

OSHA Energy & Utility Safety Pack

FORBES SAFETY SOLUTIONS

Complete bundle — 10 templates included

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FORBES SAFETY SOLUTIONS

JOB HAZARD ANALYSIS

Cable Pulling / Wire Stringing

Regulatory References: 29 CFR 1910.269, 29 CFR 1926 Subpart V, IEEE 524

Document No: FSS-JHA-039 | Revision: 0 | Date: _____

Project Name:		Date:	
Location:		JHA Number:	
Supervisor:		Permit Required:	☐ Yes ☐ No
Prepared By:		Reviewed By:	

JOB HAZARD ANALYSIS TABLE

Task Step	Hazard	Risk Level (H/M/L)	Control Measures
1. Reel Setup & Pulling Equipment Positioning	Heavy reel handling (tip-over, crush) Equipment struck-by Uneven ground/terrain Traffic near setup area	H M M M	Use mechanical means (forklift, crane) to position reels; never roll by hand on grade Set reel jacks on firm, level ground; chock to prevent movement Verify pulling equipment capacity exceeds maximum pulling tension Establish traffic control for roadside operations per MUTCD Brief crew on pulling plan, communication signals, and emergency stops Position equipment to minimize cable bends and crossing hazards
2. Cable Feeding & Pulling Tension Monitoring	High pulling tension (cable snap/whip) Pinch points at sheaves/rollers Cable abrasion damage Communication failure	H H M M	Set tension limiter on puller per cable manufacturer MSBP specifications Monitor dynamometer continuously; stop if tension exceeds limits Apply approved cable lubricant to reduce friction per IEEE 524 Keep all personnel clear of cable path and behind sheave guards Establish continuous radio communication between reel and puller ends Emergency stop capability at both ends of pull
3. Cable Routing Through Conduit/Duct Bank	Cable jamming Existing cable damage Confined space in manholes Chemical exposure (lubricants)	M H H L	Conduct duct survey (mandrel test) before pulling to verify clear path Identify and protect existing cables in shared duct banks Follow confined space entry procedures for all manhole entries (29 CFR 1910.146)

Task Step	Hazard	Risk Level (H/M/L)	Control Measures
			Atmospheric testing before and during manhole operations Use cable guides/rollers at all direction changes to prevent damage Use SDS-approved cable lubricants; provide PPE for chemical handling
4. Splice/Termination Preparation	Electrical contact (adjacent energized cables) Sharp cable edges/cutting tools Chemical exposure (splice materials) Ergonomic strain	H M M M	Verify zero-energy state on cable to be spliced/terminated; use LOTO Identify and maintain safe distance from adjacent energized cables Use proper cable-cutting and stripping tools; cut away from body Follow manufacturer splice/termination procedures exactly Use chemical-resistant gloves when handling splice compounds Provide adequate lighting and ergonomic positioning for workers
5. Testing & Energization Preparation	High-voltage testing (hipot) shock Incorrect cable identification Premature energization	H H H	Clear all personnel from cable route before high-potential testing Post warning signs: 'DANGER - HIGH VOLTAGE TESTING IN PROGRESS' Verify cable phase identification with multiple methods (tone, tag, trace) Ground all cable ends not being tested per IEEE 400 Confirm LOTO clearance before energization steps Notify control center and receive authorization before switching
6. Cleanup & Demobilization	Trip/slip hazards from materials Reel handling injuries Unsecured manhole/vault covers	L M M	Remove all pulling equipment, lubricant containers, and debris Secure all manhole and vault covers flush with grade Verify all cable openings are properly sealed (fire-stop, duct seal) Return reels and equipment using mechanical handling Conduct final site walkthrough for housekeeping Complete as-built documentation and pulling records

REQUIRED PERSONAL PROTECTIVE EQUIPMENT (PPE)

☐ Hard Hat (ANSI Z89.1 Type I, Class E)	☐ Safety Glasses (ANSI Z87.1)
☐ Leather Work Gloves (abrasion-resistant)	☐ Steel-Toe Boots (ASTM F2413)
☐ High-Visibility Vest (ANSI/ISEA 107 Class 2)	☐ FR-Rated Clothing (near energized lines)
☐ Hearing Protection (pulling equipment noise)	☐ Full-Body Harness (if working at height or near openings)
☐ Rubber Insulating Gloves (if near energized conductors)	☐ Knee Pads (for conduit work)

EMERGENCY PROCEDURES

1. If cable snaps or whips under tension, all personnel immediately take cover behind solid barriers. Do NOT attempt to grab a cable under tension. Account for all workers.
2. For pinch-point injuries at sheaves or rollers, stop all pulling operations immediately. Administer first aid and call 911 for crush injuries. Do NOT reverse equipment to free trapped limbs without medical guidance.
3. If overhead line contact occurs, assume everything in the work area is energized. Do NOT touch any equipment or cables. Evacuate using shuffle step (feet together). Call utility for emergency de-energization.
4. For manhole/confined space emergencies, do NOT enter for rescue without proper equipment. Activate retrieval system from surface. Call 911 and initiate confined space rescue plan.
5. For heavy reel handling injuries (strain, crush), stop operations and assess injury. Apply RICE protocol for strains. Call 911 for crush or suspected fracture injuries.
6. All incidents require immediate work stoppage, supervisor notification, and incident report within 24 hours.

Emergency Contact:	911 / Site-specific: _____
Assembly Point:	
Nearest Hospital:	
First Aid Kit Location:	

WORKER SIGN-OFF

By signing below, I acknowledge that I have reviewed and understand this Job Hazard Analysis, the associated hazards, and the required control measures.

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REVIEW & APPROVAL

This JHA has been reviewed and approved by the following authorized personnel:

Role	Name / Signature	Date
Prepared By (Safety Professional)		
Reviewed By (Site Supervisor)		
Approved By (Project Manager)		
Client Representative (if required)		

Next Review Date:	
Revision Notes:	

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This document is valid only when all sections are completed and signatures obtained.

FORBES SAFETY SOLUTIONS

JOB HAZARD ANALYSIS

Energized Electrical Work

Regulatory References: NFPA 70E, 29 CFR 1910.331-335, 29 CFR 1926 Subpart K

Document No: FSS-JHA-037 | Revision: 0 | Date: _____

Project Name:		Date:	
Location:		JHA Number:	
Supervisor:		Permit Required:	☐ Yes ☐ No
Prepared By:		Reviewed By:	

JOB HAZARD ANALYSIS TABLE

Task Step	Hazard	Risk Level (H/M/L)	Control Measures
1. Energized Work Permit & Justification	Unnecessary exposure to electrical hazards Inadequate planning Failure to justify energized work	H H M	Complete Energized Electrical Work Permit (EEWP) per NFPA 70E Document justification: de-energizing creates greater hazard or is infeasible Obtain approval from qualified electrical safety supervisor Perform shock and arc flash risk assessments Brief all workers on specific hazards, boundaries, and emergency plan
2. Approach Boundary Establishment	Unauthorized personnel in danger zone Incorrect boundary distances Arc flash exposure	H H H	Determine Limited, Restricted, and Arc Flash boundaries per NFPA 70E Table 130.4(E)(a) Mark boundaries with barricades, tape, and warning signs Post arc flash labels with incident energy (cal/cm ²) on equipment Only qualified persons within Limited Approach Boundary Attendant posted to control access at boundary perimeter
3. Arc Flash PPE Donning	Inadequate PPE rating Improper donning Heat stress from PPE	H M M	Select PPE based on incident energy analysis (cal/cm ² rating) Inspect all PPE for damage, cleanliness, and proper rating before use Don arc-rated layers: base layer, coverall/flash suit, hood, gloves, boots Verify all gaps sealed: no exposed skin within arc flash boundary Monitor workers for heat stress; rotate personnel as needed

Task Step	Hazard	Risk Level (H/M/L)	Control Measures
4. Voltage Testing & Verification	Contact with energized parts Faulty test equipment Incorrect readings	H M H	Use voltage-rated test instruments rated for the voltage present Verify tester operation on known live source BEFORE and AFTER testing (Live-Dead-Live method) Maintain safe approach distances while testing Use insulated tools and one-hand technique Communicate readings clearly to all team members
5. Energized Work Execution	Arc flash (temps to 35,000°F) Arc blast (pressure wave) Electrical shock Burns Secondary blast-force injuries	H H H H H	Only qualified electrical workers perform energized tasks Work one phase/conductor at a time; insulate adjacent conductors Use insulated hand tools rated for voltage Position body to minimize exposure; turn face away from potential arc Maintain minimum approach distance per NFPA 70E Safety watch/attendant present with rescue equipment ready No loose clothing, jewelry, or conductive items
6. Re-establishment of Covers/Barriers	Accidental contact during closeout Unsecured covers Incomplete restoration	H M M	Replace all covers, guards, and barriers before removing PPE Verify all connections are secure and properly torqued Confirm no tools or materials left inside equipment Update arc flash labels if modifications were made Close out Energized Electrical Work Permit Document all work performed and any anomalies found

REQUIRED PERSONAL PROTECTIVE EQUIPMENT (PPE)

☐ Arc-Rated Face Shield / Hood (cal/cm ² per hazard analysis)	☐ Arc-Rated Coveralls or Flash Suit
☐ Voltage-Rated Insulating Gloves with Leather Protectors	☐ Safety Glasses (ANSI Z87.1) under face shield
☐ Dielectric Safety Boots	☐ Hard Hat (ANSI Z89.1 Type I, Class E)
☐ Hearing Protection (arc blast noise)	☐ Arc-Rated Balaclava
☐ FR Underwear/Base Layers	☐ Voltage-Rated Insulating Blankets/Mats

EMERGENCY PROCEDURES

1. In case of arc flash event, evacuate all personnel from the immediate area. Call 911 immediately. Do NOT attempt to touch the victim until power is confirmed de-energized.
2. For electrical shock, de-energize the circuit from a safe location using insulated tools. Begin CPR/AED if victim is unresponsive. Do NOT move the victim unless in immediate danger.
3. For arc blast injuries (pressure wave), assess for internal injuries, hearing damage, and burns. Treat burns with sterile dressings; do NOT apply ointments or remove fused clothing.
4. If secondary fire occurs from arc flash, use Class C fire extinguisher (CO2 or dry chemical). Evacuate if fire cannot be controlled within 30 seconds.
5. All arc flash incidents require immediate notification to safety department, investigation, and incident report within 24 hours regardless of injury severity.
6. Ensure AED is staged within 2 minutes of the work area. Two qualified first aid/CPR responders must be present.

Emergency Contact:	911 / Site-specific: _____
Assembly Point:	
Nearest Hospital:	
First Aid Kit Location:	

WORKER SIGN-OFF

By signing below, I acknowledge that I have reviewed and understand this Job Hazard Analysis, the associated hazards, and the required control measures.

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REVIEW & APPROVAL

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Prepared By (Safety Professional)		
Reviewed By (Site Supervisor)		
Approved By (Project Manager)		
Client Representative (if required)		

Next Review Date:	
Revision Notes:	

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FORBES SAFETY SOLUTIONS

JOB HAZARD ANALYSIS

Substation Maintenance

Document No: FSS-JHA-048

Regulatory References: 29 CFR 1910.269, NFPA 70E, NESC (National Electrical Safety Code), IEEE C2

PROJECT INFORMATION

Project Name:		Date:	
Location:		JHA Number:	
Supervisor:		Permit Required:	☐ Yes ☐ No
Work Description:	Substation Maintenance	Revision:	0

JOB HAZARD ANALYSIS

Task Step	Hazard	Risk Level (H/M/L)	Control Measures
1. Switching and Isolation	Arc flash (extreme energy levels) Electrocution during switching operations Induced voltage from adjacent energized equipment	H H H	Follow switching order approved by system operator; wear full arc flash PPE per incident energy study Only qualified switchmen perform operations; verify visible open gap on disconnect switches Maintain Minimum Approach Distance (MAD) per 1910.269 Table R-3; treat adjacent circuits as energized
2. Grounding and Testing	Step and touch potential Electrocution from stored energy (capacitance) Induced voltage on de-energized lines	H H H	Test for absence of voltage with rated equipment; apply temporary protective grounds (TPGs) on all phases Ground all capacitive sources; wait for discharge time; test with hot stick-mounted voltmeter Apply grounds as close to work location as possible; use equipotential zone grounding mat
3. Transformer Inspection/Maintenance	PCB exposure (older equipment) Hot oil burns Fall hazards (climbing transformer) SF6 gas exposure (gas-insulated equipment)	H H M H	Check nameplate for PCB content; if suspect, sample and test per EPA 40 CFR 761; use appropriate PPE and disposal Verify oil temperature before opening; wear heat-resistant gloves; have spill containment in place Use fall protection when climbing; three-point contact on ladders; ensure structural integrity of platforms SF6 is an asphyxiant — monitor oxygen levels; ventilate confined areas; by-products from arcing are toxic (use supplied air for suspected decomposition)
4. Breaker/Relay Testing	Unexpected breaker operation Stored spring energy (mechanism) Electrical contact during testing	H H M	Rack breaker to test position; verify control power isolated; follow manufacturer test procedures Block breaker mechanism before working on springs; wear face shield during spring compression work Use appropriately rated test equipment; maintain clearances; only qualified relay technicians perform testing
5. Bus Work and Connections	Arc flash during connection work Falls from elevated bus structures Induced voltage from parallel	H H H	Verify de-energized and grounded; apply equipotential grounding; wear arc-rated PPE Use aerial lifts or scaffolding with fall protection; 100% tie-off above 4 feet Install temporary protective grounds bracketing work area;

Task Step	Hazard	Risk Level (H/M/L)	Control Measures
	conductors		use insulated tools
6. Re-Energization	Arc flash during energization Equipment failure on first energization Personnel in restricted area	H H H	Remove all temporary grounds; verify all tools/personnel clear; energize remotely from control room when possible Perform insulation resistance testing before energization; have protection systems in service Complete personnel sweep; verify all LOTO devices removed; obtain authorization from system operator before switching

REQUIRED PERSONAL PROTECTIVE EQUIPMENT (PPE)

- Arc-rated clothing per NFPA 70E incident energy study (often 40+ cal/cm² for substation work)
- Arc-rated face shield with balaclava (or arc flash suit hood for higher incident energies)
- Voltage-rated gloves (class per voltage level) with leather protectors
- Safety glasses (ANSI Z87.1) under face shield at all times
- Dielectric overshoes or EH-rated safety boots (ASTM F2413)
- Hard hat (ANSI Z89.1 Type I, Class E) — arc-rated for flash hazard areas
- Hearing protection (breaker operation can exceed 85 dB)
- FR-rated high-visibility vest
- Respiratory protection available for SF₆/PCB exposure potential
- Fall protection harness (ANSI Z359) for elevated work

ADDITIONAL SAFETY REQUIREMENTS

- All work within substation requires approved switching orders and clearance tags
- Minimum Approach Distances (MAD) per 29 CFR 1910.269 Table R-3 must be maintained at all times
- Two-person rule: minimum two qualified workers present for all substation work
- Ground grid integrity must be verified before any maintenance activities
- Induced voltages from parallel circuits can be lethal — always apply temporary protective grounds
- Wildlife/pest inspection before work — snakes, wasps, and rodents common in substations
- All test equipment must be CAT IV rated for substation environments

EMERGENCY PROCEDURES

- For electrocution: De-energize using emergency trip if safe; do NOT touch victim in contact with energized equipment; call 911; begin CPR/AED if trained and victim is clear of source
- For arc flash: Evacuate area; do NOT remove melted clothing; cool burns with water; call 911; treat for shock
- For SF₆ exposure: Move victim to fresh air; administer oxygen if available; call 911; SF₆ decomposition products are extremely toxic — do NOT re-enter without SCBA
- For PCB spill: Contain with absorbent; avoid skin contact; notify EPA if spill exceeds 1 lb; document per 40 CFR 761
- Fire response: Use CO₂ or dry chemical extinguisher on electrical fires — NEVER water on energized equipment
- Emergency switching procedures posted at: _____
- First aid kit, AED, and emergency supplies located at: _____
- Nearest hospital/emergency room: _____
- Utility dispatch/control room: _____

WORKER SIGN-OFF

By signing below, I acknowledge that I have reviewed and understand this Job Hazard Analysis, the associated hazards, and the required control measures for this work activity.

#	Print Name	Signature	Date	Company/Trade
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REVIEW & APPROVAL

Role	Name / Signature	Date	Next Review Date
Prepared By			
Reviewed By			
Approved By			
Site Safety Manager			

DISCLAIMER: This JHA is a template provided by Forbes Safety Solutions for general guidance. It must be reviewed, customized, and approved by a qualified safety professional before use on any specific project. Site-specific conditions may require additional hazard controls not listed herein.

FORBES SAFETY SOLUTIONS

JOB HAZARD ANALYSIS

Wind Turbine Maintenance & Inspection

Applicable Standards: 29 CFR 1926 Subpart M (Fall Protection) • 29 CFR 1910.269 (Electric Power Generation) • 29 CFR 1910.147 (LOTO) • NFPA 70E (Arc Flash) • OSHA Wind Energy eTool • ANSI Z359 (Fall Protection Systems) • ANSI/ISEA 121 (Dropped Object Prevention)

PROJECT INFORMATION

Company Name:		Date:	
Project/Site:		JHA Number:	
Supervisor:		Work Activity:	
Turbine ID:		Crew Size:	

JOB HAZARD ANALYSIS — TASK BREAKDOWN

TASK STEP	HAZARD	RISK (H/M/L)	CONTROL MEASURES
1. Pre-Task Safety Briefing & LOTO Verification	• Failure to identify hazards • Incomplete lockout/tagout • Energized components • Arc flash exposure	H	• Conduct tailboard meeting reviewing scope, hazards, and emergency plan • Verify LOTO per 29 CFR 1910.147 — each worker applies personal lock • Confirm zero-energy state with voltage tester • Review rescue plan and confirm rescue-trained personnel on site • Check weather forecast — abort if winds >35 mph or lightning within 30 miles
2. Climb/Ascent to Nacelle (Ladder or Service Lift)	• Falls from 300+ feet • Cardiac event during climb • Dropped objects • Fatigue/overexertion • Ergonomic strain	H	• 100% tie-off with dual-lanyard system or self-retracting lifeline (SRL) • Use climb-assist system or service elevator where available • Verify anchor points and SRL inspection current • Mandatory rest stops per climb protocol • Tool tethering for all hand tools and equipment • Radio communication maintained at all times • Medical fitness-for-duty certification current
3. Hub Access and Transfer	• Falls during nacelle-to-hub transfer • Confined space conditions in hub • Rotating equipment (blade pitch system) • Pinch points	H	• Verify blade pitch system is locked out before hub entry • Use hub-specific fall protection anchorage • Confined space entry permit if ventilation is inadequate • Atmospheric monitoring (O₂, LEL, CO, H₂S) before entry • Maintain communication with ground crew • Never work alone in hub — minimum two-person team
4. Gearbox / Generator Inspection & Service	• Electrical contact with energized components • Arc flash • Hydraulic fluid under pressure • Rotating equipment • Noise exposure >85 dBA • Slips on oil residue	H	• Verify LOTO on all energy sources (electrical, hydraulic, pneumatic) • Wear arc-rated PPE per NFPA 70E arc flash boundary calculations • Use insulated tools for electrical work • Bleed hydraulic pressure before disconnecting lines • Hearing protection required in nacelle • Clean spills immediately — maintain housekeeping • Follow OEM service manual procedures

TASK STEP	HAZARD	RISK (H/M/L)	CONTROL MEASURES
5. Blade Inspection / Repair	- Falls from blade or platform - Suspended at height in harness - Lightning strike - High wind gust exposure - Dropped tools/materials - UV/weather exposure	H	- Platform or rope-access crew with SPRAT/IRATA certification 100% tie-off with twin-leg Y-lanyard or SRL - Lightning 30-30 rule: suspend work if <30 sec between flash and thunder - Wind speed limit: abort exterior blade work at >25 mph sustained - All tools and materials tethered per ANSI/ISEA 121 - Sunscreen, hydration, and shade breaks for outdoor exposure
6. Descent & LOTO Release	- Falls during descent (fatigue) - Premature LOTO removal - Equipment left in nacelle - Incomplete task verification	M	- Controlled descent using climb-assist or service elevator 100% tie-off maintained until ground level - Systematic LOTO removal — each worker removes own lock - Verify all tools accounted for (tool inventory check) - Supervisor sign-off on completed work before energization - Post-task debrief documenting lessons learned

FORBES SAFETY SOLUTIONS

PERSONAL PROTECTIVE EQUIPMENT (PPE) REQUIREMENTS

PPE ITEM	SPECIFICATION / STANDARD	WHEN REQUIRED
Full Body Harness	ANSI Z359.11 — Class III full body harness with dorsal D-ring	All work at height; donned before ascending tower
Twin-Leg SRL / Y-Lanyard	ANSI Z359.14 — self-retracting lifeline, 6 ft. max arrest distance	100% tie-off during climb, nacelle, hub, and blade work
Hard Hat with Chin Strap	ANSI/ISEA Z89.1, Type I, Class E — chin strap rated for at-height use	All times on site and during tower/nacelle operations
Arc-Rated Clothing	NFPA 70E — minimum 8 cal/cm ² arc rating (or per arc flash study)	Electrical inspection, LOTO verification, generator/switchgear work
Dielectric Gloves	ASTM D120 — Class 00 or higher, voltage-rated for task	Any work on or near energized electrical components
Safety Glasses / Goggles	ANSI Z87.1 — impact-rated, anti-fog	All maintenance tasks; goggles for grinding/cutting
Hearing Protection	ANSI S3.19 — NRR 25+ dB (plugs or muffs)	Inside nacelle during generator operation or when noise >85 dBA
Rescue/Descent Device	ANSI Z359.4 — controlled descent device, rated for user + tools	Staged at nacelle; all personnel trained in self-rescue
High-Visibility Vest	ANSI/ISEA 107, Class 2 minimum	Ground-level operations and when working near vehicles
Tool Lanyards / Tethers	ANSI/ISEA 121 — rated for tool weight	All hand tools and small equipment used at height

EMERGENCY PROCEDURES & RESCUE PLAN

EMERGENCY PROCEDURES
Rescue Plan: Trained rescue team on site with nacelle rescue kit (descent device, stretcher, trauma bag). Self-rescue and assisted-rescue drills completed within last 12 months.
Fall from Height: Activate rescue team immediately. Do not leave suspended worker hanging >6 minutes (suspension trauma). Use pre-rigged descent system to lower worker to ground.
Medical Emergency at Height: Stabilize worker in nacelle. Contact emergency services and advise of high-angle rescue need. Use service elevator for patient transport if available.
Severe Weather / Lightning: Monitor weather continuously via SCADA and portable weather station. Evacuate nacelle immediately if lightning within 30 miles (30-30 rule) or winds exceed safe threshold.
Fire in Nacelle: Evacuate immediately via controlled descent. Do NOT attempt fire suppression if automatic system fails. Account for all personnel at ground-level muster point.
Emergency Contacts: Site Safety Officer: _____ Local EMS: 911 Nearest Hospital: _____ Poison Control: 1-800-222-1222

FORBES SAFETY SOLUTIONS

WORKER ACKNOWLEDGMENT & SIGN-OFF

By signing below, I acknowledge that I have reviewed this JHA, understand the identified hazards and control measures, and agree to follow all safety procedures outlined herein.

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JHA REVIEW & APPROVAL

This JHA must be reviewed and approved before work commences. Review is required whenever scope, conditions, or personnel change.

ROLE	NAME	SIGNATURE	DATE
Prepared By (Safety Professional)			
Reviewed By (Site Supervisor)			
Approved By (Project Manager)			
Approved By (HSE Manager)			

REVISION HISTORY

REV #	DATE	DESCRIPTION	REVISED BY

DISCLAIMER: This JHA template is provided as a guide for safety planning and does not replace site-specific hazard assessments. Employers are responsible for ensuring compliance with all applicable OSHA standards, manufacturer requirements, and company-specific safety programs. This document should be adapted to reflect actual site conditions, equipment, and personnel qualifications.

FORBES SAFETY SOLUTIONS

ELECTRICAL SAFETY PROGRAM

OSHA-Compliant Workplace Safety Program

[COMPANY NAME]

Effective Date: [DATE]

Revision Number: [REV #]

Prepared By: [NAME / TITLE]

Approved By: [NAME / TITLE]

Approval Date: [DATE]

TABLE OF CONTENTS

1. PURPOSE & SCOPE

The purpose of this Electrical Safety Program is to establish minimum requirements and procedures for protecting [COMPANY NAME] employees from electrical hazards encountered during work activities. This program applies to all employees, contractors, and visitors who may be exposed to electrical hazards at [COMPANY NAME] job sites and facilities.

This program addresses both general industry and construction electrical safety requirements, ensuring compliance with applicable OSHA standards and recognized industry best practices.

Scope of Application:

- All work performed on or near energized electrical equipment or conductors
- Installation, maintenance, and repair of electrical systems
- Use of portable electrical equipment and extension cords
- Work performed near overhead and underground power lines
- Arc flash hazard assessment and mitigation

2. REGULATORY REFERENCES

This program is designed to comply with the following regulatory standards:

- **29 CFR 1910.331–335** — OSHA General Industry: Electrical Safety-Related Work Practices
- **29 CFR 1910.301–308** — OSHA General Industry: Electrical Design Safety Standards
- **29 CFR 1926 Subpart K (§1926.400–449)** — OSHA Construction: Electrical
- **NFPA 70E** — Standard for Electrical Safety in the Workplace (current edition)
- **NFPA 70** — National Electrical Code (NEC)
- **ASTM F1506** — Standard Performance Specification for FR Textile Materials for Wearing Apparel
- **IEEE 1584** — Guide for Performing Arc Flash Hazard Calculations

3. DEFINITIONS

3.1 Qualified Person

An individual who has training and demonstrated skills and knowledge in the construction and operation of electrical equipment and installations, and has received safety training to identify and avoid the

hazards involved. A Qualified Person must be able to distinguish exposed live parts, determine nominal voltage, and know the clearance distances required per NFPA 70E.

3.2 Unqualified Person

An individual with little or no training regarding electrical hazards. Unqualified persons must be trained in and familiar with any electrically related safety practices necessary for their safety. Unqualified persons shall not approach energized parts closer than the Limited Approach Boundary without the guidance of a Qualified Person.

3.3 Approach Boundaries

NFPA 70E defines the following shock protection approach boundaries for AC systems:

- **Limited Approach Boundary** — The distance from an exposed energized conductor within which a shock hazard exists. Unqualified persons may not cross this boundary.
- **Restricted Approach Boundary** — The distance from an exposed energized conductor within which there is an increased likelihood of electric shock. Only Qualified Persons wearing appropriate PPE may cross this boundary.
- **Prohibited Approach Boundary** — The distance from an exposed energized conductor within which work is considered the same as making contact with the conductor. Crossing this boundary requires the same PPE and procedures as direct contact.
- **Arc Flash Boundary** — The distance from an arc source at which incident energy equals 1.2 cal/cm² (the threshold for a second-degree burn).

4. ROLES & RESPONSIBILITIES

4.1 Management / Employer

- Provide adequate resources for implementation and maintenance of this program
- Ensure an arc flash hazard analysis is performed and labels are applied to equipment
- Provide appropriate PPE and ensure it is maintained in safe, reliable condition
- Ensure only Qualified Persons perform work on energized electrical equipment
- Maintain and make available all required safety documentation and permits

4.2 Safety Manager

- Administer this Electrical Safety Program and ensure compliance

- Conduct periodic audits of electrical safety practices (at least annually)
- Review and approve all Energized Electrical Work Permits
- Investigate all electrical incidents and near-misses
- Coordinate training programs for Qualified and Unqualified Persons

4.3 Qualified Persons / Employees

- Follow all established electrical safety work practices and procedures
- Inspect tools, equipment, and PPE before each use
- Report unsafe conditions, damaged equipment, and near-misses immediately
- Maintain current training qualifications
- Participate in all required safety training

5. PROGRAM PROCEDURES

5.1 Energized Electrical Work Permit

All work on energized electrical conductors or circuit parts operating at 50 volts or more shall be de-energized before work begins, unless one of the following conditions applies:

- De-energization introduces additional or increased hazards (e.g., loss of ventilation in a hazardous location, deactivation of emergency systems)
- De-energization is infeasible due to equipment design or operational limitations

When energized work is justified, an **Energized Electrical Work Permit** (see Appendix A) must be completed and approved by the Safety Manager before work begins. The permit must document:

- Description and location of the circuit/equipment
- Justification for why the work must be performed energized
- Shock and arc flash hazard analysis results
- Safe work practices to be employed
- Required PPE for each task
- Means of restricting access to the work area
- Evidence of job briefing completion

5.2 De-Energization (Lockout/Tagout) Procedures

The following steps shall be followed for de-energizing electrical equipment:

1. Identify all sources of electrical energy and the means of disconnecting them.

2. Notify all affected personnel that equipment will be de-energized.
3. Load the equipment/circuit, if applicable, before disconnecting.
4. Open the disconnecting device(s) for each source of energy.
5. Apply lockout/tagout devices per [COMPANY NAME]'s LOTO program.
6. Verify the equipment is de-energized using an appropriately rated voltage testing device. Test the tester before and after use on a known live source.
7. Ground all phase conductors if there is a possibility of induced voltage or stored electrical energy.
8. Perform work only after all steps are complete and verified.

Re-Energization: Before circuits or equipment are re-energized, conduct visual inspection to ensure all tools, test equipment, and personnel are clear. Remove lockout/tagout devices. Notify affected personnel before energizing.

5.3 PPE Categories and Arc Flash PPE Table

The following table outlines the minimum PPE requirements for each arc flash PPE Category per NFPA 70E:

PPE Category	Cal/cm ² Rating	Required PPE
CAT 1	4 cal/cm ²	Arc-rated long-sleeve shirt and pants or coverall (min 4 cal/cm ²); arc-rated face shield or flash suit hood; hard hat; safety glasses; hearing protection; heavy-duty leather gloves; leather footwear
CAT 2	8 cal/cm ²	Arc-rated long-sleeve shirt and pants or coverall (min 8 cal/cm ²); arc-rated flash suit hood or face shield with balaclava; hard hat; safety glasses; hearing protection; arc-rated gloves; leather footwear
CAT 3	25 cal/cm ²	Arc flash suit (jacket, pants, and hood) rated min 25 cal/cm ² ; arc-rated gloves; hard hat; safety glasses; hearing protection; arc-rated jacket and pants worn underneath; leather footwear
CAT 4	40 cal/cm ²	Arc flash suit (jacket, pants, and hood) rated min 40 cal/cm ² ; arc-rated gloves; hard hat; safety glasses; hearing protection; arc-rated shirt and pants worn underneath; leather footwear

Note: All arc-rated clothing and equipment must be properly maintained and inspected before each use. Contaminated, damaged, or worn PPE must be replaced immediately.

5.4 GFCIs and Assured Equipment Grounding

Per 29 CFR 1926.404(b)(1), [COMPANY NAME] shall use one or both of the following methods on construction sites:

Ground-Fault Circuit Interrupters (GFCIs):

- All 120-volt, single-phase, 15- and 20-ampere receptacle outlets on construction sites that are not part of the permanent wiring shall have GFCI protection.

- GFCIs shall be tested before each day's use per manufacturer's instructions.
- Defective GFCIs shall be removed from service immediately.

Assured Equipment Grounding Conductor Program (AEGCP):

- As an alternative or supplement to GFCIs, [COMPANY NAME] may implement an AEGCP.
- All equipment grounding conductors shall be tested for continuity and correct attachment.
- Testing shall occur before first use, after any repair, at intervals not exceeding 3 months, and before use after any incident that could cause damage.
- A competent person shall be designated to implement the program.
- All tests shall be documented and records maintained at the jobsite.

5.5 Overhead Power Line Clearance Distances

Per 29 CFR 1926.1408 and OSHA requirements, the following minimum clearance distances must be maintained from overhead power lines:

Voltage Range (kV)	Minimum Clearance Distance
Up to 50 kV	10 feet (3.05 m)
Over 50 to 200 kV	15 feet (4.60 m)
Over 200 to 350 kV	20 feet (6.10 m)
Over 350 to 500 kV	25 feet (7.62 m)
Over 500 to 750 kV	35 feet (10.67 m)
Over 750 to 1,000 kV	45 feet (13.72 m)

Note: If voltage is unknown and the utility owner cannot provide the information, the minimum clearance distance is 20 feet for lines rated over 350 kV to 1,000 kV, or 10 feet for voltages below 50 kV.

5.6 Temporary Wiring Requirements

Temporary electrical wiring on construction sites must comply with the following:

- Temporary wiring shall be removed immediately upon completion of the project or purpose.
- All temporary branch circuits shall originate from an approved power outlet or panel board.
- Receptacles on temporary circuits shall be of the grounding type.
- All flexible cords shall be rated for hard or extra-hard usage (e.g., S, ST, SO, STO, SJ, SJT, SJO, SJTO types).
- Flexible cords shall not be fastened with staples, hung from nails, or suspended by wire.
- All cords passing through work areas shall be protected from damage (covered, elevated, or routed away from traffic).
- Extension cords used with portable tools and equipment shall be the three-wire type.
- Each temporary circuit shall be protected by an overcurrent device of appropriate rating.

6. TRAINING REQUIREMENTS

[COMPANY NAME] shall provide electrical safety training to all employees who face risk of electric shock or arc flash hazards. Training shall be appropriate to the employee's job duties and classification.

6.1 Qualified Person Training

- Skills and techniques necessary to distinguish exposed live parts from other parts of electrical equipment
- Skills and techniques necessary to determine nominal voltage of exposed live parts
- Knowledge of approach boundary distances for the voltage levels involved
- Decision-making process for determining degree and extent of the hazard, including arc flash hazard analysis
- Proper selection and use of arc-rated PPE
- Lockout/tagout procedures for de-energizing electrical equipment
- Emergency procedures, including CPR/AED and rescue from contact with energized conductors
- Retraining at intervals not exceeding three (3) years or when procedures change

6.2 Unqualified Person Training

- Recognition of electrical hazards and understanding of approach boundaries
- Procedures for safe interaction around electrical equipment
- Emergency response and reporting procedures
- Proper use of GFCIs and extension cords

7. RECORDKEEPING

[COMPANY NAME] shall maintain the following records:

- **Training records:** Names, dates, content, and trainer information for all electrical safety training. Retained for duration of employment plus three (3) years.
- **Energized Electrical Work Permits:** All completed permits retained for a minimum of three (3) years.
- **Arc flash hazard analysis records:** All arc flash study reports, labels, and updates retained for the life of the equipment.
- **Equipment inspection and testing records:** GFCI testing logs, AEGCP testing records, and PPE inspection logs.

- **Incident investigation reports:** All electrical incidents and near-misses retained for a minimum of five (5) years.

APPENDIX A: ENERGIZED ELECTRICAL WORK PERMIT

ENERGIZED ELECTRICAL WORK PERMIT

Permit Number: _____ Date: _____

Job Location / Description: _____

Equipment / Circuit Identification: _____

Voltage Level: _____

Justification for Energized Work (check one):

- ☐ De-energization would create additional or increased hazards
- ☐ De-energization is infeasible due to equipment design or operational limitations

Explain justification: _____

: _____

Hazard Analysis Results:

Shock Hazard Analysis: _____ Available Fault Current: _____

Arc Flash Boundary: _____ Incident Energy (cal/cm²): _____

PPE Category Required: _____ Working Distance: _____

Required PPE for This Task:

- ☐ Arc-rated clothing (min _____ cal/cm²)
- ☐ Arc-rated face shield / flash suit hood
- ☐ Arc-rated gloves (Class _____)
- ☐ Hard hat (non-conductive)
- ☐ Safety glasses / goggles
- ☐ Hearing protection
- ☐ Insulated tools
- ☐ Voltage-rated rubber gloves with leather protectors

☐ Rubber insulating matting

☐ Other: _____

Safe Work Practices:

Barriers / barricades used: _____

Means of restricting access: _____

Shock protection approach boundaries identified? (Y/N):

Job Briefing Conducted:

Briefing Conducted By: _____ **Date / Time:** _____

Attendees:

1: _____

2: _____

3: _____

Approvals:

Requested By (Qualified Person): _____ **Date:** _____

Approved By (Safety Manager): _____ **Date:** _____

APPENDIX B: ELECTRICAL SAFETY INSPECTION CHECKLIST**ELECTRICAL SAFETY INSPECTION CHECKLIST**

Project / Location: _____

Date: _____

Inspector Name: _____

Title: _____

General Electrical Safety:

- ☐ All electrical panels are accessible (36-inch clearance maintained)
- ☐ Panel covers and doors are in place and closed
- ☐ Circuit breakers and disconnects are properly labeled
- ☐ No evidence of overheating, burning, or smoke damage
- ☐ Arc flash labels are present on all applicable equipment
- ☐ Approach boundary signage is posted where required

Portable Equipment & Extension Cords:

- ☐ Extension cords are rated for hard or extra-hard usage
- ☐ No visible damage to cords (cuts, fraying, exposed conductors)
- ☐ All cords have grounding prongs intact
- ☐ GFCIs are in use on all temporary circuits
- ☐ GFCIs have been tested today
- ☐ Cords are protected from damage in traffic areas
- ☐ No cords run through doors, windows, or holes in walls/ceilings

Overhead Power Lines:

- ☐ Minimum clearance distances are maintained
- ☐ Warning signs/barriers in place where applicable
- ☐ Spotters assigned for crane/equipment operations near power lines

PPE & Tools:

- ☐ Insulated tools are in good condition (no cracks or damage)

- ☐ Voltage-rated gloves are within test date
- ☐ Arc-rated clothing is clean and undamaged
- ☐ Voltage detectors are functioning and calibrated

Corrective Actions Required:

Item 1: _____

Item 2: _____

Item 3: _____

Inspector Signature: _____

Date: _____

Supervisor Signature: _____

Date: _____

FORBES SAFETY SOLUTIONS

Electrical Grounding & Bonding Program

GFCI Protection, AEGCP & Equipment Grounding Requirements

Prepared for:

[COMPANY NAME]

Reference Standards:

29 CFR 1926.404-405 | NFPA 70 (NEC) | NFPA 70E

Date: [DATE] | Revision: [REV NUMBER]

Table of Contents

1. Purpose

This Electrical Grounding and Bonding Program establishes requirements for the proper grounding and bonding of electrical equipment and systems at [COMPANY NAME] construction sites and facilities. This program ensures compliance with 29 CFR 1926.404-405, NFPA 70 (National Electrical Code), and NFPA 70E (Standard for Electrical Safety in the Workplace).

Proper grounding and bonding protects employees from electrical shock, electrocution, and fire hazards by providing a low-impedance path for fault currents to safely return to the source and trip protective devices.

2. Scope

This program applies to all [COMPANY NAME] construction sites, temporary wiring installations, and operations where portable electric tools, equipment, and extension cords are used. It covers:

- Ground-fault circuit interrupter (GFCI) protection
- Assured Equipment Grounding Conductor Program (AEGCP) as an alternative
- Equipment grounding requirements
- Temporary wiring installations
- Extension cord use and inspection
- Double-insulated tool identification

3. Responsibilities

3.1 Management

- Provide GFCI-protected outlets or fund the AEGCP
- Ensure adequate electrical testing equipment is available
- Support program enforcement and employee training

3.2 Safety Manager / Competent Person

- Develop and maintain this program
- Designate a competent person to implement the AEGCP (if used)
- Conduct or oversee required electrical testing

- Maintain all test logs and inspection records
- Conduct employee training on electrical safety

3.3 Designated Competent Person (AEGCP)

Per 29 CFR 1926.404(b)(1)(iii), when the AEGCP is implemented in lieu of GFCIs, a designated competent person shall:

- Implement and oversee the daily testing and inspection program
- Conduct or supervise all required equipment grounding conductor tests
- Maintain written test records and inspection logs
- Remove defective equipment from service immediately

3.4 Supervisors

- Ensure GFCI protection is used or AEGCP is in effect before work begins
- Monitor employees for proper cord and equipment use
- Report defective equipment and remove from service

3.5 Employees

- Use GFCI-protected outlets for all 120-volt, single-phase, 15- and 20-ampere receptacle outlets on construction sites
- Visually inspect cords and equipment daily before use
- Report defective equipment immediately; do not use
- Never remove or bypass the ground prong on a plug

4. Equipment Grounding Requirements

4.1 General Requirements

Per 29 CFR 1926.404(f), the following equipment must be grounded:

- All 120-volt, single-phase, 15- and 20-ampere receptacle outlets on construction sites that are not part of the permanent wiring
- All frames of non-current-carrying metal parts of portable and plug-connected equipment
- All cord sets (extension cords) must have an equipment grounding conductor

- Generator frames must be grounded to the system ground unless meeting specific isolation exceptions

4.2 Ground-Fault Protection Methods

[COMPANY NAME] shall use one of the following two methods for ground-fault protection on construction sites per 29 CFR 1926.404(b)(1):

Option 1: Ground-Fault Circuit Interrupters (GFCIs)

- All 120-volt, single-phase, 15- and 20-ampere receptacle outlets that are not part of the permanent wiring must be protected by GFCIs
- GFCIs detect imbalances as low as 4–6 milliamps and disconnect power in 1/40th of a second
- GFCI protection may be provided by GFCI-protected receptacles, portable GFCI devices, or GFCI breakers

Option 2: Assured Equipment Grounding Conductor Program (AEGCP)

- An alternative to GFCIs that relies on a rigorous testing and inspection program
- Requires a designated competent person to administer
- See Section 5 for detailed AEGCP requirements

5. Assured Equipment Grounding Conductor Program (AEGCP)

When [COMPANY NAME] elects to use the AEGCP as an alternative to GFCI protection per 29 CFR 1926.404(b)(1)(iii), the following requirements apply:

5.1 Written Program Requirements

- The AEGCP must be in writing
- The written program must be available on the job site
- A designated competent person must be responsible for the program
- The program must cover all cord sets, receptacles not part of permanent wiring, and equipment connected by cord and plug that are available for use or used by employees

5.2 Testing Requirements

The following tests must be performed on all covered equipment and cord sets:

Test Type	Requirement	Frequency
-----------	-------------	-----------

Continuity Test	Verify the equipment grounding conductor is electrically continuous from the tool/equipment through the cord to the plug ground prong	Before first use, after repair, and every 3 months
Ground Prong Test	Verify the ground prong is present, not bent or broken, and makes proper contact	Before first use, after repair, and every 3 months
Terminal Connection Test	Verify proper connections of the equipment grounding conductor at the tool and at all plug/receptacle connections	Before first use, after repair, and every 3 months

5.3 Testing Frequency Summary

- Before first use on a job site
- Before return to use after any repairs
- Before use after any incident that could have caused damage
- At intervals not exceeding 3 months (quarterly)

Note: More frequent testing may be warranted in harsh environments or where damage is likely.

5.4 Testing Procedures

1. Use a circuit tester or continuity tester approved for the purpose
2. Test from the ground pin of the plug to the exposed metal frame of the tool
3. Resistance should read near zero ohms (typically <1 ohm for continuity)
4. For receptacles: test from the ground slot to the ground bus in the distribution panel
5. Record all test results on the AEGCP Test Log (Appendix A)

5.5 Color Coding / Identification

Equipment and cord sets that pass testing must be identified by a color-coded marking system:

Quarter	Period	Color Code
Q1	January – March	[COMPANY DESIGNATED COLOR]
Q2	April – June	[COMPANY DESIGNATED COLOR]
Q3	July – September	[COMPANY DESIGNATED COLOR]
Q4	October – December	[COMPANY DESIGNATED COLOR]

Equipment that has not been tested or has failed testing shall NOT have the current quarter color code applied and shall be removed from service.

6. Visual Inspections

In addition to the AEGCP testing, all employees shall perform visual inspections of electrical equipment and cords before each use:

- Check for external defects — fraying, exposed conductors, cut or damaged outer jacket
- Verify ground prong is intact and not bent or missing
- Check plug and connector housing for cracks or damage
- Verify strain relief is intact at both ends
- Check for signs of overheating (discoloration, melting, burning smell)
- Inspect tool housing for cracks that expose internal components

Any cord or equipment failing visual inspection shall be immediately removed from service, tagged "DEFECTIVE — DO NOT USE," and reported to the supervisor.

7. Ground Fault Interrupters

When GFCIs are used as the primary protection method:

- Test GFCI devices before each day's use by pressing the "TEST" button to verify the device trips, then pressing "RESET"
- GFCI devices that do not trip during the test shall be removed from service
- Use GFCI protection on all generators used on construction sites for 15- and 20-amp, 120-volt circuits
- Portable GFCI devices must be connected directly to the outlet — not on extension cords downstream
- Replace GFCI devices that show signs of damage or malfunction

8. Temporary Wiring

Temporary wiring installations on construction sites shall comply with 29 CFR 1926.405(a):

- Temporary wiring is permitted during construction, remodeling, maintenance, or demolition
- All temporary wiring shall be removed immediately upon completion of the project
- Receptacles shall be of the grounding type and connected to a ground
- Branch circuits must have an equipment grounding conductor

- Temporary lights must be protected by guards unless bulbs are deeply recessed
- Temporary lights must not be suspended by their cords unless designed for that purpose
- Splices in temporary wiring must have insulation equivalent to the cord
- Lamps for general illumination must be protected from contact and breakage

9. Extension Cord Requirements

Extension cords (cord sets) used on [COMPANY NAME] job sites must meet the following requirements:

- Three-wire type (hot, neutral, ground) with an equipment grounding conductor
- Listed or labeled by a nationally recognized testing laboratory (UL, CSA, ETL)
- Rated for hard or extra-hard usage (SO, SOW, ST, STW, or equivalent designations)
- Proper wire gauge for the load and length (e.g., 12 AWG minimum for 100-foot runs at 15 amps)
- Must be protected from damage — not run through doorways, windows, or holes unless protected
- Must not be fastened with staples, hung from nails, or suspended by the cord unless designed for it
- Must be used within rated capacity — never daisy-chain multiple extension cords
- Ground prong must NEVER be removed, bent back, or bypassed

10. Double-Insulated Tool Identification

Double-insulated tools are an acceptable alternative to equipment grounding per 29 CFR 1926.404(f)(3) (i):

- Double-insulated tools are identified by the "double square" symbol (◻ within ◻) on the tool nameplate
- These tools have two-prong plugs (no ground prong) and do not require grounding
- The outer housing provides a second layer of insulation beyond the normal internal insulation
- Double-insulated tools must still be visually inspected before use
- If the outer housing is cracked or damaged, the tool shall be removed from service — the secondary insulation has been compromised
- Double-insulated tools should not be used in wet conditions without additional GFCI protection

11. Training

All employees who use portable electrical tools, equipment, or extension cords shall be trained on:

6. Electrical hazards (shock, electrocution, arc flash, fire)
7. The purpose and function of equipment grounding
8. GFCI operation, testing, and use
9. AEGCP requirements (if applicable to the job site)
10. Visual inspection procedures for cords and equipment
11. Extension cord requirements and limitations
12. Identification of double-insulated tools
13. Reporting procedures for defective equipment
14. Emergency procedures for electrical incidents

Training shall be provided before initial assignment and refreshed annually or when site conditions change.

12. Recordkeeping

- AEGCP test logs (retain for duration of project plus 3 years)
- Equipment and cord inspection logs
- GFCI test documentation (daily test records)
- Employee training records
- Records of defective equipment removed from service

Appendix A: AEGCP Test Log

Job Site / Location: _____

Competent Person: _____

Testing Quarter / Period: _____

Color Code for This Quarter: _____

Date	Equipment / Cord ID	Description	Continuity OK?	Ground Prong OK?	Connections OK?	Pass/ Fail	Color Applied	Tester Initials

Equipment Failing Test — Corrective Action:

Competent Person Signature: _____

Date: _____

Appendix B: Extension Cord / Equipment Inspection Log

Job Site / Location: _____

Inspector Name: _____

Date: _____

Daily Visual Inspection Record:

Date	Cord / Equipment ID	Type	Jacket OK?	Ground Prong?	Plug/ Connector OK?	Strain Relief?	Pass/ Fail	Inspect or

Items Removed from Service:

Date	Cord / Equipment ID	Reason Removed	Disposition (Repair/Destroy)	Follow-Up Date

Inspector Signature: _____

Date: _____

FORBES SAFETY SOLUTIONS

Hydrogen Sulfide (H₂S) Safety Program

Exposure Prevention, Monitoring & Emergency Response

Company:	[COMPANY NAME]
Prepared By:	[NAME / TITLE]
Effective Date:	[DATE]
Revision:	[REV NUMBER]
Regulatory Ref:	29 CFR 1910.1000 / 29 CFR 1926.55 / ANSI Z390.1

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Table of Contents

1. Purpose & Scope

[COMPANY NAME] is committed to protecting employees from the hazards of hydrogen sulfide (H₂S) exposure. This program establishes procedures for H₂S detection, monitoring, personal protective equipment, emergency response, and training to ensure compliance with applicable standards.

This program applies to all employees, contractors, and visitors working at or visiting [COMPANY NAME] locations where H₂S exposure is possible, including oil and gas production, wastewater treatment, confined space entry, and drilling operations.

2. Regulatory References

- 29 CFR 1910.1000 — Air Contaminants (General Industry)
- 29 CFR 1926.55 — Gases, Vapors, Fumes, Dusts, and Mists (Construction)
- ANSI Z390.1 — Accepted Practices for Hydrogen Sulfide (H₂S) Training Programs
- NIOSH Pocket Guide to Chemical Hazards — Hydrogen Sulfide
- 29 CFR 1910.134 — Respiratory Protection
- 29 CFR 1910.146 — Permit-Required Confined Spaces

3. Properties of Hydrogen Sulfide

Understanding the physical and chemical properties of H₂S is critical for safe operations:

Property	Description
Chemical Formula	H ₂ S
Appearance	Colorless gas
Odor	"Rotten egg" smell at low concentrations — DO NOT rely on odor for detection
Vapor Density	1.189 (heavier than air — accumulates in low-lying areas)
Flammability	Flammable — LEL: 4.0%, UEL: 44.0%
Solubility	Soluble in water; released when agitated or heated
Key Hazard	Olfactory fatigue — paralyzes sense of smell at ≥50 ppm

NOTE: NEVER rely on your sense of smell to detect H₂S. Olfactory fatigue occurs rapidly at higher concentrations, and the gas becomes odorless. Always use calibrated gas detection instruments.

4. Exposure Limits

Standard	Limit	Concentration
OSHA PEL (Ceiling)	Maximum at any time	20 ppm
OSHA PEL (Peak)	10-minute maximum	50 ppm
NIOSH REL (Ceiling)	10-minute ceiling	10 ppm
ACGIH TLV-TWA	8-hour average	1 ppm
ACGIH TLV-STEL	15-minute short-term	5 ppm
IDLH	Immediately Dangerous to Life/Health	100 ppm

5. Health Effects by Concentration

The following table summarizes the health effects of H₂S at various concentrations:

Concentration (ppm)	Health Effects
0.01 – 0.3	Odor threshold — faint "rotten egg" smell detectable
1 – 10	Noticeable odor; eye irritation at upper range; headache with prolonged exposure
10 – 50	Strong offensive odor; eye and respiratory irritation; headache; nausea; dizziness
50 – 100	Olfactory fatigue (loss of smell); severe eye and respiratory irritation; pulmonary edema possible
100 – 200	IDLH zone; loss of smell immediate; severe respiratory distress; rapid loss of consciousness possible
200 – 500	Rapid unconsciousness; respiratory paralysis; death possible within minutes
500 – 1000	Immediate collapse; respiratory paralysis; death within minutes without rescue
1000+	Immediate death — single breath can be fatal

6. Common Sources of H₂S

6.1 Oil & Gas Operations

- Wellheads, flow lines, and production equipment
- Tank batteries and storage vessels
- Gas sweetening and sulfur recovery units
- Drilling operations (especially in H₂S-bearing formations)

6.2 Other Sources

- Wastewater treatment plants and collection systems
- Confined spaces (manholes, vaults, pits, tanks)
- Landfills and waste disposal facilities
- Pulp and paper mills
- Agricultural operations (manure pits, silos)

- Geothermal areas and hot springs

7. Roles & Responsibilities

7.1 Management

- Ensure H₂S hazard assessments are conducted for all applicable work locations
- Provide monitoring equipment, respiratory protection, and rescue equipment
- Establish H₂S danger zones, alarm systems, and evacuation routes
- Ensure adequate staffing for buddy system compliance

7.2 Supervisors

- Verify atmospheric monitoring before and during H₂S operations
- Enforce buddy system, PPE requirements, and wind direction awareness
- Ensure all personnel on-site are H₂S-trained before work begins
- Brief all workers on evacuation routes, alarm signals, and assembly points

7.3 Employees

- Attend and complete required H₂S safety training
- Use personal and area monitors as required
- Know evacuation routes and emergency assembly points
- Never enter an H₂S-contaminated area without proper PPE and authorization
- Report all alarms, leaks, and suspected H₂S exposures immediately

8. Atmospheric Monitoring

8.1 Equipment Requirements

- Calibrated personal H₂S monitors shall be worn by all personnel in H₂S areas
- Area monitors shall be placed at strategic locations around work zones
- Monitors shall be bump-tested daily and calibrated per manufacturer specifications
- Spare batteries and sensor replacements shall be available on-site

8.2 Alarm Set Points

Alarm Level	Concentration	Action
Low Alarm	10 ppm	Alert — increase awareness, check wind direction, prepare to evacuate
High Alarm	20 ppm (PEL Ceiling)	Evacuate — move upwind and crosswind to assembly point
TWA Alarm	10 ppm (8-hr average)	Evacuate — cumulative exposure limit reached

8.3 Wind Direction Awareness

- Windsocks shall be installed and visible at all H₂S work locations

- Workers shall be aware of wind direction at all times
- Evacuation routes shall be upwind and crosswind of the H₂S source
- Briefings shall include wind direction and potential changes

9. Buddy System

No person shall work alone in areas where H₂S concentrations may exceed 10 ppm:

- Minimum two-person buddy system required in all H₂S danger areas
- Each buddy must maintain visual and/or voice contact
- Each buddy must carry a personal H₂S monitor and have access to escape SCBA
- Buddy pairs shall monitor each other for signs of H₂S exposure

10. Escape Route Planning

- Primary and secondary evacuation routes shall be established and communicated
- Routes shall be upwind and/or crosswind from potential H₂S sources
- Evacuation maps posted at visible locations around the work area
- Wind direction indicators (windsocks) at assembly points
- Muster/assembly points at safe distances upwind of the source
- Regular drills to ensure all personnel are familiar with evacuation procedures

11. Respiratory Protection

Respiratory protection for H₂S shall follow this hierarchy:

Exposure Level	Required Respiratory Protection
Below 10 ppm	No respiratory protection required (monitoring continues)
10 – 50 ppm	Full-face APR with appropriate cartridges (only for escape, not for entry)
50 – 100 ppm	Full-face SAR (Supplied Air Respirator) in pressure-demand mode
Above 100 ppm (IDLH)	Full-face pressure-demand SCBA or combination SCBA/SAR
Unknown concentration	Full-face pressure-demand SCBA

NOTE: APRs (Air Purifying Respirators) do NOT protect against IDLH concentrations. SCBA is mandatory for concentrations above 100 ppm or unknown atmospheres.

Escape-only SCBA (5–10 minute units) shall be readily available at all H₂S work locations.

12. Rescue Procedures

In the event of an H₂S exposure emergency:

12.1 Self-Rescue

- Hold your breath, don escape SCBA if immediately available
- Move upwind and crosswind to the designated assembly point
- Alert others by radio, horn, or alarm
- Do NOT re-enter the area to assist others unless wearing SCBA

12.2 Rescue of Others

IMPORTANT: Attempting rescue without proper SCBA is the leading cause of multiple H₂S fatalities.

- Do NOT enter an H₂S atmosphere without full-face pressure-demand SCBA
- Contact emergency services (911) immediately
- Only trained rescue personnel wearing SCBA shall attempt rescue
- Remove the victim to fresh air upwind of the source
- Begin CPR if the victim is not breathing (H₂S may cause respiratory arrest)
- Administer supplemental oxygen if trained and equipment is available
- Stay with the victim until EMS arrives

13. Medical Surveillance

Medical surveillance shall be provided for employees routinely working in H2S environments:

- Pre-assignment baseline health assessment
- Annual medical evaluation (focused on respiratory and neurological function)
- Post-exposure medical evaluation following any exposure above the PEL
- Pulmonary function tests, chest X-ray, and neurological screening as directed by the physician
- Medical records retained for duration of employment plus 30 years

14. Training Requirements

14.1 Initial Training (ANSI Z390.1 Compliant)

All employees who may be exposed to H2S shall complete initial training covering:

- Properties, sources, and health hazards of H2S
- Exposure limits and effects at various concentrations
- Detection and monitoring equipment operation
- Respiratory protection selection and use
- Buddy system and wind direction awareness
- Evacuation routes and alarm procedures
- Rescue procedures including CPR and first aid
- Hands-on equipment use (monitor, SCBA donning/doffing)

14.2 Refresher Training

- Annual refresher training for all H2S-exposed employees
- Retraining when job conditions change or new H2S sources are identified
- Retraining after any H2S exposure incident

15. Recordkeeping

- Atmospheric monitoring records — retained for 30 years
- Personal exposure monitoring results — retained for 30 years
- Medical surveillance records — retained for duration of employment plus 30 years
- Training records — retained for duration of employment plus 3 years
- Equipment calibration and maintenance records — retained for 3 years
- Incident and near-miss reports — retained for 5 years

16. Program Review

This program shall be reviewed annually or after any H2S exposure incident, near-miss, or change in operations that may affect H2S exposure risk.

Appendix A: H2S Monitoring Log

Use this log to document atmospheric monitoring results at H2S work locations.

Site / Location: _____ Date: _____

Instrument Type: _____ Serial #: _____

Last Calibration Date: _____ Bump Test: ☐ Pass ☐ Fail

Time	Location / Area	H2S (ppm)	Wind Dir.	Action Taken	Initials

Monitor: _____ Reviewed By: _____

Appendix B: H2S Emergency Action Checklist

Post at all H2S work locations. Review with all personnel before work begins.

IF H2S ALARM SOUNDS OR H2S IS DETECTED:

Step	Action	✓
1	STOP work immediately	☐
2	Hold your breath — don't escape SCBA if immediately available	☐
3	Move UPWIND and CROSSWIND to the assembly point	☐
4	Alert others by radio, horn, or verbal warning	☐
5	Account for all personnel at assembly point (buddy check)	☐
6	Call 911 and notify the Site Supervisor	☐
7	DO NOT re-enter the area without SCBA	☐
8	If rescue needed — only trained rescuers with SCBA	☐
9	Administer first aid / CPR if trained	☐
10	Remain at assembly point until "All Clear" is given	☐

EMERGENCY CONTACTS:

Emergency Services: 911

Site Supervisor: _____ Phone: _____

Safety Department: _____ Phone: _____

Poison Control: 1-800-222-1222

Assembly Point Location: _____

Primary Evacuation Route: _____

Secondary Evacuation Route: _____

Wind Direction (current): _____ Windsock Location: _____

HOT WORK PERMIT PROGRAM

Written Safety Program

Per 29 CFR 1910.252 & NFPA 51B

[COMPANY NAME]

[Company Address]

Effective Date: _____

Revision Date: _____

Prepared by Forbes Safety Solutions

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1.0 Purpose and Scope

The purpose of this Hot Work Permit Program is to establish procedures and requirements for the safe performance of hot work operations at [Company Name] facilities and jobsites. This program is designed to prevent fires, explosions, and injuries resulting from welding, cutting, brazing, soldering, grinding, and other spark-producing operations.

This program applies to all employees, contractors, and subcontractors who perform or supervise hot work operations. It complies with the requirements of:

- OSHA 29 CFR 1910.252 — General Requirements for Welding and Cutting
- OSHA 29 CFR 1926.352 — Fire Prevention (Construction)
- NFPA 51B — Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
- NFPA 241 — Standard for Safeguarding Construction, Alteration, and Demolition Operations

2.0 Definitions

Hot Work: Any operation that involves open flames, produces sparks, or generates sufficient heat to ignite flammable or combustible materials. This includes, but is not limited to, welding, cutting, brazing, soldering, grinding, thermal spraying, and thawing pipes with open flames.

Hot Work Permit: A written authorization issued by a designated authority that documents the fire safety precautions in effect for a specific hot work operation at a specific location and time.

Fire Watch: A trained individual stationed at or near a hot work operation to watch for fires and be ready to use fire-extinguishing equipment. Required during hot work and for a minimum of 30 minutes after work is completed.

Designated Hot Work Area: A permanent or semi-permanent location specifically designed, maintained, and approved for hot work operations, where combustible materials are controlled.

Prohibited Area: A location where hot work is not permitted under any circumstances, including areas with flammable atmospheres, near explosive materials, or in areas not authorized by management.

Competent Person: An individual who is capable of identifying hot work hazards, has the authority to take corrective action, and is designated to authorize hot work permits.

Permit Authorizing Individual (PAI): The person responsible for reviewing fire safety conditions at the hot work site, issuing the hot work permit, and verifying that all safety precautions are in place.

3.0 Responsibilities

3.1 Management

- Designate Permit Authorizing Individuals (PAIs) for all work areas
- Ensure adequate resources for fire prevention equipment and training
- Review and update this program annually or when conditions change
- Establish and maintain designated hot work areas

3.2 Permit Authorizing Individual (PAI)

- Inspect the hot work area before issuing permits
- Verify all fire prevention measures are in place
- Issue and post hot work permits at the work location
- Assign qualified fire watch personnel
- Cancel permits if conditions change or precautions are not maintained

3.3 Hot Work Operators

- Obtain a valid hot work permit before beginning any hot work
- Inspect equipment before use and report defects
- Comply with all permit conditions and fire prevention measures
- Stop work immediately if unsafe conditions develop

3.4 Fire Watch Personnel

- Maintain continuous observation during hot work and for a minimum of 30 minutes after completion
- Have fire-extinguishing equipment immediately available and know how to use it
- Know how to activate the fire alarm and contact the fire department
- Have no other duties that would prevent effective monitoring
- Be trained in the use of fire extinguishers

4.0 Hot Work Permit System

A Hot Work Permit must be issued before any hot work is performed outside of designated hot work areas. The permit system includes the following requirements:

4.1 Permit Issuance

- Permits are valid for one shift only (maximum 12 hours) and must be renewed for continued work.
- A new permit is required any time the work location changes.
- The PAI must physically inspect the hot work area and surrounding spaces (including floors above and below, and adjacent rooms) before issuing the permit.
- The completed permit must be posted at the hot work location for the duration of the work.

4.2 Pre-Hot Work Checklist

The PAI must verify the following before issuing a permit:

- Fire detection/sprinkler systems are operational (or alternative protection provided if impaired)
- Combustible materials within 35 feet have been relocated or protected with fire-resistant covers/shields
- Flammable liquids and gases are removed from the area or properly secured
- Floor and wall openings within 35 feet are covered to prevent spark passage
- Atmospheric testing has been conducted if flammable gases/vapors may be present (results must be below 10% LEL)
- Fire extinguisher(s) appropriate for the hazard are immediately available at the work area
- Fire watch personnel are assigned and briefed

4.3 Permit Completion

Upon completion of hot work, the fire watch must remain on duty for a minimum of 30 minutes. The PAI or fire watch must conduct a final inspection of the area. The completed permit must be returned to the site safety office for recordkeeping.

5.0 Designated Hot Work Areas

Designated hot work areas are permanent locations specifically set up and maintained for hot work. A hot work permit is NOT required for work performed in these areas, provided they meet all of the following criteria:

- Floors are non-combustible (concrete, metal, or equivalent)
- Walls and ceilings are non-combustible construction
- No combustible materials are stored within 35 feet
- Adequate ventilation is provided

- Fire extinguishing equipment is readily accessible
- The area is clearly marked as a "Designated Hot Work Area"
- The area is inspected regularly and kept free of combustible accumulations

6.0 Prohibited Areas

Hot work is strictly prohibited in the following areas:

- Areas with explosive or flammable atmospheres (above 10% LEL)
- In or adjacent to areas storing large quantities of flammable or explosive materials
- On or inside containers that have held flammable substances, unless properly cleaned, purged, and tested
- Areas with dust accumulations that could create an explosive atmosphere
- Near sprinkler system risers, fire suppression system components, or fire alarm equipment (unless coordination with the fire alarm monitoring company is completed)
- Any area where the PAI determines conditions are unsafe

7.0 Fire Watch Requirements

A fire watch is required in all of the following situations:

- Hot work is performed in locations where other than a minor fire might develop
- Combustible material in building construction or contents is within 35 feet of the hot work operation and cannot be removed
- Wall or floor openings within 35 feet expose combustible material in adjacent areas
- Combustible materials are adjacent to the opposite side of metal partitions, walls, ceilings, or roofs

7.1 Fire Watch Duration

The fire watch must continue for a minimum of 30 minutes after hot work operations are completed. If conditions warrant (large amounts of combustible material, confined spaces, or adverse conditions), the fire watch period should be extended to 60 minutes or longer as determined by the PAI.

7.2 Fire Watch Qualifications

Fire watch personnel must be trained in the use of fire-extinguishing equipment, familiar with the facility's emergency alarm procedures, and able to identify fire hazards. Fire watch individuals must have no other assigned duties during the fire watch period that would distract from their monitoring responsibilities.

8.0 Fire Prevention Measures

The following fire prevention measures must be implemented for all hot work operations:

- **Combustible Material Control:** Remove all combustible and flammable materials within 35 feet of the hot work operation. Where removal is not practical, protect materials with fire-resistant covers, curtains, or shields.
- **Floor Protection:** Sweep floors clean of combustible debris. If floors are combustible, wet them down or cover with fire-resistant material.
- **Opening Protection:** Seal or cover all openings in floors, walls, and ducts within 35 feet to prevent sparks from traveling to other areas.
- **Fire Suppression Equipment:** A minimum of one portable fire extinguisher (minimum 2A:10BC rating) must be within immediate reach at the work area. For large-scale operations, additional extinguishers, fire hoses, or standpipes may be required.
- **Sprinkler Systems:** Do not impair fire sprinkler systems or automatic fire detection systems for hot work. If impairment is necessary, notify the fire alarm monitoring service and implement alternative protective measures.
- **Ventilation:** Ensure adequate ventilation to prevent the accumulation of flammable vapors and to maintain safe atmospheric conditions.
- **Atmospheric Monitoring:** Conduct atmospheric testing before and during hot work in areas where flammable gases, vapors, or dust may be present. Work must stop immediately if readings exceed 10% LEL.

9.0 Contractor Requirements

All contractors performing hot work on [Company Name] premises or jobsites must:

- Comply with all requirements of this Hot Work Permit Program
- Obtain a hot work permit from the designated PAI before beginning any hot work
- Provide proof that their employees have completed hot work safety training
- Provide their own fire-extinguishing equipment, unless otherwise arranged
- Designate their own fire watch personnel who meet the qualifications in Section 7.2
- Immediately stop work and notify the PAI if unsafe conditions are observed
- Submit completed hot work permits to the site safety office at the end of each shift

10.0 Training Requirements

All personnel involved in hot work operations must receive training on this program. Training must be provided:

- Upon initial assignment to hot work duties
- Annually thereafter

- When changes are made to this program
- When observations indicate that retraining is needed

Training must cover the following topics:

- Fire hazards associated with hot work operations
- The hot work permit system and procedures
- Fire prevention measures and combustible material control
- Fire watch duties and responsibilities
- Proper use of fire extinguishers
- Emergency procedures and alarm activation
- Atmospheric monitoring and testing procedures

11.0 Recordkeeping

The following records must be maintained:

- Completed hot work permits — retained for a minimum of 1 year (or per company/project requirements)
- Hot work training records for all employees and contractors
- Documentation of designated hot work areas and their inspections
- Any incident reports related to hot work operations

HOT WORK PERMIT

[Company Name] — Per 29 CFR 1910.252 / NFPA 51B

Permit #:		Date:	
Start Time:		End Time:	

Location / Area:	
Building / Floor:	
Work Description:	
Type of Hot Work:	☐ Welding ☐ Cutting ☐ Brazing ☐ Grinding ☐ Soldering ☐ Other: _____

FIRE PREVENTION CHECKLIST — Verify BEFORE Issuing Permit

☐	Sprinklers in service / operable? If impaired, notify fire alarm service.
☐	Combustibles removed or protected within 35 feet
☐	Flammable liquids/gases removed or properly secured
☐	Floor/wall openings covered within 35 feet
☐	Fire-resistant covers/shields in place over immovable combustibles
☐	Fire extinguisher(s) available at work area (min. 2A:10BC)
☐	Fire watch assigned and briefed
☐	Floors swept clean of combustible debris

ATMOSPHERIC TESTING (If Required)

LEL Reading:	_____ %	O ₂ Reading:	_____ %
Instrument:		Calibration Date:	

PERSONNEL

Hot Work Operator:	
Fire Watch Name:	
Fire Extinguisher Location:	

AUTHORIZATION

Issued By (PAI):	Signature:	Date/Time:
Operator:	Signature:	Date/Time:
Fire Watch:	Signature:	Date/Time:

POST-WORK FIRE WATCH COMPLETION

Fire Watch End Time:	(minimum 30 minutes after hot work completion)
Area Inspected By:	
Signature:	
Conditions Satisfactory?	☐ Yes ☐ No — If No, describe: _____

FORBES SAFETY SOLUTIONS

LOCKOUT/TAGOUT

Control of Hazardous Energy Program

29 CFR 1910.147

[COMPANY NAME]

[ADDRESS]

[CITY, STATE ZIP]

Effective Date: [DATE]

Revision: [REV #]

Approved By: [NAME/TITLE]

1. PURPOSE & SCOPE

This Lockout/Tagout (LOTO) Program establishes the minimum requirements for the control of hazardous energy during servicing and maintenance of machines and equipment at [COMPANY NAME]. This program is designed to prevent the unexpected energization, startup, or release of stored energy that could cause injury to employees.

This program applies to all [COMPANY NAME] employees, contractors, and subcontractors who perform servicing, maintenance, or repair work on machines and equipment where the unexpected energization or release of stored energy could cause injury. This program covers all forms of hazardous energy including, but not limited to: electrical, mechanical, hydraulic, pneumatic, chemical, thermal, gravitational, and other energy sources.

This program does not apply to:

- Minor tool changes and adjustments that are routine, repetitive, and integral to the use of the equipment, provided work is performed using alternative protective measures
- Work on cord-and-plug-connected electrical equipment where the hazard is controlled by unplugging the equipment and the plug is under the exclusive control of the employee performing the work
- Hot tap operations involving transmission and distribution systems for gas, steam, water, or petroleum products when performed under established procedures and continuity of service is essential

2. REGULATORY REFERENCES

- 29 CFR 1910.147 — The Control of Hazardous Energy (Lockout/Tagout)
- 29 CFR 1910.333 — Selection and Use of Work Practices (Electrical)
- 29 CFR 1910.269 — Electric Power Generation, Transmission, and Distribution
- ANSI/ASSE Z244.1 — Control of Hazardous Energy
- NFPA 70E — Standard for Electrical Safety in the Workplace

3. DEFINITIONS

Authorized Employee: A person who locks out or tags out machines or equipment in order to perform servicing or maintenance. An authorized employee and an affected employee may be the same person when the affected employee's duties also include performing servicing or maintenance on a machine or equipment that must be locked or tagged out.

Affected Employee: An employee whose job requires operating or using a machine or equipment on which servicing or maintenance is being performed under lockout or tagout, or whose job requires working in an area in which such servicing or maintenance is being performed.

Other Employee: An employee who may be in the area where energy control procedures are being implemented but is neither an authorized nor affected employee.

Energy Isolating Device: A mechanical device that physically prevents the transmission or release of energy, including but not limited to: manually operated electrical circuit breakers, disconnect switches, manually operated switches, slide gates, slip blinds, line valves, blocks, and similar devices used to block or isolate energy. Push buttons, selector switches, and other control circuit type devices are NOT energy isolating devices.

Lockout: The placement of a lockout device on an energy isolating device, in accordance with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Tagout: The placement of a tagout device on an energy isolating device, in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

Lockout Device: A device that uses a positive means (such as a lock, either key or combination type) to hold an energy isolating device in the safe position and prevent the energizing of a machine or equipment.

Tagout Device: A prominent warning device, such as a tag and a means of attachment, which can be securely fastened to an energy isolating device to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

Zero Energy State: The condition achieved when all hazardous energy sources have been isolated, locked/tagged out, and verified as de-energized.

4. ROLES & RESPONSIBILITIES

4.1 Management/Program Administrator

- Establish, implement, and maintain this LOTO program
- Ensure adequate resources are available for program implementation (locks, tags, hasps, lockout devices)
- Ensure periodic inspections are conducted at least annually
- Ensure all affected employees receive appropriate training
- Review and update this program as necessary, but at least annually
- Maintain records of training, inspections, and equipment-specific procedures

4.2 Supervisors

- Ensure employees under their supervision comply with this program

- Ensure equipment-specific LOTO procedures are developed for all applicable machines and equipment
- Coordinate lockout/tagout activities with affected departments and contractors
- Ensure employees are trained and authorized before performing LOTO
- Participate in periodic inspections and enforce corrective actions

4.3 Authorized Employees

- Apply lockout/tagout devices in accordance with this program and equipment-specific procedures
- Perform servicing and maintenance activities only after verifying zero energy state
- Remove only their own locks and tags upon completion of work
- Notify affected employees before applying and removing LOTO devices
- Participate in required training and periodic inspections

4.4 Affected Employees

- Do not attempt to restart or re-energize machines or equipment that are locked/tagged out
- Understand the purpose and function of LOTO procedures
- Report any violations of this program to their supervisor
- Participate in required training

5. ENERGY SOURCE IDENTIFICATION

[COMPANY NAME] shall conduct a survey of all machines and equipment to identify all sources of hazardous energy. The following energy sources shall be identified and documented for each piece of equipment:

Energy Type	Examples	Isolation Methods
Electrical	Power supply, batteries, capacitors, static charge	Disconnect switch, circuit breaker, removal of fuses
Mechanical	Flywheels, springs, gears, belts, pulleys	Blocking, braking, disconnecting
Hydraulic	Hydraulic lines, accumulators, rams	Valve closure, bleeding, blanking
Pneumatic	Air lines, compressed gas cylinders, reservoirs	Valve closure, bleeding, disconnecting
Chemical	Process lines, tanks, piping systems	Double block & bleed, blanking, draining
Thermal	Steam lines, furnaces, heated materials	Valve closure, cooling, insulating
Gravitational	Elevated components, counterweights,	Blocking, pinning, cribbing, lowering

Energy Type	Examples	Isolation Methods
	suspended loads	
Stored/Residual	Capacitors, springs, elevated machine members	Grounding, repositioning, bleeding, blocking

Equipment-specific energy control procedures shall be developed for each machine or piece of equipment and shall include:

- A description of the machine/equipment and its intended use
- The specific location of all energy isolating devices
- The type and magnitude of energy the machine/equipment uses
- The specific steps required to shut down, isolate, block, and secure the machine/equipment
- The specific steps required to verify isolation and de-energization
- The specific steps for returning the machine/equipment to normal operation

6. LOCKOUT/TAGOUT PROCEDURES

6.1 Preparation for Shutdown

1. The authorized employee shall identify the type and magnitude of energy that the machine or equipment utilizes.
2. The authorized employee shall understand the hazards of the energy to be controlled and the method(s) to control the energy.
3. The authorized employee shall review the equipment-specific LOTO procedure.
4. The authorized employee shall notify all affected employees that servicing is required and that the machine/equipment will be shut down and locked out.
5. The authorized employee shall gather all necessary lockout/tagout devices and hardware.

6.2 Machine/Equipment Shutdown

6. Shut down the machine or equipment using the normal stopping procedure.
7. Operate all shut-down controls to bring the machine or equipment to a complete stop.
8. Move all control switches and selectors to the "OFF" or "NEUTRAL" position.

6.3 Machine/Equipment Isolation

9. Locate all energy isolating devices for the machine/equipment as identified in the equipment-specific procedure.
10. Operate all energy isolating devices to isolate the machine/equipment from its energy source(s).
11. Ensure all stored or residual energy is relieved, disconnected, restrained, or otherwise rendered safe.

6.4 Application of Lockout/Tagout Devices

12. Each authorized employee shall affix their individually assigned lock to each energy isolating device.
13. Each authorized employee shall attach a completed tagout tag to each lock identifying: the employee's name, date, department, reason for lockout, and expected duration.
14. Locks shall be applied so that the energy isolating device is held in the "safe" or "off" position.
15. Where a tagout device is used without a lock (only when lockout is not possible), the tag shall be attached at the same location the lock would have been placed.

6.5 Verification of Isolation (Zero Energy State)

16. After applying LOTO devices, verify that all energy sources have been isolated by attempting to restart the machine/equipment using normal operating controls.
17. Return operating controls to the "OFF" or "NEUTRAL" position after verification.
18. Test all electrical circuits using an appropriate voltage testing device to verify de-energization.
19. Verify that all stored/residual energy has been relieved (check pressure gauges, try moving mechanical parts, check for flow, temperature, etc.).
20. The machine/equipment is now in a zero energy state and servicing may begin.

6.6 Restoring Machine/Equipment to Service

21. Inspect the work area to ensure all tools, parts, and non-essential items have been removed.
22. Ensure all guards and safety devices have been reinstalled and are functional.
23. Verify all employees are clear of the machine/equipment and positioned safely.
24. Notify all affected employees that locks and tags are being removed and the machine/equipment will be re-energized.
25. Each authorized employee shall remove ONLY their own lock(s) and tag(s).
26. Re-energize the machine/equipment following the equipment-specific procedure.
27. Verify proper operation of the machine/equipment and all safety devices.

7. GROUP LOCKOUT/TAGOUT PROCEDURES

When servicing or maintenance is performed by a crew, crafts, departments, or other group, a group lockout/tagout procedure shall provide a level of protection equivalent to that provided by personal lockout/tagout devices.

28. A designated authorized employee shall be assigned overall responsibility for the group lockout/tagout.
29. The designated authorized employee shall ascertain the exposure status of all members of the group.
30. The designated authorized employee shall apply a group lockout device (multi-lock hasp) to each energy isolating device.
31. Each authorized employee in the group shall affix their personal lock to the group lockout device.
32. The designated authorized employee shall verify isolation and communicate the zero energy state to the group.
33. When work is completed, each authorized employee shall remove their personal lock.
34. The designated authorized employee shall remove the group lockout device only after all personal locks have been removed and all group members are accounted for.

7.1 Shift/Personnel Changes

When servicing extends across shifts, the following procedures shall be followed:

- The off-going shift's authorized employee(s) shall communicate the status of lockout to the on-coming shift's authorized employee(s).
- On-coming authorized employees shall apply their locks BEFORE off-going employees remove their locks.
- A documented transfer of lockout responsibility shall be completed at each shift change.

8. LOCK REMOVAL BY OTHER THAN THE APPLYING EMPLOYEE

In the rare situation where an authorized employee is not available to remove their lock, the following procedure shall be followed:

35. Verify that the authorized employee who applied the lock is not at the facility.
36. Make all reasonable efforts to contact the authorized employee to inform them that their lock is being removed.
37. The removal must be authorized by [COMPANY NAME] management (minimum Supervisor level).
38. Document the circumstances and authorization for the removal.
39. Ensure the authorized employee is informed that their lock was removed before they resume work at the facility.

NOTE: This procedure should be used only as a last resort. Management shall investigate why the lock was not removed through normal procedures and take corrective action.

9. ENERGY ISOLATION DEVICE REQUIREMENTS

9.1 Lockout Devices

- Shall be standardized within [COMPANY NAME] by color, shape, or size
- Shall be durable enough to withstand the environment for the maximum period of expected exposure
- Shall be substantial enough to prevent removal without the use of excessive force or unusual techniques (bolt cutters, etc.)
- Each authorized employee shall be assigned their own uniquely keyed lock(s)
- No two locks shall be keyed alike; master keys are prohibited
- Locks shall be identified with the authorized employee's name

9.2 Tagout Devices

- Shall be standardized in print and format
- Shall be durable enough to withstand the environment for the maximum period of expected exposure
- Shall be attached with a non-reusable, self-locking nylon cable tie (minimum 50 lb. tensile strength)
- Shall clearly state: "DANGER — DO NOT OPERATE" or equivalent warning
- Shall include: employee name, date, department, reason, expected duration

- Tags shall never be bypassed, ignored, or removed by anyone other than the person who applied it

9.3 Additional Lockout Hardware

- Multi-lock hasps for group lockout situations
- Valve lockout devices for ball valves, gate valves, and butterfly valves
- Circuit breaker lockouts for various breaker types
- Plug lockout devices for electrical plugs
- Pneumatic/hydraulic lockout devices
- Lockout stations/boards for organized storage of lockout equipment

10. PERIODIC INSPECTIONS

[COMPANY NAME] shall conduct a periodic inspection of the energy control procedure at least annually to ensure the procedure and the requirements of this program are being followed.

10.1 Inspection Requirements

- The inspection shall be performed by an authorized employee other than the one(s) using the energy control procedure being inspected.
- The inspection shall include a review between the inspector and each authorized employee of the employee's responsibilities under the energy control procedure.
- Where tagout is used, the inspection shall include a review between the inspector and each authorized and affected employee of that employee's responsibilities under the energy control procedure.

10.2 Inspection Documentation

Each periodic inspection shall be documented and shall include:

- The machine or equipment on which the procedure was being utilized
- The date of the inspection
- The employees included in the inspection
- The name and signature of the person performing the inspection
- Any deficiencies identified and corrective actions taken

Inspection records shall be maintained by [COMPANY NAME] for a minimum of three (3) years.

11. TRAINING REQUIREMENTS

11.1 Authorized Employee Training

Each authorized employee shall receive training in the following:

- Recognition of applicable hazardous energy sources
- Type and magnitude of energy available in the workplace
- Methods and means necessary for energy isolation and control
- Purpose and use of the energy control procedure
- Equipment-specific LOTO procedures for equipment they are authorized to service
- Proper use of lockout/tagout devices and hardware
- Verification of zero energy state
- Group lockout/tagout procedures
- Procedures for lock removal by other than the applying employee

11.2 Affected Employee Training

Each affected employee shall receive training in the following:

- The purpose and use of energy control procedures
- Recognition of when the energy control procedure is being implemented
- The prohibition against attempting to restart or re-energize equipment that is locked/tagged out

11.3 Other Employee Training

All other employees whose work operations are or may be in an area where energy control procedures may be used shall be instructed about the prohibition against removing lockout/tagout devices and attempting to restart equipment that is locked/tagged out.

11.4 Retraining

Retraining shall be provided:

- When there is a change in job assignments
- When there is a change in machines, equipment, or processes that present a new hazard
- When there is a change in the energy control procedures
- When a periodic inspection reveals inadequacies in the employee's knowledge or use of the procedure
- At minimum intervals as determined by [COMPANY NAME] (recommended: annually)

11.5 Training Documentation

Training records shall include the employee's name, date of training, topics covered, trainer's name, and shall be maintained for the duration of employment plus three (3) years. All training shall be documented and records retained by [COMPANY NAME].

12. RECORDKEEPING

[COMPANY NAME] shall maintain the following records:

- This written LOTO program (current and previous versions)
- Equipment-specific energy control procedures for all applicable machines/equipment
- Energy source survey/inventory documentation
- Employee training records (initial and retraining)
- Annual periodic inspection records
- Lock removal authorization records
- Incident/near-miss investigation reports related to LOTO

All records shall be maintained for a minimum of three (3) years and shall be made available to employees and their authorized representatives upon request.

13. CONTRACTOR COORDINATION

When outside contractors perform work that requires lockout/tagout:

- [COMPANY NAME] shall inform the contractor of the energy control procedures used at the facility.
- The contractor shall inform [COMPANY NAME] of their lockout/tagout procedures.
- [COMPANY NAME] and the contractor shall coordinate their energy control activities to ensure full protection of all employees.
- Contractor employees shall use their own locks (distinctly different from [COMPANY NAME] locks) and shall be trained in [COMPANY NAME]'s LOTO program requirements.

14. PROGRAM REVIEW & REVISION HISTORY

This program shall be reviewed at least annually or whenever changes in operations, equipment, or regulatory requirements necessitate a revision.

Revision #	Date	Description of Change	Approved By

APPENDIX A: LOTO PROCEDURE FORM

Complete this form for each piece of equipment requiring lockout/tagout procedures.

Field	Information
Equipment Name:	
Equipment ID/Number:	
Equipment Location:	
Date Prepared:	
Prepared By:	
Approved By:	

Energy Source Identification

Energy Type	Source/Location	Magnitude	Isolation Device	Isolation Method
Electrical				
Mechanical				
Hydraulic				
Pneumatic				
Chemical				
Thermal				
Gravitational				
Other:				

Lockout/Tagout Sequence

Step #	Procedure Description	Isolation Device Location
1		
2		
3		
4		

Step #	Procedure Description	Isolation Device Location
5		
6		
7		
8		

Verification of Zero Energy State

Verification Method	Result (Pass/Fail)	Verified By	Date

Restoring Equipment to Service

Step #	Procedure Description
1	
2	
3	
4	
5	

APPENDIX B: ANNUAL PERIODIC INSPECTION LOG

Use this form to document the required annual periodic inspection of energy control procedures per 29 CFR 1910.147(c)(6).

Field	Information
Inspection Date:	
Inspector Name:	
Inspector Signature:	
Equipment/Procedure Inspected:	
Location:	

Employees Reviewed During Inspection

Employee Name	Role (Auth/Affected)	Review Completed (Y/N)	Signature

Inspection Findings

Item #	Finding/Deficiency	Corrective Action Required	Date Corrected
1			
2			
3			
4			
5			

Inspector Certification

I certify that the periodic inspection was conducted in accordance with 29 CFR 1910.147(c)(6) and that the energy control procedure(s) identified above have been reviewed with the employees listed.

Inspector Signature: _____ Date: _____

Management Review: _____ Date: _____

FORBES SAFETY SOLUTIONS

ELECTRICAL SAFETY & ARC FLASH AWARENESS

Toolbox Talk — Electrical Hazard Awareness

[Company Name]

[Date]

Reference: 29 CFR 1910.331-335 | NFPA 70E | 29 CFR 1926.405

WHY THIS MATTERS

Arc flash can reach temperatures of 35,000°F — four times hotter than the surface of the sun.

~1,000

Electrical injuries
per year in
U.S. workplaces

5–10

Arc flash incidents
per day in the U.S.
(NFPA data)

35,000°F

Arc flash
temperature —
explosive force

ARC FLASH & APPROACH BOUNDARIES

WHAT IS ARC FLASH?

An arc flash is an explosive release of energy caused by an electrical fault between conductors or a conductor and ground.

Dangers include:

- Temperatures up to 35,000°F
- Explosive pressure wave (blast)
- Molten metal shrapnel
- Intense light — can cause blindness
- Severe burns and hearing damage

APPROACH BOUNDARIES (NFPA 70E)

BOUNDARY	WHO MAY ENTER	REQUIREMENT
Arc Flash Boundary	Qualified / Unqualified w/ PPE	Arc-rated PPE required
Limited Approach	Qualified persons only	Shock hazard awareness
Restricted Approach	Qualified with written plan	Insulated tools & shock PPE
Prohibited Approach	Same as direct contact	Same PPE as direct contact

PPE CATEGORIES & QUALIFIED PERSONS

ARC FLASH PPE CATEGORIES (NFPA 70E)

CAT	cal/cm ²	REQUIRED PPE
1	4	Arc-rated shirt/pants, safety glasses, hearing protection, leather gloves
2	8	Cat 1 + arc-rated face shield, balaclava
3	25	Arc flash suit hood, arc-rated jacket/pants, insulated gloves w/ leather protectors
4	40	Multi-layer arc flash suit, heavy-duty insulated gloves, full face shield + hood

QUALIFIED VS. UNQUALIFIED

Qualified Person:

- Trained to work on or near exposed energized parts
- Can identify hazards and determine approach boundaries
- Authorized to enter restricted/prohibited boundaries

Unqualified Person:

- Must stay outside the limited approach boundary
- May NOT work on energized equipment
- Must be escorted if entering limited boundary

KEY ELECTRICAL SAFETY RULES

DE-ENERGIZE FIRST

De-energizing is ALWAYS the safest option.

Lockout/Tagout (LOTO) Steps:

- Notify all affected employees
- Identify all energy sources
- Isolate energy sources
- Apply lockout/tagout devices
- Verify zero energy state
- Test before you touch!

CONSTRUCTION SITE REQUIREMENTS

GFCIs required on all construction sites

(29 CFR 1926.405)

- Inspect all cords and tools before each use
- Keep minimum 10 ft clearance from overhead power lines (up to 50kV)
- Never use damaged cords — replace immediately
- Do not overload circuits or use multi-outlet adapters
- Mark all electrical panels — keep 36" clearance
- Report any shock, tingle, or sparking immediately

QUIZ / DISCUSSION

Q1 What is the safest approach before performing electrical work?

Answer: De-energize the equipment first using Lockout/Tagout (LOTO) procedures, then verify zero energy before starting work.

Q2 What PPE category requires a full arc flash suit, and what is its cal/cm² rating?

Answer: Category 4 — rated at 40 cal/cm². Requires multi-layer arc flash suit, heavy-duty insulated gloves, full face shield and hood.

Q3 Can an unqualified person work inside the limited approach boundary?

Answer: No. Unqualified persons must stay outside the limited approach boundary and may only enter if escorted by a qualified person.

ATTENDANCE SIGN-OFF

By signing below, I acknowledge that I attended and understood this Toolbox Talk on Electrical Safety / Arc Flash Awareness.

#	PRINTED NAME	SIGNATURE	DATE
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