditionally held during project close-out, near the completion of the project. However, lessons learned may be identified and documented at any point during the project's life cycle.

Contextual Variables

Range of Context

- Number and types of resources required will vary with size/scope of the project.
- Tender work breakdown structure, including detailed project requirements, may be provided to contractors as part of a request for a quote for tender.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- | | |
|-------------------------------------------|------------------------------------------------------|
| <input type="checkbox"/> Recall, Remember | <input type="checkbox"/> Analyze |
| <input type="checkbox"/> Understand | <input type="checkbox"/> Evaluate |
| <input type="checkbox"/> Apply | <input checked="" type="checkbox"/> Create/Transform |

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Word processing software
- Proprietary project management software
- Design drawings and diagrams
- Material lists of suppliers, supplies and costs

Major Category

Design

Competency Area

Provide Post-Design Support

Competency Unit

Provide technical expertise

Purpose

Providing technical expertise after the design process provides the opportunity for stakeholders to confirm design components and resolve potential construction issues. The expertise of all stakeholders is an important safeguard to prevent minor errors or oversights from becoming costly mistakes.

Performance/Abilities

- P1** Confirm source of request for assistance, for example:
 - client
 - project manager
 - contractor/technician
 - regulatory authority
- P2** Determine purpose of request, for example:
 - understanding equipment selections
 - implications of making changes to an existing design
 - potential for future expansion/flexibility of an existing design
- P3** Ask questions to clarify purpose of request, if required
- P4** Conduct site visit, if requested
- P5** Provide advice:
 - state assumptions
 - provide technical advice
 - provide reasoning for advice
- P6** Document request and provided advice
- P7** Provide documentation to client and other relevant stakeholders, if requested

Knowledge

- K1** Organization policies, procedures and plans, e.g. communication protocols
- K2** Organizational document management system
- K3** Relevant CSA Standards, e.g. Canadian Electrical Code (CE code)
- K4** Jurisdictional requirements, e.g. fire code, building code
- K5** Principles of electrical/power system design
- K6** Design process
- K7** Construction process
- K8** Regulatory permitting and approval processes
- K9** Stakeholders involved in permitting and approval processes
- K10** Role of stakeholders in permitting and approval processes

Contextual Variables

Range of Context

- Type, size, and scope of project may impact to whom design practitioners provide technical expertise.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Relevant project documentation, e.g. design plans, construction and installation drawings, materials lists, equipment and materials specifications
- Site visit tools and PPE, e.g. digital camera, measuring tape/wheel, writing materials, reflective vest

Major Category

Design

Competency Area

Provide Post-Design Support

Competency Unit

Assist with utility and regulatory permitting applications

Purpose

Assisting with the client's permitting application processes is important to ensure that projects can move ahead without unnecessary delays and that no work proceeds without the required permits in place.

Performance/Abilities

- P1** Identify permits or regulatory requirements required to move forward with project, for example:
 - approvals from provincial/territorial government departments, e.g. department/ministry of transportation
 - permits from municipal building departments
 - existing agreements, e.g. use of public easements
 - approvals from utilities, e.g. right of ways
 - regulatory amendments
- P2** Review approval processes for each stakeholder, for example:
 - application process
 - submission process
 - approval process
 - appeal process
 - requirements
 - time frames
 - cost, if applicable
- P3** Determine sequence for application submissions, if applicable, e.g. approval from department of transportation before applying for municipal permit
- P4** Provide client with required documents, e.g. construction drawings
- P5** Assist client with completing applications, ensuring:
 - wording is appropriate
 - information is complete
 - required documentation is attached
- P6** Direct client to file applications or file applications on behalf of clients to appropriate authorities/agencies, ensuring:
 - applications and relevant documentation are submitted within required time frame
 - permits are submitted in required order
- P7** Keep up to date with permitting process changes

Knowledge

- K1** Organization policies, procedures and plans, e.g. communication protocols
- K2** Jurisdictional requirements, e.g. bylaws, zoning
- K3** Organizational document management system
- K4** Sources of permitting process information
- K5** Documentation required for applications
- K6** Stakeholders involved in permitting and approval processes
- K7** Role of stakeholders in permitting and approval processes

Contextual Variables

Range of Context

- Type, size and scope of project, and type of client (e.g. internal or external client), will impact the responsibilities involved in the permitting and approval processes.
- Size and structure of the organization providing design services will impact who is responsible for assisting with the permitting process.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- | | |
|-------------------------------------------|---------------------------------------------|
| <input type="checkbox"/> Recall, Remember | <input checked="" type="checkbox"/> Analyze |
| <input type="checkbox"/> Understand | <input type="checkbox"/> Evaluate |
| <input type="checkbox"/> Apply | <input type="checkbox"/> Create/Transform |

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Documentation relevant to jurisdictional requirements, e.g. bylaws, CSA codes, application forms
- Relevant project documentation, e.g. design plans, construction and installation drawings

Major Category

Design

Competency Area

Provide Post-Design Support

Competency Unit

Prepare tender package

Purpose

Tender documentation must be accurate and complete to ensure that all contractors receive the same specifications so their quotes can be more easily and fairly compared. A tender package facilitates contractors' efforts to submit complete bids. Incomplete or inaccurate bids can result in inaccurate budgets and work not being completed as required.

Performance/Abilities

- P1** Review completed design package, including, for example:
 - work breakdown structure
 - cost estimates
 - drawings
 - other itemized services
- P2** Develop tender using consistent approach
- P3** Clearly define work scope and responsibilities of contractor
- P4** Use organization's format for request for proposals
- P5** Itemize interim and final deliverables, i.e. project deadlines
- P6** Specify site visit times, bidding deadlines and exclusions
- P7** Provide draft tender package to appropriate personnel for review, e.g. legal department, project manager
- P8** Revise tender package as appropriate
- P9** Send tender package to approved/specific contractors, if applicable
- P10** Conduct site visits with interested contractors, if applicable

Knowledge

- K1** Organization's policies, procedures and plans, e.g. communication protocols
- K2** Organization's information/record management system
- K3** Relevant CSA and organizational construction standards, e.g. Canadian Electrical Code (CE code)
- K4** Jurisdictional requirements including permit requirements, e.g. building code
- K5** Required information for tender package, e.g. bidding deadlines, site visit times
- K6** Design drawings and specifications
- K7** Relationships between different types of design documents
- K8** Construction work practices
- K9** Operational practices
- K10** Project scope
- K11** Scope of tender
- K12** Stakeholders involved in tender processes

Contextual Variables

Range of Context

- Tender packages may be prepared by an independent third party.
- Practitioners may perform this entire competency or complete portions, depending on organizational policy, their level of experience, and the complexity of the design.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Relevant documents, e.g. detail design drawings, bylaws
- Computer, e.g. desktop, laptop, mobile device
- Software, e.g. word processing, viewing
- Tender package template, if applicable

Major Category

Safety

Competency Area

Maintain a Safe Working Environment

Competency Unit

Follow safe work practices

Purpose

Following safe work practices is critical to protect employees, contractors, customers and the general public against injury or death, and to protect the organization and its assets from loss and liability.

Performance/Abilities

- P1** Participate in safety orientations and training
- P2** Complete safety certifications, as required, e.g. confined space
- P3** Identify locations of:
 - first aid kit
 - emergency equipment
 - emergency access routes
- P4** Participate in daily safety meeting/tail-board meetings
- P5** Follow safety policies and procedures on site, e.g. limits of approach
- P6** Respect physical limitations of self and others
- P7** Use protection systems, as required, e.g. lock-out tag-out, card system
- P8** Inspect safety systems, as required, e.g. guards, emergency stops
- P9** Perform tests, as required, e.g. test voltage level
- P10** Establish exclusion zones, when required, e.g. around open trench or working heavy equipment:
 - place barriers and/or signage
- P11** Identify hazards on site, e.g. personal safety, work site, environmental:
 - monitor weather conditions, as necessary
- P12** Minimize or remove hazards, as necessary, for example:
 - protect self from weather-related conditions, e.g. wear sunscreen and sunglasses, keep hydrated, wear warm clothing
- P13** Use equipment only as intended/classified:
 - ensure equipment is appropriate for work site conditions
- P14** Maintain clean, orderly work area
- P15** Dispose of waste materials, as required:
 - dispose of hazardous materials (e.g. chemicals, batteries) according to legislation and organizational policies
- P16** Store materials and equipment in designated areas
- P17** Communicate issues to relevant personnel, e.g. co-workers, project manager:
 - document work safety issues, as required

Knowledge

- K1** Relevant legislation, including Occupational Health and Safety (OH&S)
- K2** Safety Management Plan
- K3** Organizational safety policies and procedures, including OH&S
- K4** Workplace Hazardous Materials Information System (WHMIS)
- K5** Required training and certifications for specific work, e.g. confined space

- K6** Required personal protective equipment (PPE)
- K7** Types of safety hazards on site
- K8** Available emergency response services and their contact information
- K9** Available equipment on worksite/in vehicles, e.g. first aid, containment equipment
- K10** Procedures for safe excavation, if required
- K11** Safety reporting procedures

Major Category	Safety
Competency Area	Maintain a Safe Working Environment
Competency Unit	Use personal protective equipment (PPE)

CONTEXTUAL VARIABLES

Range of Context

- Quantity and type of safety hazards varies with type of work and work location.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- | | |
|-------------------------------------------|-------------------------------------------|
| <input type="checkbox"/> Recall, Remember | <input type="checkbox"/> Analyze |
| <input type="checkbox"/> Understand | <input type="checkbox"/> Evaluate |
| <input checked="" type="checkbox"/> Apply | <input type="checkbox"/> Create/Transform |

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- First aid kits
- Safety equipment, e.g. spill kit, fire extinguisher
- Safety features on equipment
- Personal protective equipment (PPE)
- Rated tools, e.g. screwdriver rated for particular voltage

Purpose

Using PPE correctly protects employees against injury or death, and protects the organization and its assets from loss and liability.

Performance/Abilities

- P1** Ensure required training is up to date, e.g. fall arrest equipment training
- P2** Select equipment appropriate to task and work environment
- P3** Inspect/test PPE before use:
 - check expiry dates, if applicable
 - document condition
- P4** Ensure PPE is properly fitted and adjusted
- P5** Use PPE only for intended purpose
- P6** Communicate issues with PPE to relevant personnel, e.g. co-workers, supervisor
- P7** Tag defective equipment:
 - turn in to relevant personnel or department
- P8** Clean PPE after use:
 - store in designated location

Knowledge

- K1** Relevant legislation, including Occupational Health and Safety (OH&S)
- K2** Organizational safety policies and procedures, including OH&S
- K3** Potential safety hazards on site
- K4** PPE required for specific tasks, equipment and environments

CONTEXTUAL VARIABLES

Range of Context

- Quantity and type of PPE varies with type of work and work location.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- | | |
|-------------------------------------------|-------------------------------------------|
| <input type="checkbox"/> Recall, Remember | <input type="checkbox"/> Analyze |
| <input type="checkbox"/> Understand | <input type="checkbox"/> Evaluate |
| <input checked="" type="checkbox"/> Apply | <input type="checkbox"/> Create/Transform |

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- PPE, e.g. hard hats, safety glasses, safety boots, rubber gloves, fall arrest and restraint equipment, fire-retardant clothing, shock hazard PPE, arc flash hazard PPE, hearing protection, respiratory protection equipment

Major Category	Safety
Competency Area	Maintain a Safe Working Environment
Competency Unit	Participate in safety meetings and emergency drills

Purpose

Participating in safety meetings and emergency drills is important to ensure employees, contractors and customers work in a safe manner and are prepared for unexpected events. This also protects the organization and its assets against loss and liability.

Performance/Abilities

- P1** Attend meetings and drills at scheduled times
- P2** Identify role of self and team members in meetings and drills
- P3** Share knowledge and skills with co-workers
- P4** Communicate work issues to the group
- P5** Participate in emergency drills, e.g. evacuation, fire, environmental, sabotage/terrorist/bomb threat, electrical restoration
- P6** Debrief drills and exercises:
 - provide feedback
- P7** Take notes, if applicable

Knowledge

- K1** Relevant legislation
- K2** Organizational safety policies and procedures, including communication protocols
- K3** Own and others' roles and responsibilities during emergencies
- K4** Contact information for emergency services
- K5** Types of safety hazards on site

CONTEXTUAL VARIABLES

Range of Context

- Types of meetings and emergency drills will vary with organization, type of work and work location.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

Major Category	Safety
Competency Area	Maintain a Safe Working Environment
Competency Unit	Work in confined spaces

Purpose

Working in confined spaces must be performed correctly to ensure the safety of employees and contractors. Performing this task incorrectly can lead to serious injury or death. This task also protects the organization against loss and liability.

Performance/Abilities

- P1** Ensure confined space training is up to date
- P2** Preplan entry:
 - identify hazards, e.g. gases, multiple power sources
 - discuss with team members
 - review rescue procedures
- P3** Select appropriate personal protective equipment (PPE)
- P4** Erect barriers and warning signs, as necessary
- P5** Gather tools and equipment before entering space
- P6** Use confined space equipment according to manufacturer's instructions
- P7** Verify entry permit
- P8** Monitor and document atmospheric conditions:
 - evacuate space, as necessary
- P9** Maintain constant communication with team members outside of confined space
- P10** Secure confined space during inactivity

Knowledge

- K1** Relevant legislation, including Occupational Health & Safety (OH&S)
- K2** Organizational safety policies and procedures
- K3** Manufacturer's instructions and recommendations
- K4** Location of first aid stations and procedures
- K5** Definition of confined space, e.g. locations that require care and monitoring
- K6** Types of confined space monitoring equipment and their operation
- K7** Hazards associated with confined spaces
- K8** Types of gasses and their properties
- K9** Rescue procedures for confined spaces

CONTEXTUAL VARIABLES

Range of Context

- Types of confined spaces vary, e.g. trenches, tanks, stacks.
- Types of hazards vary, e.g. lack of ventilation, inert gas, oxygen deficiency, exceeding explosive limits.
- Types of gasses encountered in confined spaces vary, e.g. chlorine, carbon monoxide.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Equipment for communication, e.g. two-way radios, air horns, closed circuit video
- Equipment for securing confined spaces, e.g. signage, tape, barricades, barriers, locks, hole covers
- Personal protective equipment, e.g. safety harness, respirator
- Space conditioning equipment, e.g. fans, inert gas, pressurized air, sump pump
- Monitoring equipment
- Rescue equipment

Major Category

Safety

Competency Area

Maintain a Sustainable Environment

Competency Unit

Follow sustainable work practices

Purpose

Following sustainable work practices is critical to protect the environment and to protect employees, contractors and the general public against personal injury. It creates a positive public impression of the organization and its commitment to social responsibility, and protects the organization from loss and liability.

Performance/Abilities

- P1** Ensure required training is up to date, e.g. WHMIS
- P2** Identify potential environmental hazards, including:
 - contaminants of water, air and soil
 - hazardous materials
- P3** Identify locations of:
 - first aid kit
 - spill kits
 - emergency access routes and personnel
 - Safety Data Sheets (SDS)
- P4** Monitor weather conditions, as necessary, e.g. consider direction of chemical drift
- P5** Follow waste management practices:
 - sort waste by type
 - place waste in correct disposal container or area
- P6** Use recycled products and materials when possible
- P7** Store hazardous materials and equipment in designated areas
- P8** Dispose of hazardous materials (e.g. chemicals, batteries) according to legislation and organizational policies
- P9** Communicate issues to relevant personnel, e.g. co-workers, supervisor:
 - document issues, as required

Knowledge

- K1** Relevant legislation, including Occupational Health and Safety (OH&S)
- K2** Organizational safety policies and procedures, including OH&S
- K3** Sustainability plan and practices, e.g. energy and water conservation, commitment to low-carbon energy
- K4** Importance of sustainable practices, e.g. controlled use of ozone depleting substances
- K5** Safety Management Plan
- K6** Workplace Hazardous Materials Information System (WHMIS)
- K7** Types of hazardous materials associated with specific work activities
- K8** Available emergency response services and their contact information
- K9** Available equipment on site or in vehicles, e.g. first aid, containment equipment
- K10** Procedures for safe evacuation, if required
- K11** Procedures for containment, if required
- K12** Safety reporting procedures

CONTEXTUAL VARIABLES

Range of Context

- Quantity and type of hazards vary with type of work and work location.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- | | |
|-------------------------------------------|-------------------------------------------|
| <input type="checkbox"/> Recall, Remember | <input type="checkbox"/> Analyze |
| <input type="checkbox"/> Understand | <input type="checkbox"/> Evaluate |
| <input checked="" type="checkbox"/> Apply | <input type="checkbox"/> Create/Transform |

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- First aid kits
- Spill kit
- Personal protective equipment
- Safety Data Sheets (SDS)

Major Category

Safety

Competency Area

Respond to Emergencies

Competency Unit

Respond to non-electrical emergencies

Purpose

Responding quickly and correctly to non-electrical emergencies reduces the chance of injury or death to employees, contractors, customers and the public as well as minimizes damage to the environment. It also protects the organization and its assets against loss and liability.

Performance/Abilities

- P1** Remain calm
- P2** Initiate Emergency Response Plan for type of risk, if required, for example:
 - notify internal and external authorities
 - evacuate
 - follow direction of emergency authority
 - assist emergency authorities
 - secure area
- P3** Assess level of hazard:
 - determine what is exposed to risk, e.g. unit, station, site, field operations
- P4** Record details of emergency, for example:
 - date and time
 - nature of emergency
 - time authorities were contacted
 - time authorities arrived
 - action taken
 - names and contact information for witnesses
- P5** Follow up, as required, for example:
 - take action to prevent recurrence

Knowledge

- K1** Relevant legislation
- K2** Emergency Response Plan
- K3** Organizational safety policies and procedures, including Occupational Health & Safety (OH&S)
- K4** Workplace Hazardous Materials Information System (WHMIS)
- K5** Available emergency response services and their contact information
- K6** Procedures for safe evacuation, if required
- K7** Emergency reporting procedures

CONTEXTUAL VARIABLES

Range of Context

- Type of emergencies encountered will vary, e.g. bomb threat, sabotage threat, natural disaster.
- Severity of emergency situation will vary.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- | | |
|-------------------------------------------|---------------------------------------------|
| <input type="checkbox"/> Recall, Remember | <input checked="" type="checkbox"/> Analyze |
| <input type="checkbox"/> Understand | <input type="checkbox"/> Evaluate |
| <input type="checkbox"/> Apply | <input type="checkbox"/> Create/Transform |

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Communication equipment
- Emergency response equipment, e.g. first aid kits, fire extinguishers
- Notebook

Major Category

Safety

Competency Area

Respond to Emergencies

Competency Unit

Participate in incident and accident investigations

Purpose

Participating in the investigation of an incident or accident will help to determine what happened, why it occurred, and how to prevent similar events from occurring in the future.

Performance/Abilities

- P1** Survey scene, as required:
 - make the scene safe
 - secure the scene, as necessary
 - tag relevant equipment or materials
 - photograph environment, as necessary
- P2** Gather information, as required, for example:
 - people directly and indirectly involved
 - relevant equipment or material
 - site
 - process, i.e. work procedures, instructions, training, safety records
- P3** Participate in interviews with relevant parties, e.g. emergency authority, Worker's Compensation Board (WCB), supervisor:
 - describe events in own words
- P4** Document events, as necessary, e.g. write witness report
- P5** Participate in root-cause analysis, as required

Knowledge

- K1** Relevant legislation
- K2** Safe work procedures
- K3** Incident investigation and reporting requirements
- K4** Types of safety hazards on site

Glossary

- **Accident:** an accident is an unplanned, unwanted event that disrupts the orderly flow of the work process. It involves the motion of people, objects or substances.
- **Incident:** an accident or other occurrence which resulted in or had the potential to cause injury or occupational disease. The term incident includes "close-call" or "near-miss" events.
- **Workers' Compensation Board (WCB):** WCB is an insurance program that covers injuries in the workplace. It covers wage replacement for injured workers, healthcare costs and rehabilitation costs. It is paid for by employers and is no fault.

CONTEXTUAL VARIABLES

Range of Context

- Complexity of investigation and required reports will depend upon the accident/incident, type of work and work location.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Camera
- Notebook
- Computer software
- Legal forms related to incident/accident reporting
- Personal protective equipment (PPE)

Major Category

Security

Competency Area

Follow Security Practices

Competency Unit

Follow security practices for physical work environment

Purpose

Following practices to protect the physical work environment is critical to protect project/organizational assets, employees, contractors, customers and the general public.

Performance/Abilities

- P1** Adhere to security procedures, including:
 - participate in NERC training, as required
 - use tools and equipment, e.g. access cards
 - identify situations that may cause security issues, e.g. door propped open, gate access point unmanned
- P2** Update procedures/tools on regular basis, as required, e.g. use new codes
- P3** Report unsafe or suspicious activity, e.g. unauthorized visitors, equipment being removed from site unexpectedly
- P4** Document work security issues

Knowledge

- K1** Relevant legislation
- K2** NERC Standards
- K3** Organizational/project security policies and procedures
- K4** Types of security hazards on site
- K5** Authorized access systems and their use

CONTEXTUAL VARIABLES

Range of Context

- Quantity and type of security hazards varies with type of work and work location.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Access tools and equipment, e.g. key cards, identification cards

Major Category

Security

Competency Area

Follow Security Practices

Competency Unit

Follow cybersecurity procedures

Purpose

Along with Information and Communication Technology (ICT) security functions that are built into an organization's computer system, it is essential for users to follow cybersecurity protocols to prevent intentional damage to an organization through cyberattacks. Users following security protocols are another layer of protection from external threats.

Performance/Abilities

- P1** Follow system log-in/out protocols:
 - log out of system when work is completed
- P2** Participate in organization's cybersecurity training
- P3** Use passwords:
 - change passwords when requested or required by organization's ICT procedures
 - do not share passwords with others
 - do not write passwords down in a visible place
 - use a mix of characters, letters and numbers for passwords
- P4** Operate organization's computer system in a secure manner, for example:
 - use computers and smart mobile devices approved by organization
 - do not leave computer equipment unattended, e.g. computer, smart phone, tablet, flash drives, hard drives
 - do not plug unauthorized flash drives or smart phones into computer
 - use organization's sites and applications for field devices
 - comply with assigned permissions and access limits
 - upload security updates as directed, and use newest versions of application software
- P5** Carry out work on organization's computer system securely, for example:
 - use approved web browsers and search engines
 - check all URLs for indications of a phishing site, e.g. spelling errors, complete "https://" on secure sites
 - avoid using links, when possible, even on secure websites
 - do not download from unknown websites
 - do not work using unsecured internet connections or public computers
- P6** Use communication applications in a secure manner:
 - do not accept or open mail or attachments from unknown senders
 - use approved communication channels and protocols, especially when communicating with other organizations
 - do not provide confidential work information to an unknown email source/caller:
- P7** Do not upload personal applications or access personal websites on organization's devices
- P8** Do not post unauthorized work information on social networks
- P9** Back up files to specified drives and at specified times, as directed
- P10** Contact ICT immediately when:
 - computer device is unresponsive or is operating in odd manner
 - windows or communications open with unusual messages, demands, or instructions, especially when system will not respond
 - there are frequent information or data disruptions, misconfigurations, and gaps or unexplained changes

Knowledge

- K1** Organization's cybersecurity protocols
- K2** Approved applications
- K3** Personal password for access to system
- K4** Access permissions and restrictions
- K5** Indicators of data corruption
- K6** Potential risks to system, e.g. viruses, malware, ransomware
- K7** Normal application operations
- K8** Indicators of unsecured or fraudulent websites

Glossary

- **Cybersecurity:** the practice of protecting systems, networks, and programs from digital attacks that interrupt normal business operations. Digital or cyberattacks try to:
 - access confidential and/or sensitive information to use for illegal purposes, e.g. identity theft;
 - destroy or change confidential and/or sensitive information to disrupt business operations; or,
 - extort money from users by holding their systems hostage until some form of payment is received.
- **Malware:** software that is specifically designed to access and/or damage a computer without owner of the computer being aware of what is happening, e.g. viruses, worms, spyware.
- **Ransomware:** software that prevents users from accessing their own data until the user pays a ransom.
- **Phishing:** a scam to obtain personal information to commit fraud, often involving social engineering, e.g. email or phone calls from distant relative requesting money, phony websites with sign up forms, message from bank requiring confirmation of account information.
- **Social engineering:** attempts to obtain personal or confidential information or to get the user to perform certain tasks by what appears to be a legitimate source or person; a component of phishing.

CONTEXTUAL VARIABLES

Range of Context

- While many cybersecurity safeguards are built into the design of the system software, users working from home, working remotely in the field, or on personal devices, e.g. smart phones, may change the performance of this skill.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Passwords
- Computers, mobile devices
- Cybersecurity software
- Key fob, e.g. RSA SecurID token

Major Category	Organizational Policies and Procedures
Competency Area	Follow Organizational Policies and Procedures
Competency Unit	Follow organizational policies and procedures

Purpose

Following policies and procedures is important to create a consistent work environment for employees and to provide consistent service delivery to internal/external customers.

Performance/Abilities

- P1** Review organizational policies and procedures
- P2** Participate in orientation and on-the-job training
- P3** Complete all work-related tasks according to organizational policies and procedures
- P4** Identify opportunities for improvement to policies and procedures:
 - communicate to team members and supervisors, as appropriate
- P5** Keep up to date with changes to policies and procedures, e.g. access online library for updates

Knowledge

- K1** Organization policies, procedures and plans, e.g. occupational health and safety, workplace health and wellness
- K2** Organization/project goals, vision and status
- K3** Organizational document management system, e.g. where to find latest policies and communication documents

CONTEXTUAL VARIABLES

Range of Context

- Number of policies and procedures to be followed will vary.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Organizational policies and procedures manual
- Documents associated with organizational policies and procedures, including forms, checklists

Major Category	Information/Record Management
Competency Area	Complete Information/Record Management Tasks
Competency Unit	Maintain technical information and data

Purpose

Maintaining technical information and data is important so that critical and up to date information is available. This data is the basis for setting goals and objectives for the short-, medium- and long-term. It also ensures that legislative requirements are met.

Performance/Abilities

- P1** Identify types of information/records that are required, for example:
 - operations and maintenance manual
 - bill of material parts
 - asset related information, e.g. type of equipment, location
 - event and call logs
 - drawings
 - test results
- P2** Provide information as required, e.g. fill out online or paper forms:
 - ensure information is provided/records are completed within required timelines, e.g. daily, weekly, monthly
- P3** Ensure information recorded is accurate and complete
- P4** Complete field mark-ups, as required
- P5** Verify that drawing revisions match field wiring, as required
- P6** Update drawings or ensure drawings are sent for update, as required
- P7** File revised drawings according to information/record management protocols

Knowledge

- K1** Legislation, e.g. NERC Standards
- K2** Organization policies, procedures and plans
- K3** Organization/project goals, vision and status
- K4** Organizational document management system
- K5** Use of relevant software, e.g. CAD, GIS

CONTEXTUAL VARIABLES

Range of Context

- Work environment can make this skill challenging to perform, e.g. outdoors.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- CAD software
- Mobile workforce technology

Major Category

Information and Communication Technology Foundations

Competency Area

Use Digital Technology

Competency Unit

Use communication applications

Purpose

Communication applications allow efficiencies when sending and receiving messages. This includes combinations of visual and audio communication and document sharing over distance which in turn allow for virtual meetings, educational webinars, and other communication formats that can save time and money.

Performance/Abilities

- P1** Open desired communication application on system, online, or on cell phone e.g. email, text messaging
- P2** Verify message before sending
- P3** Select communication recipients:
 - verify who will receive message, e.g. only include relevant parties
- P4** Use email:
 - follow email etiquette, e.g. do not use all uppercase, keep message professional in tone
 - include purpose of message in subject line
 - create concise and clear message
 - add attachments following email application protocols, e.g. drop and click, select file using paperclip icon:
 - follow application instructions to make attachment smaller or use alternative document sharing applications if attachment is too large
 - close message with appropriate salutation and sign-off, e.g. organization logo and contact information
 - proofread message before sending
 - manage mailboxes:
 - use settings to designate type of mail, if appropriate, e.g. check junk mail regularly, check auto rules to ensure up to date and correct
 - delete messages in trash and junk mail periodically
- P5** Use text messaging:
 - keep messages brief
 - do not use texting abbreviations, e.g. lol, btw
 - do not use emojis and animated images, e.g. GIFs
- P6** Use conferencing applications authorized by organization:
 - ensure appropriate documents are open and screen background is appropriate when screen sharing
 - ensure quiet environment when using audio
 - mute microphone when not speaking
 - consider lag time when speaking and sharing documents
 - announce name when entering conference and before speaking, if appropriate

Knowledge

- K1** Organization's policies and procedures, e.g. cybersecurity, logging into applications
- K2** Application functions and icons, e.g. trash can, flags, reply
- K3** Purpose of communication
- K4** Audience
- K5** Writing protocols for email and text messages
- K6** Communication considerations, e.g. background noise, time lag, pitch of voice

Glossary

- **Cybersecurity:** the practice of protecting systems, networks, and programs from digital attacks that interrupt normal business operations. Digital or cyberattacks try to:
 - access confidential and/or sensitive information to use for illegal purposes, e.g. identity theft;
 - destroy or change confidential and/or sensitive information to disrupt business operations; or,
 - extort money from users by holding their systems hostage until some form of payment is received.
- **Emoji:** a small digital icon used to express a feeling or idea.
- **GIF:** series of images encoded to automatically replay back as an animated sequence.

CONTEXTUAL VARIABLES

Range of Context

- Communication applications on mobile devices may differ from desktop system and clarity of communication may vary.
- Communication applications differ depending on system and device being used.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Computer
- Tablet
- Cell phone
- Communication software applications
- Headsets

Major Category

Information and Communication Technology Foundations

Competency Area

Use Digital Technology

Competency Unit

Use common software applications

Purpose

Common computer software applications for word processing, data spreadsheets, and presentations help to increase the productivity and efficiency of the organization.

Performance/Abilities

- P1** Select appropriate application for task, e.g. word processing, presentation, spreadsheets
- P2** Use application's tools to create, enhance or customize content
- P3** Save document to appropriate folder and drive

Knowledge

- K1** Organizational policies and procedures, e.g. file naming, file sharing, cybersecurity
- K2** Purpose and features of common applications
- K3** Links between applications, e.g. cell phone camera photos are saved automatically in photo application

Glossary

- **Cybersecurity:** the practice of protecting systems, networks, and programs from digital attacks that interrupt normal business operations. Digital or cyberattacks try to:
 - access confidential and/or sensitive information to use for illegal purposes, e.g. identity theft;
 - destroy or change confidential and/or sensitive information to disrupt business operations; or,
 - extort money from users by holding their systems hostage until some form of payment is received.

CONTEXTUAL VARIABLES

Range of Context

- Applications will differ depending on device and operating systems.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Computer
- Tablet
- Cell phone
- Common software applications

Major Category	Information and Communication Technology Foundations
Competency Area	Use Digital Technology
Competency Unit	Use navigation and mapping applications

Purpose

Navigation and mapping applications are used to ensure accurate identification and documentation of asset and work locations, as well as ensure the safety of personnel in the field and the efficient use of resources.

Performance/Abilities

- P1** Use global positioning system (GPS) and geographical information system (GIS) device required for tasks e.g. GPS receiver, truck tracker, cell phone
- P2** Follow manufacturer’s instructions
- P3** Ensure correct types of maps of field work area are uploaded or correct views selected, for example:
 - street maps
 - topographical maps
 - satellite view
- P4** Comply with GPS features in vehicles and personal tracking fob requirements when working in field

Knowledge

- K1** Manufacturer’s instructions
- K2** Organization’s policies and procedures, e.g. safety
- K3** Capabilities and limitations of different types of devices and applications
- K4** Types of maps
- K5** Geographical coordinates
- K6** Functions of navigation and mapping applications

Glossary

- **Geographic information system (GIS):** a computer application that captures, stores, checks and displays data related to positions on Earth’s surface; may include cartographic data, photographic data, digital data, or data in spreadsheets.
- **Geographic coordinates:** a grid system consisting of lines of latitude (north-south) and lines of longitude (east-west) that allow users to define a precise location on the earth’s surface. Expressed in degrees and minutes.
- **Global Positioning System (GPS):** a computer program that uses triangulation to determine a user’s location on the earth by feedback received from at least three satellites orbiting the earth.
- **Waypoint:** is the marking of a location by obtaining the geographic coordinates with a GPS unit.

CONTEXTUAL VARIABLES

Range of Context

- Locating assets may require both GIS and GPS.
- There is generally no cellular or wireless service in remote destinations which may impact the type of GPS device that can be used.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom’s Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- GPS receiver
- Cell phone
- Computer

Major Category	Information and Communication Technology Foundations
Competency Area	Use Digital Technology
Competency Unit	Use digital mobile radios

Purpose

Digital mobile radios (DMRs) are used for internal communications between departments and work groups for the purposes of primary and emergency backup communication.

Performance/Abilities

- P1** Use digital mobile radios as required, for example:
 - from field to office
 - between work groups
 - within own work group
 - for emergency communications
- P2** Follow manufacturer's instructions
- P3** Comply with organization's policies and guidelines
- P4** Comply with Industry Canada's radio communication regulations, e.g. licensing requirements

Knowledge

- K1** Applicable legislation, e.g. Industry Canada's radio communication regulations
- K2** Manufacturer's instructions and recommendations
- K3** Organization's policies and procedures, e.g. safety, communication protocols
- K4** Capabilities and limitations of different types of devices

CONTEXTUAL VARIABLES

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Digital mobile radio

Major Category	Information and Communication Technology Foundations
Competency Area	Use Organization's ICT System
Competency Unit	Use organization's ICT system

Purpose

Following the organization's protocols to enter and retrieve information in the computer system is essential to ensure the organized, accurate, and secure documentation of an organization's activities across various types of computerized equipment.

Performance/Abilities

- P1** Follow organization's policies and procedures, e.g. data entry, cybersecurity
- P2** Retrieve required information from saved files or databases, for example:
 - access information from saved files or databases as permitted from:
 - computer hard drive
 - organization's shared drive(s)
 - use appropriate search terms to find required information, e.g. file name, subject matter, customer name
- P3** Enter/update information, for example:
 - complete all data fields accurately
 - check accuracy of manual data entry
 - do not enter same data more than once
 - do not edit or change data without appropriate permissions
- P4** Upload information, e.g. files, photograph, prints, data:
 - ensure information sources are secure
- P5** Save work:
 - use file naming protocol
 - save in appropriate drive(s) and folder

Knowledge

- K1** Organization's protocols, for example:
 - cybersecurity
 - access permissions
 - file naming
 - organization of shared drives
 - printing
 - file sharing
- K2** Applications purposes and functions
- K3** Consequences of inaccurate or incomplete data
- K4** Different uses of data
- K5** Allowable data requests
- K6** Organization of shared drive(s)
- K7** Uploading and downloading of documents, files, drawings and photos

Glossary

- **Computer Aided Design (CAD):** a computer application that is used to produce 2- and 3-dimensional drawings of an engineered design that details the physical components and layout.
- **Cybersecurity:** the practice of protecting systems, networks, and programs from digital attacks that interrupt normal business operations. Digital or cyberattacks try to:
 - access confidential and/or sensitive information to use for illegal purposes, e.g. identity theft;
 - destroy or change confidential and/or sensitive information to disrupt business operations; or,
 - extort money from users by holding their systems hostage until some form of payment is received.
- **Geographic Information Systems (GIS):** a computer application that manages geographic information, which can be manipulated to display aspects of geographical information in a map format.

CONTEXTUAL VARIABLES

Range of Context

- Organizations will have different levels of permissions and access to different applications and shared drives based on occupational requirements and responsibilities.
- Organizations may use proprietary closed computer systems and networks.
- Access to system and applications may differ if using a mobile device.
- Cybersecurity protocols may differ in levels of automation and auto-surveillance, e.g. audit trails.
- Organizations may use different purchased applications.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Computer or mobile device
- Software programs

Major Category

Personal Competencies

Competency Area

Demonstrate Professionalism

Competency Unit

Work as a member of a team

Purpose

Working as a member of a team helps to ensure that operations run smoothly, and allows project managers, supervisors, employees and contractors to be proactive before small issues become large problems.

Performance/Abilities

- P1** Demonstrate respect and empathy towards others:
 - respect diversity
 - respect differing perspectives
 - promote an inclusive work environment
 - recognize changes in team members' behaviours, e.g. mental health strain
- P2** Be accountable:
 - report unexpected conditions
 - be punctual
 - comply with schedule
 - take action when issues arise
- P3** Initiate contact with other team members on regular basis:
 - ask questions
- P4** Share knowledge and skills
- P5** Recognize others' contributions and success
- P6** Accept and provide constructive feedback
- P7** Ask for help, when needed
- P8** Offer help to team members
- P9** Respond to requests in a timely manner
- P10** Be open to change
- P11** Participate actively in team meetings

Knowledge

- K1** Organization policies, procedures and plans
- K2** Organization/project goals, vision and status
- K3** Roles and responsibilities of team members, including own role
- K4** Team members' contact information
- K5** Sector and project terminology and common abbreviations
- K6** Symptoms of psychological strain, e.g. decreased quality of work, withdrawal

CONTEXTUAL VARIABLES

Range of Context

- Team members will vary, for instance, there may be a range of small, temporary working groups and more permanent, long-term working groups.
- Physically locations may change the way this skill is performed, e.g. communication may have to occur via distance means.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- Recall, Remember
- Understand
- Apply
- Analyze
- Evaluate
- Create/Transform

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Software, e.g. video chat, virtual meeting
- Communication tools, e.g. email, telephone

Major Category

Personal Competencies

Competency Area

Demonstrate Professionalism

Competency Unit

Develop professionally

Purpose

Developing professionally is important to keep current with sector trends, products and services. It improves an individual's attitude, knowledge, self-confidence and skills.

Performance/Abilities

- P1** Maintain qualifications and certifications, as required, e.g. trade license, professional designation, First Aid, CPR
- P2** Assess own skills, knowledge and abilities:
 - reflect on feedback from peers and supervisor
 - identify areas for improvement
- P3** Identify areas of interest where new skill and knowledge development might be useful, e.g. new methods/products used in the sector
- P4** Upgrade skills and knowledge, for example:
 - attend courses offered by equipment manufacturers
 - read sector-specific publications
 - conduct research
 - enroll in educational and professional development courses and programs
 - participate in mentorship programs
 - ask for assistance or instruction
- P5** Participate in local trade and business organizations, as applicable
- P6** Network with professional peers, e.g. attend conferences or trade shows
- P7** Join and participate in associations, as applicable
- P8** Ensure professional development is documented in organization's record management system, as required

Knowledge

- K1** Organization policies, procedures and plans
- K2** Organization/project goals, vision and status
- K3** Own skills, knowledge and abilities
- K4** Roles and responsibilities of team members, including own role
- K5** Where to find up-to-date and accurate information on the sector
- K6** Relevant training providers and their offerings

CONTEXTUAL VARIABLES

Range of Context

- Access to resources may affect the way this skill is performed, e.g. organization's professional development budget, individuals may only attend provided professional development sessions during work time.
- Physical location may change the way this skill is performed, e.g. all professional development may have to be pursued via distance means.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- | | |
|-------------------------------------------|---------------------------------------------|
| <input type="checkbox"/> Recall, Remember | <input checked="" type="checkbox"/> Analyze |
| <input type="checkbox"/> Understand | <input type="checkbox"/> Evaluate |
| <input type="checkbox"/> Apply | <input type="checkbox"/> Create/Transform |

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Computer access
- Mentoring/coaching program
- Education grant program, if available
- Collective agreement

Major Category

Personal Competencies

Competency Area

Demonstrate Professionalism

Competency Unit

Demonstrate professional and ethical conduct

Purpose

Demonstrating professional and ethical conduct is important to build trust and respect in relationships with others. It also helps to promote a positive image of the organization and the sector.

Performance/Abilities

- P1** Participate in relevant training, e.g. conflict of interest, code of conduct, ethics
- P2** Support high standards and practices that protect public and bring credibility to organization, sector, and community, for example:
 - follow professional code of ethics/code of conduct, as applicable
 - implement responsible policies
 - avoid degrading or malicious discussion
 - recognize potential conflict of interest
- P3** Demonstrate professional attributes, including:
 - approachability, e.g. be available to coworkers and clients
 - composure, e.g. remain calm in emergency
 - empathy, e.g. show concern for others' problems
 - emotional intelligence, e.g. awareness of own and others' emotional states
 - fairness, e.g. treat all equally
 - flexibility, e.g. be open to new situations and approaches
 - being proactive, e.g. address issues before they become large problems
 - initiative
 - QA/QC principles in relation to work, e.g. catching potential errors prior to issues
 - trustworthiness, e.g. honour commitments
 - social responsibility, e.g. report injured wildlife to appropriate authorities
- P4** Ensure appearance is professional, e.g. wear uniform or organizational id/tag, ensure attire is in good repair
- P5** Comply with legal requirements, e.g. high visibility clothing, NERC requirements, conflict of interest
- P6** Maintain confidentiality of information, as required
- P7** Maintain accurate records
- P8** Show respect for organization's assets, e.g. take proper care of tools and equipment

Knowledge

- K1** Relevant legislation, e.g. Freedom of Information and Protection of Privacy (FOIP), NERC Standards
- K2** Organization policies, procedures and plans
- K3** Organization/project goals, vision and status
- K4** Code of conduct/Code of ethics
- K5** Own skills, knowledge and abilities
- K6** Roles and responsibilities of team members, including own role
- K7** Where to find up-to-date and accurate information on standards and practices

CONTEXTUAL VARIABLES

Range of Context

- Formal codes of ethics may exist in some subsectors and not others.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- | | |
|-------------------------------------------|-------------------------------------------|
| <input type="checkbox"/> Recall, Remember | <input type="checkbox"/> Analyze |
| <input type="checkbox"/> Understand | <input type="checkbox"/> Evaluate |
| <input checked="" type="checkbox"/> Apply | <input type="checkbox"/> Create/Transform |

Major Category

Personal Competencies

Competency Area

Demonstrate Professionalism

Competency Unit

Mentor/coach others

Purpose

Mentoring/coaching others is important to help create an environment of continuous learning within the organization. It helps to ensure consistency in the work being completed, and assists with building positive workplace relationships. It contributes to an improvement of both individual and team performance.

Performance/Abilities

- P1** Initiate contact with other team members/learners on regular basis:
 - ask questions
- P2** Use positive approach to help team members/learners solve problems:
 - ask questions to help focus on problem
 - guide resolution/performance
 - demonstrate patience
- P3** Demonstrate tasks for others, as required:
 - explain importance of and reasons for process/tasks
 - link learning to other tasks and overall job
- P4** Set up environment for learner to practice skills, as required:
 - ensure safety of learning environment
- P5** Recognize success, e.g. praise team member/learner
- P6** Assess learners' progress, as appropriate
- P7** Provide supportive and corrective feedback
- P8** Ask for feedback on own performance as coach/mentor

Knowledge

- K1** Organization policies, procedures and plans
- K2** Organization/project goals, vision and status
- K3** Roles and responsibilities of team members/learners, including own role
- K4** Role of workplace mentor/coach
- K5** Sector and project terminology and common abbreviations
- K6** Different ways of learning/learning needs and strategies to address them, e.g. language proficiency, learning preference
- K7** How to adjust to different learning styles
- K8** Importance of, and techniques for, providing effective feedback

CONTEXTUAL VARIABLES

Range of Context

- Mentoring/coaching may be a formalized or informal process, which will affect how this skill is performed.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- | | |
|-------------------------------------------|---------------------------------------------|
| <input type="checkbox"/> Recall, Remember | <input checked="" type="checkbox"/> Analyze |
| <input type="checkbox"/> Understand | <input type="checkbox"/> Evaluate |
| <input type="checkbox"/> Apply | <input type="checkbox"/> Create/Transform |

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Software, e.g. video chat, virtual meeting
- Communication tools, e.g. email, telephone

Major Category

Personal Competencies

Competency Area

Demonstrate Professionalism

Competency Unit

Manage stress

Purpose

Managing stress is important to improve one's own ability to balance personal and professional demands, perform one's job competently, and contribute to a harmonious workplace.

Performance/Abilities

- P1** Attend to own physical, emotional, spiritual, family and financial needs:
 - ask for help, if needed
- P2** Recognize own limitations and those of others, e.g. know when to say no
- P3** Recognize how your stress affects others
- P4** Manage time effectively:
 - prioritize tasks to be done
 - ensure schedule is realistic
 - negotiate or discuss with team members/supervisor, as required
- P5** Delegate responsibilities, when appropriate
- P6** Adapt to shift work, as required, for example:
 - prepare self for shifts
 - ensure proper rest/sleep
 - ensure proper nutrition
- P7** Maintain open communication with others
- P8** Identify coping strategies, e.g. maintain a sense of humour

Knowledge

- K1** Organization policies, procedures and plans
- K2** Organization/project goals, vision and status
- K3** Organization's wellness program, e.g. available gym memberships, counselling programs
- K4** Own skills, knowledge and abilities
- K5** Roles and responsibilities of team members, including own role
- K6** Symptoms of psychological strain, e.g. fatigue, irritability, difficulty concentrating, isolation

CONTEXTUAL VARIABLES

Range of Context

- Availability of an organization wellness program, and its associated offerings, may alter the way this skill is performed.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- | | |
|-------------------------------------------|---------------------------------------------|
| <input type="checkbox"/> Recall, Remember | <input checked="" type="checkbox"/> Analyze |
| <input type="checkbox"/> Understand | <input type="checkbox"/> Evaluate |
| <input type="checkbox"/> Apply | <input type="checkbox"/> Create/Transform |

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Psychological health and wellness program

Major Category

Personal Competencies

Competency Area

Demonstrate Professionalism

Competency Unit

Manage time

Purpose

Managing time is important to support efficiency and productivity by allowing the required time to be spent on the areas/tasks of most importance, and ensures that all tasks can be completed according to schedule.

Performance/Abilities

- P1** Set goals:
 - ensure goals are realistic and relevant
 - outline objectives to be achieved for each goal
- P2** Identify tasks that need to be achieved for each objective:
 - prioritize based on importance and urgency
- P3** Determine amount of time each task will take, considering:
 - previous experience
 - available resources
 - competing priorities
 - possible delays
- P4** Use time management system, e.g. electronic calendar, daytimer:
 - record appointments, meetings and critical dates
- P5** Create action plan:
 - identify timelines and critical dates
- P6** Schedule tasks:
 - delegate tasks, as required
- P7** Monitor progress of tasks and action plan:
 - review/update timelines regularly
- P8** Identify incomplete tasks:
 - develop plan for completion
- P9** Review goals and objectives periodically:
 - review time management system
 - evaluate own tasks
 - evaluate progress toward goals
 - make adjustments, as required

Knowledge

- K1** Organization policies, procedures and plans
- K2** Organization/project goals, vision and status
- K3** Own skills, knowledge and abilities
- K4** Roles and responsibilities of team members, including own role

CONTEXTUAL VARIABLES

Range of Context

- Complexity of time management will vary with job role and current tasks.
- Goals, objectives and action plans may be provided, depending upon job role and organization.
- Unplanned situations, including emergencies, can make it difficult to perform this skill.
- Collaboration may or may not be required, e.g. some activities need to be coordinated with others/other work teams.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- | | |
|-------------------------------------------|---------------------------------------------|
| <input type="checkbox"/> Recall, Remember | <input checked="" type="checkbox"/> Analyze |
| <input type="checkbox"/> Understand | <input type="checkbox"/> Evaluate |
| <input type="checkbox"/> Apply | <input type="checkbox"/> Create/Transform |

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Time management systems, e.g. electronic calendar, daytimer
- Software, e.g. project management software

Major Category

Personal Competencies

Competency Area

Communicate Effectively

Competency Unit

Use active listening skills

Purpose

Using active listening skills helps to ensure that all parties understand each other. This promotes effective teamwork, improves productivity and reduces stress.

Performance/Abilities

- P1** Choose appropriate time and place to listen, if possible:
 - remove distractions, as required
- P2** Listen carefully to message:
 - be open-minded
 - use attentive body language, e.g. face speaker
 - listen until message is complete, i.e. do not interrupt
 - give speaker undivided attention
- P3** Watch for nonverbal indicators that reinforce or contradict message, e.g. nod, rolling eyes
- P4** Respond to message, for example:
 - use nonverbal indicators, e.g. nod, smile
 - offer comments
 - use questions to seek additional information or clarify details
 - paraphrase to confirm understanding

Knowledge

- K1** Relevant legislation, e.g. Freedom of Information and Protection of Privacy
- K2** Organization policies, procedures and plans
- K3** Organization/project goals, vision and status
- K4** Effective communication practices, e.g. verbal versus non-verbal, characteristics of respectful communication
- K5** Sector, trade and project terminology and common abbreviations
- K6** Question types, e.g. open-ended, closed, probing, mirror
- K7** Communication that constitutes harassment and discrimination

CONTEXTUAL VARIABLES

Range of Context

- Physical location may change the way this skill is performed, e.g. all listening may have to occur via distance means.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- | | |
|-------------------------------------------|---------------------------------------------|
| <input type="checkbox"/> Recall, Remember | <input checked="" type="checkbox"/> Analyze |
| <input type="checkbox"/> Understand | <input type="checkbox"/> Evaluate |
| <input type="checkbox"/> Apply | <input type="checkbox"/> Create/Transform |

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Software, e.g. video chat, virtual meeting
- Communication tools, e.g. telephone

Major Category

Personal Competencies

Competency Area

Communicate Effectively

Competency Unit

Use speaking skills

Purpose

Using speaking skills helps to ensure that all parties understand each other, and reduces errors due to misinterpretation. This promotes effective teamwork, improves productivity and reduces stress.

Performance/Abilities

- P1** Identify purpose of message
- P2** Consider needs and limitations of listeners
- P3** Organize ideas before speaking
- P4** Determine appropriate time and place to deliver message
- P5** Determine appropriate format, e.g. formal/informal, group/individual
- P6** Make final revisions to message
- P7** Communicate message:
 - be concise
 - speak clearly
 - use proper grammar
 - vary tone, volume, inflection and rate of speech
 - make eye contact
 - use positive language whenever possible
 - ensure that verbal and non-verbal communication convey same message
- P8** Adjust message to listener, if appropriate, for example:
 - simplify technical information
 - use different question types to determine listener's needs
 - avoid using slang, jargon, profanity or sarcasm
 - consider impact of message on listener, e.g. time restrictions, emotional impact
- P9** Confirm understanding:
 - ask for questions and feedback
 - review what was explained
- P10** Encourage additional questions at later date, if appropriate
- P11** Answer questions or know where to find answer:
 - follow up with listener who asked question

Knowledge

- K1** Relevant legislation, e.g. Freedom of Information and Protection of Privacy
- K2** Organization policies, procedures and plans
- K3** Organization/project goals, vision and status
- K4** Organizational communication protocols, e.g. who needs what information, speaking to media
- K5** Effective communication practices, e.g. verbal versus non-verbal, characteristics of respectful communication
- K6** Sector, trade and project terminology and common abbreviations
- K7** Question types, e.g. open-ended, closed, probing, mirror
- K8** Communication that constitutes harassment and discrimination

CONTEXTUAL VARIABLES

Range of Context

- Physical location may change the way this skill is performed, e.g. speaking may have to occur via distance means.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- | | |
|-------------------------------------------|---------------------------------------------|
| <input type="checkbox"/> Recall, Remember | <input checked="" type="checkbox"/> Analyze |
| <input type="checkbox"/> Understand | <input type="checkbox"/> Evaluate |
| <input type="checkbox"/> Apply | <input type="checkbox"/> Create/Transform |

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Software, e.g. video chat, virtual meeting
- Communication tools, e.g. telephone

Major Category

Personal Competencies

Competency Area

Communicate Effectively

Competency Unit

Use writing skills

Purpose

Using writing skills helps to ensure that all parties understand each other, and reduces errors due to misinterpretation. This promotes effective teamwork, improves productivity and reduces stress.

Performance/Abilities

- P1** Determine purpose of message
- P2** Identify target audience
- P3** Provide accurate, complete and concise information
- P4** Use format, tone, and style suited to purpose, e.g. email, business letter, report
- P5** Consider reader's:
 - perceptions
 - reading ability
 - needs
 - technical understanding
- P6** Write first draft, if required:
 - arrange ideas logically
 - be clear and concise
- P7** Proofread message:
 - correct errors
- P8** Produce final copy:
 - send to reader(s)/recipient(s)
- P9** File copy according to organizational/project protocol
- P10** Follow up, as required, e.g. ensure message was received

Knowledge

- K1** Relevant legislation, e.g. Freedom of Information and Protection of Privacy
- K2** Organization policies, procedures and plans
- K3** Organization/project goals, vision and status
- K4** Organizational document management system
- K5** Organizational communication protocols, e.g. who needs what information
- K6** Basic spelling and grammar
- K7** Sector, trade and project terminology and common abbreviations
- K8** Communication that constitutes harassment and discrimination

CONTEXTUAL VARIABLES

Range of Context

- Depending upon the message and audience, process may be formal or informal.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- | | |
|-------------------------------------------|---------------------------------------------|
| <input type="checkbox"/> Recall, Remember | <input checked="" type="checkbox"/> Analyze |
| <input type="checkbox"/> Understand | <input type="checkbox"/> Evaluate |
| <input type="checkbox"/> Apply | <input type="checkbox"/> Create/Transform |

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Software, e.g. Microsoft Word
- Communication tools, e.g. email

Major Category

Personal Competencies

Competency Area

Communicate Effectively

Competency Unit

Negotiate with internal and external stakeholders

Purpose

Negotiating effectively with internal and external stakeholders helps to ensure all parties are satisfied with the resulting outcomes.

Performance/Abilities

- P1** Determine who needs to be involved in negotiation
- P2** Determine own position:
 - represent project/organization's position, as required
- P3** Identify what is flexible and what is not
- P4** Present offer to other party
- P5** Acknowledge position or offer of other party
- P6** Discuss possible outcomes with other party:
 - remain open, honest and flexible
 - focus on positive outcomes
 - clarify position, as required, e.g. provide supporting information, discuss ramifications
 - focus on issue at hand
 - suggest alternatives
- P7** Analyze impacts of possible outcomes, e.g. schedule, resources/cost
- P8** Facilitate agreement
- P9** Confirm agreement in writing:
 - File agreement according to project/organizational protocol

Knowledge

- K1** Relevant legislation, e.g. Freedom of Information and Protection of Privacy
- K2** Organization policies, procedures and plans
- K3** Organization/project goals, vision and status
- K4** Organizational document management system
- K5** Effective communication practices, e.g. verbal versus non-verbal, characteristics of respectful communication
- K6** Project stakeholders and their contact information
- K7** Relevant government agencies and their contact information
- K8** Sector and project terminology and common abbreviations
- K9** Negotiation techniques and strategies

Glossary

- **Stakeholders:** individuals and groups who are impacted by the activities or decisions of others; the individuals and groups could be within (internal) or outside (external) of the organization or project, e.g. co-workers, supervisors, contractors, customers, the public, government, union, shareholders.

CONTEXTUAL VARIABLES

Range of Context

- Stakeholders involved in interactions will vary, e.g. tradespeople, team members, managers, agency representatives, and this may affect the tone of the communication, i.e. formal or informal.
- Physical location may change the way this skill is performed, e.g. all communication may have to occur via distance means.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- | | |
|-------------------------------------------|----------------------------------------------|
| <input type="checkbox"/> Recall, Remember | <input type="checkbox"/> Analyze |
| <input type="checkbox"/> Understand | <input checked="" type="checkbox"/> Evaluate |
| <input type="checkbox"/> Apply | <input type="checkbox"/> Create/Transform |

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Software, e.g. video chat, virtual meeting, Microsoft Word, project management software
- Communication tools, e.g. email, telephone

Major Category

Personal Competencies

Competency Area

Communicate Effectively

Competency Unit

Conduct meetings and presentations

Purpose

Conducting meetings and presentations effectively allows the sharing of information and ideas, which results in positive and solution-focused working relationships and working environments.

Performance/Abilities

- P1** Determine if meeting or presentation is required:
 - identify what message needs to be conveyed and within what timeframe
 - identify best type of meeting/presentation for the purpose
- P2** Determine who needs to be:
 - participant at meeting
 - in audience at presentation
- P3** Prepare for meeting/presentation:
 - confirm availability of key persons
 - prepare outline or agenda
 - make room arrangements, as required
 - determine resources or materials required
- P4** Inform participants/audience of location, start time and duration
- P5** Conduct meeting/presentation:
 - stay on topic
 - allow time for questions and feedback
- P6** Adjourn according to schedule
- P7** Document event, as necessary:
 - distribute documentation, as necessary
 - file according to organizational/project protocol
- P8** Complete any follow-up required, e.g. find answer to question asked during session

Knowledge

- K1** Relevant legislation, e.g. Freedom of Information and Protection of Privacy
- K2** Organization policies, procedures and plans
- K3** Organization/project goals, vision and status
- K4** Organizational document management system
- K5** Effective communication practices, e.g. verbal versus non-verbal, characteristics of respectful communication
- K6** Sector and project terminology and common abbreviations
- K7** Software applications for building visual presentations

CONTEXTUAL VARIABLES

Range of Context

- Stakeholders involved in meetings and presentations will vary, e.g. tradespeople, team members, managers, agency representatives, and this may affect the tone of the communication, i.e. formal or informal.
- Physical location may change the way this skill is performed, e.g. all communication may have to occur via distance means.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- | | |
|-------------------------------------------|---------------------------------------------|
| <input type="checkbox"/> Recall, Remember | <input checked="" type="checkbox"/> Analyze |
| <input type="checkbox"/> Understand | <input type="checkbox"/> Evaluate |
| <input type="checkbox"/> Apply | <input type="checkbox"/> Create/Transform |

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Software, e.g. Powerpoint, project management software, video chat, virtual meeting
- Communication tools, e.g. email, telephone, projectors, flip charts

Major Category

Personal Competencies

Competency Area

Communicate Effectively

Competency Unit

Exchange information with internal and external stakeholders

Purpose

Interacting effectively and appropriately with internal and external stakeholders helps to ensure that operations run smoothly and allows managers, supervisors, co-workers, customers and other stakeholders to be proactive before small issues become large problems. Exchanging relevant and accurate information in a timely manner is essential for good performance and relations between individuals and stakeholder groups.

Performance/Abilities

- P1** Determine what information needs to be shared and within what timeframe:
 - respect confidentiality of sensitive information
 - tailor message to audience
 - collect information from stakeholders to make decisions or take action, e.g. communicate with host of co-generation station to meet their needs
- P2** Determine who needs information, e.g. department head, team members, customers, government agency
- P3** Determine best method for communicating information, e.g. conduct meeting, hold conference call, send email, share data analysis via SCADA
- P4** Share information through best method, including:
 - conduct or participate in face-to-face meetings
 - communicate over distance, e.g. call department of environment about a log jam in dam, share video or photos of equipment and systems with maintenance team
 - email information and updates to have permanent record of exchanges
 - use specialized communication/reporting software, e.g. OASIS, Reliability Coordinator Information System
 - use three-way communication to confirm understanding and ensure safety
- P5** Monitor own communication devices frequently, e.g. smartphone, email
- P6** Document communication, as necessary:
 - file according to organization's information/record management system

Knowledge

- K1** Relevant legislation, e.g. NERC Standards of Conduct, Freedom of Information and Protection of Privacy
- K2** Organization policies, procedures and plans
- K3** Organizational goals, vision and status
- K4** Organizational information/record management system
- K5** Effective communication practices, e.g. verbal versus non-verbal, characteristics of respectful communication, three-way communication
- K6** Relevant stakeholders, e.g. team members, other departments, contractors, customers, government agencies,
- K7** Information needs of stakeholders
- K8** Industry terminology and common abbreviations
- K9** Basics of how overall electricity system works and how components impact each other, e.g. how distribution and transmission affect generation

Glossary

- **Stakeholders:** individuals and groups who are impacted by the activities or decisions of others; the individuals and groups could be within (internal) or outside (external) of the organization or project, e.g. co-workers, supervisors, contractors, customers, the public, government, union, shareholders.
- **Three-way communication:** sharing a message in three steps: 1. sender states message, 2. receiver repeats message, 3. sender confirms that receiver has repeated message correctly or corrects any misunderstandings.

CONTEXTUAL VARIABLES

Range of Context

- Stakeholders involved in interactions will vary, e.g. tradespeople, team members, managers, agency representatives, and this may affect the tone of the communication, i.e. formal or informal.
- Physical location may change the way this skill is performed, e.g. all communication may have to occur via distance means.
- Continuous training for proper communication, and monitoring of practice, is commonplace for many occupations within the industry.

Level of Practice

- Frontline
- Supervisor
- Manager/Executive

Adapted Bloom's Taxonomy

- | | |
|-------------------------------------------|---------------------------------------------|
| <input type="checkbox"/> Recall, Remember | <input checked="" type="checkbox"/> Analyze |
| <input type="checkbox"/> Understand | <input type="checkbox"/> Evaluate |
| <input type="checkbox"/> Apply | <input type="checkbox"/> Create/Transform |

RWATEM (Requisite Work Aids, Tools, Equipment or Materials)

- Software, e.g. video chat, virtual meeting, OASIS, RCIS
- Communication devices, e.g. email, telephone

Notes

Electricity Human Resources Canada would like to acknowledge all of the industry subject matter experts from across Canada who were involved in drafting, reviewing and validating this National Occupational Standard.