

ACP Guidelines for Clean Energy Construction Worker Training

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Contents

SCOPE AND PURPOSE	
OBJECTIVES AND TARGET GROUP	
TARGET GROUP: ALL CONSTRUCTION WORKERS	4
CAREER PATHWAYS	5
PROGRAM DEVELOPMENT SUGGESTION	(
MODEL & EXPLANATION	6
Core Training	6
Project Orientation	
Specific Trades & Sector Specific Skills	6
CRITERIA FOR STANDARDIZATION	7
Individual Modules	
CORE TRAINING: APPLICABLE TO ALL WORKERS	{
SAFETY	8
OSHA 10-Hour (OSHA 30 for leads/supervisors), or Equivalent	8
Ergonomics, Body Positioning, & Manual Handling	8
Working at Heights	8
PPE Use & Inspection	8
Vehicle Safety	9
Lockout/Tagout Awareness	9
Confined Space Awareness	10
Hazard Communication	10
Fire Awareness & Extinguishing	10
Working Near High Voltage Systems & Substations	10
TECHNICAL	11
Basic Construction Math	11
Introduction to Clean Energy Systems (Wind, Solar, BESS)	11
Hand & Power Tool Safety	12
Mechanical Assembly & Fastening	12
Rigging, Lifting, & Material Handling	12



PROJECT ORIENTATION (SITE SPECIFIC TRAININGS)	13
ALL CONSTRUCTION WORKER RECOMMENDATIONS	13
First Aid & CPR (specific to remote locations & electrical exposure)	13
Manual Handling & Material Movement	13
Basic Fire & Electrical Awareness	
SITE/ROLE SPECIFIC RECOMMENDATIONS	14
Site Specific Hazardous Energy Control (Advanced LOTO)	14
NFPA 70E	14
NFPA 70B	14
Daily pre-task planning & hazard identification	14
Working at Heights	15
Environmental Awareness & Reporting	15
General Technical Operations	15
APPENDIX	16
APPENDIX A (SPECIFIC TRADES)	16
Civil/Site Prep Crews	16
Mechanical/Structural Workers	16
APPENDIX B (SECTOR SPECIFIC SKILLS)	16
Solar	16
Wind	16
Battery Storage	16
Substation/Grid Interconnection	16
REFERENCES	17



Scope and Purpose

These guidelines have been developed in response to demand from American Clean Power Association (ACP) members to establish a transparent and valid set of knowledge, skills, and abilities for identified construction workers across solar energy, wind energy, and battery energy storage facilities.

As a collective body representing the world's largest employers in clean energy construction, ACP has the necessary scale and insight to provide clear guidance to the industry with reference to identified roles that are carried out by entry-level construction workers within core components of the clean energy industry. These requirements may be met prior to or during entry-level employment, and competency timeframes may vary.

Objectives and Target Group

The goal of these guidelines is to provide clear pathways for construction workers in the clean energy industry and guide a person towards the appropriate training for the different job profiles of clean energy construction workers. The Guidelines for Clean Energy Construction Worker Training will establish a transparent and valid set of standardized skills for construction roles in wind energy, solar energy, and battery energy storage facilities.

The ACP Guidelines for Clean Energy Construction Worker Training are intended for technical or vocational training and educational institutions and their students who are looking to start and further a career as construction workers for clean energy facilities. This is also intended for employers who are validating an applicant's training history. Employers with in-house training programs could also use these guidelines to ensure their training program meets a similar standard.

Diversity, equity, and inclusion should be intentionally built into the training program design. This includes offering language support for participants with English as a second language, creating flexible and supportive options to increase women's participation, and actively engaging minority groups through safe and inclusive practices. To reduce barriers for disadvantaged or economically challenged communities, programs should also provide supportive services.

Target Group: All Construction Workers

These training guidelines are targeted at entry-level or experienced construction workers in the clean energy industry. An entry-level construction worker is considered an employee that has not attended training or worked on jobsites directly related to the clean energy industry previously. Elements of the clean energy industry make construction projects in the field unique, meaning that individuals with previous general construction experience are still considered entry-level to the clean energy industry. All clean energy construction workers are expected to perform a wide variety of tasks, mechanical and electrical, which contain intrinsic hazards. Without proper training, these tasks would be considered very dangerous. Additionally, construction workers often work without direct supervision, so it is critical that skills be taught, and competency verified, before the worker is considered qualified to perform a task alone. It is also critical to nurture a culture of personal responsibility and a high level of conformance to procedures as part of the overall construction management strategy. Workers can only be expected to remain safe if they clearly understand the hazards associated with given tasks and are motivated to avoid unnecessary risk to themselves or others.

Although various agency requirements may apply, the focus will be primarily on construction personnel who generally would be expected to:

- Have the ability to follow all health and safety and operating procedures
- Use stop-work authority when unsure or unsafe
- Perform daily job task planning activities as it relates to the safe performance of tasks
- Assess hazard recognition of the work area to determine personal protective equipment (PPE) requirements
- Properly use of PPE such as arc flash clothing, insulated gloves, glasses, helmets, and boots
- Interact with stakeholders as directed by managers and ensure safety
- Work in accordance with written procedures and equipment manuals, communicating hazards when necessary
- Interpret of and respond to weather impacts
- Know how to safely and efficiently move objects at jobsites



Assist under the supervision of a Qualified Electrical Worker (QEW) in:

- Safe instillation of clean energy technologies
- Identify proper site-specific PPE and verify based on the scope of work for workers
- Perform appropriate lock out tag out (LOTO) procedures based on jobsite requirements

The fundamental areas of knowledge, skill, and ability typically required for an entry-level clean energy construction worker are:

- Ability to maintain employer specific fitness for duty requirements
- Attention to detail
- Comprehend basic system diagrams, schematics, and symbols
- Collaboration and teamwork
- Mechanical and/or electrical fundamentals
- Proficient with basic software, computer, and mobile devices
- Ability working in small spaces and work at heights
- Understanding and awareness of emergency procedures and preventive measures

Career Pathways

With experience and further training, the clean energy construction worker may progress to carry out more complex jobs depending on interests and abilities. These include job roles such as construction managers and supervisors. Training in these roles include advanced safety and technical focuses, outlined further in ACP Frontline Supervisor Skills, and are subject to site specific requirements. Training can additionally change if the supervisor's work includes a focus on Civil and Site Preparation or Mechanical/Structural work. Further guidance on how these advanced trainings can be modeled is found in Appendix A.

For further guidance on career pathways please see: ACP Clean Energy Career Pathways Catalog.





Program Development Suggestion

ACP, with a member-led working group, completed the training guidelines to ensure a minimum level of training is set and to standardize the program. These guidelines are not a requirement but offer guidance on what employers are looking for regarding worker training, qualifications, and competency.

Model & Explanation

The ACP Guidelines for Construction Training describe a set of recommended training courses and demonstrated competencies. The guidelines build core training, along with specific role and company training, to develop and achieve qualified and competent workers.

Recommended training has been divided into three distinct areas:

CORE TRAINING

Advised training to meet the requirements for all construction works on clean energy site. This section is broken down into Safety and Technical sections.

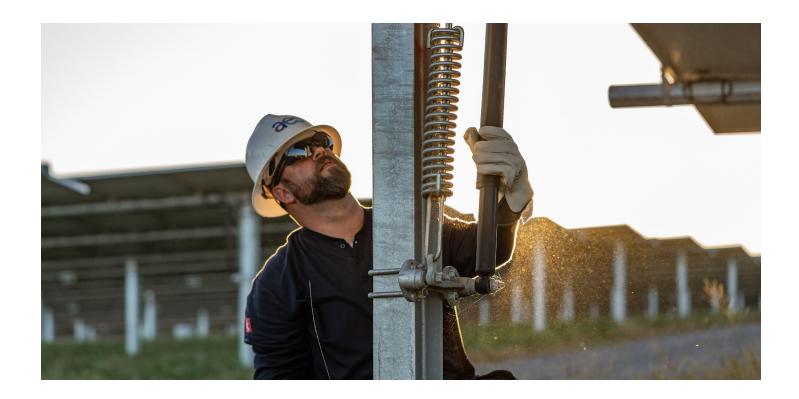
PROJECT ORIENTATION

Recommended dependent on the groups of tasks or scope of the construction worker. This section is broken down into Recommendations for All Workers based on general site differences and Role Specific based on the different scope or levels of work.

SPECIFIC TRADES & SECTOR SPECIFIC SKILLS

Each trade will determine the competency requirements and will base its determinations on a combination of training, practical application, on-the-job training, and competency validation.

The competency validation of the training completed is the employer's responsibility.



Criteria for Standardization

The approach to training can vary based on company culture, maturity, and region. To encourage a standard methodology, the following guidelines are provided.

These guidelines pertain to the individual training modules and to the overall program. Ensuring that each of these guidelines are met will aid training providers in complying with the standardized requirements.

INDIVIDUAL MODULES

- Learning objectives that describe what the participant should know and do when the training is completed.
- Recommended time durations to adequately achieve the learning objectives.
- Delivery method and recommended instructor to student ratio.
- List of equipment required for delivering each module in the training program.
- Refresher training requirements/due dates.
- Theoretical elements, which may be delivered during the practical exercises when feasible.

Overall Program

- Audits of the training organization are recommended to include validation of the following:
 - Quality Management System and supporting processes to ensure the consistent delivery of training objectives, which
 defines:
 - organizational roles and responsibilities
 - handling of training records
 - training document management
 - processes for conducting training risk assessments/mitigations
 - handling non-conformities
 - incident reporting and corrective actions
 - Training equipment and physical facilities:
 - Buildings, training structures, training equipment, and PPE meet local and national safety regulations, with documented maintenance.
 - Processes are in place for validating on-site training locations for safe training.
 - Instructor qualification process:
 - Designated instructors are adequately trained and certified by the employer, training provider, or other relevant certifying body to deliver the training in accordance with the educational materials used to achieve learning objectives.
 - ▶ It is highly advisable to have an instructor with direct construction field experience.
 - On-the-job training Instructors:
 - Designated field or on-the-job training should be performed by qualified and competent workers properly trained through a train-the-trainer program or have received training instruction guidance.
 - Training delivery and assessment:
 - Education materials, including presentation slides, handouts, practical exercises, guides, and instructor lesson plans to ensure consistent delivery of training and achieving learning objectives.
 - ▶ Tests and quizzes for knowledge-based learning objectives (as applicable).
 - Performance assessments for skills and ability-based learning objectives.
- Understand and maintain designated safety zones around all moving vehicles on a construction site, ensuring that only authorized personnel enter these areas
- Use trained spotters to guide vehicle movements, communicate hazards, and prevent collisions with workers or equipment



Core Training: Applicable to ALL Workers

Safety

OSHA 10-HOUR (OSHA 30 FOR LEADS/SUPERVISORS), OR EQUIVALENT

The purpose is to promote workplace safety and health and to make workers more knowledgeable about workplace hazards and their rights. Employers are responsible for providing additional training for their workers on specific hazards of their job as noted in the Occupational Safety and Health Administration (OSHA) standards. This guideline was based on the OSHA 10-hour construction industry guidance at the time of publishing. Organizations or institutions could meet the minimum standard through similar and equivalent means.

Learning Objectives:

- Act independently recognizing the workplace hazards, including avoidance, abatement, and prevention thereof
- Knowledge and understanding of information regarding OSHA, including workers' rights, employer responsibilities, and how to file a complaint

ERGONOMICS, BODY POSITIONING, & MANUAL HANDLING

This module aims to enable participants, through theoretical and practical training, to reduce the risk of musculoskeletal injuries and to perform tasks in the safest way when working in a clean energy construction environment. Organizations or institutions could meet the minimum standard through similar and equivalent means.

Learning Objectives:

 Use of essential manual handling principles to reduce the risk of musculoskeletal injury when performing physical tasks and activities in the construction industry

WORKING AT HEIGHTS

The aim of this module is to enable the participants, through theoretical and practical training, to use basic personal protective equipment and work safely at heights in a remote clean energy construction environment. Additionally, participants will learn the purpose of and how to use ladders, fall arrest systems, and restraints. Organizations or institutions could meet the minimum standard through similar and equivalent means.

Learning Objectives:

 Act safely and responsibly when using basic personal protective equipment and working at heights in a remote clean energy construction environment

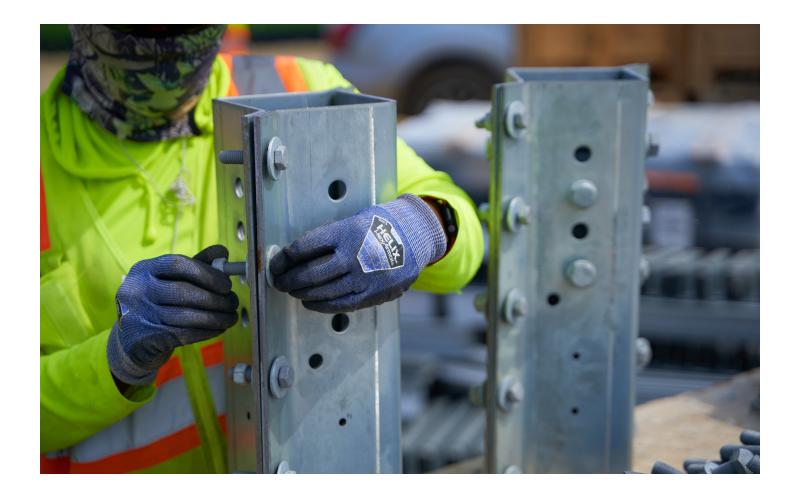
PPE USE & INSPECTION

The aim of this module is to enable participants to understand the proper personal protective equipment for scenarios unique to the clean energy construction environment. Participants will also be able to inspect PPE equipment to determine if the equipment is able to perform its intended function prior to beginning work.

Learning Objectives:

- Determine what PPE is to be used dependent on the task at hand in a clean energy construction environment
- Identify flaws in personal protective equipment prior to work to ensure that the PPE will serve its intended function in the event of an emergency





VEHICLE SAFETY

Driving vehicles, such as trucks, all-terrain vehicles (ATV), or utility-terrain vehicles (UTV) is an essential part of a clean energy construction worker's role. This module aims to enable participants to understand the importance of vehicle safety and defensive driving. Additionally, this module will educate participants on heavy equipment operations, spotter use, and terrain awareness. Organizations or institutions could meet the minimum standard through similar and equivalent means.

Learning Objectives:

- Act safely and responsibly when using vehicles in a clean energy construction environment
- Understand and maintain designated safety zones around all moving vehicles on a construction site, ensuring that only authorized personnel enter these areas
- Use trained spotters to guide vehicle movements, communicate hazards, and prevent collisions with workers or equipment

LOCKOUT/TAGOUT AWARENESS

This module's aim is to provide participants with reasoning for the importance of LOTO procedures in the clean energy industry. Participants will understand the essential steps in LOTO procedures for clean energy facilities, as well as the equipment associated with the procedures. Furthermore, participants will understand the different requirements of LOTO procedures in electrical, hydraulic, mechanical, and thermal systems.

Learning Objectives:

- Understand the importance of LOTO procedures in the clean energy industry
- Describe the main components of LOTO procedures and equipment involved at clean energy facilities
- Identify LOTO procedures for electrical, hydraulic, mechanical, and thermal systems



CONFINED SPACE AWARENESS

This module will give workers basic awareness of confined spaces. Instruction will include general information on confined space awareness for nacelles, substations, and battery enclosures.

Learning Objectives:

- Identify the hazards that come with confined and enclosed spaces specific to the site
- Explain how to avoid injuries while working in tight spaces
- Discuss what to do in a potentially dangerous situation

HAZARD COMMUNICATION

The purpose of this module is to provide participants with the knowledge and skills of basic hazard communication (HAZCOM). Interpreting safety labels, understanding the safe handling of chemicals, noise awareness, and the function of Safety Data Sheets (SDS).

Learning Objectives:

- Understand the basic elements of HAZCOM in a clean energy construction environment
- Demonstrate basic HAZCOM skills to prevent safety incidents from occurring in a clean energy environment

FIRE AWARENESS & EXTINGUISHING

This module's aim is to enable the participants to prevent fires, make appropriate judgements when evaluating a fire, manage evacuation of personnel, and ensure all are safely accounted for in the event of an unmanageable fire. If the incident is judged to be safe, the participants should be able to efficiently extinguish an initial fire by using basic handheld firefighting equipment. Trainees should understand hazards unique to electrical fires and lithium-ion batteries. Companies could meet the minimum standard through similar and equivalent means.

Learning Objectives:

- Identify fire hazards and prevent fires in a clean energy construction environment
- Assess a fire and, if needed, be able to select the right extinguishing media according to the fire classes
- Evacuate personnel and ensure all are safely accounted for in the event of an unmanageable fire
- Efficiently extinguish an initial fire by using basic handheld firefighting equipment, if the incident is judged to be safe

WORKING NEAR HIGH VOLTAGE SYSTEMS & SUBSTATIONS

This module's aim is to instruct participants on the unique hazards posed by high voltage systems and substations which may be found in a clean energy environment. Participants will understand the proper precautions that must be taken to prevent safety incidents from occurring as a result of high voltage systems and substations.

Learning Objectives:

- Identify high voltage systems and substations in clean energy environments
- Understand the unique precautions necessary to be taken in the presence of high voltage systems and substations

Technical

BASIC CONSTRUCTION MATH

The aim of this module is to enable trainees to understand and be able to apply the math skills needed in basic construction environments. These skills include addition, subtraction, temperature, metric conversions, different mechanical and electrical measurements, units of measure, and electrical calc.

Learning Objectives

- Demonstrate an ability to understand basic construction math skills
- Learn where to apply basic construction math skills in a clean energy construction environment
- Understand the importance of knowing how and where to properly use basic construction math skills

INTRODUCTION TO CLEAN ENERGY SYSTEMS (WIND, SOLAR, BESS)

The aim of this module is to orient trainees with the basic operating systems of clean energy technologies, including generation, transmission, and storage. While not participating in the Operations and Maintenance phase of clean energy, it is vital for construction workers to understand the mechanics of the specific system that they are working on to ensure safety, quality assurance, and individual career development

Learning Objectives

- Recognize the unique function of clean energy technologies and what role they play in the broad energy generation process
- Identify the installation processes related to particular clean energy technologies



HAND & POWER TOOL SAFETY

This module will overview best practices for common hand and power tools used on clean energy construction sites, including some tools that are unique to clean energy. Individuals will understand how to ensure the safety of themselves and those around them when using hand and power tools. Additionally, proper tool inspection and maintenance practices will be covered.

Learning Objectives

- Identify and understand the purpose of common hand and power tools at clean energy construction sites
- Determine when tools require maintenance with proper inspection methods
- Recognize hand and power tools unique to clean energy construction sites
- Understand the importance of and how to ensure the safety of the trainee and those around them while using hand and power tools

MECHANICAL ASSEMBLY & FASTENING

This module will overview proper mechanical assembly techniques for constructing utility scale clean energy projects. Trainees will understand the concepts of torque and tension when fastening materials, as well as the importance of using the concepts on construction sites.

Learning Objectives

- Recognize common mechanical assembly situations found on clean energy construction sites
- Understand the concepts of torque and tension in mechanical fastening and the importance of both in ensuring the structural integrity of construction

RIGGING, LIFTING, & MATERIAL HANDLING

This module will educate trainees on basic rigging concepts that are used in clean energy construction environments to prevent workplace hazards, including the use of hand signal communication. Trainees will be instructed on best practices for general material handling and lifting, incorporating basic ergonomic concepts. The importance of having situational awareness in the workplace when handling materials will be emphasized.

Learning Concepts

- Understand basic rigging concepts and their importance in construction environments
- Recognize ergonomical best practices when lifting and handling materials at worksites
- Safely identify potential hazards that could occur around the trainee at a construction site when lifting or rigging objects



Project Orientation (Site Specific Trainings)

All Construction Worker Recommendations

FIRST AID & CPR (SPECIFIC TO REMOTE LOCATIONS & ELECTRICAL EXPOSURE)

The aim of this module is to enable participants, through theoretical and practical training, to recognize signs and symptoms of life threating situations and to administer safe and effective first aid in the clean energy construction environment, until the casualty can be handed over to the next level of care. Organizations or institutions could meet the minimum standard through similar and equivalent means.

Learning Objectives:

- Recognize, assess, and prioritize the need for basic first aid and provide lifesaving first aid until the casualty can be handed over to the next level of care
- Recognizing the limitations as a basic first aid responder, call for help and enable evacuation of the casualty in case of an
 incident in the clean energy construction environment

Specific Lessons

- Site Specific First Aid (Wilderness First Aid, Heat Illness Prevention, Cold Injury Prevention, etc.)
- Electrical Hazard Emergency Response
- First Aid Equipment Use (AED, Bandages, etc.)

MANUAL HANDLING & MATERIAL MOVEMENT

The purpose of this module is to discuss site specific best practices for lifting and moving materials on worksites, expanding previous learnings which cover general ergonomics, body positioning, and manual handling. This module will also discuss lifting larger objects and more complicated lifting methods, tailored to the specific sites of trainees.

Learning Objectives

- Understand and recognize lifting and moving best practices at clean energy construction sites
- Evaluate complex lifting situations and apply suitable techniques or tools to ensure safety
- Build off foundational manual handling knowledge by adapting skills to site-specific conditions and material types

Specific Lessons

Heavy Equipment Spotting & Movement

BASIC FIRE & ELECTRICAL AWARENESS

The purpose of this module is to build off previous general training on fire and electrical awareness in the workplace to identify skills unique to the construction worksites that trainees will encounter. The importance of such systems will be highlighted through specific potential hazards which could occur at worksites. Participants will understand how to interpret and interact with fire and electrical safety systems on worksites.

Learning Objectives

- Identify fire and electrical safety systems unique to a participant's job site, as well as the hazards which they prevent
- Understand how to implement fire and electrical hazard prevention methods on worksites

Specific Lessons

- Site-Specific Emergency Response Plans/EAP
- Spill & Fire Response (especially for BESS electrolyte leaks, PV DC fires, or nacelle fires)
- Pressure Systems & Fluid Safety (e.g., hydraulics in wind towers or tracking systems)



Site/Role Specific Recommendations

SITE SPECIFIC HAZARDOUS ENERGY CONTROL (ADVANCED LOTO)

For workers that may perform mechanical or electrical isolations, the outcome of this module will enable participants to manage the risks related to hazardous energies in the clean energy industry and act safely when in the vicinity of hazardous energies or when working on systems and equipment containing hazardous energies. Sometimes this is commonly referred to as LOTO or Hazardous Energy Control (HEC).

Organizations or institutions could meet the minimum standard through similar and equivalent means.

Learning Objectives:

Solve the challenge of how to act safely while working in the vicinity of hazardous energies in the construction industry
and will on their own initiative seek guidance when needed

NFPA 70E

For workers that have electrical scope, the outcome of NFPA 70E (National Fire Protection Association Standard for Electrical Safety in the Workplace) training is essential for ensuring the safety of employees who work with electrical systems. This curriculum should cover a range of topics related to electrical safety.

Organizations or institutions could meet the minimum standard through similar and equivalent means.

Learning Objectives:

- Understand the purpose and scope of NFPA 70E
- Identify electrical hazards in the workplace
- Implement safety measures to prevent electrical accidents
- Develop and use an electrical safety program
- Use appropriate PPE
- Safely work on energized electrical equipment
- Respond to electrical emergencies effectively

NFPA 70B

For workers that have electrical or commissioning scope, the outcome of NFPA 70B (Recommended Practice for Electrical Equipment Maintenance) training is important for ensuring the reliability and safety of electrical systems in various facilities. This curriculum should cover key topics related to electrical equipment installation practices. Organizations or institutions could meet the minimum standard through similar and equivalent means.

Learning Objectives:

- Understand the purpose and scope of NFPA 70B as it relates to installation and commissioning
- Identify the importance of regular electrical equipment installation practices
- Equipment condition assessment
- Testing categories
- Enhance the safety and reliability of electrical systems

DAILY PRE-TASK PLANNING & HAZARD IDENTIFICATION

This module is aimed to provide participants with the ability to develop a systematic approach to identifying hazards and planning tasks at various job site environments. Participants will understand how to develop a work plan which incorporates hazard avoidance tactics while ensuring efficient work streams.

Learning Objectives

- Identify hazards and develop site specific work plans through a systematic approach
- Understand the importance of incorporating hazard avoidance tactics in workplans
- Fine tune workplans for site specific conditions and personnel differences

Specific Lessons

- Incident/Near-Miss Reporting
- Project-Specific Rules & Stop Work Authority



WORKING AT HEIGHTS

This module will build off the general safety lessons from basic working at heights and focus on site specific circumstances for working at greater heights such as wind turbines, transformers, or larger installation situations. Module instructions can include lessons on wind towers, nacelles, rescue, and rope access dependent on the sector that participants will become involved in.

Learning Objectives

- Understand working at heights requirements and hazards unique to sites relevant to participants
- Review general working at heights lessons from basic working at heights and discover how they apply to site specific situations

Specific Lessons

- Wind towers, nacelles
- Includes rescue and rope access
- Transformer or substation

ENVIRONMENTAL AWARENESS & REPORTING

This module will review how to identify environmental hazards and prevention methods for such hazards on worksites. Participants will learn the importance of preventing environmental hazards for both the company and surrounding community.

Learning Objectives

- Develop a systematic approach from identifying and preventing environmental hazards on jobsites
- Learn the importance of preventing environmental hazards from occurring, along with the various environmental hazards that could occur on specific worksites

Specific Lessons

- Spill Prevention, Countermeasure, and Control (SPCC)
- Permit requirements (CUP)
- Battery fie or thermal runaway
- Vegetation or erosion control
- Wildlife and/or Protected species
- Reporting requirements

GENERAL TECHNICAL OPERATIONS

This module aims to cover technical skills necessary for construction workers to perform tasks for their company which were not covered in previous technical training sections.

Learning Objectives

Understand technical requirements unique to the operations and policies of the company a worker will be employed by

Specific Lessons

- Original equipment manufacturer (OEM) Equipment Training (e.g., wind turbines, inverters, trackers, BESS modules)
- Documentation Practices (-logs, punch lists, inspection forms)
- Quality Control Procedures
- Customer Interaction/Communication Guidelines



Appendix

Appendix A (Specific Trades)

CIVIL/SITE PREP CREWS

- Site Orientation
- · Civil and Site Prep Crews
- Environmental Awareness (e.g, erosion, spills, wildlife, and thermal runaway risks, CUP, SUP, environmental compliance policies)
- · Erosion and sediment control
- · Grading and trenching safety
- Roadway and drainage installation
- Racking, tower base, or enclosure foundation installation

MECHANICAL/STRUCTURAL WORKERS

- Site Orientation
- Environmental Awareness(e.g, erosion, spills, wildlife, and thermal runaway risks, CUP, SUP, environmental compliance policies)
- Bolt torquing and tensioning
- Tracker assembly (solar), nacelle component installation (wind)
- Gearbox, hydraulic, or actuator system inspection

Appendix B (Sector Specific Skills)

SOLAR

- PV module handling, wiring, and tracker setup
- Inverter and combiner box installation
- · Grounding and wire management

WIND

- Tower climbing, nacelle work, and blade prep
- Bolt tensioning and torque sequences
- Mechanical/electrical system access (gears, yaw motors)
- Crane Work

BATTERY STORAGE

- Battery module installation and interconnects
- Thermal management systems
- Monitoring and control panels (EMS/BMS awareness)
- · Safe handling of damaged cells and isolating units

SUBSTATION/GRID INTERCONNECTION

- Grounding
- Equipment tagging/isolation
- High-voltage PPE and proximity awareness



References

ACP Guidelines for Entry-Level Wind Technician Training

ACP Guidelines for Entry-Level Solar PV O&M Technician Training

ACP Guidelines for Entry-Level Battery Energy Storage (BESS) Technician Training

Qualified Electrical Worker (QEW) Program for Wind Operations

Qualified Electrical Worker (QEW) Program for Solar PV Operations

Qualified Electrical Worker (QEW) Program for Battery Energy Storage Operations

OSHA Construction Standard (Standard 1926)

OSHA 29 CFR 1910 - General Industry

NFPA 70E

ANSI/OPEI B71.9: Safety standard for UTVs

ANSI/ASSE A10.32: Personal fall protection in construction

ANSI/ASSEA10.39: Multi-employer worksite safety

ANSI/ASSEA10.49: Control of hazardous energy (LOTO)

ANSI/ASSP A.10 Standards

ANSI Z359 - Fall Protection Code

ASTM F1506 - Clothing for protection from electric arc

ASTM F2413 - Protective footwear

GWO Basic Safety Training

ANSI/ACP 1000-2.2-2023 Rescue And Fall Protection Standard: Rescue Training Requirements

ANSI/ACP 1000-2.3-2023 Rescue And Fall Protection Standard: Fall Protection Training Requirements

ANSI/ACP 1000-2.1-2023 Rescue And Fall Protection Standard: Definitions And Nomenclatures