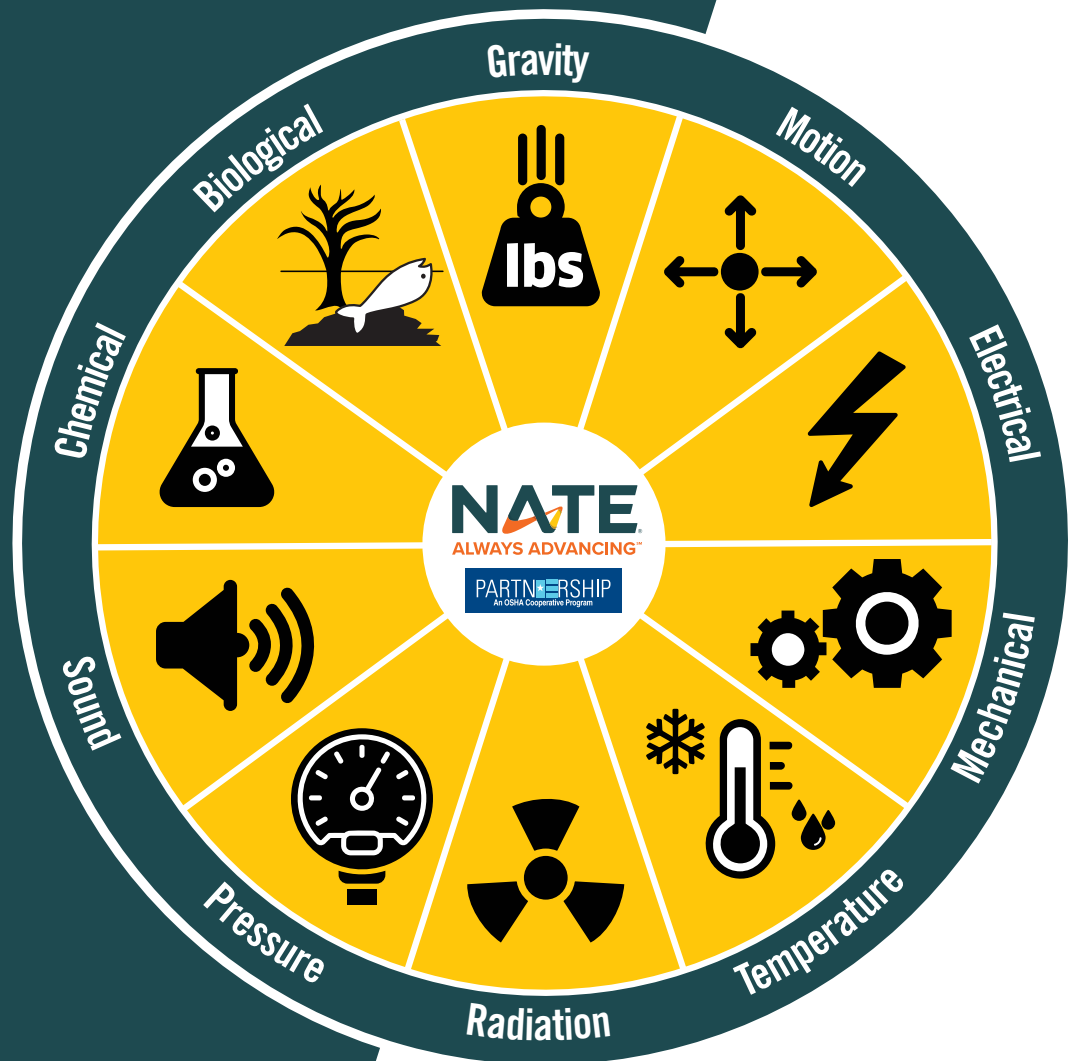


ENERGY WHEEL GUIDE

Incident Prevention for
Critical Hazard Activities



Acknowledgment

NATE sincerely acknowledges the support and collaboration of the Occupational Safety and Health Administration (OSHA), the Federal Communications Commission (FCC), and the OSP Task Teams for their invaluable support and contributions to the development of the NATE Energy Wheel Field Guide. Their expertise, collaboration, and shared commitment to advancing safety and hazard recognition have been instrumental in creating a resource that strengthens risk awareness and promotes safe work practices across the communications infrastructure industry.

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ENERGY WHEEL GUIDE

Incident Prevention for Critical Hazard Activities

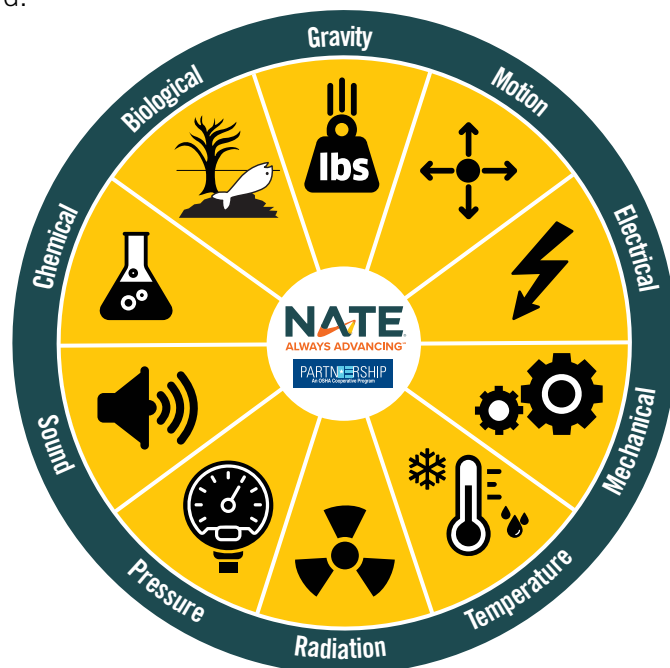
Introduction

Ensuring workplace safety requires a structured approach to hazard identification, assessment, and mitigation. Traditional safety practices rely on workers recognizing hazards instinctively; however, research has shown that many hazards remain overlooked. The Energy-Based Hazard Recognition and Risk Management system provides a comprehensive methodology to systematically identify, assess, and mitigate hazards by focusing on energy sources present in the workplace.

This document is written as a guide to assist in the identification of “Stuff That Can Kill You” specifically, hazards and controls while working in the telecommunication industry using the Energy Wheel approach.

It covers 10 different categories of energy and describes potential high-energy hazards, direct controls, and alternate controls associated with each hazard.

1. Gravity
2. Motion
3. Electrical
4. Mechanical
5. Temperature
6. Radiation
7. Pressure
8. Sound
9. Chemical
10. Biological



Definitions

Energy Wheel and Sources of Energy – A visual tool used to identify the 10 sources of energy and to assess and control the hazards associated with each form of energy.

Exposure – Exposure is when you are at risk from a hazard.

Hazard – A hazard is any source of potential damage, harm, or adverse effects on something or someone under certain conditions.

Hazard Recognition – The initial step in the systematic observation of unsafe conditions, negative behaviors and weaknesses that could lead to injuries and illness on-the-job.

Risk – A risk is the chance or probability that you will be harmed or injured if exposed to a hazard.

Risk Analysis – Risk analysis is a proactive process of eliminating or reducing the threat of hazards.

What is a High Energy Hazard?

A High Energy hazard is one that exposes a human to approximately 500-foot pounds of energy and includes health hazards that exceed workplace exposure limits. The threshold at which, a SIF, (Serious Injury or Fatality), is likely to occur, is called “Stuff That Can Kill You” (S.T.C.K.Y.).

What controls should be used when dealing with High Energy Hazards – Stuff That Can Kill You?

Direct Controls: these are the strongest and preferred form of control when dealing with a high energy hazard. The control meets all three of the following requirements:

1. It is targeted to the high energy hazard. The control is designed and intentionally used to specifically address the high energy hazard.
2. It effectively mitigates the high-energy hazard when installed, verified, and used properly. It should eliminate or mitigate energy exposure. The control is considered “absent” if it is incorrectly installed or not regularly inspected or maintained.
3. It is effective even with unintentional human error during work; i.e., control against the high-energy hazard must be functional even when someone makes a mistake during work.

Indirect Controls: are necessary when no direct controls are available. Alternate controls often (but not always) consist of different levels or hierarchies.

It is important that they do not compensate for the absence of direct control. This document (guide) will highlight examples of alternate controls which typically consist of:

1. Training
2. PPE
3. Temporary barriers
4. Signage
5. Instructions

Applying the Guide to Your Work

Scope of Work

Identify the Scope of Work and tasks for the scope of work.

Job Hazard Analysis

Review the scope of work and utilize pre-job safety meetings, site inspections, and JHA's to identify potential critical hazards, or STCKY with each task.

Hazard Recognition (Critical Risks) (STCKY)

Once hazards have been identified, evaluate the level of risk associated with each energy source associated with the hazard, as per the Energy Wheel.

Energy Sources

Every hazard comes from an energy source. The Energy Wheel identifies 10 sources of energy that can cause injury or illness on telecommunication jobsites. All injuries result from undesirable contact between a person and one or more energy sources. Traditional JHA documents focus on checkbox hazard controls for worker safety.

Training Workers

Hazard Recognition – Workers notice the presence of a hazard. Make sure they understand the energy source itself is not the hazard, but “undesirable” contact with that source of energy. Working on a ladder presents hazards such as the potential to fall, or the potential to drop tools from the ladder. Gravity is the type of energy in those hazards, not the hazard itself.

Risk Perception – Workers judge how much risk the hazard presents.

Risk Tolerance – Workers decide how much risk exposure to tolerate.

Behavior – Workers choose how to behave in response to their hazard assessment.

The Point in this Guide

1. Recognize the Energy Sources
2. Identify Hazards
3. Implement Controls

Stuff That Can Kill You - STCKY



Fall from Heights



Electrical



Rigging & Hoisting



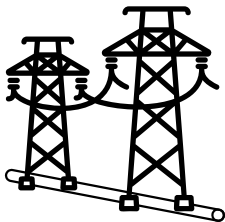
Trenching & Excavation



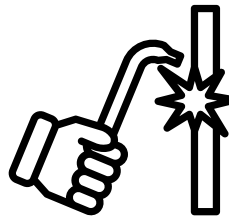
Dropped Objects



Personnel Hoisting



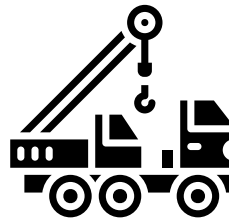
Utilities



Hot Work



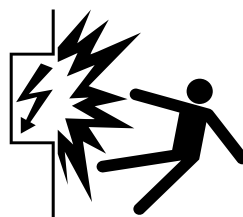
Contact Injuries



Mobile Equipment



RF Hazards



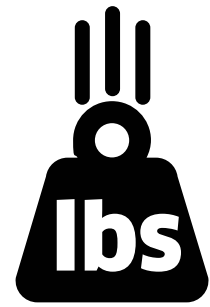
Hot Work

Energy Sources

GRAVITY

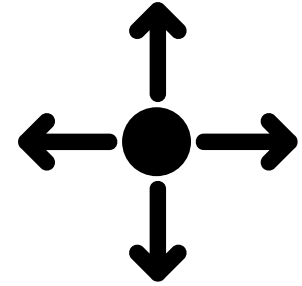
Force caused by the attraction of all objects to the earth.

EXAMPLE: Falling objects, equipment tipping over, collapsing trench, body tripping or falling.



High Energy Hazards	Work Activity	STCKY Examples	Direct Controls	Alternate Controls
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	Any situation working around:	Exposure to:	Provision of:	Provision of:
Work on Structures or Equipment at Height	<ul style="list-style-type: none"> Structures (towers) Platforms Roofs/mezzanines 	<ul style="list-style-type: none"> Falls from height Falling objects Collapsing structures or equipment Tripping 	<ul style="list-style-type: none"> Use of approved guardrail system/parapet wall (42" in height plus or minus 3") with toeboard and midrail Use of full body harness with the use of a fall restraint or fall arrest system Housekeeping tasks to prevent trips 	<ul style="list-style-type: none"> Adequate training for workers Equipment that is operated and maintained in accordance with the manufacturer's instructions Specific training on anchorages and anchorage connection Fall protection/rescue plan Warning line Designated spotter
Rigging/Lifting	<ul style="list-style-type: none"> Lifting/hoisting material Lifting personnel 	<ul style="list-style-type: none"> Dropped objects Rigging component failure 	<ul style="list-style-type: none"> Rigging configured in accordance with Construction Plan Verify the Working Load Limits (WLL) are able to withstand the forces induced throughout all stages of the lift Eliminate unstable configurations including over-extended or overloaded boom Establish drop zone to prevent workers from being in the fall zone and exposed to dropped objects Use adequately sized tool tethering solutions Use redundancies when able (e.g., secondary sling, tether, or short rope) Use of equipment per engineering manufacturer guidelines 	<ul style="list-style-type: none"> Adequate training for workers Knowledge of ground bearing pressures to enable adequate support and stability Construction Plan to ensure tower loading and/or modification requirements Rigging equipment inspections
Unstable Ground Conditions	<ul style="list-style-type: none"> Open trenches or excavations Uneven gradients, surfaces, ground, steep slopes 	<ul style="list-style-type: none"> Being trapped or engulfed by subsidence or collapse Equipment tipped over 	<ul style="list-style-type: none"> Use adequately sized trench supports (e.g., shoring, boxes, piles, or other bracing) Material stabilization Bench or slope excavation according to soil type Establish controlled access zone - barricade Stage spoils no less than 2' from the edge of the excavation Provide and use crane or MEWP matting 	<ul style="list-style-type: none"> Soil stability testing Establish controlled access zone - warning line Establish means of safe access and egress (not to exceed 25' travel distance in any direction) Eliminate water from excavations and trenches

MOTION

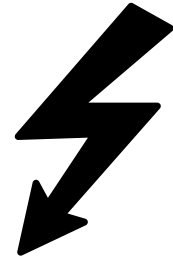


A change in the physical position or location of objects or substances.

EXAMPLE: Vehicle, equipment movement, flowing water, wind and body positioning when lifting, straining, or bending

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	Any situation working around:	Exposure to:	Provision of:	Provision of:
Vehicles	<ul style="list-style-type: none"> Public or private property or roads Construction sites 	<ul style="list-style-type: none"> Being struck by moving vehicles Being caught between moving vehicles Crushed by overturning vehicles 	<ul style="list-style-type: none"> Barricades Effective traffic management plan outlining vehicle and human pathways Designate secure exclusion zones Designate work areas Ensure spotter and flagger guide vehicle movement safely 	<ul style="list-style-type: none"> Warning signage Vehicles with proximity sensors High visibility clothing Ensure loads are secure around and on vehicles Pre-work daily checks Safe speed limits
Machinery and Equipment	<ul style="list-style-type: none"> Heavy equipment or machinery (e.g., backhoe, skid steer, forklift, etc.) Hoists Capstans 	<ul style="list-style-type: none"> Flying objects being released or projected from machinery or equipment Being caught between moving parts of equipment Crushed by overturning machinery or equipment Rollovers 	<ul style="list-style-type: none"> Fixed machine guards Designate secure exclusion zones Spotter or flagger 	<ul style="list-style-type: none"> Machinery back-up alarms Utilize restraint system Enforce strict weight limits Operator training
Swinging Items	<ul style="list-style-type: none"> Rigging or lifting 	<ul style="list-style-type: none"> Moving objects or loads 	<ul style="list-style-type: none"> Use tag lines to control load movement during lifting Implement slow, controlled movements when lifting and lowering loads Use of alternate rigging configurations when a tag is not feasible 	<ul style="list-style-type: none"> Establish swing radius zones Monitor wind and weather conditions to avoid excessive swinging Coordination between riggers and equipment operators Follow employer, manufacturers, and standard guidelines for excessive wind requirements

ELECTRICAL

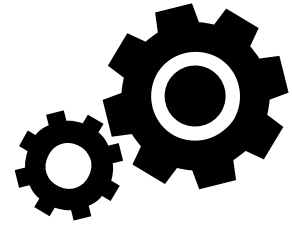


The presence of electrical charge or current.

EXAMPLE: Power lines, static charges, lightning, energized equipment, wiring and batteries.

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	Any situation working around:	Exposure to:	Provision of:	Provision of:
Tools	<ul style="list-style-type: none"> Generators Power tools Extension cords 	<ul style="list-style-type: none"> Electrocution due to faulty tools 	<ul style="list-style-type: none"> Isolation and lockout/tagout procedures Grounded electrical systems Ground Fault Circuit Interrupter (GFCI) Use of insulated tools 	<ul style="list-style-type: none"> Regular maintenance Appropriate PPE Training on proper use of extension cords - no daisy chains
Exposure to Live Wires, Equipment, or Electrical Shock From Other Contact Sources (e.g., Static Electricity)	<ul style="list-style-type: none"> Live overhead powerlines (both high and low voltage) Excavations or ground penetration zones Electrical wiring 	<ul style="list-style-type: none"> Electrocution from: <ul style="list-style-type: none"> - both high and low voltage overhead power lines and underground service - site and electrical equipment - site electrical services - arc flash releasing intense heat and pressure, causing serious burns - improper grounding 	<ul style="list-style-type: none"> Lockout/tagout procedures Ground Fault Circuit Interrupters (GFCI) Barriers to prevent contact with services Maintain minimum approach distance (MAD) for overhead power lines Perform underground utility locates before digging 	<ul style="list-style-type: none"> Training programs for workers to learn safety practices such as recognizing electrical hazards and response procedures Regular inspections
Batteries	<ul style="list-style-type: none"> Site backup battery systems 	<ul style="list-style-type: none"> Arc flash and electrical shock (DC exposure) 	<ul style="list-style-type: none"> Insulated tools/equipment Face shields, gloves, other PPE 	<ul style="list-style-type: none"> NFPA 70E training Signage/labeling
Environmental - Lightning	<ul style="list-style-type: none"> Adverse lightning weather 	<ul style="list-style-type: none"> Strike by lightning 	<ul style="list-style-type: none"> Follow company policy 	<ul style="list-style-type: none"> Monitor weather

MECHANICAL

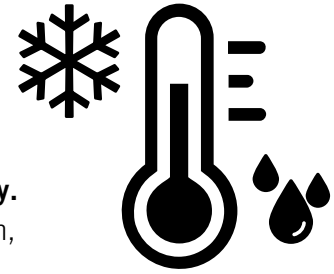


Working parts of a machine or assembly, including rotation, tension, or compression.

EXAMPLE: A worker’s glove gets caught in a grinding wheel; wheels not chocked.

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	Any situation working around:	Exposure to:	Provision of:	Provision of:
Mobile Equipment	<ul style="list-style-type: none"> • Mobile cranes • Forklifts • Cars, vans, trucks • MEWP's • Backhoe 	<ul style="list-style-type: none"> • Trapped, caught in between, and/or crush hazards • Overturned machinery/equipment • Equipment in motion • Contact with obstructions (i.e., buildings) 	<ul style="list-style-type: none"> • Use of machine guarding • Use stability systems (e.g., outriggers for cranes or stabilizers for heavy equipment) • Establish controlled access zone (e.g., warning line or barricade) • Use of lock out/tag out procedures • Emergency stop systems to halt machine operation 	<ul style="list-style-type: none"> • Adequate training for workers specific to the equipment in use • Equipment proximity sensors and/or cameras • Conduct routine maintenance and inspections • Use PPE suitable for assigned task(s) • Warning lines
Hand Tools and Equipment	<ul style="list-style-type: none"> • Equipment with exposed parts 	<ul style="list-style-type: none"> • Entanglement 	<ul style="list-style-type: none"> • Safety features that are part of the power tool such as guards, safety switches, and anti-kickback devices • No loose clothing or hair 	<ul style="list-style-type: none"> • Routine tool inspection and assessment • Training and certifications for equipment • PPE such as gloves, respiratory, eye, and hearing protection

TEMPERATURE

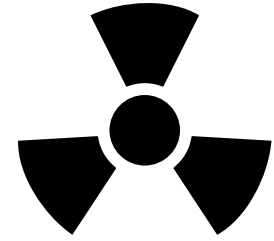


Differences in thermal energy of objects or the environment with the human body.

EXAMPLE: Open flame ignition sources hot or cold surfaces, liquids or gases, steam, friction, and general environmental or weather conditions.

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	Any situation working around:	Exposure to:	Provision of:	Provision of:
Extreme Hot Environment	<ul style="list-style-type: none"> Welding and torch cutting Grinding and cutting Direct sunlight or work in excessive temperatures Non-HVAC Controlled buildings 	<ul style="list-style-type: none"> Heat stress Dehydration Heat stroke Heat exhaustion Sunburn or skin cancer (long term) Sweat production affecting gripping 	<ul style="list-style-type: none"> PPE such as cooling vests Provide and require water for hydration Maintain communication with co-worker 	<ul style="list-style-type: none"> Shaded areas, adequate hydration, and breaks in hot weather Utilization of sunscreen Scheduling of work during cooler times of day, if possible (e.g., early morning) Training on heat stress and emergency situations, to include training on proper clothing Provide training on arriving at work hydrated
Extreme Cold Environment	<ul style="list-style-type: none"> Cold/freezing temperatures 	<ul style="list-style-type: none"> Hypothermia Frostbite Icy conditions leading to slippery surfaces, slips, trips, and falls Reduced dexterity from the cold affecting the ability to safely climb and use power tools 	<ul style="list-style-type: none"> Use of insulated clothing and attire Heated garments and devices Wind mitigation 	<ul style="list-style-type: none"> Training workers on cold weather safety Provide warm refuge shelter Provide breaks, if needed

RADIATION

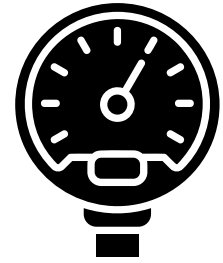


Objects or substances that emit electromagnetic waves or subatomic particles.

EXAMPLE: Lighting issues, welding arcs, solar rays, employee sick from RF energy.

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	Any situation working around:	Exposure to:	Provision of:	Provision of:
RF (Non-Ionizing)	<ul style="list-style-type: none"> Radio Frequency devices (antennas, transmitters) 	<ul style="list-style-type: none"> High-gain RF antennas can cause thermal injuries and biological effects 	<ul style="list-style-type: none"> Establish RF zone and restrict access based on field intensity Use RF-blocking PPE (suits or shielding garments) Time-weighted average Lock down or deactivate transmitters Provide and require use of RF monitors to prevent exposure or overexposure 	<ul style="list-style-type: none"> Training for workers on recognizing the dangers of radio frequency Ensure compliance with RF exposure limits set by regulatory agencies (FCC, OSHA, IEEE, ICNIRP) Establish RF safety plan as part of JHA Installation of warning signage
Non-Ionizing	<ul style="list-style-type: none"> Arc welding Solar exposure 	<ul style="list-style-type: none"> Laser damage to the eyes High-intensity light which can lead to burns Prolonged sun exposure 	<ul style="list-style-type: none"> Machine guarding Provide welding curtains Exclusion zones Limit exposure Require use of protective glasses and correct filter for welding helmets 	<ul style="list-style-type: none"> Training for workers on recognizing the dangers of non-ionizing radiation

PRESSURE



A form of stored energy, capable of sudden and uncontrolled release if containment is compromised.

EXAMPLES: A high-pressure hydraulic hose bursts, spraying fluid and causing unsafe conditions. A sudden release of stored energy, such as a break in a rigging line.

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Equipment Under Pressure	<ul style="list-style-type: none"> Air compressors Pneumatic tools Equipment utilizing hydraulic powered components 	<ul style="list-style-type: none"> Failure of hydraulic/ gas hoses and/or coupling causing high-pressure release 	<ul style="list-style-type: none"> Inspect and utilize equipment and components in accordance with manufacturer requirements and in alignment with applicable standards (e.g., prior to use, annual, etc.) 	<ul style="list-style-type: none"> Utilize PPE Train workers
Pressure Vessels and Pipes	<ul style="list-style-type: none"> Cutting, welding, soldering, heating, that have high pressure tanks Underground and/ or above ground gas/liquid utilities 	<ul style="list-style-type: none"> Sudden release of trapped gas/liquid in underground cavities Pressurized pipelines rupture during excavation Gas cylinders tipping over causing rupture Improperly stored gas tanks causing explosion from heat Over pressurized hoses/lines bursting Improperly maintained equipment resulting in failure 	<ul style="list-style-type: none"> Store gas cylinders upright and secure properly Inspect components for leaks prior to use (e.g., hoses, regulators, etc.) Inspect, mark, and verify location(s) of pressurized pipelines before breaking ground (e.g., using 811, pothole/daylight, etc.) Utilize safe handling techniques (e.g., carts, dolly, storage caps/containment) Protective barriers to shield workers from pressurized systems 	<ul style="list-style-type: none"> Utilize PPE Train workers Provide atmospheric testing
Stored Energy in Components/ Members, Rigging, and Cables, Including Pre-Tensioned Cables, Guy Wires, and Equipment	<ul style="list-style-type: none"> Guy wire Base-mounted hoists, winches, and capstan hoists Post-tensioned slab (e.g., structural cabling) Components/ members with stored energy (e.g., bent, twisted, bound, or force-induced mechanical advantage, etc.) 	<ul style="list-style-type: none"> Sudden release of stored energy within components (e.g., cables, steel, structural members, equipment) Entanglement, crushed by, or caught-in-between 	<ul style="list-style-type: none"> Safety guards and barriers to prevent workers from working near tensioned equipment Follow the construction plan Installation of the guy wire based on standards Utilize suitable tools, equipment, and techniques for assigned task Identify and avoid caught-in-between, crushed by, and line-of-fire situations 	<ul style="list-style-type: none"> Utilize PPE Train workers

SOUND



Audible vibration caused by the contact of two or more objects.

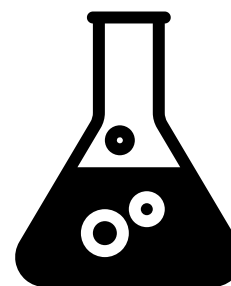
EXAMPLE: Heavy machinery, power tools, nail gun.

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	Any situation working around:	Exposure to:	Provision of:	Provision of:
High Levels of Noise and Vibration	<ul style="list-style-type: none"> Construction equipment including but not limited to: <ul style="list-style-type: none"> - Handheld power tools - Base-mounted hoists - Pneumatic drill - Cranes - Vehicles Surrounding traffic High-level wind 	<ul style="list-style-type: none"> Distracted or loss of situation awareness Miscommunication due to loud noise 	<ul style="list-style-type: none"> Isolating noisy equipment or machinery from people Engineering controls to eliminate or reduce noise levels Equipment with lower sound characteristics Limiting exposure to noise over time Use of radios, hand signals, or visual warning systems for communication in noisy environments Use of hearing protection 	<ul style="list-style-type: none"> Monitor exposure using a dosimeter Awareness of noise induced hearing loss on workers Work scheduling (e.g., perform noisy tasks during less busy periods or location) Regular maintenance for equipment

CHEMICAL

Substances that inherently or through reaction have the potential to create a physical or health hazard.

EXAMPLE: Flammable vapors, reactive hazards, carcinogens, corrosives, combustibles, oxygen deficient atmospheres, welding fumes, silica, wood dusts.

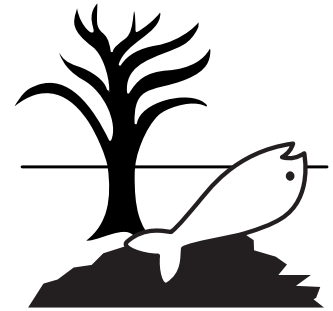


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	Any situation working around:	Exposure to:	Provision of:	Provision of:
Toxic, Carcinogenic, and Corrosive Chemicals	<ul style="list-style-type: none"> Concrete Cement Paints and sealants Mercury from fluorescent bulbs Excavation 	<ul style="list-style-type: none"> Acids and alkali used for cleaning or prepping surfaces Airborne lead-based paint Chemical release during excavation Chemicals used to kill weeds, insects, fungus, and rodents 	<ul style="list-style-type: none"> Alternate products that are less harmful or not harmful Implement systems to capture airborne contaminants Perform underground locates prior to dig Ensure proper handling and storage of chemicals used for pest and vegetation control Provide appropriate PPE 	<ul style="list-style-type: none"> Other clothing specific to the substance being handled Regular monitoring chemical exposure levels Provide information and training on plant identification, safe application when using pesticides or herbicides, and wildlife awareness Processes that eliminate exposure to harmful materials
Fibers, Dusts, Vapors, and Fumes	<ul style="list-style-type: none"> Cutting or grinding cement (Silica) Welding Lead Glass fibers Solvents 	<ul style="list-style-type: none"> Lung disease from inhalation Skin and eye irritation 	<ul style="list-style-type: none"> Process to isolate area with established exclusion zone Dust extraction or wet system PPE: masks or respirators preventing inhalation of hazardous particles Substitution for non-toxic products 	<ul style="list-style-type: none"> Respiratory protective equipment Training for workers Health surveillance and monitoring
Sensitizing Agents	<ul style="list-style-type: none"> Epoxy resins Solvents Paints 	<ul style="list-style-type: none"> Health conditions causing respiratory, asthma, and dermatitis Post exposure complications such as blood poisoning and infection 	<ul style="list-style-type: none"> Alternate materials with no sensitizing agents PPE such as gloves and respiratory protection 	<ul style="list-style-type: none"> Health screening, surveillance, and monitoring for workers who may be exposed Training on the identification, storing and handling of sensitizing agents
Hazardous Atmospheres - Flammable or Explosive, Toxic, or Oxygen-Deficient	<ul style="list-style-type: none"> Spaces can include: <ul style="list-style-type: none"> Manholes Vaults Enclosed areas 	<ul style="list-style-type: none"> Toxic atmospheres, or oxygen deficient atmospheres lead to health effects 	<ul style="list-style-type: none"> Conduct air quality testing for hazardous atmospheres Complete JHA that includes rescue plan prior to entry Maintain two-way communication Maintain proper ventilation 	<ul style="list-style-type: none"> Training on confined space procedures, or hazardous atmospheres recognition

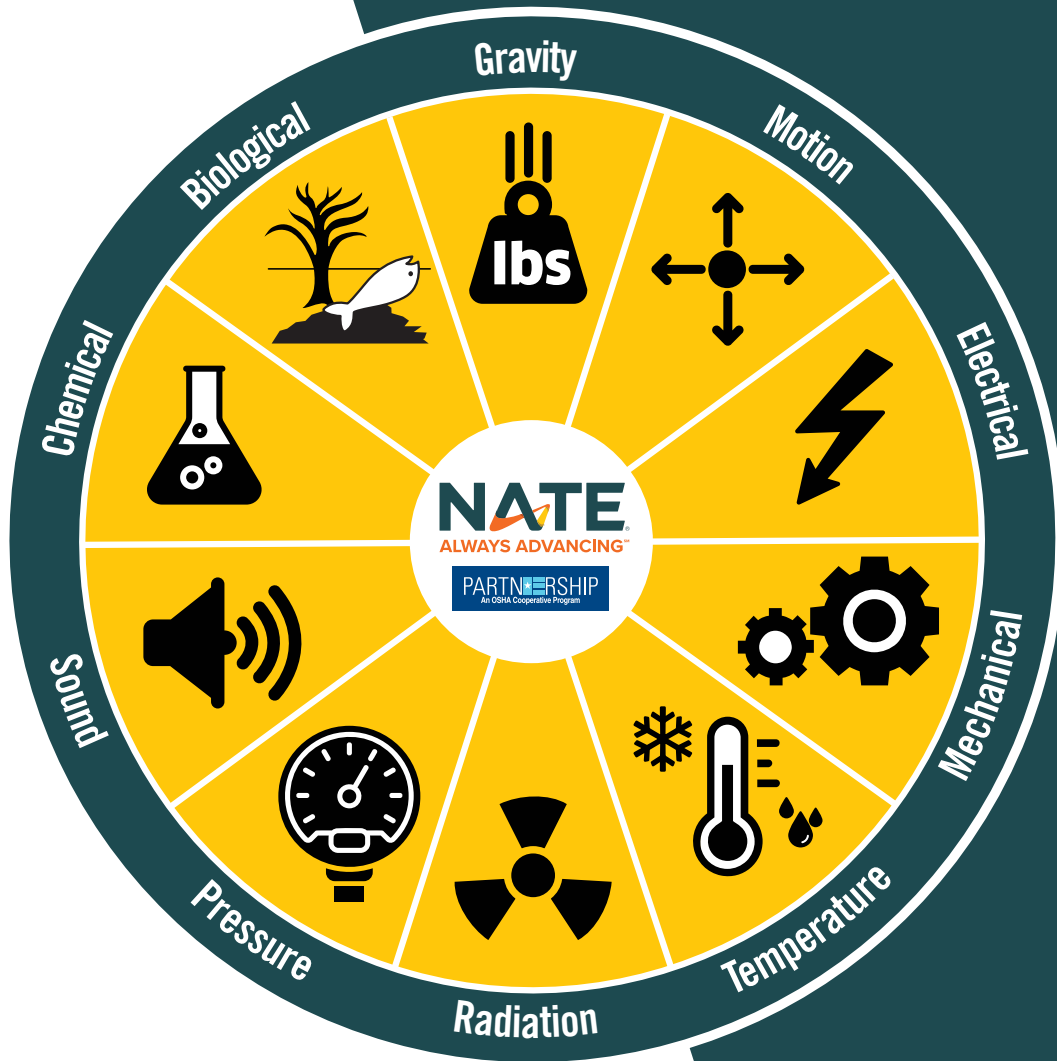
BIOLOGICAL

Living organisms or viruses.

EXAMPLE: Animals, bacteria, viruses, insects, blood-borne pathogens, contaminated water.



High Energy Hazards	Work Activity	STCKY Examples	Direct Controls	Alternate Controls
High energy hazards are sources of harm that could cause serious ill-health, serious injury, or death.	Where might these high energy sources of harm be found in the scope of work?	(including serious harm)	Direct Controls are specifically targeted to the energy source, effectively mitigates a person's exposure to high energy, effective even if a person makes a mistake.	Often necessary, but do not compensate for a lack of direct controls.
	Any situation working around:	Exposure to:	Provision of:	Provision of:
Contaminated Surfaces, Soils and Personnel	<ul style="list-style-type: none"> Excavations and grading Demolition materials Handling and disposing materials Accessing structure Infected individuals 	<ul style="list-style-type: none"> Infectious diseases Hydrogen sulfide (decaying matter) Bacterial diseases like psittacosis (parrot fever), and histoplasmosis due to bird droppings Exposure to contaminated water 	<ul style="list-style-type: none"> Good hand wash hygiene PPE like gloves and coveralls to minimize direct contact with contaminated surfaces or personnel Thorough assessment to test contaminated surfaces, soil, or personnel 	<ul style="list-style-type: none"> Clean surface areas Disposal facilities for contaminated clothing
Wildlife, Insects, Vegetation	<ul style="list-style-type: none"> All Sites 	<ul style="list-style-type: none"> Encounters with wildlife Mosquito-borne and tick-borne diseases Bites or stings from snakes, spiders, scorpions, etc., can lead to cardiac, respiratory, pulmonary, allergic, and neurological conditions Noxious vegetation (e.g., poison ivy, poison sumac, and poison oak) 	<ul style="list-style-type: none"> Provide PPE, such as gloves, masks, and insect repellent, when needed Implement pest control measures to manage hazards Maintain clear areas to minimize contact with hazardous vegetation or wildlife 	<ul style="list-style-type: none"> Conduct site assessments to identify hazards before access Educate workers on how to identify and avoid hazards Ensure proper waste management to prevent attracting wildlife to work areas Provide insect repellent and protective clothing in areas prone to insect-borne disease



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