TERMINAL-ANDRAE INC.
ELECTRICAL CONTRACTORS & ENGINEERS

COMPANY SAFETY PROGRAM

Terminal-Andrae Inc. conducts their operations so that injuries to people, damage to the property and/or the environment will be avoided. Every effort will be made to prevent accidents. We recognize accidents happen and we will work hard to control and eliminate all workplace hazards. It is our intention to comply with all standards relating to safety and health matters that are enforced by local, state or federal authorities.

Safety meetings for all employees and supervisory staff are scheduled periodically. They are often helpful to instruct employees in accident prevention. We expect all employees to work according to good safety practices as posted, instructed and discussed and to be a safe worker off the job as well as on.

GENERAL SAFETY POLICY

1. All employees of this firm shall follow company safety rules, render every possible aid to safe operation, and report all unsafe conditions or practices to their supervisor/employer.

2. Supervisors shall insist that employees observe and obey every rule, regulation and order necessary to the safe conduct of the work, and shall take such action necessary to obtain compliance.

3. All employees shall be given frequent accident prevention instruction. Instructions, practice drills, and articles concerning workplace safety and health shall be given at least once every 60 working days.

4. Anyone known to be under the influence of alcohol and/or drugs will be dismissed from their duties before or during the work day. Persons with symptoms of alcohol and/or drug abuse are encouraged to discuss personal or work-related problems with the supervisor/employer.

5. No one shall knowingly be permitted or required to work while his or her ability or alertness is impaired by fatigue, illness, or other causes that might expose the individual or others to injury.

6. Employees should be alert to see that all guards and other protective devices are in place, properly adjusted, and shall report deficiencies to management. Approved protective equipment shall be worn in specified work areas.

7. Horseplay, scuffing and other acts which tend to endanger the safety or well being of employees are prohibited.

8. Work shall be well planned and supervised to prevent injuries when working with equipment and handling heavy materials. When lifting heavy objects, employees should bend their knees and use the muscles of the leg instead of the smaller muscles of the back. Back injuries are the most frequent and often the most persistent and painful type of workplace injury.

9. Workers shall not handle or tamper with any electrical equipment, machinery or air or water lines in the manner not within the scope of their duties, unless they have received instructions from their supervisor/employer.

10. All injuries shall be reported promptly to the supervisor/employer so that arrangements can be made for medical and/or first aid treatment.

    First-aid materials are located at Tool Boxes.

    Emergency phone numbers have been posted at Tool Boxes or Job Trailers.

GENERAL SAFETY PRECAUTIONS

- Do not throw material, tools, or other objects from heights (whether structures or buildings) until proper precautions are taken to protect others from the falling object hazard.

- Wash thoroughly after handling hazardous substances.

- Gasoline shall not be used for cleaning purposes.

- Arrange work so that you are able to face ladder and use both hands when climbing.

- Do not lift or lower portable electric tools by the power cord; use a rope. Do not leave the cords of these tools where cars or trucks will run them over.

- Do not attempt to operate machinery or equipment without proper authorization.

- Comply with all safety rules and signs: they are there for a purpose.

- Use necessary protective equipment. Wear eye protection, gloves, etc., when required. Do not wear clothing that is unsafe for the job. Do not wear contact lenses when working with chemicals or mechanical grinding equipment, or where there is potential exposure to strong electrical arcs or flashes. Do not wear watches, rings or other jewelry while operating or servicing machines or equipment with exposed, moving parts or while working with chemicals or live, electrical circuits.

- NEVER immerse hands in chemicals, even when wearing protective gloves.

- Review emergency evacuation procedures for immediate evacuation of an area or building in event of an emergency.

- All required guards and interlocks must be in place and functional before operating equipment.

- Hard hats and safety glasses must be worn on job sites at all times.

- Smoking or chewing tobacco will not be allowed on job sites, other than in designated areas.

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J. Patrick Loftus, P.E.
President

James H. Seefeldt
Vice President-Estimating &
Safety Director

Jon F. Hill
Vice President-Construction

II. SAFETY EQUIPMENT

1. Welding, flash or safety goggles, face shields or similar eye or face protective equipment must be worn on any work where there is any possibility whatsoever of injury to your eyes or face. This includes all drilling and cutting of steel and concrete or working in dusty places. The same applies to welding, cutting, chipping, peening or cleaning welds.

2. Respirators of the proper type must be worn when performing any operation under conditions where the air circulation is not sufficient to prevent the inhaling, to a harmful extend of dust, cement or toxic fumes.

3. In places where no other form of protection from falling is available, safety harnesses and/or life lines must be used, unless in the opinion of the Foreman, they are impractical or unsafe.

4. Safety hard hats must be worn in or around all construction sites or places designated by a sign reading "Hard Hat Area" or in areas where there is a possible danger of head injury from impact, or from falling or flying objects or from electrical shocks and burns.

5. The proper style of pants and shirt should be rugged enough to stand up to the use it will get on a construction site. No shorts or sleeveless shirts allowed on T-A jobsite. Work grade shoes or boots must be worn! No tennis, or dress boots allowed.

6. The above equipment, and/or any other type of safety equipment not listed, but necessary for the safe performance of your job, should be requested if not available in the tool room.

III. ELECTRICAL SAFETY

Fire, personal injury or death can result from electrical energies. Only qualified personnel are permitted to work with live, electrical circuits.

All electrical equipment must be maintained by qualified personnel. Safety covers and safety devices, such as interlocks, must be restored after servicing.

All electrical equipment, which has exposed metal parts or covers and which operates at a voltage presenting a shock hazard, must be grounded through a grounding conductor or be UL approved, double insulated. All other potentially hazardous ungrounded equipment must be isolated and have signs.

IV. FIRST AID GENERAL RULES

The following rules are applicable to most first aid situations that would be encountered:

A. Be calm, size up the situations as completely and quickly as possible before giving first aid.

B. Do simplest things consistent with good first aid.

C. Take care of the most important conditions first. Severe bleeding, stoppage of breathing and poisoning must be treated immediately before anything else is done.

D. Be gentle in handling an injured person. If the injury is serious, keep the person lying down and make him as comfortable as possible. Do not move him unless you know it can be done without making the person worse.

E. Be clean in treating a wound.

F. Call a doctor immediately if the condition is serious.

TERMINAL-ANDRAE INC.
ELECTRICAL CONTRACTORS & ENGINEERS

WRITTEN HAZARD COMMUNICATION PROGRAM

I. GENERAL

The purpose of this instruction is to ensure Terminal-Andrae is in compliance with the OSHA Hazard Communication Standard (HCS) 29 CFR 1926.59.

The Hazcom coordinator is the overall coordinator of the company program and has overall responsibility. The job foreman has responsibility at each job site.

In general, each employee of the company will be apprised of the substance of the Hazard Communication Standard, the hazardous properties of chemicals they work with, and measures to protect themselves from these chemicals.

II. LIST OF HAZARDOUS CHEMICALS

The job foreman will maintain a list of all hazardous chemicals used on the job site, and update the list as necessary.

The hazardous chemical list will be updated upon receipt of hazardous chemicals at the job site. The list of hazardous chemicals is maintained at the job trailer or job gang box.

III. MATERIAL SAFETY DATA SHEETS (MSDS'S)

The job foreman will maintain a file of MSDS's covering every substance on the list of hazardous chemicals. The MSDS will include all of the information required by the OSHA Hazard Communication Standard. MSDS's will be readily available to all employees.

The superintendent is responsible for acquiring and updating MSDS's for checking the completeness of the MSDS's for arranging to provide the appropriate and necessary copies to the job site. MSDS's that meet the requirements of Hazard Communication Standard must be fully completed and received at the job site either prior to, or at the time of receipt of the first shipment of any potentially hazardous chemical.

IV. LABELS AND OTHER FORMS OF WARNING

The job foreman is designated to ensure that all hazardous chemicals on the job site are properly labeled. Labels should list at least the chemical identity, appropriate hazard warnings, and the name and address of the manufacturer, importer or other responsible party. The (job foreman or other designated person) will refer to the corresponding MSDS to verify label information. Immediate use containers, small containers into which materials are drained for use on that shift by the employee drawing the material, do not require labeling. To meet the labeling requirements for other in-house containers, refer to the label supplied by the manufacturer. Labels shall be checked on a regular basis and any that are illegible or missing shall be replaced.

V. TRAINING

Each employee who works with or is potentially exposed to hazardous chemicals will receive initial training on the Hazardous Communication Standard and the safe use of those hazardous chemicals.

Additional training will be provided for employees whenever a new hazard is introduced into their work areas. The training will include these elements.

A summary of the standard, this written program and an employee handbook:

- Hazardous chemical properties including visual appearance and odor and methods that can be used to detect the presence or release of hazardous chemicals.
- Physical and health hazards associated with potential exposure to workplace chemicals.
- Procedures to protect against hazards, e.g. personal protective equipment, work practices, and emergency procedures:
- Hazardous chemical spill and leak procedures: and
- Where MSDS's are located, how to understand their content, and how employees may obtain and use appropriate hazard information.

A record of each training session, the material covered, the names of employees attending, and the trainer(s) will be maintained.

VI. OTHER JOB SITE EMPLOYERS

The job foreman will advise other employers on he job site of any chemical hazards which may be encountered in the normal course of their work on the job, the availability of MSDS's, the labeling system used, and any precautionary measures that should be taken.

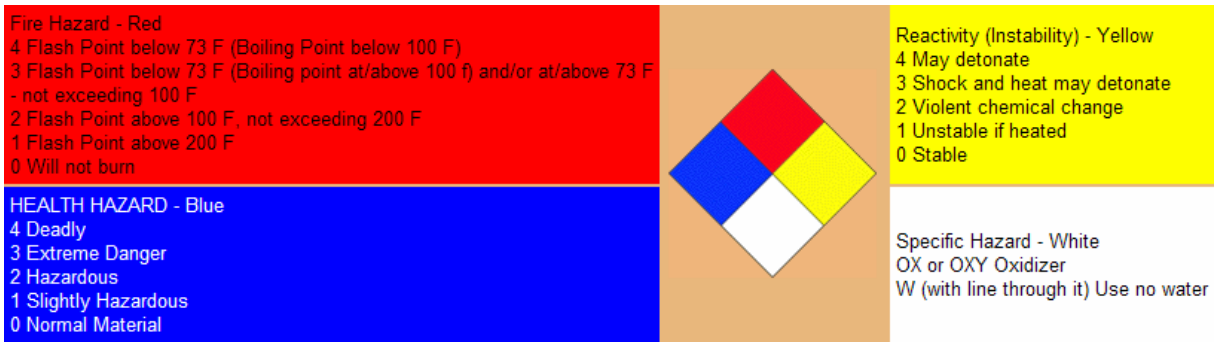
LABELING SYSTEMS

The OSHA hazard communication standard does not provide any specific method or system of labeling hazardous materials. The "Fire Diamond" developed by the National Fire Protection Association is becoming a readily recognized method of identification of hazardous materials. This system is described in NFPA704, Standard System for the identification of Fire Hazards of Materials. (Copies may be obtained from the National Fire Protection Association, Quincy, Massachusetts). As originally conceived, the purpose of the standard is to safeguard the lives of those individuals concerned with fires where the fire hazards of the materials may not be readily apparent. This standard now applies to the facilities for the manufacturing, storage, or use of hazardous materials. It is concerned with the health, fire, reactivity, and other related hazards. Although somewhat similar, it is different in some respects from requirements of the U.S. Department of Transportation.

The "Fire Diamond" provides a simple system of recognizable and easily understood markings, which will give at a glance, a general idea of the inherent hazards of materials and the order of severity of these hazards. This system identifies the hazards of the material in terms of three principal categories, namely, "health", "flammability", and "reactivity (instability)", and indicates the order of severity numerically by five divisions ranging from "(4)", indicating a severe hazard to "(0)", indicating no special hazard. This information is provided by a spatial diagram with "health" always being on the left; "inflammability" at the top; and "reactivity (instability)" on the right. Supplementing the spatial arrangement color backgrounds or numbers is used for the three categories - blue for "health" hazard, red for "flammability", and yellow to "reactivity (instability"). The fourth space in the "Diamond" is used to indicate other hazards such as radiation.

A diagram of the "Fire Diamond" is shown below. The Table provides the usual severity descriptions indicated by the numerals.

NFPA "Fire Diamond"



TERMINAL-ANDRAE INC.
ELECTRICAL CONTRACTORS & ENGINEERS

FALL PROTECTION SAFETY PROGRAM

It shall be the policy of Terminal-Andrae Inc. to implement the various requirements of the fall protection regulations as required by the U.S. Department of Labor, Occupational Safety and Health Administration.

Further information on this written program is available from the Safety Director at Terminal-Andrae Inc.

It shall be the policy of Terminal-Andrae Inc. to fulfill its obligations under 29 CFR 1926.20 to implement its hazard and accident prevention program, and under 29 CFR 1926.21 a training program which addresses all of the hazards present in the workplace. Terminal-Andrae Inc. is committed to an effective fall prevention program.

BACKGROUND

The final rule, published on July 1, 1992, is the OSHA standards for occupational health and environmental controls 29 CFR XVII of the Title 29 code of Federal Regulations (CFR) Section 1926.20 contains employee protection requirements for construction.

SCOPE AND APPLICATION

Terminal-Andrae Inc.'s fall protection program applies to all construction work where an employee may be occupationally exposed to fall hazards. All work related to construction, alteration or repair – including painting and decorating – is included. Under our plan, construction includes, but is not limited to, the following:

- demolition or salvage of structures.
- removal or encapsulation of materials.
- new construction, alteration, repair or renovation of structures, substrates.
- maintenance operations associated with construction activities described above.

GENERAL REQUIREMENTS

1. Terminal-Andrae Inc. shall be responsible for the fall protection program to be followed throughout all phases of construction and will provide the safety equipment as required.
2. Terminal-Andrae Inc. will provide access to all available fall protection and prevention equipment and shall maintain equipment as per the appropriate standard.
3. All fall protection equipment provided by Terminal-Andrae Inc. shall be conspicuously located.
4. All fall protection equipment shall be periodically inspected and maintained in operating condition. Defective equipment shall be immediately replaced.

GUARDRAILS, HANDRAILS AND COVERS

General Provisions

Terminal-Andrae Inc. understands the hazards of employees or materials falling through floor, roof or wall openings, or from stairways or runways, and will implement its fall protection program to address the following topics:

A. Guarding of floor openings and floor holes.
   Terminal-Andrae Inc. will guard floor opening with a standard railing or toeboards or cover on all exposed sides except at entrances to stairways.
B. Terminal-Andrae Inc. will guard all ladder way floor openings with standard railings and standard toeboard.
C. Terminal-Andrae Inc. will guard all hatchways and chute floor opening by:

    1. Hinged covers of standard strength and construction and standard railing with only one exposed side.
    2. A removable standard railing with toeboards on two sides of the opening and fixed standard railings with toeboards on all other exposed sides.
    3. Skylight openings shall be guarded by fixed standard railings.
    4. Fixed and trap door openings shall be guarded by floor opening covers of standard strength and construction.
    5. Manhole openings shall be guarded by standard covers.

TERMINAL-ANDRAE MOTION STOPPING SAFETY SYSTEM

Terminal-Andrae Inc. will protect employees from falling from all sides and edges of roofs or elevated areas by one of the three methods described below:

1. By the use of a motion stopping safety system (MSS).

2. By the use of a warning line system, or
3. By the use of a safety monitoring system.

TRAINING

Terminal-Andrae will provide a training program for all employees engaged in hazardous areas so that they are able to recognize the hazards of falling while working near a roof or elevated area.

PERSONAL CLIMBING EQUIPMENT

Terminal-Andrae will protect its employees working at elevated locations on poles, towers or other structures by the use of body harnesses with straps meeting the requirements of 1926.959. Additionally, Terminal-Andrae will employ approved tool rings for the purpose of holding tools.

Terminal-Andrae will inspect all body harnesses and straps for each use to determine their safe working condition.

All life lines and lanyards shall comply with provisions of the OSHA standard, and defective equipment shall be replaced.

FALL PROTECTION FOR LADDERS

The following applies to CONSTRUCTION ONLY:

A. There is no fall protection requirement for portable ladders on construction sites.

B. For fixed ladders there is no fall protection requirement below 25 feet.

TERMINAL-ANDRAE INC.
ELECTRICAL CONTRACTORS & ENGINEERS

LOCKOUT/TAGOUT PROCEDURE FOR TERMINAL-ANDRAE INC.

Purpose

This procedure establishes the minimum requirements for the lockout/tagout of energy isolating devices. It shall be used to ensure that the machine or equipment are isolated from all potentially hazardous energy, and locked out or tagged out before employees perform any servicing or maintenance activities where the unexpected energization, start-up or release of stored energy could cause injury.

Responsibility

Appropriate employees shall be instructed in the safety significance of the lockout/tagout procedure. Each new or transferred affected employee and other employees whose work operations are or may be in the area shall be instructed in the purpose and use of the lock/out tagout procedure.

Preparation of Lockout/Tagout

Make a survey to locate and identify all isolating devices to be certain which switch(s), valve(s) or other energy isolating devices apply to the equipment to be locked or tagged out. More than one energy source (electrical, mechanical, or others) may be involved.

Sequence of Lockout/Tagout System Procedure

1. Notify all affected employees that a lockout/tagout system is going to be utilized and the reason therefore. The authorized employee, generally the foreman, shall know the type and magnitude of energy that the machine or equipment utilizes and shall understand the hazards thereof.

2. If the machine or equipment is operating, shut it down by the normal stopping procedure (depress stop button, open toggle switch, etc.)

3. Operate the switch, valve, or other energy isolating device(s) so that the equipment is isolated from its energy source(s). Stored energy (such as

that in springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam or water pressure, etc.) must be dissipated or retrained by methods such as repositioning, blocking, bleeding down, etc.

4. Lockout/tagout the energy isolating devices with **assigned individual lock(s) for tag(s).**

5. After ensuring that no personnel are exposed, and as a check on having disconnected the energy sources, operate the push button or other normal operating controls to make certain the equipment will not operate.
   CAUTION: Return operating control(s) to "neutral" or "off" position after the test.

6. The equipment is now locked out or tagged out.

Restoring Machines or Equipment to Normal Production Operations

1. After the servicing and/or maintenance are complete and equipment is ready for normal production operations, check the area around the machines or equipment to ensure that no one is exposed.

2. After all tools have been removed from the machine or equipment, guards have been reinstalled and employees are in the clear, remove all lockout/tagout devices. Operate the energy isolating devices to restore energy to the machine or equipment.

Procedure Involving More Than One Person

In the preceding steps, if more than one individual is required to lockout/tagout equipment, each shall place his/her own personal lockout device or tagout device on the energy isolating device(s). When an energy isolating device cannot accept multiple locks or tags, a multiple lockout or tagout device (hasp) may be used. If lockout is used, a single lock may be used to lockout the machine or equipment with the key being placed in a lockout box or cabinet which allows the use of multiple locks to secure it. Each employee will then use his/her own lock to secure the box or cabinet. As each person no longer needs to maintain his or her lockout protection, that person will remove his/her lock from the box or cabinet.

Basic Rules for Using Lockout/Tagout System Procedure

All equipment shall be locked out or tagged out to protect against accidental or inadvertent operation when such operation could cause injury to personnel. Do not attempt to operate any switch, valve, or other energy isolating device where it is locked or tagged out.

TERMINAL-ANDRAE INC.
ELECTRICAL CONTRACTORS & ENGINEERS

NFPA 70E PERSONAL PROTECTIVE EQUIPMENT

It is the policy of Terminal-Andrae Inc. that no employee work on electrical circuits HOT. In the event that an employee has to work on live circuits or equipment, the following procedures will be followed.

Clothing Not Permitted

Clothing made from such non-flame resistant synthetic materials as acetate, nylon, polyester, rayon, either alone or in blends, with non-flame resistant cotton, **shall not be worn.**

Clothing should be 100% cotton or fire resistant cotton.

Jewelry will not be worn (rings, watches, earrings, etc.)

Tight fitting clothing shall be avoided.

Clothing shall cover potentially exposed areas as completely as possible.

Meltable synthetic fibers shall be avoided in fabric under layers next to the skin.

Fire Retardant and natural fiber garments shall be permitted to be used for a layered system for added protection. A typical layering system may include an undershirt, a shirt and trouser and coverall.

Employees shall wear nonconductive head protection wherever there is a danger of head injury from electric shock or burn due to contact with live parts or from flying objects resulting from an electrical explosion.

Employees shall wear protective equipment for the eyes whenever there is danger of injury from electric arcs, flashes, or from flying objects resulting from electrical explosion.

TERMINAL-ANDRAE INC.

WORKING IN CONFINED SPACES

A "confined space" may be generally defined as any area which has limited means of egress and is subject to oxygen deficient atmosphere or to the accumulation of toxic or flammable gases or vapors. Examples of these are: tanks, vats, boilers, bins, hoppers, process vessels, sewers, pits, deep trenches, manholes, vaults, and silos.

Working in any confined space is a potential killer. The hazards are lack of oxygen and a variety of gases/vapors which may replace the oxygen and/o accumulate to toxic or explosive levels.

A normal atmosphere contains approximately 20% oxygen. Any atmosphere containing less than 19.5% oxygen is considered to be oxygen deficient. Air containing 16% or less oxygen is lethal. An oxygen deficient atmosphere may be produced by consumption of oxygen without replacement or displacement of oxygen by another gas.

The following safety precautions should be taken to avoid death or serious injury when working in confined spaces:

a. Don't enter any confined space without knowing what is in it, what was in it and what precautions should be taken.
b. If possible, purge the involved space with steam, water, compressed air or fresh air using exhaust and blowing devices. Retest the atmosphere after purging.
c. Test the atmosphere with gas detection equipment to determine if there are any toxic gases and if there is sufficient oxygen to support life.
d. Close and lock-out supply lines, chutes, pipes, etc. to confined space in which work is being done. Continue to monitor the atmosphere in a confined space even if it was "safe" when work began.
e. Where an explosive or flammable atmosphere is present, avoid all possible sources of ignition and use extreme care in purging the contaminated space.
f. If purging is impossible or impractical:
    1. Inform employees of the hazards, what they can expect and what they must do.
    2. Provide sufficient general ventilation to guarantee fresh air.
    3. Provide an approved air-supplied respirator and safety harness with a life line if there is a possibility of the atmosphere becoming hazardous.
    4. Don't contaminate your own air. Avoid use of toxic solvents, leaky acetylene hoses, carbon tetrachloride and other similar lethal materials.

Anyone entering a hazardous atmosphere should be equipped with an air-supplied respirator or self-contained breathing equipment, a safety harness and a life line. He/she should be backed up by a similarly equipped worker to assist in the event of any emergency. A third worker within sight and hearing of this work should be informed that workers are going into the confined space.

If an emergency situation arises in a confined space, the "stand-by" man, before entering the area, should:

- Sound an alarm or summon help by voice communication.
- Put on and properly adjust the life line and respiratory protective equipment.
- Enter confined space only after help has arrived.

Another condition frequently encountered in confined spaces is high temperature. Heat stroke, which can be fatal, or more commonly, heat cramps or heat exhaustion causing only temporary discomfort can result from physical exertion in a hot atmosphere. Methods used to alleviate this condition are:

a. Adequate natural or forced ventilation.
b. Cooling of air by portable air conditioning units.
c. Providing intermittent rest periods in cooler atmosphere outside the confined space.
d. Use of salt tablets and ample drinking water to replace liquids and salts lost.

Shock protection **and** arc flash protection will be used per the following standards and tables.

Approach Boundaries to Live Parts. No qualified person shall approach or take any conductive object closer to live parts than the restricted approach boundary set forth in Table 2-1.3.4 of Part II, unless:

a. The qualified person is insulated or guarded from the live parts (insulating gloves or insulating gloves and sleeve are considered insulation only with regard to the energized parts upon which work is being performed), and no uninsulated part of the qualified person's body enters the prohibited space set forth in Table 2-1.3.4 or Part II, or
b. The live part is insulated from the qualified person and from any other conductive object at a different potential, or
c. The qualified person is insulated from another conductive object as during live-line bare-handed work.

Unqualified Persons.

Where an unqualified person(s) is (are) working at or close to the limited approach boundary, the designated person in charge of the work space where the electrical hazard exists shall cooperate with the designated person in charge of the unqualified person(s) to ensure that all work can be done safely. This shall include advising the unqualified person(s) of the electrical hazard and warning him or her to stay outside of the limited approach boundary.

Work On or Near Uninsulated Overhead Lines.

Uninsulated and Energized. Where work is performed in locations containing uninsulated energized overhead lines that are not guarded or isolated, precautions shall be taken to prevent employees from contacting such lines directly with any unguarded parts of their body or indirectly through conductive materials, tools, or equipment. Where the work to be performed is such that contact with uninsulated energized overhead lines is possible, the lines shall be deenergized and visibly grounded at the point of work, or suitably guarded.

Deenergizing or Guarding. If the lines are to be deenergized, arrangements shall be made with the person or organization that operates or controls the lines to deenergize them and visibly ground them at the point of work. If arrangements are made to use protective measures, such as guarding, isolating or insulation, these precautions shall prevent each employee from contacting such lines directly with any part of his or her body or indirectly through conductive materials, tools or equipment.

Employer and Employee Responsibility. The employer and employee shall be responsible to ensure that guards or protective measures are satisfactory for the conditions. Employees shall comply with established work methods and the use of protective equipment.

Approach Distances for Unqualified Persons. When employees without electrical training are working on the ground or in an elevated position near overhead lines, the location shall be such that the employee and the longest conductive object the employee might contact cannot come closer to any unguarded, energized overhead power line than the limited approach boundary. If the voltage on the line exceeds 50 kV, the distance shall be 10-ft. plus 4-in. for every 10 kV over 50 kV.

Vehicular and Mechanical Equipment. Where any vehicle or mechanical equipment structure will be elevated near energized overhead lines, they shall be operated so that the limited approach boundary distance of Table 2-1.3.4 of Part II, Column 2, is maintained. However, under any of the following conditions, the clearances shall be permitted to be reduced.

Conductive Materials, Tools, and Equipment Being Handled. Conductive materials, tools, and equipment that are in contact with any part of an employee's body shall be handled in a manner that will prevent accidental contact with live parts. Such materials and equipment include but are not limited to long conductive objects, such as ducts, pipes and tubes, conductive hose and rope, metal-lined rules and scales steel tapes, pulling lines, metal scaffold parts, structural members, bull floats, and chains.

Means shall be employed to ensure that conductive materials approach live parts no closer than that permitted by Table 2-1.3.4 of Part II.

Insulated Tools and Equipment. Employees shall use insulated tools and/or handling equipment when working inside the limited approach boundary of live parts where tools or handling equipment might make accidental contact. Insulated tools shall be protected from damage to the insulating material.

Fuse or fuse holder handling equipment, insulated for the circuit voltage, shall be used to remove or install a fuse if the fuse terminals are energized.

Ropes and hand lines used near live parts shall be non-conductive.

Protective Shields. Protective shields, protective barriers, or insulating materials shall be used to protect each employee from shock, burns, or other electrically related injuries while that employee is working near live parts which might be accidentally contacted or where dangerous electric heating or arcing might occur. When normally enclosed live parts are exposed for maintenance or repair, they shall be guarded to protect unqualified persons from contact with the live parts.

Portable Ladders. Portable ladders shall have nonconductive side rails if they are used where the employee or the ladder could contact live parts.

Confined or Enclosed Work Spaces. When an employee works in a confined or enclosed space (such as a manhole or vault) that contains live parts, the employer shall provide, and the employee shall use protective shields, protective barriers, or insulating materials as necessary to avoid inadvertent contact with these parts. Doors, hinged panels, and the like shall be secured to prevent their swinging into an employee and causing the employee to contact live parts.

Safety Interlocks. Only a qualified person following the requirements for working inside the restricted approach boundary as covered by 2-1.3.4 of Part II shall be permitted to defeat or bypass an electrical safety interlock over which the person has sole control, and then only temporarily while the qualified person is working on the equipment. The safety interlock system shall be returned to its operable condition when the work is completed.

Housekeeping Duties. Where live parts present an electrical contact hazard, employees shall not perform housekeeping duties inside the limited approach boundary where there is a possibility of contact, unless adequate safeguards (such as insulating equipment or barriers) are provided to prevent contact. Electrically conductive cleaning materials (including conductive solids such as steel wool, metalized cloth, and silicone carbide, as well as conductive liquid solutions) shall not be used inside the limited approach boundary unless procedures to prevent electrical contact are followed.

Occasional Use of Flammable Materials. Where flammable materials are present only occasionally, electric equipment capable of igniting them may not be used, unless measures are taken to prevent hazardous conditions from development. Such materials include, but are not limited to: flammable gases, vapors, or liquids; combustible dust; and ignitable fibers or flyings.

Anticipating Failure. When there is evidence that electric equipment could fail and injure employees, the electric equipment shall be deenergized unless the employer can demonstrate that deenergizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitation. Until the equipment is deenergized or repaired, employees shall be protected from hazards associated with the impending failure of the equipment.

Personal and Other Protective Equipment

General. Employees working in areas where there are electrical hazards shall be provided with, and shall use, protective equipment that is designed and constructed for the specific part of the body to be protected and for the work to be performed.

Care of Equipment. Protective equipment shall be maintained in a safe, reliable condition. The protective equipment shall be visually inspected before each use.

Personal Protective Equipment

General. When an employee is working within the flash protection boundary he/she shall wear protective clothing and other personal protective equipment.

Movement and Visibility. When flame-resistant, flame retardant or treated clothing is worn to protect an employee, it shall cover all ignitable clothing and shall allow for movement and visibility.

Head, Face, Neck, and Chin Protection. Employees shall wear nonconductive head protection wherever there is a danger of head injury from electric shock or burns due to contact with live parts or from flying objects resulting from an electrical explosion.

Eye Protection. Employees shall wear protective equipment for the eyes whenever there is danger of injury from electric arcs, flashes, or from flying objects resulting from electrical explosion.

Body Protection. Employees shall wear clothing resistant to flash flame wherever there is possible exposure to an electric arc flash.

NOTE:

Hand and Arm Protection. Employees shall wear rubber insulating gloves where there is danger of hand and arm injury from electric shock and burns due to contact with live parts. Hand and arm protection shall be worn where there is possible exposure to arc flash burn.

Foot and Leg Protection. Where insulated footwear is used as protection against step and touch potential, dielectric overshoes shall be required.

Standards for Personal Protective Equipment. Personal protective equipment shall conform to the standards given in Table 3-3.8.

Personal Protective Equipment Required for Various Tasks. Listed in Table 3-3.9.1 of Part II are a number of common work tasks with the respective Hazard/Risk Category associated with each task. Once the Hazard/Rick Category has been identified, refer to Table 3-3.9.2 of Part II. The assumed "normal" short circuit current capacities and fault clearing times for various tasks conducted on low-voltage (600 V, and below) equipment are listed in the notes to Table 3-3.9.1 of Part II. For tasks not listed, or for power systems of greater than the assumed "normal" short circuit current capacity or for longer than assumed fault clearing times (for the assumed current and time values, see the Notes to Table 3-3.9.1 of

Part II), a flash hazard analysis is required

NOTE: Energized parts that operate at less than 50 volts are not required to be de-energized to satisfy an "electrically safe work condition." Consideration should be given to the capacity of the source, any over current protection between the energy source and the worker, and whether the work task related to the source operating at less than 50 volts increases exposure to electrical burns or to explosion from an electric arc.

Protective Clothing and Personal Protective Equipment Matrix. Once the Hazard/Risk Category has been identified, refer to Table 3-3.9.2. Table 3-3.9.2 lists the requirements for protective clothing and other protective equipment based on Hazard/Risk Category numbers 0 through 4. This clothing and equipment shall be used when working on or near energized equipment within the Flash Protection Boundary.

The PPE requirements of this section are intended to protect a person from arc-flash and shock hazards. While some situations may result in burns to the skin, even with the protection described in Table 3-3.9.2, any burn injury should be relatively minor and survivable. Due to the explosive effect of some arc events, physical trauma injuries may occur. The PPE requirements of this section do not provide protection against physical trauma.

Protective Clothing Characteristics. Table 3-3.9.3 lists the characteristics and degree of protection for various clothing. The protective clothing selected for the corresponding Hazard/Risk Category Number shall have an arc thermal performance exposure value (ATPV) of at least the value listed in the last column of Table 3-3.9.3.

NOTE: The ATPV for particular clothing system may be obtained from the FR clothing manufacturer.

Factors in Selection of Protective Clothing. Protective clothing includes shirts, pants, coveralls, jackets, and parkas worn routinely by workers who, under normal working conditions, are exposed to momentary electric arc and related thermal hazards. Arc and flame resistant rainwear worn in inclement weather are included I this category of clothing.

Clothing and equipment that maximize worker protection shall be utilized. Clothing and equipment required by the degree of exposure shall be permitted to be worn alone or be integrated with normal apparel. It shall cover associated parts of the body and all normal apparel that is not flash-flame resistant, while allowing movement and visibility. All personal protective equipment shall be maintained in a sanitary and be used in conjunction with one another as a system to provide appropriate protection.

Layering. FR and natural fiber garments shall be permitted to be used for layered system for added protection. A typical layering system may include an undershirt, a shirt and trouser and coverall. Specific tasks may call for specific protection systems.

Outer Layers. Garments worn as outer layers over FR clothing, such as jackets or rainwear, shall also be made from FR material.

Underlayers. Meltable synthetic fibers shall be avoided in fabric underlayers next to the skin. Garments worn as underlayers (underwear) that neither ignite nor melt and drip in the course of an exposure to the electric arc and related thermal hazard may provide additional thermal protection.

Coverage. Clothing shall cover potentially exposed areas as completely as possible.

Fit. Tight-fitting clothing shall be avoided. Loose fitting clothing provides additional thermal insulation due to air spaces. FR apparel shall fit properly such that it does not interfere with the work task.

Interference. The garment selected shall result in the least interference with the task, but still provide the necessary protection. The work method, location, and task may influence the protective equipment selected.

Arc Flash Protective Equipment. Flash suits and their closure design shall permit easy and rapid removal. The entire flash suit, including the window, shall have energy absorbing characteristics that are suitable for the arc-flash exposure.

Face Protection. Face shields made of polycarbonate material are more appropriate for use in situations with relatively low radiation exposure. Safety glasses and goggles provide lesser protection, but in low risk tasks they may be justified if the task involves substantial physical work in combination with good visual requirements. Eye protection (safety glasses or goggles) shall always be worn under face shields or hoods.

Hand Protection. Gloves made from layers of flame resistant material provide the highest level of hand protection. Heavy-duty leather gloves also provide good protection. Where voltage-rated gloves are used, leather protection shall be worn over the rubber gloves. The leather protectors also provide good arc-flash protection for the hands.

Foot Protection. Heavy-duty leather work shoes normally provide a significant degree of protection to the feet. They are recommended for all tasks and shall be used for incident energy exposure levels 5 cal/cm2, and higher (Hazard/Risk

Category 2, and higher).

Care and Maintenance of FR Clothing and FR Flash Suits.

Inspection. FR apparel shall be inspected before each use. Work clothing or flash suits that are contaminated, greasy, worn, or damaged to the extend their protective qualities are impaired, shall be cleaned, repaired or replaced. Protective items that become soiled with grease or flammable liquids shall be removed from surface and cleaned.

Manufacturer's Instructions. The garment manufacturer's instructions for care and maintenance of FR apparel shall be followed.

Table 1. Approach boundaries to live parts for shock prevention

	Limited approach boundary			
Nominal system voltage range, phase to phase	**Exposed movable conductor**	**Exposed fixed-circuit part**	**Restricted approach boundary (allowing for accidental movement)**	**Prohibited approach boundary**
0 to 50 volts	Not specified	Not specified	Not specified	Not specified
51 to 300 volts	10 ft. 0 in.	3 ft. 6 in.	Avoid contact	Avoid contact
301 to 750 volts	10 ft. 0 in.	3 ft. 6 in.	1 ft. 0 in.	0 ft. 1 in.
751 to 15,000 volts	10 ft. 0 in.	5 ft. 0 in.	2 ft. 2 in.	0 ft. 7 in.

Source: From a portion of table 2-1.3.4, Approach Boundaries to Live Parts for Shock Protection (NFPA 70E *Standard for Electrical Safety Requirements for Employee Workplaces, 2000 edition*). This reprinted material is not the complete and official position of the National Fire Protection Association on the referenced subject, which is represented only by the standard in its entirety.

Table 2. Hazard risk category classification (within flash protection boundary)

For low-voltage tasks (600 volts and below), this table applies only when there is an available short-circuit capacity of 25 kA or less, and when the fault clearing time is 0.03 seconds (2 cycles) or less. For 600-volt-class motor control centers, a short-circuit current capacity of 65 kA or less and fault-clearing time of 0.33 seconds (20 cycles) is allowed. For 600-volt-class switchgear, you need a short-circuit current capacity of 65 kA or less and fault-clearing time of 1 second (60 cycles). For tasks not covered in this table and tasks involving equipment with larger short-circuit current capacities or longer fault-clearing times, a qualified person must conduct a flash hazard analysis (see section 2-1.3.3, Part II, NFPA 70E).

	Hazard/risk category	Voltage-rated Gloves	Tools
Opening Doors and Covers			
Opening hinged covers (to expose bare, energized parts)			
240 volts or less	0	N	N
600-volt-class motor control centers	1	N	N
600-volt-class lighting or small power transformers	1	N	N
600-volt-class switchgear (with power circuit breakers or fused switches)	2	N	N
NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV	3	N	N
1 kV and over (metal clad switchgear)	3	N	N
1 kV and above metal clad load interrupter switches, fused or unfused	3	N	N
Removing bolted covers (to expose bare, energized parts)			
240 volts or less	1	N	N
600-volt-class motor control centers or transformers	2*	N	N
600-volt-class lighting or small power transformers	2*	N	N
600-volt-class switchgear (with power circuit breakers or fused switches)	3	N	N
NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV	4	N	N
1 kV and above (metal clad switchgear)	4	N	N
1 kV and above metal clad load interrupter switches, fused or unfused	4	N	N
Opening transformer compartments for metal clad switchgear 1 kV and above	4	N	N
Installing, Removing or Operating Circuit Breakers (CBs), Fused Switches, Motor			

Starters or Fused Contactors			
Installing or removing circuit breakers or fused switches, 240 volts or less	1	Y	Y
Inserting or removing (racking) CBs from cubicles, doors closed			
600-volt-class switchgear (with power circuit breakers or fused switches)	2	N	N
NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV	2	N	N
1 kV and above metal clad switchgear	2	N	N
Inserting or removing (racking) CBs or starters from cubicles, doors open			
600-volt-class switchgear (with power circuit breakers or fused switches)	3	N	N
NEMA E2 (fused contactor) Motor Starters, 2.3 kV through 7.2 kV	3	N	N
1 kV and above metal clad switchgear	4	N	N
Operating circuit breaker (CB), fused switch, motor starter or fused contactor, covers on/doors closed			
240 volts or less	0	N	N
>240-<600 volt panelboards/switchboards (molded case or insulated case CBs)	0	N	N
600 volt class motor control centers	0	N	N
600 volt class switchgear (with power circuit breakers or fused switches)	0	N	N
NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV	0	N	N
1 kV and above (metal clad switchgear)	2	N	N
1 kV and above metal clad load interrupter switches, fused or unfused	2	N	N
Operating circuit breaker, fused switch, motor starter or fused contactor, covers off/doors open			
240 volts or less	0	N	N
>240-<600 volt panelboards/switchboards (molded case or insulated case CBs)	1	N	N
600 volt class motor control centers	1	N	N
600 volt class switchgear (with power circuit breakers or fused switches)	1	N	N
NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV	2*	N	N
1 kV and above (metal clad switchgear)	4	N	N
Working on Energized Parts			
Working on energized parts, voltage testing, applying safety grounds			

	240 volts or less	1	Y	Y
	>240-<600 volt panelboards/switchboards (molded case or insulated case CBs)	2*	Y	Y
	600-volt-class motor control centers	2*	Y	Y
	600-volt-class switchgear (with power circuit breakers or fused switches)	2*	Y	Y
	600-volt-class lighting or small power transformers	2*	Y	Y
	600-volt-class revenue meters	2*	Y	Y
	NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV	3	Y	Y
	1 kV and above metal clad switchgear	4	Y	Y
	1 kV and above metal clad load interrupter switches, fused or unfused	4	Y	Y
Working on control circuits with exposed energized parts, 120 volts or below				
	600-volt-class motor control centers	0	Y	Y
	600-volt-class switchgear (with power circuit breakers or fused switches	0	Y	Y
	NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV	0	Y	Y
	1 kV and above metal clad switchgear	2	Y	Y
Working on control circuits with exposed energized parts, over 120 volts				
	600-volt-class Motor Control Centers	2*	Y	Y
	600-volt-class switchgear (with power circuit breakers or fused switches)	2*	Y	Y
	NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV	3	Y	Y
	1 kV and above metal clad switchgear	4	Y	Y
Other Tasks				
Reading panel meters while operating meter switches		0	N	N
Metal clad load interrupter switches, fused or unfused, 1 kV and above				
	Outdoor disconnect switch operation (hookstick operated)	3	Y	Y
	Outdoor disconnect switch operation (gang-operated, from grade)	2	N	N
	Insulated cable examination, in open area	2	Y	N
	Insulated cable examination, in manhole or other confined space	4	Y	N
Removing/installing other equipment				
	Starter "buckets" for 600-volt-class motor control	3	Y	N

centers			
600-volt-class revenue meters	2*	Y	N
Covers or cable troughs for 600-volt-class revenue meters	1	N	N

2* = A double-layer switching hood and hearing protection are required, in addition to the other hazard/risk category 2 requirements of table 3-3.9.2 of Part II of NFPA 70E. *See* tables 3 and 4.

kV = kilovolt

Note: Applying safety grounds after voltage testing does not require voltage-rated tools. Voltage-rated gloves or tools are rated and tested for the maximum line-to-line voltage on which work will be done. The hazard/risk category may be reduced by one number for low-voltage equipment listed here where the short-circuit current available is less than 15 kA (less than 25 kA for 600-volt-class switchgear).

Source: Adapted from table 3-3.9.1, Hazard Risk Category Classifications (*NFPA 70E Standard for Electrical Safety Requirements for Employee Workplaces, 2000 edition*). Tables are reprinted with permission. Copyright ©2000 National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the National Fire Protection Association on the referenced subject, which is represented only by the standard in its entirety.

Table 3. Simplified, two-category, flame-resistant clothing system

Applicable tasks	Clothing requirement
All hazard/risk category 1 and 2 tasks listed in table 2 On systems operating at less than 1000 volts, these tasks include work on all equipment *except* • Insertion/removal of low-voltage motor starter "buckets" • Insertion/removal of power circuit breakers with the switchgear doors open • Removal of bolted covers from switchgear. On systems operating at 1000 volts or more, tasks also include the operation, insertion, or removal of switching devices *with equipment enclosure doors closed.*	**Everyday work clothing** Flame-resistant long-sleeve shirt (minimum ATPV of 5) worn over an untreated cotton T-shirt with FR pants (minimum ATPV of 8) *Or* FR coveralls (minimum ATPV of 5) worn over an untreated cotton T-shirt (or an untreated natural-fiber long-sleeve shirt) with untreated natural-fiber pants.
All hazard/risk category 3 and 4 tasks listed in table 2 On systems operating at 1000 volts or more, these tasks include work on energized parts of all equipment. On systems of less than 1000 volts, tasks include insertion or removal of low-voltage motor-start motor control center "buckets," insertion or removal of power circuit breakers with the switchgear enclosure doors open, and removal of bolted covers from switchgear.	**Electric "switching" clothing** Double-layer FR flash jacket and FR bib overalls worn over either FR coveralls (minimum ATPV of 5) or FR long-sleeve shirt and FR pants (minimum ATPV of 5) worn over untreated natural-fiber long-sleeve shirt and pants worn over an untreated cotton T-shirt *Or* Insulated FR coveralls (minimum ATPV of 25, independent of other layers) worn over untreated natural-fiber long-sleeve shirt with untreated cotton blue jeans ("regular weight," minimum 12 oz./sq. yd. fabric weight), worn over an untreated cotton T-shirt.

FR - flame resistant.
ATPV - arc thermal performance exposure value of the clothing in calories/cm2.
Source: Based on Table F-1 in appendix F of NFPA 70E, *Electrical Safety Requirements for Employee Workplaces*, 2000.

Table 4. Flame-resistant protective clothing and equipment

Flame-resistant protective clothing and equipment	**Protective systems for hazard/risk category (4 = most hazardous)**			
Hazard/risk category number	**1**	**2**	**3**	**4**
Flash suit jacket (2-layer)				X
Flash suit pants (2-layer)				X
Head protection				
Hardhat	X	X	X	X
Flame-resistant hardhat liner			X	X
Eye protection (safety glasses + side shields or safety goggles)	X	X	X	X
Face protection (double-layer switching hood)		2* tasks	X	X
Hearing protection (ear canal inserts)		2*tasks	X	X
Leather gloves or voltage-rated gloves			X	X
with leather protectors	As needed	X		X
Leather work shoes	As needed	X	X	X

Source: Based on personal protective equipment requirements of table 3-3.9.2 of NFPA 70E, *Electrical Safety Requirements for Employee Workplaces*. This reprinted material is not the complete and official position of the National Fire Protection Association on the referenced subject, which is represented only by the standard in its entirety.

** OSHA defines an electrical-qualified person as "one familiar with the construction and operation of the equipment and the hazards involved."*

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