Lineman

Occupational Analysis Report

January 2014

Commission
de la construction
du Québec

The purpose of this report is to describe as accurately as possible the occupation of lineman as currently practiced in Quebec's construction industry. It is a record of discussions held by a group of workers who met for the occasion after industry partners recommended them to the Commission de la construction du Québec (CCQ) for their expertise in the occupation.

The occupational analysis is a first step in the definition of the competencies required for practicing the occupation. This report becomes one of the reference and decision-making tools used by the CCQ for teaching and learning purposes.

This report does not bind the CCQ in any way. It has no legal effect and is meant as a reflection of discussions held on the date of the analysis workshop.

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The masculine gender is used generically
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INTRODUCTION

In early 2009, the Direction de la formation professionnelle of the Commission de la construction du Québec (CCQ) launched a large-scale operation to review the occupational analyses[1] of all construction industry trades and specialized occupations.

The CCQ undertook this operation for many reasons, particularly the following:

- the project to reform the construction workforce apprenticeship and management system, and the coming design of qualitative apprenticeship logbooks requiring a detailed description of each trade;
- the fact that most construction occupational analyses [2] had been conducted between 1987 and 1991 and had not been reviewed since;
- updates to vocational qualification examination question banks;
- implementation of Chapter 7 of the Agreement on Internal Trade (AIT) and of the Québec-France Understanding on the Mutual Recognition of Professional Qualifications.

These factors demonstrate the necessity of updating the occupational analyses in order to obtain a current and complete profile of the various trades and specialized occupations in Quebec.

The occupational analysis of the lineman occupation belongs to this context [3]. Its purpose is to describe this specialized occupation as currently practiced in the construction industry. This report was written in order to collate and organize the information gathered during the occupational analysis workshop held in Laval on March 1 and 2, 2012.

This analysis draws a portrait of the occupation (tasks and operations) and its working conditions, and identifies the skills and behaviours required. The report of the occupational analysis workshop is an accurate reflection of the consensus reached by a group of experienced linemen. A special effort was made to include in this report all the data collected during the workshop and to ensure that the data accurately depict the realities of the occupation analysed.

1. The terms “profession” and “occupation” are considered synonymous.
2. Called “work situation analyses” at the time.
3. This occupational analysis was conducted according to the *Cadre de référence et instrumentation pour l’analyse d’une profession*, produced in 2007 by the ministère de l’Éducation, du Loisir et du Sport (Direction générale de la formation professionnelle et technique) and the Commission des partenaires du marché du travail, ministère de l’Emploi et de la Solidarité sociale.

1. GENERAL CHARACTERISTICS OF THE OCCUPATION

1.1 DEFINITION OF THE OCCUPATION

According to Schedule B, Subschedule C of the 2010-2013 Civil Engineering and Roadwork Sector Collective Agreement, the term “lineman” means:

Distribution lines, distribution stations and catenaries

1) Lineman, 1st class: Any employee assigned to construction, dismantling, painting and maintenance work on distribution lines, stations, and catenaries who, under the general supervision of a group leader or a crew leader with this occupational title, carries out complex operations such as: properly sagging conductors; installing clamps and hardware; inspecting and painting structures, conductors and insulators; making joints; erecting wooden, galvanized steel and other types of structures; and installing busbars, circuit breakers, switches, transformers and capacitors, as well as other station equipment. The term also means anyone who performs aerial work on live or dead circuits using hot-line tools, as required, and who assists the group leader or crew leader in crew work.

He may also dig and install poles, pull underground cables, drive trucks, operate equipment related to his job, and install and remove street lamps when the latter are located on poles and near the electric power network.

Electric power transmission lines, electric power stations and communication towers

Lineman, 1st class: An employee who, under the general supervision of a group leader or crew leader with this occupational title, performs, if he has the required physical fitness, all duties necessary to the construction, dismantling, and maintenance (including painting) of electric power transmission lines and stations, and communication towers, such as, but not limited to: Installing busbars, circuit breakers, switches, transformers (including outgassing) and capacitors, as well as other station equipment; aerial work on live or dead circuits using hot-line tools, as needed; assisting the group leader or crew leader with crew work; and supervising, as needed, the work of any employee of lower classification.

He may also dig holes and install poles, pull underground cables, drive trucks, operate equipment related to his duties and install and remove street lamps when the latter are located on poles and near the electric power network.

Communication networks

“T” lineman: An employee who carries out construction, maintenance and alteration work on telephone and television network aerial circuits.

According to the participants in the occupational analysis, the definition of work for the sectors of distribution lines, distribution stations and catenaries, and for electric power transmission lines, electric power stations – hereinafter called “substations” – and communication towers, is complete and realistic.

However, the definition of the work of “T” linemen is incomplete. It lacks many references to the assembly and erection of towers, the installation of guy wires, the placing and alignment of antennae, the installation of communication cables, etc.

Moreover, some linemen who install towers and poles hold a blaster-driller competency certificate and occasionally use backhoes to plant those structures in the ground.

1.2 JOB TITLES

The job title used in this occupational analysis for describing the occupation is “lineman.” However, there are other job titles associated to the sectors of activity or tasks: “pole planters”; linemen — distribution; linemen — transportation; linemen — electric stations; and linemen — telecommunications.

Job titles not to be confused with “lineman” are those of other occupations that have certain similar tasks to those of linemen: “heavy equipment operator,” “blaster-driller,” “structural steel erector” and “electrician.”

1.3 SECTORS OF ACTIVITY

Linemen are active in the roads and civil engineering sector of the construction industry.

Linemen may also work for a network operator (Hydro-Québec or a communications company, for example).

1.4 FIELD OF PRACTICE

The occupation's field of practice is the construction industry. The Act respecting labour relations, vocational training, and workforce management in the construction industry (R.S.Q., c. R-20) defines construction as follows:

> […] the foundation, erection, maintenance, renewal, repair, alteration and demolition work on buildings and civil engineering works carried out on the job site itself and vicinity including the previous preparatory work on the ground;
>
> In addition, the word "construction" includes the installation, repair and maintenance of machinery and equipment, work carried out in part on the job site itself and in part in the shop, moving of buildings, transportation of employees, dredging, turfing, cutting and pruning of trees and shrubs and laying out of golf courses, but solely in the cases determined by regulation.

1.5 LAWS, REGULATIONS AND STANDARDS

Linemen in the construction industry are subject to:

- the Act respecting labour relations, vocational training and workforce management in the construction industry (S.S.Q., c. R–20);
- the Civil Engineering and Roadwork Sector Collective Agreement;
- the Act Respecting Occupational Health and Safety (R.S.Q., c. S-2.1);
- the Safety Code for the construction industry (R.Q. c. S-2.1, r.6);
- Hydro-Québec standards or standards for operating an electrical network;
- standards for operating a communications network;
- the Highway Safety Code;
- ministère des Transports standards;
- municipal by-laws, if applicable.

1.6 WORKING CONDITIONS[4]

The following information provides an overview of the conditions and context of the work of linemen, as commented by the participants in the occupational analysis workshop. To obtain up-to-date and complete information that has legal effect, it is necessary to refer to the civil engineering and roadwork collective agreement.

Salary

The average annual salary of a construction industry lineman who worked at least 500 hours in 2010 was $69,095. The proportion of linemen who had worked at least 500 hours was 87% for the same period. As of May 1, 2011, the daytime hourly wage was as follows:

	Distribution Lines, Distribution Stations and Catenaries	Electric Power Transmission Lines, Substations, Communication Towers	Communication Networks
Lineman			
Class 1	$34.45	$34.45	
Class 2	$33.00	$33.00	
Class 3	$29.22	$29.22	
Class 4	$28.46	$28.46	
“T” lineman			$32.57

Vacations and time off

Mandatory annual holidays of four weeks – two weeks in summer and two in winter at fixed periods determined in collective agreements – are the general rule in the construction industry. To avoid penalizing employers and employees experiencing special constraints, the industry’s four collective agreements allow certain possibilities for changing the vacation periods prescribed by the general rule.

To these vacation periods are added eight not worked statutory holidays, as well as a lump sum for sick leaves not otherwise paid.

4. The general data on working conditions are excerpted from the 2010-2013 collective agreement of the civil engineering and roads sector and from the document *Careers – Construction*, 2011-2012 edition, published by the la Commission de la construction du Québec.

Pension plan

Construction industry workers have access to a pension plan. They retain their eligibility for this pension plan throughout their career in construction, even if they change employer, trade or sector.

Insurance

The group insurance plan (medications, illness, disability, death) is fully paid by employers. Workers (and their families, as the case may be) are eligible for it so long as they remain active in the construction industry and work the required number of hours, whether or not they change employer.

Physical requirements

The lineman occupation involves specific physical requirements. The lineman must:

- be physically strong;
- demonstrate manual dexterity and good coordination;
- be able to adapt to weather changes;
- be in good physical condition.

Obviously, linemen must not be subject to vertigo, because they have to climb structures of up to 25 metres for distribution lines, 75 metres for transmission lines and 175 metres for communication networks.

Work schedules

A 40-hour workweek from Monday to Friday is the general rule in all construction industry sectors. The daily limit is 8 hours a day, except in the light residential sector, where it can be up to 10 hours within a 40-hour week.

To avoid penalizing employers and employees experiencing special constraints, the industry's four collective agreements allow many possibilities for changing the schedule prescribed by the general rule: compressed schedule, schedule shift, make-up time in the light residential sector, etc. These special schedules confer good flexibility to the work schedules in effect in the construction industry.

According to the participants in the occupational analysis workshop, the work is usually done in the daytime. However, the schedule may be extended substantially in the event of malfunctions and emergencies caused by storms or accidents (black ice or cables breaking during excavation work, for example). In those circumstances, linemen have an intensive work schedule of up to 16 hours a day.

In the sector of communication networks and for some types of work, linemen may work at night, to reduce the number of persons affected by a power failure.

1.7 WORK ORGANIZATION

The work is assigned to teams specializing in the power transmission and distribution sectors (for example, one team is responsible for erecting structures, and another for putting conductors in place), whereas a single team does all the work in the telecommunication network sector.

1.8 JOB MARKET ENTRY CONDITIONS[5]

To obtain the competency certificate-occupation, it is necessary to:

- be at least 16 years of age;
- have successfully passed the course *Santé et sécurité générale sur les chantiers de construction*;
- have successfully passed the *Cours de connaissance générale de l'industrie de la construction* (CCGIC);

Moreover, certain qualities are sought by employers hiring new linemen. The following list presents the main qualities, in the order they were mentioned and not in order of importance:

- hold a class 3 driver's licence (straight truck) and preferably a class 1 licence (all heavy vehicles), for linemen installing poles;

5. Other conditions than those listed may apply. For a complete list of entry conditions for this occupation, see the Act respecting labour relations, vocational training and workforce management in the construction industry (R.S.Q., c. R-20). The CCQ's website may also be consulted: http://www.ccq.org/en/DevenirTravailleur/E_CertificatsCompetence.

- hold a diploma of vocational studies (DEP) – Montage de lignes électriques[6], for persons working in the sectors of distribution lines, power distribution stations and catenaries, power transmission lines and substations;

- be available and prepared to travel and stay away from home.

1.9 PLACE OF WOMEN IN THE OCCUPATION

Section 126.0.1 of the Act respecting labour relations, vocational training and workforce management in the construction industry pertains to women's access to the construction industry: "The Commission, after consultation with the Commission des droits de la personne et des droits de la jeunesse, shall develop measures to favour the access of women to and their maintenance and greater representation on the labour market in the construction industry."

According to the CCQ, no woman was practicing the lineman occupation in 2010, out of a total of 902 linemen.

According to the linemen attending the occupational analysis workshop, the absence of women may be explained by the persistence of sexist prejudice, the lack of sanitary facilities near the work, the necessary physical strength for performing the tasks, and the rarity of tools adapted to lessen physical effort.

1.10 CAREER PROSPECTS

With experience, linemen can become team leaders, crew leaders, foremen, superintendents and contractors.

6. Of the participants in the analysis workshop, six persons followed the vocational studies program for line work, and eight persons acquired the necessary qualifications in the workplace.

1.11 DEVELOPMENT OF THE OCCUPATION

In recent years, the occupation's development has been marked by substantially heightened requirements in occupational health and safety. Those requirements have resulted in, among other things, the arrival of new safety mechanisms, new work methods, and stricter work arrangements from clients, mainly Hydro-Québec.

Moreover, the frequency of optical fibre installations has accelerated in all construction sectors, which should substantially increase the volume of work for linemen who install those cables on distribution lines.

Lastly, new tools that perform better and are more suitable for the tasks to be performed, as well as new materials (such as synthetic sheaths and crossarms made of synthetic resin, for example), have appeared and modified work methods.

1.12 IMPACT OF ENVIRONMENTAL STANDARDS ON THE PRACTICE OF THE OCCUPATION

Tighter environmental standards have modified the work of linemen. The participants in the occupational analysis workshop give as examples the protective measures to be applied for erecting structures in wetlands or near streams, the recovery of contaminated soils after removal of old poles treated with products damaging to the environment, and the precautions to take when handling and disposing of transformer oils.

2. WORK DESCRIPTION

2.1 TASKS AND OPERATIONS

List of tasks

The following list presents the main tasks of linemen. The order in which the tasks are presented does not necessarily reflect their importance in the occupation.

Task 1	Erect a metal structure for a substation or a transmission line
Task 2	Erect a wooden structure for a transmission line or a distribution line
Task 3	Install, with the power off or near a live transmission line, the conductors of a transmission line
Task 4	Install, with the power off or near a live distribution line, the conductors of a distribution line
Task 5	Install or replace suspension cables and communication cables
Task 6	Install or replace an underground electric or communication cable
Task 7	Install or replace instrumentation for a substation
Task 8	Install or replace instrumentation on a distribution line
Task 9	Install or maintain a wireless communication system

The table of linemen's tasks and operations is presented in the following pages.

Table 2.1 Tasks and Operations

TASKS	OPERATIONS					
1 ERECT A METAL STRUCTURE FOR A SUBSTATION OR A TRANSMISSION LINE	1.1 Interpret the plan	1.2 Take safety measures	1.3 Plan the work	1.4 Assemble parts, sections or towers	1.5 Fasten the safety rope	1.6 Position the lifting equipment
	1.7 Participate in lifting operations	1.8 Attach guy wires to the anchors	1.9 Inspect the metal structure	1.10 Repaint a metal structure	1.11 Free up the work area	
2 ERECT A WOODEN STRUCTURE FOR A TRANSMISSION LINE OR A DISTRIBUTION LINE	2.1 Interpret the plan	2.2 Take safety measures	2.3 Plan the work	2.4 Plant poles	2.5 Frame or replace a structure, if applicable	2.6 Secure the guy wires
	2.7 Request the return of the working regime (régime de travail), if applicable	2.8 Free up the work area				
3 INSTALL, WITH THE POWER OFF OR NEAR A LIVE TRANSMISSION LINE, THE CONDUCTORS OF A TRANSMISSION LINE	3.1 Interpret the installation plan and specifications	3.2 Take safety measures	3.3 Assemble and raise insulators and pulleys	3.4 Install unwinding sites for the overhead ground wire(s) and optical fibre	3.5 Position the equipment	3.6 Install temporary grounds
	3.7 Fasten temporary protections, if applicable	3.8 Run the pull line	3.9 Check the communication system between cable pulling teams	3.10 Pull the overhead ground wire(s) and the optical fibre	3.11 Install the conductor unwinding site	3.12 Install temporary grounds
	3.13 Unwind the conductors	3.14 Turn the conductors off	3.15 Clamp the conductors	3.16 Turn the conductors off permanently at their end	3.17 Build and install jumpers between the two stops	3.18 Install dampers and spacers
	3.19 Conduct the final inspection	3.20 Remove temporary protections, temporary grounds and safety ropes	3.21 Request the return of the working regime (régime de travail), if applicable	3.22 Free up the work area		

TASKS	OPERATIONS					
4 INSTALL, WITH THE POWER OFF OR NEAR A LIVE DISTRIBUTION LINE, THE CONDUCTORS OF A DISTRIBUTION LINE	4.1 Interpret the installation plan and specifications	4.2 Take safety measures	4.3 Prepare temporary crossarms	4.4 Install unwinding sites	4.5 Run the pull line	4.6 Secure the conductor's temporary grounds
	4.7 Secure temporary protections to existing secondary lines	4.8 Pull the conductors on temporary crossarms	4.9 Raise the conductors to the top of the pole	4.10 Put the cables under mechanical tension	4.11 Turn the conductor off permanently	4.12 Make the connections
	4.13 Clamp the conductor or attach it	4.14 Install permanent grounds, if applicable	4.15 Conduct the final inspection	4.16 Remove temporary installations	4.17 Request the return of the working regime (régime de travail), if applicable	4.18 Free up the work area
5 INSTALL OR REPLACE SUSPENSION CABLES AND COMMUNICATION CABLES	5.1 Interpret the installation plan and specifications	5.2 Take safety measures	5.3 Install the guy wire	5.4 Fasten the suspension cable	5.5 Put the suspension cable under mechanical tension	5.6 Install permanent grounds
	5.7 Install the pulleys and pull line	5.8 Lay out the reels	5.9 Unwind the suspension cable	5.10 Unwind the communication cable	5.11 Tie the communication cable to the suspension cable	5.12 Prepare communication cables for splicing work
	5.13 Free up the work area					

TASKS	OPERATIONS					
6 INSTALL OR REPLACE AN UNDERGROUND ELECTRIC OR COMMUNICATION CABLE	6.1 Interpret the installation plan and specifications	6.2 Take safety measures	6.3 Request a restraint regime (régime de retenue)	6.4 Test the air quality	6.5 Open the manhole	6.6 Install a water pump and pump, if applicable
	6.7 Check the premises' condition and safety	6.8 Introduce the cable or the mickey mouse plug	6.9 Clean a new conduit, if applicable	6.10 Attach the cable-pulling rope	6.11 Lay out the reels	6.12 Unwind and pull the cables
	6.13 Cut the cables and identify them	6.14 Cap the cables	6.15 Place the cables on brackets and in the access shaft	6.16 Close the manhole	6.17 Request the return of the restraint regime (régime de retenue)	6.18 Free up the work area
7 INSTALL OR REPLACE INSTRUMENTATION FOR A SUBSTATION	7.1 Interpret the station's plan and the specifications of the construction standard	7.2 Take safety measures	7.3 Install power transformers	7.4 Install or replace disconnect switches	7.5 Install or replace circuit breakers	7.6 Install and replace auxiliary service transformers
	7.7 Install and replace the measuring equipment	7.8 Install and replace capacitor batteries	7.9 Make connections between conductors and busbars	7.10 Install SF_6 gas equipment	7.11 Request the return of the working regime (régime de travail)	7.12 Free up the work area
8 INSTALL OR REPLACE INSTRUMENTATION ON A DISTRIBUTION LINE	8.1 Interpret the overhead line network plan and the specifications of the overhead network's construction standard	8.2 Take safety measures	8.3 Install a circuit breaker and lightning arrestor	8.4 Install one or three transformers	8.5 Make a low voltage hook-up	8.6 Install a negative or positive booster, if applicable
	8.7 Install the unipolar or tripolar circuit breaker instrumentation	8.8 Install a unipolar or tripolar disconnect switch	8.9 Install a resettable circuit breaker	8.10 Install a capacitor or regulator, if applicable	8.11 Transfer the street lighting	8.12 Free up the work area

TASKS	OPERATIONS					
9 INSTALL OR MAINTAIN A WIRELESS COMMUNICATION SYSTEM	9.1 Interpret the plans and specifications	9.2 Take safety measures	9.3 Assemble the tower	9.4 Erect the tower	9.5 Adjust the tower	9.6 Ground the tower
	9.7 Conduct the final inspection	9.8 Install the tower lighting	9.9 Install the shelter on the ground	9.10 Install the antennae	9.11 Test and align the antennae	9.12 Perform system maintenance
	9.13 Free up the work area					

2.2 OPERATIONS, SUB-OPERATIONS AND CLARIFICATIONS

The following pages present sub-operations associated with certain operations, as well as a few clarifications made by the participants.

Table 2.2 Sub-Operations and Operation Clarifications

TASK 1 ERECT A METAL STRUCTURE FOR A SUBSTATION OR A TRANSMISSION LINE

Operations	Sub-Operations	Clarifications
Linemen assemble and install standard towers, waist-type towers, guyed-V towers, tubular towers and daisy-chained guyed towers.		
1.1 Interpret the plan	1.1.1 Learn about the plan 1.1.2 Check the assembly sequence	
1.2 Take safety measures	1.2.1 Participate in safety meetings	
1.3 Plan the work	1.3.1 Prepare the tools 1.3.2 Do the parts inventory 1.3.3 Classify the angle irons by number 1.3.4 Check quantities etc.	
1.4 Assemble parts, sections or towers	1.4.1 Proceed with bolt assembly on the ground 1.4.2 Perform the tightening torques 1.4.3 Check the assembly	
1.5 Fasten the safety rope		
1.6 Position the lifting equipment	1.6.1 Delimit the work area 1.6.2 Install temporary grounds on lifting equipment 1.6.3 Consult the lifting chart regarding the loads to be lifted 1.6.4 Request the installation of the crane locking system, if applicable	

TASK 1	ERECT A METAL STRUCTURE FOR A SUBSTATION OR A TRANSMISSION LINE			
Operations		**Sub-Operations**		**Clarifications**
1.7	Participate in lifting operations	1.7.1 1.7.2 1.7.3 1.7.4 1.7.5	Install a temporary ground on the structure Coordinate with the crane operator Attach the structure to the crane hook Install guy wires on the structure Orient the faces (A, B, C, D or 1, 2, 3, 4)	
1.8	Attach guy wires to the anchors			This operation applies to transmission lines only.
1.9	Inspect the metal structure	1.9.1 1.9.2 1.9.3 1.9.4	Check the bolts' length Check the bolts' orientation Check the tightening torques Make corrections	
1.10	Repaint a metal structure	1.10.1 1.10.2 1.10.3	Sand the structure Prepare the paint Paint the structure	
1.11	Free up the work area			

TASK 2	ERECT A WOODEN STRUCTURE FOR A TRANSMISSION LINE OR A DISTRIBUTION LINE			
Operations		**Sub-Operations**		**Clarifications**
Linemen install individual poles or portal structures.				
2.1	Interpret the plan			
2.2	Take safety measures	2.2.1 2.2.2 2.2.3	Participate in safety meetings Check the terrain conditions Determine the applicable working regime (régime de travail)	
2.3	Plan the work			

TASK 2 ERECT A WOODEN STRUCTURE FOR A TRANSMISSION LINE OR A DISTRIBUTION LINE

Operations	Sub-Operations	Clarifications
2.4 Plant poles	2.4.1 Locate the planting site 2.4.2 Dig holes 2.4.3 Drill and dynamite, if necessary[7] 2.4.4 Install guy wire anchors 2.4.5 Install an anchoring mechanism on the rock 2.4.6 Install a pole caisson 2.4.7 Install a base plate according to the type of soil 2.4.8 Ground the equipment, machinery and pole (live-line work) 2.4.9 Secure the counterweight or ground 2.4.10 Install a protector on the pole, if necessary (live-line work) 2.4.11 Lift the pole and insert it in the hole 2.4.12 Adjust the pole's height 2.4.13 Backfill 2.4.14 Compact the soil 2.4.15 Level and vertically position the pole 2.4.16 Restore the soil to the natural terrain 2.4.17 Perform a compaction test	A blaster's safety certificate is required for doing dynamiting work. Securing the counterweight or ground applies to transmission lines.
2.5 Frame or replace a structure, if applicable	2.5.1 Remove damaged elements (pole, crossarm, etc.) 2.5.2 Install insulators and pulleys 2.5.3 Raise the crossarm with: • a winch • a crane • a bucket 2.5.4 Install the spider(s) 2.5.5 Link the counterweight to metal parts	This operation applies to the erection of portal structures only.
2.6 Secure the guy wires	2.6.1 Run the cable 2.6.2 Put the cable under mechanical tension 2.6.3 Secure the cable	

7. The CCQ's Direction de l'application des conventions collectives has published a notice that drilling and dynamiting belong to the driller and blaster occupations, respectively.

TASK 2 ERECT A WOODEN STRUCTURE FOR A TRANSMISSION LINE OR A DISTRIBUTION LINE

Operations	Sub-Operations	Clarifications
2.7 Request the return of the working regime (régime de travail), if applicable		
2.8 Free up the work area		

TASK 3 INSTALL, WITH THE POWER OFF OR NEAR A LIVE TRANSMISSION LINE, THE CONDUCTORS OF A TRANSMISSION LINE

Operations	Sub-Operations	Clarifications
3.1 Interpret the installation plan and specifications		
3.2 Take safety measures	3.2.1 Participate in safety meetings 3.2.2 Fill the checklist of safety measures according to the applicable working regime (régime de travail) 3.2.3 Plan the work 3.2.4 Delimit approach distances when work is near a live line	
3.3 Assemble and raise insulators and pulleys		
3.4 Install unwinding sites for the overhead ground wire(s) and optical fibre		
3.5 Position the equipment	3.5.1 Install the device for pulling the overhead ground wire 3.5.2 Install the device for putting the optical fibre under mechanical tension	
3.6 Install temporary grounds	3.6.1 Link the equipment, equipotentiality grids, unwinding site and anchors	

TASK 3	INSTALL, WITH THE POWER OFF OR NEAR A LIVE TRANSMISSION LINE, THE CONDUCTORS OF A TRANSMISSION LINE			
Operations		**Sub-Operations**		**Clarifications**
3.7	Fasten temporary protections, if applicable	3.7.1 3.7.2 3.7.3	Install pole crossarms for temporary protection of a distribution line, railroad, etc. Install a dead-front shield on a distribution line's conductors Install an insulated cable, if applicable	
3.8	Run the pull line			
3.9	Check the communication system between cable pulling teams			
3.10	Pull the overhead ground wire(s) and the optical fibre	3.10.1 3.10.2 3.10.3 3.10.4	Make the joints on the overhead ground wire Put the overhead ground wire and the optical fibre under mechanical tension Clamp the overhead ground wire and the optical fibre Shut down the overhead ground wire and the optical fibre	
3.11	Install the conductor unwinding site	3.11.1	Position the equipment	
3.12	Install temporary grounds	3.12.1	Link the equipment, equipotentiality grids, unwinding site and anchors	
3.13	Unwind the conductors	3.13.1 3.13.2 3.13.3 3.13.4	Recheck radio communication between cable pulling teams Proceed with pulling conductors Make the joints on conductors Temporarily shut down the conductors at both ends	
3.14	Turn the conductors off	3.14.1 3.14.2	Permanently shut down the conductor at one end Put the conductor under mechanical tension and do the sagging	

TASK 3 INSTALL, WITH THE POWER OFF OR NEAR A LIVE TRANSMISSION LINE, THE CONDUCTORS OF A TRANSMISSION LINE

Operations	Sub-Operations	Clarifications
3.15 Clamp the conductors		
3.16 Turn the conductors off permanently at their end		
3.17 Build and install jumpers between the two stops		
3.18 Install dampers and spacers		
3.19 Conduct the final inspection		
3.20 Remove temporary protections, temporary grounds and safety ropes		The removed safety ropes were installed in operation 1.5 of task 1.
3.21 Request the return of the working regime (régime de travail), if applicable		
3.22 Free up the work area		

TASK 4 INSTALL, WITH THE POWER OFF OR NEAR A LIVE DISTRIBUTION LINE, THE CONDUCTORS OF A DISTRIBUTION LINE

Operations	Sub-Operations	Clarifications
4.1 Interpret the installation plan and specifications		
4.2 Take safety measures	4.2.1 Participate in the safety meeting 4.2.2 Determine the applicable working regime (régime de travail) 4.2.3 Delimit the work area 4.2.4 Plan for the signs	

TASK 4 INSTALL, WITH THE POWER OFF OR NEAR A LIVE DISTRIBUTION LINE, THE CONDUCTORS OF A DISTRIBUTION LINE

Operations	Sub-Operations	Clarifications
4.3 Prepare temporary crossarms	4.3.1 Prepare the materials 4.3.2 Place the drive cable 4.3.3 Install a cable-pulling rope in the pulleys	This operation is performed for work near a live distribution line.
4.4 Install unwinding sites		
4.5 Run the pull line	4.5.1 Install the kellem grip to pull the cable 4.5.2 Pull the cable	
4.6 Install the conductor's temporary grounds		
4.7 Secure temporary protections to existing secondary lines		This operation is performed for work near a live distribution line.
4.8 Pull the conductors on temporary crossarms	4.8.1 Make the joints on conductors 4.8.2 Cut the conductors 4.8.3 Secure the conductors to the first and last pole 4.8.4 Make sure pulling operations proceed well	
4.9 Raise the conductors to the top of the pole	4.9.1 Obtain a work authorization 4.9.2 Lift the conductors	
4.10 Put the cables under mechanical tension		
4.11 Turn the conductor off permanently		
4.12 Make the connections	4.12.1 Install a jumper 4.12.2 Connect the conductor to the instrumentation	
4.13 Clamp the conductor or attach it		

TASK 4 INSTALL, WITH THE POWER OFF OR NEAR A LIVE DISTRIBUTION LINE, THE CONDUCTORS OF A DISTRIBUTION LINE

Operations	Sub-Operations	Clarifications
4.14 Install permanent grounds, if applicable		
4.15 Conduct the final inspection		
4.16 Remove temporary installations	4.16.1 Remove temporary crossarms 4.16.2 Remove temporary protections	This operation is performed for work near a live distribution line.
4.17 Request the return of the working regime (régime de travail), if applicable		
4.18 Free up the work area		

TASK 5 INSTALL OR REPLACE SUSPENSION CABLES AND COMMUNICATION CABLES

Operations	Sub-Operations	Clarifications
The communication cables installed by linemen are copper cables, coaxial cables or fibre optic cables.		
5.1 Interpret the installation plan and specifications		
5.2 Take safety measures	5.2.1 Participate in safety meetings 5.2.2 Check the communication system 5.2.3 Detect dangers 5.2.4 Plan for the signs	
5.3 Install the guy wire	5.3.1 Cut the guy wire 5.3.2 Put the guy wire under mechanical tension 5.3.3 Attach the guy wire 5.3.4 Install a protector on the guy wire	
5.4 Fasten the suspension cable	5.4.1 Drill a hole 5.4.2 Install a bolt 5.4.3 Thread the suspension cable 5.4.4 Identify the suspension cable	

TASK 5 INSTALL OR REPLACE SUSPENSION CABLES AND COMMUNICATION CABLES

Operations	Sub-Operations	Clarifications
5.5 Put the suspension cable under mechanical tension		
5.6 Install permanent grounds		
5.7 Install the pulleys and pull line		
5.8 Lay out the reels	5.8.1 Place the reels at the appropriate locations 5.8.2 Install the kellem grip	
5.9 Unwind the suspension cable	5.9.1 Place the cable on the pulley 5.9.2 Pull the cable 5.9.3 Leave cable links for maintenance work	
5.10 Unwind the communication cable		
5.11 Tie the communication cable to the suspension cable	5.11.1 Attach the cable with pliers 5.11.2 Secure collar spacers 5.11.3 Identify the cable by the telecommunication company's name 5.11.4 Install mechanical protection on the cable	
5.12 Prepare communication cables for splicing work	5.12.1 Identify the cables 5.12.2 Place the cables for the workers responsible for splicing 5.12.3 Note the information	
5.13 Free up the work area	5.13.1 Store the tools and materials 5.13.2 Pick up the debris 5.13.3 Remove the signs 5.13.4 Fill out a time sheet	

TASK 6 INSTALL OR REPLACE AN UNDERGROUND ELECTRIC OR COMMUNICATION CABLE

Operations	Sub-Operations	Clarifications
6.1 Interpret the installation plan and specifications		
6.2 Take safety measures	6.2.1 Participate in safety meetings 6.2.2 Check the communication system 6.2.3 Detect dangers 6.2.4 Plan for the signs 6.2.5 Validate the emergency measures	
6.3 Request a restraint regime (régime de retenue)	6.3.1 Communicate with the client 6.3.2 Collect information on the structure's characteristics 6.3.3 Obtain authorization to open the shaft 6.3.4 Record the information on work in enclosed spaces	
6.4 Test the air quality		The purpose of the test is to ensure that there is no dangerous gas.
6.5 Open the manhole	6.5.1 Install the guardrail 6.5.2 Position the ladder 6.5.3 Put the tarpaulin in place	
6.6 Install a water pump and pump, if applicable		
6.7 Check the premises' condition and safety	6.7.1 Ventilate the hole 6.7.2 Repeat the gas test 6.7.3 Inspect the structure 6.7.4 Detect electrical dangers	
6.8 Introduce the cable or the mickey mouse plug		
6.9 Clean a new conduit, if applicable		Cleaning is done on new conduits that have no cables inside them (otherwise the cables would be damaged).

TASK 6 INSTALL OR REPLACE AN UNDERGROUND ELECTRIC OR COMMUNICATION CABLE

Operations	Sub-Operations	Clarifications
6.10 Attach the cable-pulling rope		
6.11 Lay out the reels		
6.12 Unwind and pull the cables		
6.13 Cut the cables and identify them		
6.14 Cap the cables		
6.15 Place the cables on brackets and in the access shaft		
6.16 Close the manhole		
6.17 Request the return of the restraint regime (régime de retenue)		
6.18 Free up the work area		

TASK 7 INSTALL OR REPLACE INSTRUMENTATION FOR A SUBSTATION

Operations	Sub-Operations	Clarifications
7.1 Interpret the station's plan and the specifications of the construction standard		
7.2 Take safety measures	7.2.1 Participate in safety meetings 7.2.2 Delimit the work area 7.2.3 Request a work authorization	

TASK 7 INSTALL OR REPLACE INSTRUMENTATION FOR A SUBSTATION

Operations		Sub-Operations		Clarifications
7.3	Install power transformers	7.3.1	Unpack the materials	
		7.3.2	Install components: • radiators • crossarms • etc.	
		7.3.3	Install lightning arrestors	
		7.3.4	Install the tank and piping	
		7.3.5	Vacuumize the tank	
		7.3.6	Put oil	
		7.3.7	Check for leaks	
		7.3.8	Do the permanent grounding	
7.4	Install or replace disconnect switches	7.4.1	Install the structures	The disconnect switches may be synchronized manually or electrically.
		7.4.2	Proceed with the assembly	
		7.4.3	Install linkages	
		7.4.4	Synchronize the disconnect switches	
		7.4.5	Clean and lubricate the disconnect switches	
		7.4.6	Do the permanent grounding	
7.5	Install or replace circuit breakers	7.5.1	Unpack the materials	
		7.5.2	Prepare and clean the parts	
		7.5.3	Assemble and install the structure	
		7.5.4	Install columns (vertical shores)	
		7.5.5	Participate in synchronizing circuit breaker phases	
		7.5.6	Install sets of bars	
		7.5.7	Clean and lubricate the circuit breakers	
		7.5.8	Do the permanent grounding	
7.6	Install and replace auxiliary service transformers	7.6.1	Prepare the structure	
		7.6.2	Put the transformers in place	
		7.6.3	Install fuse holders or a unipolar circuit breaker	
		7.6.4	Make an oil change, if applicable	
		7.6.5	Do the permanent grounding	
7.7	Install and replace the measuring equipment	7.7.1	Prepare and install the structure	
		7.7.2	Put current transformers in place	
		7.7.3	Put voltage transformers in place	
		7.7.4	Make an oil change on a current transformer, if applicable	
		7.7.5	Do the permanent grounding	

TASK 7 INSTALL OR REPLACE INSTRUMENTATION FOR A SUBSTATION

Operations	Sub-Operations	Clarifications
7.8 Install and replace capacitor batteries	7.8.1 Assemble and install the steel structure 7.8.2 Put capacitor banks in place 7.8.3 Put inductors in place 7.8.4 Do the permanent grounding	
7.9 Make connections between conductors and busbars	7.9.1 Prepare, clean and lubricate the fittings 7.9.2 Fold and adjust the busbars 7.9.3 Bolt the fittings with the torque wrench 7.9.4 Check the connections	
7.10 Install SF_6 gas equipment	7.10.1 Assemble the equipment, if applicable 7.10.2 Put the equipment in place 7.10.3 Do the permanent grounding	Assembly is required for equipment of 125 kV and over.
7.11 Request the return of the working regime (régime de travail)		
7.12 Free up the work area		

TASK 8 INSTALL OR REPLACE INSTRUMENTATION ON A DISTRIBUTION LINE

Operations	Sub-Operations	Clarifications
8.1 Interpret the overhead line network plan and the specifications of the overhead network's construction standard		
8.2 Take safety measures	8.2.1 Participate in safety meetings 8.2.2 Read the safety measures sheet 8.2.3 Delimit the work area 8.2.4 Allocate the tasks	
8.3 Install a circuit breaker and lightning arrestor	8.3.1 Install a circuit breaker over the transformer 8.3.2 Install a lightning arrestor on a transformer 8.3.3 Install a lightning arrestor on a cable end	

TASK 8 INSTALL OR REPLACE INSTRUMENTATION ON A DISTRIBUTION LINE

Operations		Sub-Operations		Clarifications
8.4	Install one or three transformers	8.4.1	Install the mounting bracket for a set of transformers	
		8.4.2	Lift the transformer(s)	
		8.4.3	Secure the transformer(s) to the poles	
		8.4.4	Make the connections	
		8.4.5	Do the permanent grounding	
8.5	Make a low voltage hook-up	8.5.1	Install the conductor up to the building	Sub-operation 8.5.4 applies to a parallel connection. This type of connection is rare.
		8.5.2	Connect the conductor to the line neutral and low voltage	
		8.5.3	Measure the rotational frequency and the voltage at transformer outputs	
		8.5.4	Check if the same conductors are interconnected	
8.6	Install a negative or positive booster, if applicable	8.6.1	Install supports for the positive or negative booster	
		8.6.2	Lift the positive or negative booster	
		8.6.3	Secure the positive or negative booster to the supports	
		8.6.4	Make the connections	
		8.6.5	Do the permanent grounding	
8.7	Install the unipolar or tripolar short-circuit instrumentation	8.7.1	Install the fuse in the fuse holder	
		8.7.2	Install the mechanical hot tap	
		8.7.3	Install a wedge-type connector	
8.8	Install a unipolar or tripolar disconnect switch	8.8.1	Secure a metal support for a unipolar disconnect switch	
		8.8.2	Install a crossarm for a tripolar disconnect switch	
		8.8.3	Secure the disconnect switch to the support or crossarm	
		8.8.4	Make the connections	
		8.8.5	Do the permanent grounding	
8.9	Install a resettable circuit breaker	8.9.1	Lift the circuit breaker	This operation applies only to private electric networks.
		8.9.2	Secure the circuit breaker to the pole	
		8.9.3	Make the connections	
		8.9.4	Do the permanent grounding	

TASK 8 INSTALL OR REPLACE INSTRUMENTATION ON A DISTRIBUTION LINE

Operations	Sub-Operations	Clarifications
8.10 Install a capacitor or regulator, if applicable	8.10.1 Secure the support between poles 8.10.2 Lift the capacitor or regulator 8.10.3 Secure the capacitor or regulator 8.10.4 Make the connections 8.10.5 Do the permanent grounding	
8.11 Transfer the street lighting	8.11.1 Undo the connections 8.11.2 Dismantle the lighting fixture's mast 8.11.3 Install the lighting fixture's mast on the new pole 8.11.4 Redo the connections	
8.12 Free up the work area		

TASK 9 INSTALL OR MAINTAIN A WIRELESS COMMUNICATION SYSTEM

Operations	Sub-Operations	Clarifications
Linemen assemble and install freestanding lattice and tubular towers as well as guyed towers. The installation is performed on the ground and on rooftops. Those installations may be performed in remote areas or in locations difficult to access.		
9.1 Interpret the plans and specifications		
9.2 Take safety measures	9.2.1 Participate in safety meetings 9.2.2 Allocate the tasks	
9.3 Assemble the tower	9.3.1 Identify the section's assembly parts 9.3.2 Proceed with the assembly: • sections • ladder • safety rail	The tower should be assembled as much as possible before it is erected.

TASK 9 INSTALL OR MAINTAIN A WIRELESS COMMUNICATION SYSTEM

Operations	Sub-Operations	Clarifications
9.4 Erect the tower	***For free-standing angular and tubular towers*** 9.4.1 Coordinate with the crane operator: • weight • wind speed 9.4.2 Proceed with lifting ***For free-standing guyed towers*** 9.4.3 Assemble the gin pole 9.4.4 Check and install the hydraulic winch 9.4.5 Place the sections upright with the crane truck 9.4.6 Install the first level of guy wires 9.4.7 Check verticality and tension 9.4.8 Place the gin pole on the side of the tower with the crane truck 9.4.9 Place the next tower's section with the gin pole 9.4.10 Lift again the gin pole with the winch 9.4.11 Repeat the operations up to the required height 9.4.12 Bring the gin pole back down	
9.5 Adjust the tower	9.5.1 Place a transit at each line of guy wires 9.5.2 Check the oscillation 9.5.3 Adjust the tower's verticality and torsion by means of guy wire turnbuckles 9.5.4 Adjust the guy wires' tension according to their length, gauge and temperature	
9.6 Ground the tower	9.6.1 Ground the structure 9.6.2 Install lightning rods 9.6.3 Ground the guy wires	
9.7 Conduct the final inspection	9.7.1 Check and correct bolt tightening 9.7.2 Finish installing the ladder and safety rail	
9.8 Install the tower lighting	9.8.1 Install aviation beacons at the top and middle of the tower 9.8.2 Lift the shielded cable (Teck cable) and connect it 9.8.3 Ground the shielded cable 9.8.4 Activate the beacons 9.8.5 Check the beacons' operation	

TASK 9 INSTALL OR MAINTAIN A WIRELESS COMMUNICATION SYSTEM

Operations	Sub-Operations	Clarifications
9.9 Install the shelter on the ground	9.9.1 Place the shelter with the crane truck 9.9.2 Install conduits for the conductors and optical fibre 9.9.3 Ground the shelter	
9.10 Install the antennae[8]	9.10.1 Place the antenna supports 9.10.2 Put iceguards in place 9.10.3 Assemble the antennae 9.10.4 Put the antennae in place 9.10.5 Lift the communication cables 9.10.6 Secure the communication cables 9.10.7 Do the grounding	
9.11 Test and align the antennae	9.11.1 Proceed with a preliminary alignment of the antennae by means of a compass 9.11.2 Proceed with the final alignment of the antennae with a radio technician 9.11.3 Check communication cables 9.11.4 Lock the antennae	
9.12 Perform system maintenance	9.12.1 Reinforce the tower 9.12.2 Replace the guy wires 9.12.3 Replace the antennae 9.12.4 Replace the cables 9.12.5 Redo the grounds	
9.13 Free up the work area		

8. The CCQ's Direction de l'application des conventions collectives has published a notice that ironworkers are responsible for mounting and assembling all iron and steel elements involved in the construction of radio and television transmitter antennae.

2.3 ACHIEVEMENT CONDITIONS AND PERFORMANCE CRITERIA

2.3.1 Achievement Conditions

Data on achievement conditions were collected for the lineman occupation. The data pertain to aspects such as work areas, levels of collaboration, work instructions, reference documents consulted, material resources used, and health and safety hazards.

Table 2.3 Achievement Conditions

TASK 1 ERECT A METAL STRUCTURE FOR A SUBSTATION OR A TRANSMISSION LINE

ACHIEVEMENT CONDITIONS
Work areas On the construction site. Outdoors.
Level of collaboration In a team. Under the supervision of the construction manager.
Instructions and references Based on plans, estimates, technical specifications, and instructions from the contractor and the client. According to the standards of Hydro-Québec or the client.
Health and safety hazards In a context involving risks: • related to heavy loads; • of electrocution; • of electrification; • related to electric arcs; • of personal falls; • of falling objects; • related to weather conditions; • of cuts.

TASK 2 ERECT A WOODEN STRUCTURE FOR A TRANSMISSION LINE OR A DISTRIBUTION LINE

ACHIEVEMENT CONDITIONS
Work areas On the construction site. Outdoors.
Level of collaboration In a team. Under the supervision of the construction manager.
Instructions and references Based on plans, estimates, technical specifications, and instructions from the contractor and the client. According to the standards of Hydro-Québec or the client.
Health and safety hazards In a context involving risks: • related to heavy loads; • of electrocution; • of electrification; • related to electric arcs; • of personal falls; • of falling objects; • related to weather conditions; • of cuts; • of burns; • of particle projections during drilling; • related to dynamiting; • of being hit by vehicles.

TASK 3 INSTALL, WITH THE POWER OFF OR NEAR A LIVE TRANSMISSION LINE, THE CONDUCTORS OF A TRANSMISSION LINE

ACHIEVEMENT CONDITIONS
Work areas On the construction site. Outdoors.
Level of collaboration In a team. Under the supervision of the construction manager.
Instructions and references Based on plans, estimates, technical specifications, and instructions from the contractor and the client. According to the standards of Hydro-Québec or the client. According to grounding and equipotentiality standards.
Health and safety hazards In a context involving risks: • related to heavy loads; • of electrocution; • of electrification; • related to electric arcs; • of personal falls; • of falling objects; • related to weather conditions; • of cuts; • of burns.

TASK 4 INSTALL, WITH THE POWER OFF OR NEAR A LIVE DISTRIBUTION LINE, THE CONDUCTORS OF A DISTRIBUTION LINE

ACHIEVEMENT CONDITIONS
Work areas On the construction site. Outdoors.
Level of collaboration In a team. Under the supervision of the construction manager.
Instructions and references Based on plans, estimates, technical specifications, and instructions from the contractor and the client. According to the standards of Hydro-Québec or the client.
Health and safety hazards In a context involving risks: • related to heavy loads; • of electrocution; • of electrification; • related to electric arcs; • related to the presence of animals (bites); • of personal falls; • of falling objects; • related to weather conditions; • of cuts; • of burns; • of being hit by vehicles; • related to relations with homeowners (neighbourhood).

TASK 5 INSTALL OR REPLACE SUSPENSION CABLES AND COMMUNICATION CABLES

ACHIEVEMENT CONDITIONS
Work areas On the construction site. Outdoors.
Level of collaboration In a team. Under the supervision of the construction manager.
Instructions and references Based on plans, estimates, technical specifications and instructions from the contractor. According to the standards of the communication network operator.
Health and safety hazards In a context involving risks: • related to heavy loads; • of electrocution; • of electrification; • related to electric arcs; • of personal falls; • of falling objects; • related to weather conditions; • of cuts; • of burns; • of being hit by vehicles; • related to relations with homeowners (neighbourhood).

TASK 6 INSTALL OR REPLACE AN UNDERGROUND ELECTRIC OR COMMUNICATION CABLE

ACHIEVEMENT CONDITIONS
Work areas On the construction site. Indoors. In enclosed spaces.
Level of collaboration In a team. Under the supervision of the construction manager.
Instructions and references Based on plans, estimates, technical specifications and instructions from the contractor. According to the standards of Hydro-Québec or the underground electric cable operator. According to the standards of the communication network operator. According to mandreling sheets[9].
Health and safety hazards In a context involving risks: • related to heavy loads; • related to work in enclosed spaces; • related to the presence of gases; • of electrocution; • of electrification; • related to electric arcs; • of personal falls; • of falling objects; • related to weather conditions; • of cuts; • of burns; • bacteriological; • of being hit by vehicles.

9. Mandreling consists of freeing conduits from concrete deposits and debris left during construction, and of checking the conduits' diameter by means of brushes and mandrels (Office québécois de la langue française).

TASK 7 INSTALL OR REPLACE INSTRUMENTATION FOR A SUBSTATION

ACHIEVEMENT CONDITIONS
Work areas On the construction site. Outdoors and indoors.
Level of collaboration In a team. Under the supervision of the construction manager.
Instructions and references Based on plans, estimates, technical specifications and instructions from the contractor. According to the standards of Hydro-Québec or the client.
Health and safety hazards In a context involving risks: • related to heavy loads; • of electrocution; • of electrification; • related to electric arcs; • of personal falls; • of falling objects; • related to weather conditions; • of cuts; • of burns.

TASK 8 INSTALL OR REPLACE INSTRUMENTATION ON A DISTRIBUTION LINE

ACHIEVEMENT CONDITIONS
Work areas On the construction site. Outdoors.
Level of collaboration In a team. Under the supervision of the construction manager.
Instructions and references Based on plans, estimates, technical specifications and instructions from the contractor. According to the standards of Hydro-Québec or the client.
Health and safety hazards In a context involving risks: • related to heavy loads; • of electrocution; • of electrification; • related to electric arcs; • of personal falls; • of falling objects; • related to weather conditions; • of cuts; • of burns.

TASK 9 INSTALL OR MAINTAIN A WIRELESS COMMUNICATION SYSTEM

ACHIEVEMENT CONDITIONS
Work areas On the construction site. Outdoors.
Level of collaboration In a team. Under the supervision of the team leader or foreman.
Instructions and references Based on estimates, technical specifications and instructions from the contractor. According to the client's standards.
Health and safety hazards In a context involving risks: • related to heavy loads; • of personal falls; • of falling objects; • related to weather conditions; • from lightning; • from exposure to electromagnetic radiation; • of cuts; • of burns.

2.3.2 Performance Criteria

Performance criteria were gathered for each task. They are used for assessing whether the tasks were performed satisfactorily. The criteria pertain to aspects such as the quantity and quality of work done, the observance of a work procedure, the attitudes adopted, etc.

To draw the list of criteria for each task, the participants worked in teams. Their results were then collected and presented in full session.

Table 2.4 Performance Criteria

TASK 1	**ERECT A METAL STRUCTURE FOR A SUBSTATION OR A TRANSMISSION LINE**
Performance Criteria	
Correct interpretation of the plan	Verticality and sturdiness of structures
Wearing personal protective equipment	Observance of tightening torques
Appropriate choice and use of tools	Meeting the standards of Hydro-Québec or the client
Appropriate verification and calibration of torque wrenches	Observance of occupational health and safety rules
TASK 2	**ERECT A WOODEN STRUCTURE FOR A TRANSMISSION LINE OR A DISTRIBUTION LINE**
Performance Criteria	
Correct interpretation of the plan	Correct installation of the counterweight
Wearing personal protective equipment	Appropriate tension of guy wires
Appropriate choice and use of tools	No insulator failure
Verticality of poles	Meeting rules for uncluttering the conductors
Sturdy installation	Meeting pole installation standards
Horizontal crossarms	Meeting the standards of Hydro-Québec or the client
Correct soil compaction	Observance of lockout procedures
Meeting hole-depth standards	Observance of occupational health and safety rules

TASK 3	**INSTALL, WITH THE POWER OFF OR NEAR A LIVE TRANSMISSION LINE, THE CONDUCTORS OF A TRANSMISSION LINE**
Performance Criteria	
Correct interpretation of the plan and specifications	No insulator failure
Wearing personal protective equipment	Observance of tightening torques
Appropriate choice and use of tools	Meeting grounding standards
Appropriate use of unwinding devices	Observance of charges
Adequate protection of distribution lines and paths crossed by the transmission line	Meeting the standards of Hydro-Québec or the client
Solid installation of conductors	Observance of lockout procedures
Solid connections	Observance of occupational health and safety rules
No conductor failure	
TASK 4	**INSTALL, WITH THE POWER OFF OR NEAR A LIVE DISTRIBUTION LINE, THE CONDUCTORS OF A DISTRIBUTION LINE**
Performance Criteria	
Correct interpretation of the plan and specifications	No insulator failure
Wearing personal protective equipment	Observance of tightening torques
Appropriate choice and use of tools	Meeting grounding standards
Appropriate use of unwinding devices	Meeting the standards of Hydro-Québec or the client
Solid installation of conductors	Observance of lockout procedures
Solid connections	Observance of occupational health and safety rules
No conductor failure	
TASK 5	**INSTALL OR REPLACE SUSPENSION CABLES AND COMMUNICATION CABLES**
Performance Criteria	
Correct interpretation of the plan and specifications	No communication cable failure
Wearing personal protective equipment	Compliant tension of the binding wire
Appropriate choice and use of tools	Observance of distances (clearance)
Appropriate use of unwinding devices	Meeting the standards of the communication network operator
Compliant installation of suspension cables and communication cables	Observance of occupational health and safety rules
No failure in the suspension cables or binding wire	

TASK 6	**INSTALL OR REPLACE AN UNDERGROUND ELECTRIC OR COMMUNICATION CABLE**
Performance Criteria	
Correct interpretation of the plan and specifications	No failure with the electric cables
Wearing personal protective equipment	No communication cable failure
Appropriate choice and use of tools	Correct identification of cables
Correct and safe execution of gas tests	Meeting the standards of Hydro-Québec or the client
Solid installation of conductors	Meeting the standards of the communication network operator
Meeting cable pulling standards	Observance of occupational health and safety rules
TASK 7	**INSTALL OR REPLACE INSTRUMENTATION FOR A SUBSTATION**
Performance Criteria	
Correct interpretation of the station's plan and the construction standard's specifications	No insulator failure
Wearing personal protective equipment	Observance of approach distances
Appropriate choice and use of tools	Observance of tightening torques
Solid assembly of instrumentation	Meeting grounding standards
Bending sets of bars precisely	Meeting the standards of Hydro-Québec or the client
Aligning and levelling sets of bars precisely	Observance of lockout procedures
No conductor failure	Observance of occupational health and safety rules
TASK 8	**INSTALL OR REPLACE INSTRUMENTATION ON A DISTRIBUTION LINE**
Performance Criteria	
Correct interpretation of the plan and specifications	Observance of tightening torques
Wearing personal protective equipment	Observance of work methods
Appropriate choice and use of tools	Meeting the standards of Hydro-Québec or the client
Appropriate choice of fastening materials	Observance of lockout procedures
Solid fastening of the instrumentation	Observance of occupational health and safety rules
Correct connection of devices	

TASK 9 INSTALL OR MAINTAIN A WIRELESS COMMUNICATION SYSTEM	
Performance Criteria	
Correct interpretation of the plan and specifications	No communication cable failure
Wearing personal protective equipment	Observance of tightening torques
Appropriate choice and use of tools	Meeting the client's standards
Appropriate use of unwinding devices	Observance of occupational health and safety rules
Solid installation of communication cables	

2.4 FUNCTIONS

A function:

- is a set of interrelated tasks;
- may be defined by work results or a procedure;
- is a natural and concrete set.

For the lineman occupation, the participants, after examining the tasks according to the definition of "function," consider that all the tasks are different and cannot be grouped by affinity.

3. QUANTITATIVE DATA ON TASKS

3.1 WORK TIME

Work time, expressed below in percentages, represents the time allocated to each task by each expert, on an annual basis.

Table 3.1 Work Time Allocated to Tasks

	Task	Work Time
1	Erect a metal structure for a substation or a transmission line	5.0%
2	Erect a wooden structure for a transmission line or a distribution line	4.5%
3	Install, with the power off or near a live transmission line, the conductors of a transmission line	25.7%
4	Install, with the power off or near a live distribution line, the conductors of a distribution line	2.4%
5	Install or replace suspension cables and communication cables	16.8%
6	Install or replace an underground electric or communication cable	4.6%
7	Install or replace instrumentation for a substation	24.3%
8	Install or replace instrumentation on a distribution line	2.4%
9	Install or maintain a wireless communication system	14.3%

3.2 IMPORTANCE AND DIFFICULTY OF TASKS

The **importance** of a task is estimated according to the more or less harmful consequences of performing a task poorly or not at all. The importance is assessed according to the following scale:

1. Not important at all: A less successful execution of the task has no consequences on the quality of the result, the costs, health and safety, etc.
2. Not very important: Poor execution of the task could lead to minimal costs, an unsatisfactory result, minor injury or accident hazards, etc.
3. Important: Poor execution of the task could lead to substantial additional costs, injuries, accidents, etc.
4. Very important: Poor execution of the task could have very major consequences in terms of costs, safety, etc.

A task's **difficulty** is assessed according to the following scale:

1. Very easy: The task involves little risk of error; it requires no notable physical or mental effort. Performing the task is less difficult than average;
2. Easy: The task involves a few risks of error; it requires minimal physical or mental effort;
3. Difficult: The task involves many risks of error; it requires a good physical or mental effort. Performing the task is more difficult than average;
4. Very difficult: The task involves a high risk of error; it requires substantial physical or mental effort. The task is among the most difficult in the occupation.

The data presented in the table below are the average results of the experts who participated in the workshop.

Table 3.2 Importance and Difficulty of Tasks

	Task	Importance	Difficulty
1	Erect a metal structure for a substation or a transmission line	3.6	2.5
2	Erect a wooden structure for a transmission line or a distribution line	3.6	2.6
3	Install, with the power off or near a live transmission line, the conductors of a transmission line	3.9	2.6
4	Install, with the power off or near a live distribution line, the conductors of a distribution line	3.9	3.3
5	Install or replace suspension cables and communication cables	3.7	3.0
6	Install or replace an underground electric or communication cable	3.8	3.0
7	Install or replace instrumentation for a substation	4.0	2.6
8	Install or replace instrumentation on a distribution line	3.8	3.0
9	Install or maintain a wireless communication system	3.3	3.8

4. KNOWLEDGE, SKILLS AND ATTITUDES

The occupational analysis enabled us to specify some of the knowledge, skills and attitudes necessary for performing the tasks. Those qualities are transferable, i.e., applicable to a variety of tasks and situations.

The following pages present the knowledge, skills and attitudes that, according to the participants, are considered essential for performing the tasks of the lineman occupation.

4.1 KNOWLEDGE

Knowledge of mathematics

Linemen have to use the four basic operations in order to convert measuring units, calculate lengths or estimate distances.

Basic concepts of geometry are also useful for calculating angles when putting cables under mechanical tension (sag).

Knowledge of plan reading

Linemen consult many plans and schematics to assemble structures and install conductors, suspension cables and communication cables. Examples of plans and schematics consulted are:

- assembly plans;
- overhead line network plans;
- device-locating plans;
- telecommunication network plans;
- wooden structure plans;
- inline schematics.

Knowledge of electricity

Practicing the occupation requires electrical knowledge. Linemen thus have to recognize types of currents; distinguish between phases, positive and neutral; and understand the meaning of tension, intensity and resistance measurements. This knowledge is used for installing conductors, cables and instrumentation. It is particularly important for working near live lines.

In some situations, linemen use multimeters to measure transformer tension and verify the absence of tension before starting the work and for restraint regime (régime de retenue) requests.

Obviously, this knowledge is essential for protection against occupational health and safety hazards and for taking measures to protect the public and devices.

Knowledge of knots and splices

Linemen make various types of knots: square knots, single and double bowline knots, figure-eight knots, brake knots, hitch knots, etc.

Linemen also use various types of splices (long splices, short splices, eye splices, back splices or dead end splices, for example) but do not make them.

This knowledge is used for all lifting operations and for conductor and cable pulling, braking and locking operations.

Knowledge of thermite welds

Linemen make thermite welds when performing the following tasks:

- Erect a metal structure for a substation or a transmission line (task 1)
- Erect a wooden structure for a transmission line or a distribution line (task 2)
- Install or replace suspension cables and communication cables (task 5)
- Install or replace an underground electric or communication cable (task 6)
- Install or replace instrumentation for a substation (task 7)
- Install or maintain a wireless communication system (task 9)

Knowledge of crane operators' sign language

This knowledge is required for communicating information during lifting operations.

Knowledge of climbing techniques and methods

Linemen have to use climbers (spurs) for climbing when they cannot use lifting equipment. They also use a pole choker that closes automatically around the pole in the event of a fall.

Linemen also climb metal structures by using crossarms and flanges (lattice towers), or permanently installed indoor or outdoor ladders.

Surveying knowledge

Surveying knowledge is necessary for interpreting information on survey stakes, aligning (azimuth) towers, and putting cables and conductors under mechanical tension.

Linemen use a compass to perform a first alignment of antennae on telecommunication towers. Afterward, a surveyor arrives to give instructions on the final orientation.

Knowledge of soils

Knowledge of soil and rock types is essential for putting poles in place, installing guy wires and dynamiting work.

Linemen have to recover contaminated soil when removing old poles treated with products damaging to the environment.

Knowledge of telecommunications

Linemen need basic knowledge regarding the characteristics of the telecommunication systems they install (wireless and microwave telephony) and the various types of cables.

4.2 SKILLS

Skills are types of know-how. They are divided into three categories: cognitive, motor and perceptual.

4.2.1 Cognitive Skills

Cognitive skills pertain to intellectual strategies applied in working. The main cognitive skills that linemen need are the following.

Problem-solving and decision-making

These skills are essential in case of power failures, because linemen must be able to diagnose the cause of the problem and determine response priorities.

Problem-solving and decision-making are also particularly useful for working near a live electric line and deciding which work methods to apply in unusual situations.

Planning activities

Given that all of the occupation's tasks are performed in a team, a skill in planning activities is particularly important in the course of the work (organizing operations, coordinating lifting work, planting poles, pulling conductors and cables, for example).

Planning activities is also useful for working near a live electric line and for adjusting the work according to changing weather conditions.

4.2.2 Motor Skills

Motor skills involve gestures and movements. The main motor skills that linemen need are the following.

Linemen need good motor skills. The work requires the ability to climb or descend metal structures of up to 175 metres. The worker must also be able to make the necessary efforts to move objects of up to 50 kilograms.

In addition, several tasks also require good dexterity, because the work is often done with glove in difficult weather conditions or in uncomfortable positions.

Lastly, good movement coordination is essential for climbing poles, moving up by means of crossarms and flanges, and using ladders installed on structures.

4.2.3 Perceptual Skills

Perceptual skills are sensory skills enabling a person to perceive by his senses what is happening in his environment. The main perceptual skills that linemen need are the following.

Good tactile sensitivity is useful for pulling operations, to perceive the movements of conductors and cables inside conduits and synchronize work without seeing the ends. Tactile skills are also useful for drilling in the ground or in structures.

Linemen also need good peripheral vision, for protection against occupational health and safety hazards. They have to distinguish between the colours of conductors, and their eyes need to adapt quickly to brightness fluctuations.

Lastly, the worker must be able to mentally represent his spatial position and visualize approach distances correctly.

4.3 ATTITUDES

Attitudes are ways of acting, reacting and relating with others or with one's environment. They involve personal skills. The main attitudes linemen need are the following:

Personal attitudes

Initiative and patience are personal attitudes appreciated in linemen, particularly when the latter repair failures and work for long hours in emergency situations.

Interpersonal attitudes

Interpersonal attitudes are important because the work is done in a team.

Moreover, the worker may be away from home for several days and share his hotel room with colleagues. This situation requires good adaptability and mutual tolerance.

Professional ethics

The professional ethics of linemen is demonstrated by work quality and quick execution in emergency situations.

Preventive health and safety attitudes and behaviours

Preventive health and safety attitudes and behaviours are manifested, among other things, when the worker:

- wears safety equipment;
- wears clothing that takes weather conditions into account;
- chooses appropriate tools;
- actively participates in safety meetings;
- demonstrates great caution during lifting operations;
- attaches himself;
- uses hot-line tools;
- maintains his tools and keeps the work area uncluttered;
- maintains the work equipment’s grounding points;
- updates his knowledge with training.

5. TRAINING SUGGESTIONS

The linemen attending the occupational analysis workshop made suggestions about initial training and professional upgrading.

The workshop participants pointed out that there is no initial training program for linemen in the telecommunications field. This situation does not foster employers' recognition and appreciation of the occupation and encourages the hiring of persons who do not have the required qualifications.

They also mentioned that the occupational study program of linemen does not cover all aspects of the work and is offered at only one location in the province.

Regarding the professional upgrading of linemen, the participants suggested the following training contents:

- grounding;
- working near live lines and induction;
- first-aid, air rescue and CPR;
- labour code;
- reading plans;
- structure assembly and guy wire tension;
- bucket operation;
- planting poles.

Lastly, regarding the organization of professional upgrading courses, the linemen attending the analysis workshop suggested the following:

- recruit more instructors;
- dispense professional upgrading sessions during the slack period for construction site work;
- put in place floating teams of instructors to make the courses more accessible.

Annex

ANNEX 1

MATRIX OF OCCUPATIONAL HEALTH AND SAFETY HAZARDS

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Commission de la santé et de la sécurité du travail

Table A.1 Occupational Health and Safety Hazards in the Lineman Occupation

N°	Hazards	Effects on Health and Safety	Means of Prevention
1	**Chemical hazards and dangers**		
	• Working in enclosed spaces (manholes, underground conduits): – Oxygen deficiency, toxic or flammable gases, etc.	• Poisoning, death • Respiratory problems • Burns	• Train for work in enclosed spaces. • Obtain and apply the procedure for working in enclosed spaces (detecting gases, controlling ignition sources, ventilation, etc.).
	• Handling equipment containing gases, oils and other chemical products (transformers, capacitor batteries, etc.) • Contaminated soils	• Health damage • Chemical burns • Poisoning, irritations	• Take WHMIS training. • Obtain and consult material safety data sheets. • Follow safety instructions.
2	**Physical hazards and dangers**		
	• Working near live components and live-line work: – Direct contact with a live component – Contact between a tool, uninsulated equipment and a live component – Power turned on accidentally and induction – Measuring voltage levels	• Electrification, falling • Electrocution, death • Burns, amputations	• Obtain a work authorization or a restraint from the client. • Observe approach distances. • Install insulator covers. • Wear required PPE and use approved tools (e.g.: insulating sticks). • Install temporary grounds. • Follow all safety instructions given.

N°	Hazards	Effects on Health and Safety	Means of Prevention
	• Working near telecommunication antennae: – High-frequency electromagnetic fields	• Thermal effects on human tissues • Electrification if charges accumulate	• Shield the equipment. • Move away from emission sources. • Reduce signal strength. • Wear PPE (metallized fabric clothing). • Install temporary grounds.
	• Working near high-voltage transformer lines and stations: – Low-frequency electromagnetic fields	• Induced currents in the human body • Accumulated charges that may cause electrification and an explosion if flammable gas is present	• Install temporary grounds. • Wear PPE.
	• Weather conditions – Cold, heat – Wind, rain, snow	• Chilblains, hypothermia, heatstroke • Fatigue, reduced vigilance • Slipping, falling	• Wear appropriate clothing for the weather conditions. • Take regular breaks in difficult conditions.
3	**Biological hazards and dangers**		
	• Working in enclosed spaces (manholes, underground conduits): – Waste water, mould, bioaerosols, sediments, dust, rodents, syringes	• Infectious disease, cold, flu, rabies, tetanus	• Apply the procedure for working in enclosed spaces (cleaning, purging, monitoring, etc.).
4	**Ergonomic hazards and dangers**		
	• Awkward posture (at a height, passing equipment from one side of a pole to another, etc.)	• Physiological effects such as musculoskeletal disorders (tendinitis, low back pain, etc.)	• Modify work techniques to adopt non-awkward postures.
	• Excessive efforts (handling heavy wire coils, towers' structural elements, etc.)	• Physiological effects such as musculoskeletal disorders (tendinitis, low back pain, etc.)	• Handle heavy objects with a lifting device, or as a team. • Perform stretching exercises.

N°	Hazards	Effects on Health and Safety	Means of Prevention
5	**Safety hazards and dangers**		
	• Falling from heights: – Sliding, losing balance, colliding with an object, etc. – Vertigo, dizziness, fatigue (erecting towers up to 150 m high or more) – Wooden poles failing under the weight	• Fracture, sprain, strain, contusion • Multiple injuries, death	• Take training in fall hazards and means of prevention. • Make sure to have stable and sturdy support to position yourself. • Wear and adjust your safety harness, attached to a compliant anchor point. • Check that your spurs are in good condition and that a pole is sturdy before climbing it.
	• Colliding with a vehicle when working at the edge of streets and other roads, or working in a manhole	• Fracture, contusion • Multiple injuries, death	• Equip the construction site with compliant signs (reference: CSEC 10.3.1). • Ensure the presence of flagmen when necessary.
	• Falling from a bucket: – Overturned bucket truck (poor stabilization of the bucket truck) – Being ejected from the bucket	• Fracture, sprain, strain, contusion • Multiple injuries, death	• Check soil stability. • Stabilize the bucket truck, inspect and maintain it according to manufacturer recommendations. • Always wear the harness, attached to a compliant anchor point.
	• Handling and using explosives	• Multiple injuries, death	• Obtain a blaster's safety certificate. • Apply the rules set out in section IV of the CSEC.
	• Being hit, hands, fingers or elbows getting stuck • Falling object (erecting a structure)	• Multiple injuries, cuts	• Avoid moving loads in an unplanned way. • Move away from loads moved by the lifting device. • Avoid superimposed work and wear your hardhat. • Do not stay under a load being lifted by lifting equipment.
6	**Psychosocial hazards and dangers**		
	• Intensification of work due to production quotas, tighter deadlines, labour shortage • Long working hours, several days outside one's region	• Sleeping disorders, depression • Psychophysiological effects (effect or mental overload, notably stress)	