

COMPETENCY-BASED OCCUPATIONAL FRAMEWORK FOR REGISTERED APPRENTICESHIP

Wind Turbine Technician

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For more information, contact:

Diana Elliott, PhD, Senior Research Associate, Urban Institute: delliott@urban.org

Robert Lerman, PhD, Institute Fellow, Urban Institute: rlerman@urban.org





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Contents

Acknowledgments.....	ii
Competency-Based Occupational Frameworks	1
Components of the Competency-Based Occupational Framework	2
Using the Competency-Based Occupational Framework to Develop a Registered Apprenticeship Program	3
Wind Turbine Technician Occupational Overview.....	4
Occupational Purpose and Context	4
Potential Job Titles.....	4
Attitudes and Behaviors.....	4
Apprenticeship Prerequisites.....	5
Occupational Pathways.....	5
Certifications, Licensure, and Other Credential Requirements	6
Job Functions	6
Stackable Programs	6
Options and Specializations.....	7
Levels.....	7
Work Process Schedule.....	8
Related Technical Instruction Plan.....	12
Cross-Cutting Competencies.....	14
Detailed Job Functions.....	16
Job Function 1: Maintains a safe and secure work environment	16
Job Function 3: Commissions new turbines.....	22
Job Function 4: Assists with major component repair and replacement	24
Job Function 5: Performs preventive and predictive maintenance	27
Job Function 6: Troubleshoots and tests systems and components.....	31
Job Function 7: Maintains records and creates reports	35
References	37
Statement of Independence	38

Competency-Based Occupational Frameworks

The Urban Institute, under contract with the US Department of Labor, has worked with employers, subject matter experts, labor unions, trade associations, credentialing organizations, and academics to develop Competency-Based Occupational Frameworks (CBOFs) for Registered Apprenticeship programs. These frameworks define the **purpose** of an occupation, the **job functions** that are carried out to fulfill that purpose, the **competencies** that enable the apprentice to execute those job functions well, and the **performance criteria** that define the specific knowledge, skills, and personal attributes associated with high performance in the workplace. This organizational hierarchy—job purpose, job functions, competencies, performance criteria—is designed to illustrate that performing work well requires more than just acquiring discrete knowledge elements or developing a series of manual skills. To perform a job well, the employee must be able to assimilate knowledge and skills learned in various settings, recall and apply that information to the present situation, and carry out work activities using sound professional judgment, demonstrating an appropriate attitude or disposition and achieving a level of speed and accuracy necessary to meet the employer’s business need.

The table below compares the terminology of Functional Analysis with that of traditional Occupational Task Analysis to illustrate the important similarities and differences. While both identify the key technical elements of an occupation, functional analysis includes the identification of behaviors, attributes, and characteristics of workers necessary to meet an employer’s expectations.

Framework Terminology	Traditional Task Analysis Terminology
Job Function: the work activities that are carried out to fulfill the job purpose	Job Duties: roles and responsibilities associated with an occupation
Competency: the actions an individual takes and the attitudes he/she displays to complete those activities	Task: a unit of work or set of activities needed to produce some result
Performance Criteria: the specific knowledge, skills, dispositions, attributes, speed, and accuracy associated with meeting the employer’s expectations	Subtask: the independent actions taken to perform a unit of work or activity

Although designed for use in competency-based apprenticeship, these Competency-Based Occupational Frameworks also support time-based apprenticeship by defining more clearly and precisely what an apprentice is expected to learn and do during the allocated time period.

CBOFs are comprehensive to encompass the full range of jobs that may be performed by individuals in the same occupation. As employers or sponsors develop their individual apprenticeship programs, they can extract from or add to the framework to meet their unique organizational needs.

Components of the Competency-Based Occupational Framework

Occupational Overview: This section of the framework provides a description of the occupation including its purpose, the setting in which the job is performed, and unique features of the occupation.

Work Process Schedule: This section includes the job functions and competencies that would likely be included in an apprenticeship sponsor's application for registration. These frameworks provide a point of reference that has already been vetted by industry leaders so sponsors can develop new programs knowing that they will meet or exceed the consensus expectations of peers. Sponsors maintain the ability to customize their programs to meet their unique needs, but omission of a significant number of job functions or competencies should raise questions about whether or not the program has correctly identified the occupation of interest.

Cross-Cutting Competencies: These competencies are common among all workers and focus on the underlying knowledge, attitudes, personal attributes, and interpersonal skills that are important regardless of the occupation. That said, while these competencies are important to all occupations, the relative importance of some versus others may change from one occupation to the next. These relative differences are illustrated in this part of the CBOF and can be used to design pre-apprenticeship programs or design effective screening tools when recruiting apprentices to the program.

Detailed Job Function Analysis: This portion of the framework includes considerable detail and is designed to support curriculum designers and trainers in developing and administering the program. The detail in this section may be confusing to those seeking a more succinct, higher-level view of the program. For this reason, we recommend that the Work Process Schedule be the focus of program planning activities, leaving the detailed job function analysis sections to instructional designers as they engage in their development work.

- a. **Related Technical Instruction:** Under each job function appears a list of foundational knowledge, skills, tools, and technologies that would likely be taught in the classroom to enable the apprentice's on-the-job training safety and success.
- b. **Performance Criteria:** Under each competency, we provide recommended performance criteria that could be used to differentiate between minimally, moderately, and highly competent apprentices. These performance criteria are generally skills based rather than knowledge based, but may also include dispositional and behavioral competencies.

Using the Competency-Based Occupational Framework to Develop a Registered Apprenticeship Program

When developing a registered apprenticeship program, the Work Process Schedule included in this CBOF provides an overview of the job functions and competencies an expert peer group deemed to be important to this occupation. The Work Process Schedule in this document can be used directly, or modified and used to describe your program content and design as part of your registration application.

When designing the curriculum to support the apprenticeship program—including on-the-job training and related technical instruction—the information the Detailed Job Functions section could be helpful. These more detailed job function documents include recommendations for the key knowledge and skills that might be included in the classroom instruction designed to support a given job function, and the performance criteria provided under each competency could be helpful to trainers and mentors in evaluating apprentice performance and insuring inter-rater reliability when multiple mentors are involved.

Wind Turbine Technician Occupational Overview

Occupational Purpose and Context

Wind Turbine Technicians install, inspect, maintain, operate, and repair wind turbines. They are typically employed by electricity generation and/or distribution companies, wind turbine maintenance and repair service providers, wind farm construction companies, and wind turbine manufacturers and suppliers. Wind turbine technicians are able to diagnose and fix a range of issues that may hinder the performance, or cause the unexpected shut down, of a wind turbine.

Wind turbine technicians inspect the exteriors of towers; climb towers to inspect, troubleshoot, or repair equipment; collect turbine data for testing and analysis; perform routine maintenance; test electrical components, systems, and mechanical and hydraulic systems; and replace worn-out or malfunctioning components.

Potential Job Titles

Wind Tech; Windsmith; Field Service Technician; Lead Technician; Maintenance Technician; Operations and Maintenance Wind Turbine Technician; Senior Wind Turbine Technician; Wind Farm Support Specialist; Wind Plant Technician; Wind Technician; Wind Turbine Service Technician; Wind Turbine Technician

Attitudes and Behaviors

Wind Turbine Technicians must be willing to visit locations where wind-generation facilities are being constructed, where maintenance is needed, and where turbines need emergency repair. Overtime is common in this occupation and crews must be easily assembled and dispatched to respond to emergencies. Wind technicians must be able to determine the cause and make the necessary repairs when a turbine performs abnormally. In order to perform their duties safely and effectively, wind technicians must properly communicate with their coworkers.

Wind technicians must understand and be able to maintain and repair all mechanical, hydraulic, braking, and electrical systems of a turbine, as well as document all of the services they perform, which require precise measurements, a strict order of operations, and numerous safety procedures. Wind technicians should be comfortable with heights, must possess the physical stamina to climb to the tops of turbines, given

that some tower ladders are as tall as 260 feet or higher, and have the physical strength to lift heavy equipment, parts, and tools, some of which weigh over 50 pounds. Wind technicians must be comfortable working in the enclosed space of the nacelle and descending from the nacelle to the section of a blade that needs servicing.

Apprenticeship Prerequisites

Wind technicians must have at least a high school diploma or GED, and they must have successfully completed one (1) full credit of high school algebra with a passing grade of “C” or better or one post-high school algebra course (e.g., Adult Education, Continuing Education, Community College, etc.) with a passing grade of “C” or better. Some employers or sponsors may require possession of a valid driver’s license, as wind turbine technicians are commonly required to drive company-owned vehicles. Employers may further scrutinize driving and arrest records, as this can affect the ability to provide insurance for their employees.

Wind technicians must be physically and mentally able to perform the work of the trade, which entails the ability to safely perform essential functions of the job, with or without reasonable accommodations; get to and from work at job sites anywhere within the coverage area; climb and work from ladders, scaffolds, poles, and towers; crawl and work in enclosed spaces; and read, hear, and understand instructions and warnings. They must meet body weight restrictions as required by Personal Protective Equipment (PPE) safety regulations.

Wind energy companies may require employees to pass a pre-employment drug test and background screening. Some employers or sponsors may require up to one year of previous experience in a mechanical or electrical field of work.

Occupational Pathways

Career pathways include advancement from an entry-level technician to full performance technician to lead technician.

Certifications, Licensure, and Other Credential Requirements

Credential	Offered by	Before, During, or After Apprenticeship
Qualified Electrical Worker Certification	Various organizations	During
Certified Electrical Safety Technician (CEST)	National Fire Protection Association (NFPA)	During
Rescue at Heights	Various organizations	During
Basic Crane Rigging Certificate	Various organizations	During
First Aid/CPR/AED	American Red Cross	Before or During
Basic Safety Training	Global Wind Organisation (certified training providers)	During
Basic Technical Training	Global Wind Organisation (member companies and their suppliers)	During
OSHA Outreach Training Program 10-Hour Safety Course	OSHA-authorized trainers	Before or During

Job Functions

Job Functions	Core or Optional
1. Maintains a safe and secure work environment	Core
2. Maintains specialized equipment	Core
3. Commissions new turbines	Optional
4. Assists with major component repair and replacement	Optional
5. Performs preventive and predictive maintenance	Core
6. Troubleshoots and tests systems and components	Core
7. Maintains records and creates reports	Core

Stackable Programs

This occupational framework is designed to link to the following additional framework(s) as part of a career laddering pathway.

Stackable Programs	Base or Higher Level	Stacks on Top of
1. n/a		
2.		
3.		

Options and Specializations

The following options and specializations have been identified for this occupation. The Work Process Schedule and individual job function outlines indicate which job functions and competencies were deemed by industry advisors to be optional. Work Process Schedules for Specializations are included at the end of this document.

Options and Specializations	Option	Specialization
n/a		

Levels

Industry advisors have indicated that individuals in this occupation may function at different levels, based on the nature of their work, the amount of time spent in an apprenticeship, the level of skills or knowledge mastery, and the degree of independence in performing the job or supervisory/management responsibilities.

Level	Distinguishing Features	Added Competencies	Added Time Requirements
n/a			

Work Process Schedule

WORK PROCESS SCHEDULE		ONET Code: 49-9081
Wind Turbine Technician		RAPIDS Code: 2000CB
Job Title: Wind Turbine Technician		
Level:	Specialization:	
Stackable Program: <input type="checkbox"/> Yes <input type="checkbox"/> No		
Base Occupation Name:		
Company Contact:		
Address:	Phone:	Email:
Apprenticeship Type: <input checked="" type="checkbox"/> Competency Based <input type="checkbox"/> Time Based <input type="checkbox"/> Hybrid		Prerequisites:

Job Function 1: Maintains a safe and secure work environment			
Competencies	Core or Optional	RTI	OJT
A. Maintains a clean and safe work area	Core		
B. Follows company and job-specific safety procedures and federal, state, and local regulations, including applicable safety, health, and environmental regulations	Core		
C. Follows ESD (electro-static discharge) procedure	Core		
D. Handles hazmats and materials according to MSDS requirements	Core		
E. Follows electrical safety procedures (low, medium, or high voltage)	Core		
F. Performs safety inspections	Core		
G. Follows environmental protection and hazardous chemical control procedures	Core		
H. Maintain personal protective equipment	Core		
I. Follows lock-out/tag-out procedures (energy flow/isolation)	Core		
J. Participates in Job Safety Analysis (JSA)	Core		

K. Stays up to date on company safety policy regulations	Core		
L. Interacts with customers and vendors in a professional manner	Core		
M. Participates in job or equipment-specific training and maintains technical skills	Core		
N. Performs work required to maintain a well-kept appearance of wind turbines	Core		

Job Function 2: Maintains specialized equipment

Competencies	Core or Optional	RTI	OJT
A. Follows the established calibration schedule	Core		
B. Runs performance checks	Core		
C. Red-tags malfunctioning and out-of-calibration equipment	Core		
D. Performs preventive maintenance on specialized equipment	Core		
E. Maintains the test equipment, where possible	Optional		
F. Evaluates the usefulness of current equipment and the need for new equipment	Core		

Job Function 3: Commissions new turbines

Competencies	Core or Optional	RTI	OJT
A. Ensures proper fluid levels	Optional		
B. Inspects fasteners	Optional		
C. Terminates and tests components	Optional		
D. Performs diagnostic checks	Optional		
E. Performs reliability checks	Optional		
F. Performs proper start-up and break-in procedures according to manufacturer's recommendations and specifications	Optional		

Job Function 4: Assists with major component repair and replacement

Competencies	Core or Optional	RTI	OJT
A. Troubleshoots, repairs, and replaces hydraulic systems	Optional		
B. Aligns shafts using laser-alignment equipment and procedures	Optional		
C. Performs mechanical shaft alignments	Optional		
D. Repairs and replaces generators	Optional		

E. Installs, repairs, and replaces equipment using hoists and rigging techniques	Optional		
F. Follows accepted standards and practices for mechanical and electrical assembly	Optional		
G. Installs and replaces bearings	Optional		

Job Function 5: Performs preventive and predictive maintenance			
Competencies	Core or Optional	RTI	OJT
A. Selects, controls, and inspects required tools and test equipment	Core		
B. Follows operating procedures and controls check sheets	Core		
C. Inspects rotors and air coils	Core		
D. Lubricates bearings, gears, and top offs	Core		
E. Selects and replaces torque and tension fasteners	Core		
F. Inspects bonding and grounding points (including lightning protection) inside and outside of turbine	Core		
G. Repairs and replaces consumable wear components	Core		
H. Works in small groups and teams to accomplish work tasks	Core		
I. Follows manufacturer specifications in the operation and maintenance of equipment	Core		
J. Monitors and uses site computer hardware and software systems	Core		

Job Function 6: Troubleshoots and tests systems and components			
Competencies	Core or Optional	RTI	OJT
A. Reviews the equipment and product information (e.g., manuals, schematics)	Core		
B. Performs inspection (visual, audio, smell, touch, measurements)	Core		
C. Traces circuits	Core		
D. Generates a nonconformance report	Core		
E. Maintains detailed records and logs	Core		
F. Replaces circuit boards	Core		
G. Loads new control system software	Core		
H. Interprets sketches, schematics, and blueprints	Core		
I. Tests and replaces motors	Core		
J. Replaces PLCs and controllers	Core		
K. Troubleshoots, calibrates, installs, and repairs components and instrumentation	Core		

Job Function 7: Maintains records and creates reports

Competencies	Core or Optional	RTI	OJT
A. Completes required reports	Core		
B. Maintains open communication with supervisor	Core		
C. Completes daily logs	Core		
D. Operates basic System Control and Data Acquisition (SCADA) control system functions	Core		
E. Maintains electronic documents and records	Core		
F. Revises and edits documents	Core		

Related Technical Instruction Plan

Learning objectives were derived from “Wind Technology Curriculum: From DACUM to Development,” by Valerie Karnes and Suzie Ama, Cerro Coso Community College, with support from the National Science Foundation.

Note: If your training institution is considering launching a wind turbine technician training program, be sure to conduct due diligence regarding assets needed to implement the training.

COURSE NAME: Safety	Course Number
	Hours
LEARNING OBJECTIVES	
<ul style="list-style-type: none"> • Climb a high tower typically used for wind turbines using safe climbing practices • Simulate the rescue of distressed personnel from tower elevation to ground level • Simulate the initial steps necessary for a first responder to aid a distressed individual who has just been lowered to ground safely • Explain and apply “Safety First” principles 	

COURSE NAME: Electrical	Course Number
	Hours
LEARNING OBJECTIVES	
<ul style="list-style-type: none"> • Identify component symbols and simple circuit schematics • Demonstrate safe operation practices around energized circuits through the proper selection and usage of appropriate test and personal protective equipment • Demonstrate competency with Programmable Logic Controller (PLC) usage and logic tracing • Perform wire tracing and isolate faults to field-replaceable components • Define and demonstrate the appropriate instrumentation and safe usage of industrial control systems • Identify the hazards of arc-over/arc-flash around high voltage and industrial power-generating systems during operation and maintenance • Define and differentiate different types of power semiconductor devices • Explain DC to AC inverters • Explain the hazards of working with power electronics and mitigating them by adopting Safe Operating Practices (SOPs), using Personal Protective Equipment (PPE) properly, and choosing the correct test instrumentation 	

COURSE NAME: Mechanical/power trains	Course Number
	Hours
LEARNING OBJECTIVES	
<ul style="list-style-type: none"> • Describe the workings of and compare the differences among the motor, generator, and alternator and the different types of each found in the renewable energy industry • Identify correct wiring to a motor and explain its start and stop operations • Explain how transformers are used in the renewable energy industry • Identify primary and secondary windings on industrial transformers and their connections • Explain torque and mechanical advantage • Explain the difference between single- and three-phase circuits and where they may be used 	

COURSE NAME: Hydraulics	Course Number
	Hours
LEARNING OBJECTIVES	
<ul style="list-style-type: none"> • Interpret fluid-powered system prints and schematics • Construct a functioning hydraulics circuit using different hydraulics components, the hydraulics lab trainer, appropriate safe operating principles (SOPs), and personal protective equipment (PPE) • Troubleshoot and repair hydraulics systems using appropriate safe operating practices (SOPs) and personal protective equipment (PPE) • Predict how hydraulics and pneumatics systems are affected by changes in the fluidics circuit components or their characteristics 	

COURSE NAME: Wind dynamics	Course Number
	Hours
LEARNING OBJECTIVES	
<ul style="list-style-type: none"> • Explain the physics behind the energy conversion process for a Wind Turbine Generator (WTG) • Draw a schematic highlighting the interoperability of Wind Turbine Generator (WTG) subsystems • Outline the key failure modes and most susceptible components and/or subsystems on WTGs • Isolate typical WTG subsystem fault areas on the simulator or trainer • Demonstrate proper setup procedures for WTG mechanical subsystems on the simulator or trainer 	

COURSE NAME: Blade inspection	Course Number
	Hours
LEARNING OBJECTIVES	
<ul style="list-style-type: none"> • Demonstrate adoption of safe operating practices (SOPs) as related to rotating mechanical components • Inspect and refurbish or repair critical subcomponents of rotating mechanical systems, such as filters, gear, belt, and chain drives per the manufacturer's specifications • Inspect and align two axial rotating shafts joined by couplings to within manufacturer's specifications • Replace or top-off hydraulics fluids with manufacturer-specified grades • Extract oil samples from wind turbine generator's gearbox or transmission for laboratory analysis 	

Cross-Cutting Competencies

COMPETENCY**		0	1	2	3	4	5	6	7	8
Personal Effectiveness	Interpersonal Skills	0	1	2	3	4	5	6	7	8
	Integrity	0	1	2	3	4	5	6	7	8
	Professionalism	0	1	2	3	4	5	6	7	8
	Initiative	0	1	2	3	4	5	6	7	8
	Dependability and Reliability	0	1	2	3	4	5	6	7	8
	Adaptability and Flexibility	0	1	2	3	4	5	6	7	8
	Lifelong Learning	0	1	2	3	4	5	6	7	8
Academic	Reading	0	1	2	3	4	5	6	7	8
	Writing	0	1	2	3	4	5	6	7	8
	Mathematics	0	1	2	3	4	5	6	7	8
	Science and Technology	0	1	2	3	4	5	6	7	8
	Communication	0	1	2	3	4	5	6	7	8
	Critical and Analytical Thinking	0	1	2	3	4	5	6	7	8
	Basic Computer Skills	0	1	2	3	4	5	6	7	8
Workplace	Teamwork	0	1	2	3	4	5	6	7	8
	Customer Focus	0	1	2	3	4	5	6	7	8
	Planning and Organization	0	1	2	3	4	5	6	7	8
	Creative Thinking	0	1	2	3	4	5	6	7	8
	Problem Solving and Decision Making	0	1	2	3	4	5	6	7	8
	Working with Tools and Technology	0	1	2	3	4	5	6	7	8
	Checking, Examining, and Recording	0	1	2	3	4	5	6	7	8
	Business Fundamentals	0	1	2	3	4	5	6	7	8
	Sustainable	0	1	2	3	4	5	6	7	8
	Health and Safety	0	1	2	3	4	5	6	7	8

** The names of the cross-cutting competencies come from the US Department of Labor’s Competency Model Clearinghouse, and definitions for each can be viewed at <https://www.careeronestop.org/CompetencyModel/competency-models/building-blocks-model.aspx>.

Cross-cutting competencies identify transferable skills—sometimes called “soft skills” or “employability skills”—that are important for workplace success, regardless of a person’s occupation. Still, the relative

importance of specific cross-cutting competencies differs from occupation to occupation. The cross-cutting competencies table, above, provides information about which of these competencies is most important to be successful in a particular occupation. This information can be useful to employers or intermediaries in screening and selecting candidates for apprenticeship programs, or to pre-apprenticeship providers who seek to prepare individuals for successful entry into an apprenticeship program.

The scoring system utilized to evaluate competency levels required in each cross-cutting skill aligns with the recommendations of the Lumina Foundation's Connecting Credentials Framework. The framework can be found at <http://connectingcredentials.org/wp-content/uploads/2015/05/ConnectingCredentials-4-29-30.pdf>.

Detailed Job Functions

Job Function 1: Maintains a safe and secure work environment

Related Technical Instruction		
KNOWLEDGE	SKILLS	TOOLS & TECHNOLOGIES
<ul style="list-style-type: none"> • Basic treatment practices for a variety of medical emergencies and emergency rescue • Advanced knowledge of fall protection • Electrical safety • Crane safety and signals • OSHA regulations and standards that pertain to the construction and maintenance of wind turbines and the energy industry • High voltage electrical safety standards; OSHA 1910-33, NFPA 70-E • General knowledge of safety regulations and personal protective equipment cleaning, as well as safe use of hand, electric, and hydraulic equipment • Material Safety Data Sheets (MSDS) • Weather patterns • Lock-out/Tag-out (LOTO) procedures • Wind turbine power-down procedures • Tower-climb techniques • Appropriate instrumentation and safe usage of industrial control systems • Hazards of working with power electronics and how to mitigate them by adopting Safe Operating Practices (SOPs), using Personal Protective Equipment (PPE) properly, and choosing the correct test instrumentation 	<ul style="list-style-type: none"> • Risk assessment • Defensive driving • Ability and willingness to work in all weather conditions • Read and interpret technical manuals, protocols, procedures, and regulations • Ability to follow safety rules • Emergency evacuation procedures • “At-height” rescue tips and techniques (i.e., lowering injured or disabled personnel to ground) • Emergency medical assistance techniques • Safe lowering of injured or disabled personnel from tower height to ground level • Advising medical personnel, the injured or disabled personnel’s condition for best initial medical response • Identify the hazards of arc-over/arc-flash around high-voltage and industrial power-generating systems during operation and maintenance • Work with people of other cultures, ages, genders, and beliefs • Professional conduct, respectfulness, courteousness • Customer service skills to meet customer needs • Openness to new ideas and change • Able to accept constructive feedback and criticism 	<ul style="list-style-type: none"> • Hand tools • Measuring tools • Timing devices • Pressure indicators • Vacuum indicators • Tachometer • Depth and protrusion gauges • Run-out indicators • Torque-measuring devices • Safety harness • Lanyard • Face and eye protection • Microsoft Windows Office productivity tools—word processing, spreadsheets, presentation, databases

Competency A: Maintains a clean and safe work area	Core or Optional
PERFORMANCE CRITERIA	
1. Work area is free of debris and oil	Core
2. Tools and materials are removed from work area and placed in storage spaces	Core
3. Fluids are contained and disposed of, as appropriate	Core

Competency B: Follows company and job-specific safety procedures and federal, state, and local regulations, including applicable safety, health, and environmental regulations	Core or Optional
PERFORMANCE CRITERIA	
1. Articulate the steps to make the turbine safe prior to disabling the ability to stop the turbine if the rotor were to rotate	Core
2. Utilize some form of lock-out, tag-out procedure	Core

Competency C: Follows ESD (electro-static discharge) procedure	Core or Optional
PERFORMANCE CRITERIA	
1. Limit movements that can cause static electricity to build up	Core
2. Keep processes and materials at the same electrostatic potential	Core
3. Provide appropriate ground paths to reduce charge generation and accumulation	Core

Competency D: Handles hazmats and materials according to MSDS requirements	Core or Optional
PERFORMANCE CRITERIA	
1. Identify hazardous materials that are present in a wind turbine	Core
2. Analyze MSDS requirements for various fluids, cleaners or greases	Core

Competency E: Follows electrical safety procedures (low, medium, and high voltage)	Core or Optional
PERFORMANCE CRITERIA	
1. Have safety glasses, high voltage gloves and arc flash personal protective equipment	Core
2. Practice the 5 universal safety steps for work on electrical circuits	Core

Competency F: Performs safety inspections	Core or Optional
PERFORMANCE CRITERIA	
1. Demonstrate proper inspection methods of all PPE	Core
2. Perform appropriate inspection of DMM and declare it safe to use	Core

Competency G: Follows environmental protection and hazardous chemical control procedures	Core or Optional
PERFORMANCE CRITERIA	
1. Perform a hazard assessment for the work to be completed	Core
2. Inspect PPE for identified hazards	Core

Competency H: Maintains personal protective equipment	Core or Optional
PERFORMANCE CRITERIA	
1. Demonstrate proper inspection methods of all PPE	Core
2. Inspect all PPE properly	Core
3. Inspect PPE for identified hazards	Core

Competency I: Follows lock-out/tag-out procedures (energy flow/isolation)	Core or Optional
PERFORMANCE CRITERIA	
1. Safely power down operating wind turbine generator	Core
2. Utilize some form of lock-out, tag-out, or tag-out procedure	Core

Competency J: Participates in Job Safety Analysis (JSA)	Core or Optional
PERFORMANCE CRITERIA	
1. Complete job safety analysis worksheets after each activity or operation	Core
2. Take proactive and preventive measures before starting each activity or operation	Core

Competency K: Stays up to date on company safety policy regulations	Core or Optional
PERFORMANCE CRITERIA	
1. Recognize differences in safety policies between organizations	Core

Competency L: Interacts with customers and vendors in a professional manner	Core or Optional
PERFORMANCE CRITERIA	
1. Remain calm and speak in an appropriate, empathetic manner when working to solve customer problems in accordance with company policy	Core
2. Provide proper information in response to inquiries	Core
3. Promptly address customer or vendor complaints	Core

Competency M: Participates in job- or equipment-specific training and maintains technical skills	Core or Optional
PERFORMANCE CRITERIA	
1. Complete all Workplace Safety Training topics	Core

Competency N: Performs work required to maintain a well-kept appearance of wind turbines	Core or Optional
PERFORMANCE CRITERIA	
1. Keep nacelle clean and orderly	Core
2. Place tools and supplies in proper storage areas when not in use	Core
3. Ensure all surfaces are clear of grease and oil	Core

Job Function 2: Maintains specialized equipment

Related Technical Instruction		
KNOWLEDGE	SKILLS	TOOLS & TECHNOLOGIES
<ul style="list-style-type: none"> • Self-lubricators; grease gun • Maintenance and troubleshooting • Sampling • Types of lubricants and uses • Lubrication methods • Maintenance of gearboxes • Filters • Cleanliness, impurities • Gear-teeth condition • Principles of shaft alignment 	<ul style="list-style-type: none"> • Composite repair • Working knowledge of measurements, layout, computation formulae, and functions 	<ul style="list-style-type: none"> • Branch circuit panels and feeders and over-current devices • Power-utilization circuits, Devices, and equipment • Amp Clamp • Megger • Phase-rotation meter • Capacitor tester • Oscilloscope • Multimeters • Conductors • Resistors • Insulators • Capacitors • Inductors

Competency A: Follows the established calibration schedule	Core or Optional
PERFORMANCE CRITERIA	
1. Checks the measurement device(s) for correct calibration	Core
2. Cleans measuring faces on the devices	Core

Competency B: Runs performance checks	Core or Optional
PERFORMANCE CRITERIA	
1. Records performance-check data	Core
2. Records data within two hours of performance check	Core
3. Records more specific information in case of a fault	Core

Competency C: Red-tags malfunctioning and out-of-calibration equipment	Core or Optional
PERFORMANCE CRITERIA	
1. Highlights and reports early failure warning signals	Core

Competency D: Performs preventive maintenance on specialized equipment	Core or Optional
PERFORMANCE CRITERIA	
1. References maintenance sheet specifications	Core
2. Properly assembles equipment before use	Core
3. Stores equipment in proper storage condition	Core
4. Keeps equipment safe from entanglement	Core
5. Cares for equipment according to manufacturer-recommended procedures	Core

Competency E: Maintains the test equipment, where possible	Core or Optional
PERFORMANCE CRITERIA	
1. Cares for test equipment according to manufacturer-recommended procedures	Optional
2. Stores test equipment in proper storage condition	Optional

Competency F: Evaluates the usefulness of current equipment and the need for new equipment	Core or Optional
PERFORMANCE CRITERIA	
1. Inspects equipment to ensure no damage occurred during use	Core
2. Brings to the attention of a lead technician or supervisor any damages to equipment	Core

Job Function 3: Commissions new turbines

Related Technical Instruction		
KNOWLEDGE	SKILLS	TOOLS & TECHNOLOGIES
<ul style="list-style-type: none"> Blade construction and assembly Explain the logistics of putting up a high tower installation Identify the steps associated with a high-tower construction for a utility-scale wind turbine generator and the pre-commissioning safety and system checks. 	<ul style="list-style-type: none"> Two-way radio communications (between crane operator, ground, tower, and nacelle crews) 	<ul style="list-style-type: none"> Rigging hardware Slings Guy wires Hoists Cranes

Competency A: Ensures proper fluid levels	Core or Optional
PERFORMANCE CRITERIA	
1. Fills the reservoir to the proper level as defined in the service manual	Optional
2. Removes fluid from the reservoir without allowing it to spill out of the catch container	Optional
3. Ensures fluid is kept at the maximum cleanliness possible	Optional
4. Verifies fluid level after test run	Optional
5. Pressurizes the system and verifies that there are no hydraulic fluid leaks	Optional

Competency B: Inspects fasteners	Core or Optional
PERFORMANCE CRITERIA	
1. Locates the proper torque value for the fastener(s) in use	Optional
2. Demonstrates the proper placement of the electric torque tool onto the fastener(s)	Optional
3. Torques fasteners to the assigned value	Optional
4. Inspects the shaft for fasteners designed to prevent the flange from moving on the shaft	Optional

Competency C: Terminates and tests components	Core or Optional
PERFORMANCE CRITERIA	
1. Identifies the nominal operating voltage of the component being tested	Optional
2. Executes the insulation test	Optional

Competency D: Performs diagnostic checks	Core or Optional
PERFORMANCE CRITERIA	
1. Uses the PLC as a diagnostic tool in the troubleshooting process	Optional
2. Checks that the circuit operates properly without any needed modifications	Optional
3. Performs continuity check of Megger	Optional
4. Checks measurement device(s) for correct calibration	Optional

Competency E: Performs reliability checks	Core or Optional
PERFORMANCE CRITERIA	
1. Records component or subsystem failures	Optional
2. Tracks cost of failures	Optional
3. Records condition of components and subsystems	Optional

Competency F: Performs proper start-up and break-in procedures according to manufacturer's recommendations and specifications	Core or Optional
PERFORMANCE CRITERIA	
1. Demonstrates that the machine is fault free and ready to run	Optional
2. Enables the remote access function of the machine	Optional

Job Function 4: Assists with major component repair and replacement

Related Technical Instruction		
KNOWLEDGE	SKILLS	TOOLS & TECHNOLOGIES
<ul style="list-style-type: none"> • Fluid power hydraulic theory • Basic principles of fluidics (hydraulics and pneumatics) • Wiring diagrams and schematics, and US, European, and Japanese component symbols • Torque procedures • Yaw systems—function of the Yaw control system, including wind vane, anemometer, Yaw angle (alignment vs. misalignment), auto rewind function, Yaw brakes, and Yaw drive system • Pitch systems • Blade repair techniques • Digital timing concept basics • Programmable logic control (PLC) systems—basic functions and applications • Basic concepts of hydraulic and pneumatic cylinder operation • Operation considerations for pneumatic and hydraulic cylinders and valves for in-circuit applications • Fiber optics • Tag lines with a suspending load • Cribbing and its use • Characteristics of gearboxes • Types of gear systems in gearboxes • Maintenance of gearboxes • Filters • Cleanliness, impurities • Gear-teeth condition • Principles of shaft alignment • Instrumentation and control logic theory • Basic rigging • Mechanical energy 	<ul style="list-style-type: none"> • System troubleshooting • Oil analysis • Gearbox alignment • Failure analysis • Vibration analysis • Hand signals • Lifting and leveling of a load 	<ul style="list-style-type: none"> • Reservoirs • Pumps • Filtration systems • Motors • Accumulators • Hoses • Tubing • Oil coolers • Servo valves • Relief valves • Hydrostatic drives • Check valves • Hold valves • Control valves • Cylinders • Fasteners • Housings • Planetaries • Bearings • Shafts • Pads • Linings • Diaphragms • Lines • Calipers • Hydraulic valves • Linkages • Reservoirs • Controls • Pressure switches • Valves • Chambers • Generators and PMGs (Permanent Magnet Generators) • Oil pump motors, starters, and controls • Fiber optics equipment • PLC programs • Service hoist • Micro-ohm meter • Recording equipment, data acquisition equipment, and data loggers • Manometer

<ul style="list-style-type: none"> • Introductory mechanical engineering concepts • Motors & Generators—basic theory and operation • Electrical components such as: motor starters, manual switches, control relays, transformers, motor controls • Describe the workings of and compare the differences among the motor, generator, and alternator and the different types of each found in the renewable energy industry • Identify correct wiring to a motor and explain its start/stop operation 		<ul style="list-style-type: none"> • Fractional horsepower motors • Motor starters and circuits
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Competency A: Troubleshoots, repairs, and/or replaces hydraulic systems	Core or Optional
PERFORMANCE CRITERIA	
1. Isolates typical Wind Turbine Generator subsystem fault areas	Optional
2. Follows fluid systems inspection procedures	Optional
3. Operates hydraulics circuits	Optional
4. Troubleshoots and repairs hydraulics systems using appropriate safe operating practices and personal protective equipment	Optional
5. Predicts how hydraulics and pneumatics systems are affected by changes in the fluidics circuit components or their characteristics	Optional

Competency B: Aligns shafts using laser-alignment equipment and procedures	Core or Optional
PERFORMANCE CRITERIA	
1. Sets up and installs the laser measurement equipment according to the turbine and manufacturer-recommended procedures	Optional
2. Keeps cables and equipment safe from entanglement, impact, and crushing	Optional
3. Makes adjustments and remeasures the machine alignment until the machine is in alignment tolerance	Optional

Competency C: Performs mechanical shaft alignments	Core or Optional
PERFORMANCE CRITERIA	
1. Conducts mechanical component tests (e.g., vibration analysis, system alignment, etc.)	Optional

Competency D: Repairs and replaces generators		Core or Optional
PERFORMANCE CRITERIA		
1. Ensures that the generator does not make unexpected movements		Optional
2. Conducts a safe lift of the generator and removes it from the nacelle without any safety concerns		Optional
3. Correctly captures the generator and places back onto the bed plate		Optional
4. Correctly completes the generator installation		Optional

Competency E: Installs, repairs, and replaces equipment using hoists and rigging techniques		Core or Optional
PERFORMANCE CRITERIA		
1. Selects rigging for a minimum of 2:1 safety factor		Optional
2. Inspects the rigging to be used		Optional
3. Connects crane rigging and crane to the generator before installation, repair, or replacement		Optional

Competency F: Follows accepted standards and practices for mechanical and electrical assembly		Core or Optional
PERFORMANCE CRITERIA		
1. Demonstrates proper setup procedures for Wind Turbine Generator mechanical subsystems		Optional
2. Takes care not to damage any seals or components during assembly		Optional

Competency G: Installs and replaces bearings		Core or Optional
PERFORMANCE CRITERIA		
1. Correctly removes the old bearing from the shaft		Optional
2. Relubricate bearings per specifications using recommended grades only		Optional
3. Inspects the bearing seating area for defects		Optional
4. Correctly heats the replacement bearing		Optional
5. Demonstrates the proper setting of the bearing onto the shaft		Optional

Job Function 5: Performs preventive and predictive maintenance

Related Technical Instruction		
KNOWLEDGE	SKILLS	TOOLS & TECHNOLOGIES
<ul style="list-style-type: none"> • Proper blade inspection • Blade performance, operation, and maintenance characteristics • Lubrication, pumps, and shaft end plates • Lubrication oil and grease; oil base (soap, clays, synthetic, animal byproduct) • Impurities • Byproducts • Self-lubricators; grease gun • Maintenance and troubleshooting • Sampling • Types of lubricants and uses; • Lubrication methods • Contamination control • Effects of poor lubrication • Fasteners and torqueing • Torque principles • Explain torque and mechanical advantage • Basic logic • The physics behind the energy conversion process for a Wind Turbine Generator • Aviation terminology and basic aerodynamics • Matter behavior • Gasses and liquids • Levers, pulleys, and machines • Renewable energy processes and industries • Environmental stewardship • Machines, friction, and bearings • Basic understanding of how a wind turbine detracts and dissipates lightning • Understand proper grounding 	<ul style="list-style-type: none"> • Composite repair • Working knowledge of measurements, layout, computation formulae, functions • Add, subtract, multiply, and divide in all measurement units • Lightning protection • Written and verbal communication skills 	<ul style="list-style-type: none"> • Airfoils • Rotors • Stator • Hydraulic torquing tools • Mechanical torque wrench • Skidmore and torque log • Lightning arrestors • Switching and grounding equipment • Grounding and bonding systems

techniques, theory, and significance <ul style="list-style-type: none"> • Bonding and grounding and lightning protection • Operability and limitations of physical infrastructure • General components and connections • Data extracted from components • Types of data collection and data use in industry • Computer process applications and networking 		
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Competency A: Selects, controls, and inspects required tools and test equipment	Core or Optional
PERFORMANCE CRITERIA	
1. Maintains, inspects, and tests tools and test equipment in accordance with applicable laws and manufacturers' recommendations	Core
2. Conducts risk assessments for test equipment	Core

Competency B: Follows operating procedures and controls check sheets	Core or Optional
PERFORMANCE CRITERIA	
1. Refers to items on control check sheet	Core
2. Tallies occurrence frequency	Core
3. Documents reasons for service interruptions	Core

Competency C: Inspects rotors and air coils	Core or Optional
PERFORMANCE CRITERIA	
1. Correctly measures the Total Indicated Run Out (TIR) of the brake rotor	Core
2. Adjusts the pad gap to be equal on both sides of the rotor	Core
3. Correctly locates the rotor relative to the stator	Core

Competency D: Lubricates bearings, gears, and top offs	Core or Optional
PERFORMANCE CRITERIA	
1. Demonstrates proper seal lubrication	Core
2. Relubricates bearings per specifications using recommended grades only	Core
3. Installs appropriate amounts of lubricant in new bearing	Core

Competency E: Selects and replaces torque and tension fasteners	Core or Optional
PERFORMANCE CRITERIA	
1. Locates the proper torque value for the fastener	Core
2. Uses the electric torque tool to torque the fastener	Core
3. Torques fasteners to the assigned value	Core
4. Demonstrates the procedure for releasing the tool when it becomes bound on a fastener	Core

Competency F: Inspects bonding and grounding points (including lightning protection) inside and outside of turbine	Core or Optional
PERFORMANCE CRITERIA	
1. Checks connections to the grounding electrode system	Core
2. Inspects bonded ground ring around the tower foundation	Core

Competency G: Repairs and replaces consumable wear components	Core or Optional
PERFORMANCE CRITERIA	
1. Maintains consumables according to manufacturers' standards, including brake pads, seals, brushes, etc.	Core
2. Replaces consumables, including brake pads, seals, brushes, etc., when appropriate	Core
3. Ensures that consumables are disposed of in compliance with safety and environmental regulations and policies	Core

Competency H: Works in small groups and teams to accomplish work tasks	Core or Optional
PERFORMANCE CRITERIA	
1. Shares information and expertise with coworkers	Core
2. Employs three-way communication techniques	Core
3. Employs proper hand signals (cranes, rigging)	Core
4. Uses the basic features of Microsoft PowerPoint including slide show creation, editing, and a variety of formatting tools	Core

Competency I: Follows manufacturer specifications in the operation and maintenance of equipment	Core or Optional
PERFORMANCE CRITERIA	
1. Maintains and inspects equipment in accordance with manufacturers' recommendations	Core
2. Adheres to manufacturer's user guidelines	Core

Competency J: Monitors and uses site computer hardware and software systems	Core or Optional
PERFORMANCE CRITERIA	
1. Uses computer-generated software program to sketch parts or systems	Core

Job Function 6: Troubleshoots and tests systems and components

Related Technical Instruction		
KNOWLEDGE	SKILLS	TOOLS & TECHNOLOGIES
<ul style="list-style-type: none"> • Electrical/Electronics theory • Understand and comprehend basic electrical theory • AC/DC voltage and current principles: resistance (series and parallel circuits), inductance, and capacitance • Power-generation principles • Basic wiring • Analog and digital signals • Overview of power generation delivery grid systems from generation to end user including VARS (volts, amps, reactive) • Power transmission • Ohm's and Kirchhoff's Laws • Series and parallel components • Periodic table and atomic structure • Electron energy bands and valence electrons • Define and differentiate different types of power semiconductor devices • Correlation between valence electrons and material properties of conductors, semiconductors, and insulators • Common conductor materials and wire sizes • Doping of semiconductor materials to make N and P semiconductor layers • Explain DC to AC inverters • Understanding of a photovoltaic (PV) cell • Wire Insulation: function and nomenclature • Familiarity with National Electrical Code (NEC) and applicability to wire sizing, 	<ul style="list-style-type: none"> • Circuit protection • Troubleshooting • Schematic and print reading • Interpret fluid-powered system prints and schematics • Applied electrical calculations • Apply Ohm's Law to circuit elements • Apply Kirchhoff's Law to circuit nodes • Apply Ohm's and Kirchhoff's Laws to voltage/current divider networks • Explain superposition of signals in terms of Ohm's and Kirchhoff's Laws • Visual analysis • Vibration and auditory analysis • Thermal analysis 	<ul style="list-style-type: none"> • Transformers • Semiconductors • Sensors • Regulators • Series-parallel switches • Circuits • Electronic controls • Wiring • Electrically controlled valves • Switches • Relay circuits • Resistors • Solenoids • Lighting systems • Accessory systems • Monitor systems • Breakers (station service, vacuum, oil, and field) • Metal clad switchgear • Battery charges and inverters • Station and auxiliary battery banks • DC exciters/sold state excitation • Annunciators and alarms • Distribution panels • Transformers (current, potential, distribution) • Auxiliary-generating equipment and auxiliary-generator controls • Isolated phase busses • Neutral ground devices • Switch boards, panels • Distribution circuits • UPS power supplies • Condition-monitoring equipment • Voltage regulators • Accumulator charging –compressed gasses • Boroscope • Thermal cameras

<p>component ratings, and protective devices</p> <ul style="list-style-type: none"> • Explain how transformers are used in the renewable energy industry • Identify primary and secondary windings on industrial transformers and their connections • Explain the difference between single- and three-phase circuits and where they may be used 		<ul style="list-style-type: none"> • Precision measuring tools—micrometers, calipers, gauges • Portable generators • Emergency lighting • LVDT (Linear Variable Differential Transformer) and proximity position sensing and indication • Outdoor lighting circuits • Indoor lighting circuits • Ventilation systems • Conduits and wire cables • Overhead and underground wiring, including triplex • Remote control circuitry • Remote telemetry unit (RTU) • Heat Exchangers • Emergency lighting • Cable trays • Ground Fault Interrupters (GFI) • Branch circuit panels and feeders and over-current devices • Power-utilization circuits, Devices, and equipment • Amp clamp • Megger • Phase rotation meter • Capacitor tester • Oscilloscope • Multimeters • Conductors • Resistors • Insulators • Capacitors • Inductors
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Competency A: Reviews the equipment and product information (e.g., manuals, schematics)	Core or Optional
PERFORMANCE CRITERIA	
1. Compares measurements to the relevant service manual	Core
2. Uses service manuals to determine appropriate values, levels, and other information	Core
3. Constructs a circuit that matches exactly the electrical schematic	Core
4. Locates faults on electrical schematics	Core
5. Correctly identifies component symbols on schematics	Core

Competency B: Performs inspection (visual, audio, smell, touch, measurements)	Core or Optional
PERFORMANCE CRITERIA	
1. Measures multiple circuit parameters and applies logical deduction	Core
2. Conducts thermal analysis of major mechanical and electrical components	Core
3. Inspects lubricants, oil, and filters	Core
4. Takes lubricant and oil samples for lab analysis	Core

Competency C: Traces circuits	Core or Optional
PERFORMANCE CRITERIA	
1. Performs wire tracing and isolates faults to field-replaceable components	Core
2. Analyzes circuits on trainer/panel (compares theoretical versus measured results)	Core
3. Constructs a functioning hydraulics circuit using different hydraulics components after selecting and using appropriate safe operating principles and personal protective equipment	Core

Competency D: Generates a nonconformance report	Core or Optional
PERFORMANCE CRITERIA	
1. Fills out and submits nonconformance report	Core
2. Includes supporting documents, as necessary	Core

Competency E: Maintains detailed records and logs	Core or Optional
PERFORMANCE CRITERIA	
1. Records required information on log sheets	Core
2. Records more specific information surrounding a fault	Core
3. Records all measurements on sketches	Core

Competency F: Replaces circuit boards	Core or Optional
PERFORMANCE CRITERIA	
1. Troubleshoots circuits that do not operate properly	Core
2. Assembles an electrical circuit following a basic electrical diagram	Core

Competency G: Loads new control system software	Core or Optional
PERFORMANCE CRITERIA	
1. Creates and uploads a program	Core
2. Understands function of the processor control system	Core

Competency H: Interprets sketches, schematics, and blueprints	Core or Optional
PERFORMANCE CRITERIA	
1. Identifies component symbols and simple circuit schematics	Core
2. Draws a schematic highlighting the interoperability of Wind Turbine Generator subsystems	Core
3. Troubleshoots schema and process flow	Core
4. Verifies circuit hookup to schematic	Core

Competency I: Tests and replaces motors	Core or Optional
PERFORMANCE CRITERIA	
1. Supports motor shaft before removing end cover	Core
2. Installs the motor cover properly	Core

Competency J: Replaces PLCs and controllers	Core or Optional
PERFORMANCE CRITERIA	
1. Conducts temperature and pitch battery testing	Core

Competency K: Troubleshoots, calibrates, installs, and repairs components and instrumentation	Core or Optional
PERFORMANCE CRITERIA	
1. Checks the measurement devices for correct calibration	Core
2. Troubleshoots in a logical manner following a causal map	Core

Job Function 7: Maintains records and creates reports

Related Technical Instruction		
KNOWLEDGE	SKILLS	TOOLS & TECHNOLOGIES
<ul style="list-style-type: none"> • CPU • Computer monitor • Printer • Parallel and serial port • USB • Supervisory Control and Data Acquisition systems (SCADA) 	<ul style="list-style-type: none"> • Effective group presentation skills • Uses appropriate language • Data acquisition and assessment • Complete forms • Manage files 	<ul style="list-style-type: none"> • Microsoft Windows Office productivity tools—word processing, spreadsheets, presentation, databases

Competency A: Completes required reports	Core or Optional
PERFORMANCE CRITERIA	
1. Completes a damage and service report	Core
2. Completes reports and paperwork accurately	Core

Competency B: Maintains open communication with supervisor	Core or Optional
PERFORMANCE CRITERIA	
1. Coordinates travel plans	Core
2. Prioritizes workload based on information from managers and supervisors	Core
3. Participates in meetings	Core
4. Suggests process and product improvements	Core
5. Prepares written reports and makes presentations	Core
6. Maintains files and records, including timekeeping	Core

Competency C: Completes daily logs	Core or Optional
PERFORMANCE CRITERIA	
1. Fills in all required information on log sheet	Core
2. Makes entries legible and orderly	Core

Competency D: Operates basic System Control and Data Acquisition (SCADA) control system functions	Core or Optional
PERFORMANCE CRITERIA	
1. Navigates through the PLC menus without any assistance	Core
2. Notifies the team members when and if a fault occurs	Core

Competency E: Maintains electronic documents and records	Core or Optional
PERFORMANCE CRITERIA	
1. Enters data within a reasonable time period	Core
2. Documents root cause of faults and failures	Core
3. Records required information on log sheets	Core
4. Records more specific information surrounding faults	Core

Competency F: Revises and edits documents	Core or Optional
PERFORMANCE CRITERIA	
1. Reviews records and documents for accuracy	Core
2. Updates records and documents, as needed	Core

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500 L'Enfant Plaza SW
Washington, DC 20024

www.urban.org