OSHA’s Revised Electric Power Standards

Construction and Maintenance

IEC Regulatory Compliance and Job, Safety & Training Departments
Agency Goals

- Update standards based upon latest consensus standards

- Provide additional protection beyond current standards – four major areas
  - Information transfer (host – contractor & job briefing)
  - Fall Protection
  - Minimum Approach Distances for Energized Work (MAD)
  - Protection from Electric Arc

- Bring the two often conflicting separate standards (general industry & construction) together so that the standards are the same.

- OSHA estimates that if the new standards are implemented properly that approximately 119 employee injuries and 20 employee deaths can be avoided.
Construction Vs. General Industry

• The two corresponding OSHA utility safety standards determined by on-site work activity

• **Construction (1926.950)** – “includes the erection of new electric power transmission and distribution lines and equipment, and the alteration, conversion, and improvement of existing electric transmission and distribution lines and equipment”.

• **General Industry (1910.269)** – “covers the operation and maintenance of electric power generation, control, transformation, transmission and distribution lines and equipment”.
Existing OSHA Standards

General Industry (1994)

- 1910.137 – Electrical Protective Equipment
- 1910.269 – Electric Power generation, transmission and distribution

Construction (1972)

- Subpart V or 1926.950 – Power Transmission and Distribution
New Revised Final Rules

- General Industry
  - 1910.137 – Electrical Protective Equipment
  - 1910.269 – Electric Power Generation, Transmission and Distribution

- Construction
  - 1926.97 – Electrical Protective Equipment
  - Subpart V – Electric Power Transmission and Distribution

Generally, if the employer is in compliance with the existing 1910.269 requirements, they will be considered in compliance with the revised 1926.950 Power Construction standards, that do not specifically reference other subparts of this part.
Significant Areas of Change

Areas of significant rule revision:

• Information Transfer to Contractors/Others
• Fall protection
• Minimum Approach Distances (MAD) to Energized Components
• Protection from Electric Arcs/Electrical Equipment
• Miscellaneous revisions and/or clarification of specific rules
Information Transfer
Host-Contractor

• Host employer:

An employer that operates, or that controls the operating procedures for, an electric power generation, transmission, or distribution installation on which a contract employer is performing work covered by [the standard].

• Contract employer

An employer, other than a host employer, that performs work covered by [the standard] under contract.
Host Employer

Host employer

• Typically an electric utility
• Must operate, or control operating procedures for an electric power installation

§§1910.269(x) & 1926.968
Host Employer

Not a host employer

- Holding company owning, but not operating, generation plant
- Another Contractor, unless it operates or controls the operation of the utility system

§§1910.269(x) & 1926.968
Contractor

Contract employer

Any contractor that performs covered work under the outlined standards (1910.269 & 1926.950)

... and including Subcontractors

But not...

A host employer

A contractor that is present at a covered installation, but does not performed covered work under these standards

§§1910.269(x) & 1926.968
Information Transfer

Information transfer requirements are contained in and processed through multiple parts of rule:

- Existing characteristics and conditions (1910.269 (a)(4) and 1926.950 (d))
- Information Transfer (1910.269 (a)(3) and 1926.950(c))
- Job briefing (1910.269 (c) and 1926.952)

**Host is only required to provide known information and information which can be obtained through existing records.**

***No additional on-site host inspections are required to obtain the information***
Information Transfer – Host to Contractor

- Host provides information to contractors under section (a) (3)
- Characteristics of the host employers installation related to safety as listed in §§1910.269(a)(4) and 1926.950(d)
- Known conditions of the work related to safety as listed in §§1910.269(a)(4) and 1926.950(d)
- System design information needed for contractor required assessments related to safety
- Other known system information (design & operation) related to safety and requested by contractor

§§1910.269(a)(3)(i) and 1926.950(c)(1)
Existing System Conditions (a)(4)

- Characteristics of the system related to safety under (a) (4)
  - Voltage, maximum overvoltage (switching, transient), presence of induced voltage
  - Presence of grounds and equipment grounding conductors
  - Location of circuits and equipment (supply lines)
- Conditions of the installation related to safety
  - Condition of grounds and poles
  - Environmental conditions

§§1910.269(a)(4) and 1926.950(d)
# Host – Contractor Assessments

<table>
<thead>
<tr>
<th>Provision</th>
<th>Assessment Required</th>
<th>Type of Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>§1910.269(e), §1926.953(a)</td>
<td>Whether an enclosed space must be entered as a permit-required confined space</td>
<td>Whether an enclosed space contains hazards, other than electrical and atmospheric hazards, that could endanger the life of an entrant or could interfere with escape from the space</td>
</tr>
<tr>
<td>§1910.269(l)(8)(i), §1926.960(g)(1)</td>
<td>Whether employees are exposed to hazards from flames or electric arcs.</td>
<td>Information on electric equipment, such as safety information provided by manufacturers, that relates to the required hazard assessment.</td>
</tr>
</tbody>
</table>
## Host – Contractor Assessments

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<tr>
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<tr>
<td>§1910.269(l)(3)(i), §1926.960(c)(1)(i)</td>
<td>What is the appropriate minimum approach distance for the work being performed?</td>
<td>What the operating conditions are for the value of the maximum transient over voltage provided to the contract employer.</td>
</tr>
<tr>
<td>§1910.269(e)(12), §1926.953(m)</td>
<td>Whether forced air ventilation has been maintained long enough that a safe atmosphere exists</td>
<td>The size of the enclosed space</td>
</tr>
</tbody>
</table>
# Host – Contractor Assessments

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<tbody>
<tr>
<td>§1910.269(l)(8)(ii), §1926.960(g)(2)</td>
<td>What is the estimated incident energy from an electric arc?</td>
<td>The electrical parameters needed to calculate incident energy, such as maximum fault current, bus spacings, and clearing times.</td>
</tr>
<tr>
<td>§1910.269(l)(12), §1926.960(k)</td>
<td>Whether devices are designed to open or close circuits under load conditions.</td>
<td>Load current for, and the opening and closing ratings of, devices used to open and close circuits under load.</td>
</tr>
</tbody>
</table>
## Host – Contractor Assessments

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<th>Assessment Required</th>
<th>Type of Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>§1910.269(m) and (w) (7)</td>
<td>What are the known sources of electric energy (including known sources of back feed) supplying electric circuits?</td>
<td>All known sources of electric energy, including known sources of back feed.</td>
</tr>
<tr>
<td>§1926.961 and 1926.967(h)</td>
<td></td>
<td>All sources of hazardous energy, including sources of potentially hazardous stored or residual energy, and any conditions that can lead to the re-accumulation of residual or stored energy to a hazardous level.</td>
</tr>
<tr>
<td>§1910.269(d)</td>
<td>What are the sources of hazardous energy, including sources of potentially hazardous stored or residual energy?</td>
<td></td>
</tr>
</tbody>
</table>
## Host – Contractor Assessments

<table>
<thead>
<tr>
<th>Provision</th>
<th>Assessment Required</th>
<th>Type of Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>§1910.269(n)(4)(i), §1926.962(d)(1)(i)</td>
<td>Whether protective grounds have adequate current carrying capacity</td>
<td>The maximum fault current and clearing time for the circuit.</td>
</tr>
<tr>
<td>§1910.269(n)(7), §1926.962(g)</td>
<td>Whether there is a possibility of hazardous transfer of potential should a fault occur.</td>
<td>Potential rise on remote ground under fault conditions.</td>
</tr>
</tbody>
</table>
Host – Contractor Assessments

<table>
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<tr>
<th>Provision</th>
<th>Assessment Required</th>
<th>Type of Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>§1910.269(q)(1)(i),</td>
<td>Whether overhead structures such as poles and towers are capable of sustaining stresses imposed by the work activity.</td>
<td>The design strength of the pole or structure.</td>
</tr>
<tr>
<td>§1926.964(a)(2)</td>
<td></td>
<td>Also, if pole inspection program, how is it administered and applied in system (e.g. tagged)</td>
</tr>
</tbody>
</table>
Host to Contractor Information Transfer

- Contractor responsible for instructing its employees in the hazardous conditions, relevant to employees’ work, of which the contractor is aware as a result of information communicated by the host

§§1910.269(a)(3)(ii)(A) and 1926.950(c)(2)(i)
Contractor to Host Information Transfer

• Before work begins, Contractor must advise the host of:

  • Any unique hazardous conditions presented by the contract employer’s work
  • Any unanticipated hazardous conditions not mentioned by the host but found by the contractor as part of the on-going work activity

    ➢ Host must be made aware of the condition within 2 working days of discovery by the contractor

§§1910.269(a)(3)(ii)(B) & (C) and 1926.950(c)(2)(ii) & (iii)
Host – Contractor Information Transfer

- Contractor and host must coordinate work rules and procedures so that each of their employees are protected

- Generally this is limited to common procedures which overlap the specific work activity involved (e.g. System Energy Control Procedures (LO/TO) or grounding procedures

**These information transfer requirements go into effect in April 30, 2015 with exception of maximum switching/transient voltages. Full rule in effect: June 30, 2015

§§1910.269(a)(3)(iii) and 1926.950(c)(3)
Job Briefing

- Employer must provide the in-house employee in charge with all available information that relates to the determination of existing characteristics and conditions under 1910.269(a)(4) and 1926.950(d)
  - Nominal voltages
  - Maximum switching/transient voltages
  - Presence of protective grounds and equipment grounding conductors
  - Locations of circuits and equipment (supply lines)
  - Condition of protective grounds and equipment grounding
  - Condition of poles and structure
  - Environmental Conditions

- Employee in charge conducts job briefing before start of work. Job briefing to cover:
  - Hazards associated with the job
  - Work procedures involved
  - Special Precautions
  - Energy source controls
  - PPE

§§1910.269(c)(1)(ii) & (c)(2) and 1926.952(a)(2) & (b)
Job Briefing

Employee in charge must conduct job briefing with on-site crew members:

- **Number of briefings:**
  - Single briefing at the start of the shift if work will be repetitive and similar
  - Additional briefings when changes affecting safety occur
  - Working Alone – No job briefing required, although work activity still needs to be planned safely.

§§1910.269(c)(3) and 1926.952(c)
Fall Protection
Fall Protection - Types

• Fall Restraint System
  ➢ A system that prevents the user from falling any distance

• Work positioning equipment
  ➢ A system rigged to allow an employee to be suspended on an elevated vertical surface and work with both hands free while leaning.

• Personal fall arrest equipment
  ➢ A system used to arrest an employee in the event of a fall from a working level

1910.269 (x) and 1926.968
Fall Restraint System
Work Positioning Equipment

(Appplies to Vertical Surfaces)
Personal Fall Arrest Equipment
Fall Arrest

A system used to arrest an employee in a fall from a working level.

- No more than 6’ freefall
- Cannot hit a lower level at any distance
Fall Protection

• Aerial Lifts
  - Fall Restraint system or Personal Fall Arrest system
  - Must be used in context to Subpart M and must be rigged to where cannot free fall more than 6 feet
  - Under memorandum (February 2015) for aerial lifts, allow those bucket/aerial lifts without a suitable anchorage built into the bucket to be used, under specific conditions.
    - Parking brake set, outriggers down
    - Fall system used meets other requirements of Subpart M
    - Employer has addressed any ejection hazards through proper application of MUTCD in application to traffic control

• Poles, towers and similar structures, more than 1.2 m (or 4 feet) above the ground
  - Fall Restraint system,
  - Work Positioning equipment or
  - Personal Fall Arrest system
  - Under memorandum for towers, allows for the utilization of the most appropriate restraint system available even if fall may allow the striking of lower portion of tower in the event of a fall.
Fall Protection

- Employees must use Fall protection 100 percent of the time under new rules!
  - Only exception is if increases hazards or if just not feasible due to site conditions.

- No additional specific fall protection training requirement other than being trained to properly utilize the specific equipment provided

- Train to manufacturer standards and recommendations

- Document, Document, Document
WP Fall Protection

- Use fall protection while climbing or changing location
  - Limited exemption
  - Provides anchorage
  - Use requirement effective May 31, 2015
  - Free Climb ended March 31, 2015

§§1910.269(g)(2)(iv)(C) and 1926.954(b)(3)(iii)
WPFRD

Wood pole fall restriction device meeting ASTM F887-12
Multipurpose Harness

Fall arrest or work positioning – must meet ASTM F887-04 or newer
Electric Arc Requirements

ASTM 887-04 and Greater

Electric Arc Performance

Electric Arc Test—Harnesses and shock absorbing lanyards shall be electric arc tested using the Test Method F1958/F1958M mannequin test set up.
Retractable Lanyards

Investigate other options for best fall protection options, per applications!
Fall Protection

- Under (g) (2) – Fall Protection – the revised standard incorporates specific equipment design/testing requirements including:
  - Exposure to heat energy (40 cal/cm²) and drop test for personal arrest systems
  - Minimum Hardware specifications for body belts and positioning straps
  - Drop testing specifications of body belts and positioning straps
  - Dielectric testing of positioning straps
  - Specifications for equipment in performance based approach:
    - Fall arrest equipment must meet Subpart M
    - Work positioning equipment must meet (b)(2) (F887-04)
    - Non-Locking snap hook equipment must be replaced…if any remains in use. Cannot use two snaps in one D-ring unless…they are locking type snaps
Protection must be appropriate for Work Application

Wood pole structure
This includes Special Ladders and Platforms

§§1910.269(h)(1) and 1926.955(a)
General PPE

• Employer is required to pay for PPE required by 1910.269, including:
  
  • Fall protection equipment,
  • Electrical protective equipment and flame resistant and arc-rated clothing and
  • Other PPE required as identified

• PPE can be purchased through an allowance program but must be fully funded by employer and must be able to replace PPE as necessary for safety
Electrical Protective Equipment

- OSHA updated consensus electrical standards for PPE within the rule revision by incorporating them into a performance based approach under 1926.97:
  - ASTM D120-09: Std. Spec for Rubber Insulating Gloves
  - ASTM D1048-12: Std. Spec for Rubber Insulating Blankets
  - ASTM D1049-98: Std. Spec for Rubber Insulating Covers
  - ASTM D1051-08: Std. Spec for Rubber Insulating Sleeves

The performance based approach is designed to provide greater flexibility to employers in their compliance approach.
PPE Consensus Standards

OSHA also incorporated the following in-service electrical consensus standards into their PPE performance based approach:

- ASTM F478-09: In-service care of insulating line hose and cover
- ASTM F479-06: In-service care of insulating blankets
- ASTM F496-08: In-service care of insulating gloves and sleeves

The final rule relies on provisions from these consensus standards that are performance based and necessary for employee safety, but does not contain many of the detailed specs from the specific standards.
1926.97 – Electrical PPE Standard (new)

• (a) Design requirements for specific types of electrical PPE:
  Rubber insulating blankets, matting, covers, line hose, insulating
gloves, and sleeve shall meeting the following –
  • Manufacturer and marking of rubber insulating equipment
  • Electrical Requirements (testing)
  • Workmanship and finish

• (b) Design requirements for other types of electrical protective
equipment:
  • Voltage withstand (maximum voltage potential – transient overvoltage)
  • Equipment Current (current test based on highest nominal voltage)
  • Plastic guard must meet ASTM F712-06 (2011) for testing

• (c) In-Service care and use of electrical protective equipment:
  • safe reliable condition
  • Inspections (daily, upon condition being questioned)
Gloves and Sleeves
# Maximum Use Voltage

<table>
<thead>
<tr>
<th>Class</th>
<th>Maximum Use Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>500</td>
</tr>
<tr>
<td>0</td>
<td>1,000</td>
</tr>
<tr>
<td>1</td>
<td>7,500</td>
</tr>
<tr>
<td>2</td>
<td>17,000</td>
</tr>
<tr>
<td>3</td>
<td>26,500</td>
</tr>
<tr>
<td>4</td>
<td>36,000</td>
</tr>
</tbody>
</table>

§§1910.137(c)(2)(i), Table I-4, and 1926.97(c)(2)(i), Table E-4
Air Test

Mechanical Inflator

Manual Inflation
Protector Gloves
Using Rubber Gloves and Sleeves

- When a worker is using the rubber glove method:
  - He or she must also wear rubber sleeves, or
  - Exposed energized parts not being worked on must be insulated, and the worker must install this insulation from a position where his or her upper arm is not exposed to contact
  - Rule applies if working inside the MAD.

§§1910.269(l)(4)(i) and 1926.960(c)(2)(i)
Don & Doff Rubber Gloves

- Put on and take off rubber insulating gloves in a position where the worker cannot reach into MAD

§§1910.269(l)(4)(ii) and 1926.960(c)(2)(ii)
Unprotected Workers

- For work near live parts of >600 volts but ≤ 72.5 kV, without rubber protection, work must be from a position where the worker cannot reach into MAD unless:
  - Don rubber insulating gloves,
  - protected by insulating equipment,
  - using live-line tools,
  - performing live-line bare hand work

§§1910.269(l)(5)(ii) and 1926.960(d)(2)
Treat as Energized

- Covered conductors
- Non-current-carry metal parts, unless determined to be grounded
  - Transformer cases
  - Circuit breaker housings
  - Other equipment enclosures

§§1910.269(l)(10) & (11) and 1926.960(i) & (j)
Fuse Handling

- If the voltage exceeds 300 V or if live parts of 50 V or more are present, use rated tools or gloves

- When installing or removing expulsion-type fuses energized at > 300 V, wear eye protection, use a rated tool, and stand clear of the exhaust path

§§1910.269(l)(9) and 1926.960(h)
Opening and Closing Circuits Under Load

• Use devices designed to carry or interrupt current under load

§§1910.269(l)(12) and 1926.960(k)
Arc-Rated PPE

• Outer layer of clothing must be FR for incident energy exceeding 2.0 cal/cm$^2$
  • Layering can be utilized to obtain the overall protection values

• Arc-rated protection must cover entire body, with certain exceptions:
  • Protection for hands (rubber gloves with protectors or, for exposures $\leq 14$ cal/cm$^2$, heavy-duty (12-oz) leather work gloves)
  • Protection for feet (heavy work shoes or boots)
  • Protection for the head under certain conditions

§§1910.269(l)(8)(v) and 1926.960(g)(5)
Head and Face Protection

- Starts at 9 cal/cm$^2$ for single-phase arcs in air
- Starts at 5 cal/cm$^2$ for other exposures (3 P or AIB)
- May be hard hat and face shield for these exposures:
  - < 13 cal/cm$^2$ for single-phase arc in open air
  - < 9 cal/cm$^2$ for other exposures (3 p or AIB)
- For open-air, single-phase arc exposures, the required arc rating is reduced by 4 cal/cm$^2$

§§1910.269(l)(8)(v)(C) - (D) and 1926.960(g)(5)(iii) - (v)
## Face/Head Protection

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Minimum head and face protection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None*</td>
</tr>
<tr>
<td>Single-phase, open air</td>
<td>2–8 cal/cm²</td>
</tr>
<tr>
<td>Three-phase</td>
<td>2–4 cal/cm²</td>
</tr>
</tbody>
</table>

* These ranges assume that employees are wearing hardhats meeting the specifications in §1910.135 or §1926.100(b)(2), as applicable.

¹ The arc rating must be a minimum of 4 cal/cm² less than the estimated incident energy. Note that §1926.960(g)(5)(v) permits this type of head and face protection, with a minimum arc rating of 4 cal/cm² less than the estimated incident energy, at any incident energy level.

¹ Note that §1926.960(g)(5) permits this type of head and face protection at any incident energy level.
Blankets, Line Hose, & Covers
Other Electrical Protective Equipment

Plastic guard equipment (ASTM F712)

Insulating shields and barriers
## Testing

<table>
<thead>
<tr>
<th>Equipment</th>
<th>When to Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line hose and covers</td>
<td>Insulation suspect, after repair</td>
</tr>
<tr>
<td>Gloves</td>
<td>Every 6 mo., insulation suspect, after repair</td>
</tr>
<tr>
<td>Blankets and sleeves</td>
<td>Every 12 mo., insulation suspect, after repair</td>
</tr>
</tbody>
</table>

§1910.137(c)(2)(viii) & (ix), Table I-4 & I-5
Other Electrical Equipment - Notes

1910.137 (a) Voltage withstand – test voltages must include maximum transient overvoltage, as well as nominal line voltage.

- Appendix B of rule provides guidance on transient overvoltage

1910.137 (b) Equipment Current – primary insulation must be capable of passing a current test when subjected to highest nominal voltage for equipment being used on.

- This requirement only applies to equipment that provide primary insulation to the employee from energized parts. Does not apply to items used for secondary insulation or used for brush contact only.
- Plastic guard used will be considered in compliance if it meets the requirements of ASTM F712-06 (2011) – Standard Test Methods and Specs for Electrically Insulating Plastic Guard Equipment (NEW)

1910.137 (c) In-service care and use of Electrical PPE –

- Marking equipment with identification, and entering onto logs with the results and dates of tests are two acceptable means of meeting the certification requirements
Training - All Employees

- Safety-related work practices, safety procedures, and other safety requirements in the standards that pertain to the job

- Other safety practices, including applicable emergency procedures (e.g. pole top) and that are not specifically addressed by the standards but that are related to work and necessary for safety

- Degree of training commensurate with risk to the employee engaged in work activity

§§1910.269(a)(2)(i) and 1926.950(b)(1)
Training - continued

- Under (a) (2) (vii) – training shall establish employee proficiency in the work practices required under the rules
  - Can be of classroom or on-the-job type

- Under (a) (2) (viii) – employer shall ensure that each employee demonstrates proficiency in work practices as part of training
  - Employment or training records can be used
  - For previous employment, can use process:
    - Confirm employee has received training (records)
    - Interview, question to initially determine if employee is knowledgeable in safe work practices
    - Supervise closely until employee has demonstrated proficiency
Qualified Employees - training

• Skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment

• Skills and techniques necessary to determine the nominal voltage of exposed live parts

• Applicable minimum approach distances and how to maintain them

• Proper use of protective equipment and tools for working on or near exposed live parts

• Recognition of electrical hazards and how to control them

§§1910.269(a)(2)(ii) and 1926.950(b)(2)
Non-qualified Line-Clearance Tree Trimmers - training

- Skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment
- Skills and techniques necessary to determine the nominal voltage of exposed live parts
- Applicable minimum approach distances and how to maintain them (for non-qualified work)

§1910.269(a)(2)(iii)
At least Two-Person Rule

- Install, remove, repair lines >600 V
- Install, remove, repair de-energized line with exposure to >600 V
- Install, remove, repair equipment with exposure to >600 V
- Mechanical equipment, other than insulated aerial lifts, near parts >600 V
- Other work posing similar electrical hazards

§§1910.269(l)(2)(i) and 1926.960(b)(3)(i)
Minimum Approach Distances (MAD)
Maintaining MAD

• Maintain MAD between the worker and all live parts, at all times unless:
  • Worker is insulated from live parts (gloves or gloves and sleeves if employee has control of parts),
    • Existing requirement clarified that an energized part must be under the full control of the employee for rubber gloves and/or rubber sleeves to be adequate insulation from the part.
  • Live parts are insulated from worker, or
  • Performing Live-line bare hand work

§§1910.269(l)(3)(iii) and 1926.960(c)(1)(iii)
Single-Phase Exposure

Electrical Component of MAD

Phase A

Minimum Approach Distance (MAD)

Conductive Object or Employee

2 feet

Electrical Component of MAD

Phase B

MAD

2 feet
Multiphase Exposure
Minimum Approach Distance

• Employer must establish minimum approach distances based on provided formulas and/or established tables listed in the standard (R-3, R-4, R-6, R-7)

• Tables were revised to add additional voltage categories

• For voltages up to 72.5 kV, working MAD was not affected greatly, but added multiplier for altitude/electrical component adjustment

• For voltages >72.5 kV, employer must determine maximum transient overvoltage (TOV)
  • Based on engineering analysis or
  • Use default values in tables (R-7 & R-9)
  • Use Appendix B for calculations

§§1910.269(l)(3)(i) & (ii) and 1926.960(c)(1)(i) & (ii)
MAD for $\leq 72.5$ kV

(showing difference compared to old §1910.269)

<table>
<thead>
<tr>
<th>Voltage (kV phase-to-phase)</th>
<th>m</th>
<th>ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.50 to 0.300</td>
<td>Avoid contact</td>
<td></td>
</tr>
<tr>
<td>0.301 to 0.750</td>
<td>0.33 (+0.33)</td>
<td>1.09 (+1.09)</td>
</tr>
<tr>
<td>0.751 to 5.0</td>
<td>0.63 (-0.01)</td>
<td>2.07 (-0.01)</td>
</tr>
<tr>
<td>5.1 to 15.0</td>
<td>0.65 (+0.01)</td>
<td>2.14 (+0.06)</td>
</tr>
<tr>
<td>15.1 to 36.0</td>
<td>0.77 (+0.05)</td>
<td>2.53 (+0.20)</td>
</tr>
<tr>
<td>36.1 to 46.0</td>
<td>0.84 (+0.07)</td>
<td>2.76 (+0.18)</td>
</tr>
<tr>
<td>46.1 to 72.5</td>
<td>1.00 (+0.10)</td>
<td>3.29 (+0.29)</td>
</tr>
</tbody>
</table>

§1910.269 Table R-6 and Subpart V Table V-5
Electric Arc Protection
Principle Requirements

• Assess workplace for hazards from flames or electric arcs

• If there is exposure, estimate incident energy

• Prohibit clothing when incident energy could ignite clothing

• Require FR under certain conditions

• Select clothing with an arc rating greater than the estimated incident energy

§§1910.269(l)(8) and 1926.960(g)
Assessment Guidelines—Arc and Flame Sources

- Sources of electric arcs
  - Unguarded, uninsulated live parts
  - Switches that arc in normal operation
  - Sliding parts subject to faults
  - Electric equipment subject to failure

- Sources of flames
  - Open flames
  - Ignitable material near flames or arcs

Appendix E to §1910.269 and Subpart V
## Assessment Examples

<table>
<thead>
<tr>
<th>Task</th>
<th>Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal operation</td>
<td></td>
</tr>
<tr>
<td>Proper maintenance and no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td>Evidence of arcing or overheating</td>
<td>Yes</td>
</tr>
<tr>
<td>Evidence of inadequate maintenance</td>
<td>Yes</td>
</tr>
<tr>
<td>Servicing and maintenance</td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>Yes</td>
</tr>
</tbody>
</table>
# Assessment Examples

<table>
<thead>
<tr>
<th>Task</th>
<th>Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspection with exposed live parts</td>
<td></td>
</tr>
<tr>
<td>Worker outside of MAD and holding no conductive objects</td>
<td>No</td>
</tr>
<tr>
<td>Worker holding conductive object</td>
<td>Yes</td>
</tr>
<tr>
<td>Worker inside MAD</td>
<td>Yes</td>
</tr>
<tr>
<td>Using open flames</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
</tr>
</tbody>
</table>
Appendix E

Appendix E provides guidance on the calculation and review of system arc risk. OSHA will honor estimations based on guidance

- Provides a guide to estimation of risk
- Provides parameters for calculation
  - Distance from an arc (e.g. rubber gloving = 15 in.)
  - Estimating arc gap

Provides guidance on the selecting a calculation method based on testing. Can use other not listed.

Provides guidance on selecting protective clothing

Provides limited table (6 & 7) references for estimated heat energy (in lieu of performing your own calculations).

Do not have to estimate for every job task. Can make broader estimates based on similar work or system area.
Guidelines for Calculation Methods

Table 3—Selecting a Reasonable Incident-Energy Calculation Method

<table>
<thead>
<tr>
<th>Incident-Energy Calculation Method</th>
<th>600 V and Less</th>
<th>601 V to 15 kV</th>
<th>More than 15 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1Φ</td>
<td>3Φa</td>
<td>3Φb</td>
</tr>
<tr>
<td>NFPA 70E-2012 Annex D (Lee equation)</td>
<td>Y-C</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Doughty, Neal, and Floyd</td>
<td>Y-C</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>IEEE Std 1584b-2011</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>ARCPRO</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

Appendix E to §1910.269 and Subpart V
Notes on Calculation Methods

- Heat flux calculator – not recommended

- NFPA 70E Task Table
  - 2012 edition – not recommended
  - 2015 edition – acceptable to use, especially generation

- ARCPRO
  - v. 2.0 – was the version evaluated. Has limitations
  - v. 2.01 – was not evaluated

Appendix E to §1910.269 and Subpart V
## Guidelines on Arc Gap

### Table 5—Selecting a Reasonable Arc Gap

<table>
<thead>
<tr>
<th>Class of Equipment</th>
<th>Single-Phase Arc mm (inches)</th>
<th>Three-Phase Arc mm¹ (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable</td>
<td>NA²</td>
<td>13 (0.5)</td>
</tr>
<tr>
<td>Low voltage MCCs and panelboards</td>
<td>NA</td>
<td>25 (1.0)</td>
</tr>
<tr>
<td>Low-voltage switchgear</td>
<td>NA</td>
<td>32 (1.25)</td>
</tr>
<tr>
<td>5-kV switchgear</td>
<td>NA</td>
<td>104 (4.0)</td>
</tr>
<tr>
<td>15-kV switchgear</td>
<td>NA</td>
<td>152 (6.0)</td>
</tr>
<tr>
<td>Single conductors in air, 15 kV and less</td>
<td>51 (2.0)</td>
<td>Phase conductor spacing</td>
</tr>
<tr>
<td>Single conductor in air, more than 15 kV</td>
<td>Voltage in kV × 2.54 (Voltage in kV × 0.1), but no less than 51 mm (2 inches)</td>
<td>Phase conductor spacing</td>
</tr>
</tbody>
</table>

Appendix E to §1910.269 and Subpart V
Appendix E Incident-Energy Tables

Table 6—Incident Heat Energy for Various Fault Currents, Clearing Times, and Voltages of 4.0 to 46.0 kV: Rubber Insulating Glove Exposures Involving Phase-to-Ground Arcs in Open Air Only

<table>
<thead>
<tr>
<th>Voltage Range (kV)**</th>
<th>Fault Current (kA)</th>
<th>Maximum Clearing Time (cycles)</th>
<th>4 cal/cm²</th>
<th>5 cal/cm²</th>
<th>8 cal/cm²</th>
<th>12 cal/cm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0 to 15.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>46</td>
<td>58</td>
<td>92</td>
<td>138</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>18</td>
<td>22</td>
<td>36</td>
<td>54</td>
<td>0</td>
<td>0</td>
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<tr>
<td>15</td>
<td>10</td>
<td>12</td>
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<td>30</td>
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</tr>
<tr>
<td>20</td>
<td>6</td>
<td>8</td>
<td>13</td>
<td>19</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>15.1 to 25.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>28</td>
<td>34</td>
<td>55</td>
<td>83</td>
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<td>10</td>
<td>11</td>
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<td>23</td>
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<td>15</td>
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</tr>
<tr>
<td>20</td>
<td>4</td>
<td>5</td>
<td>9</td>
<td>13</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>25.1 to 36.0</td>
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<td></td>
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<tr>
<td>5</td>
<td>21</td>
<td>26</td>
<td>42</td>
<td>62</td>
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<td>11</td>
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<td>0</td>
</tr>
<tr>
<td>36.1 to 46.0</td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>5</td>
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<td>20</td>
<td>32</td>
<td>48</td>
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<tr>
<td>15</td>
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<td>0</td>
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</tr>
<tr>
<td>20</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>9</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Lockout-Tagout Procedures

- Written procedures covering the scope, purpose, responsibility, authorization, rules, and techniques to be applied to the control of hazardous energy, and the measures to enforce compliance

- Statement of the intended use

- Specific steps for controlling energy for machines, system and equipment

- Specific steps for placing, removing, and transferring lockout-tagout devices

- Specific requirements for testing machines or equipment to verify the effectiveness of energy control measures

§1910.269(d)(2)(iii) & (iv)
LOTO Procedures

• LOTO device application and removal only by authorized employee performing the servicing
  • Can apply group lock or tag out if multiple crews
  • Can designate lead person to coordinate with multiple crews
  • Can remove others energy control device under rules if they are unavailable but procedure must be included in written energy control plan and trained upon meeting the requirements of (d) (7) (iv)
  • Person in charge must release clearance unless have transferred clearance under standards.

• Notification of all affected employees
  • Before application of LO/TO
  • After application of LO/TO

§1910.269(d)(4) & (5)
Annual Inspection – LO/TO

- Performed by an authorized employee who is not actually using the energy control procedure being inspected

- Designed to identify and correct any deviations or inadequacies

- Include a review, between the supervisor and each authorized employee, of that employee’s responsibilities under the energy control procedure being inspected, with a review of tag out elements if applicable

- Certify annual inspections (note: if normal work schedule and operational records demonstrate adequate inspection activity and contain required information, no additional info is required).

§1910.269(d)(2)(v)
LO/TO - Training

- Must ensure that:
  - The purpose and function of the energy control program are understood by employees
  - The knowledge and skills required for the safe application, use, and removal of energy controls are acquired by employees
  - Re-training required when inadequacy in work knowledge detected:
    - Per annual review as required by standard
    - Other information becomes available (accident investigation)
    - Introduce new procedures or equipment involving energy control

§1910.269(d)(2)(vi)
Removal of others LOTO Device

General removal of LOTO device by other authorized employee than who applied it

- If that worker is unavailable:
  - Verify that he or she is not at the facility
  - Make reasonable efforts to contact him or her
  - Make sure that he or she is aware of removal before resuming work at the facility
  - Procedures must afford equivalent safety

Transfer of clearance can be initiated through designated person or dispatch/system control

§1910.269(d)(7)(iv)
Group LOTO

• Assign one authorized employee with primary responsibility

• Primary authorized employee must ascertain exposure status of group members

• When more than one group is involved, designate authorized employee to coordinate multiple affected groups

• Each authorized employee can affix a personal LOTO device to the group mechanism

• Ensure overall protection equivalent to personal LOTO

§1910.269(d)(8)(ii)
De-energizing T&D

- System operator?
  - Yes—Requests go thru SO, who reenergizes and issues tags
  - No—Employee in charge takes place of SO
- No tags or communication with SO required
  - One crew only
- Disconnects are accessible and visible to, and under the sole control of, the employee in charge

§§1910.269(m)(2)(i) - (iii) and 1926.961(b)(1) - (3)
De-energizing T&D

• Multiple crews working on the same lines or equipment:
  • Coordinate activities with one employee in charge of the clearance for all crews or
  • Independent crews - if no system operator, crews must have separate tags and must coordinate energizing and de-energizing

§§1910.269(m)(2)(iv) and 1926.961(b)(4)
Network Protectors

• Need not tag network protectors if:
  • Maintained so that they will immediately open if closed when a primary conductor is de-energized
  • Workers cannot manually override, and the manual position is disabled
  • Procedures for overriding protector:
    • The line is not de-energized for worker protection
    • The primary line is energized

§§1910.269(m)(3)(iv) and 1926.961(c)(4)
De-energizing Procedures

- Tags must prohibit operation and indicate that employees are at work
- Test the lines and equipment with device designed to detect voltage. Must use test device.
- Install required protective grounds
- Lines and equipment may now be considered as de-energized

§§1910.269(m)(3)(v) - (viii) and 1926.961(c)(4) - (c)(8)
Grounding

- Transmission and distribution lines and equipment worked as de-energized must be grounded, except in case where:
  - The installation of ground is impracticable
  - Grounding presents a greater hazard

OSHA did revise the standard to allow, under certain conditions insulating equipment other than live line tools to apply grounds to/from circuits of 600 volts or less

§§1910.269(n)(2) and 1926.962(b)
Work Without Grounds

If grounds is impractical or would increase the work hazard, lines can be considered de-energized for work if:

• Lines and equipment are de-energized and tested in accordance with standard and

• No possibility of contact with other energized source and

• No induced voltage hazard and

• An Equipotential Zone is created to ensure protection from hazardous differences in electric potential

§§1910.269(n)(2) and 1926.962(b)
Equipotential Zone

- Grounds must protect against hazardous differences in potential

- This seems to be a focus point under the revised standards.

- Appendix C contains guidance and safe-harbor grounding practices

- If de-energized work is performed, OSHA will recognize equipotential grounding as effective if the employer follows the guidance within the appendix.

§§1910.269(n)(3) and 1926.962(c)
Appendix C

Appendix C to §1910.269 and Subpart V
Appendix C to §1910.269 and Subpart V
Appendix C

Appendix C to §1910.269 and Subpart V
Appendix C to §1910.269 and Subpart V
Grounding – Appendix C

- **Appendix C – Protection from Hazardous Differences in Electric Potential**
  - Provides guidance for proper grounding and protecting workers from step and touch potentials.
  - Expands the section focusing on protecting workers
    - States that OSHA will consider employers who follow the guidance to meet compliance requirements.
  - Outlines procedure to follow to ensure for effective grounding method without an engineering determination
    - Method used must ensure circuit opens in fastest time
    - Method used must ensure that differences in voltage potentials are kept low
  - **OSHA still allows employers to determine the appropriate method to utilize which will provide maximum protection and meet standard.**
Line-Clearance
Tree Trimming
Line-Clearance Tree Trimming: Non-Qualified

Sets rules for both qualified and non-qualified tree trimming:

Line-clearance tree trimmers (non-qualified only)

- OSHA intended line-clearance operations covered under 1910.269 (r) to apply to trimming performed:
  - For the purpose of clearing space around electric lines or equipment and
  - On behalf of an organization that operates, or controls the operating procedures for those lines and equipment. It does not apply to trimming on behalf of homeowners or commercial entities other than the above referenced organization and is not covered under 1910.269

- Work defined as pruning, trimming, repairing, maintaining, removing, or clearing of trees, brush that is within the specified distances to energized components:
  - 50 kV voltages to ground or less = 10 feet
  - 50 kV voltages to ground or more = 10 feet plus 4 added inches per every 10 KV over 50

Second trained line-clearance tree trimmer must be present if:

- Voltage > 750 V and the worker will be < 3.05 m (10 feet)
- Branches closer than MAD to lines > 750 V
- Or if Roping is necessary for clearance from MAD

§1910.269(r)(1)(i)&(ii)
Line-Clearance
Tree Trimming: Non-Qualified

• Maintain MAD during work

• Remove branches closer than MAD with insulating equipment

• Do not work in adverse weather

• Train workers performing work under emergency conditions in any additional or special hazards of this work (thunderstorms, high winds)

§1910.269(r)(1)(iii) - (vi)
Non-qualified Tree Trimmers

- Non-qualified tree trimmers (non-line clearance) are currently exempted from various part of the revised 1910.269 rule:
  - Training requirements
  - Information transfer requirements
  - Medical services/first aid requirements
  - Job Briefing requirements
  - Personal Protective Equipment Requirements
  - Material handling and storage requirement
  - Mechanical Equipment requirements
  - Line clearance tree trimming requirements

- Non-qualified tree trimming operations (at least >10 feet) are covered for time being under Electrical Safety related work practices and other standards (1910.331-335 & 1910.268)

- Per February 2015 memorandum, OSHA will issue a correcting amendment to clarify what line-clearance tree trimming work falls within the scope of the revised 1910.269 (r) standards.
Mechanical Equipment

§§1910.269(p) and 1926.959
Mechanical Equipment

Must be operated in accordance with Subpart N (cranes, derricks), Subpart O (Mechanized Equipment) and CC (Construction – crane, derrick)

• Extra Precautions if equipment could become energized includes:
  ➢ best available ground shall be established
  ➢ bonding equipment together
  ➢ Ground mats
  ➢ Additional Insulating protective equipment and/or barricades

• Employer shall ensure inspection before use: Critical safety components include:
  ➢ Boom/winch rope
  ➢ Outriggers
  ➢ Upper and lower bearing attachment weld and bolts
  ➢ Lift cylinders and attachments
  ➢ Hydraulic system
  ➢ Elbow

§§1910.269(p)(1)(i) and 1926.959(a)(2)
Live-Line Tools

- Inspection and Periodic Testing requirements of live line tools did not change in new revision of rules
  - Daily visuals
  - Biennial inspection and testing
  - Cleaning & repair guidelines (IEEE Std. 516-2009) (new)

§§1910.269(j) and 1926.957
Manholes and Vaults
Enclosed Spaces—Definitions

• “Entry“

The action by which a person passes through an opening into an enclosed space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant’s body breaks the plane of an opening into the space.

• "Attendant“

An employee assigned to remain immediately outside the entrance to an enclosed or other space to render assistance as needed to employees inside the space.

§§1910.269(x) and 1926.968
Enclosed Spaces—Definitions

• “Immediately dangerous to life or health” (IDLH)

Any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual’s ability to escape unaided from a permit space.

• OSHA also clarified that test instruments used for air quality test must have an accuracy of (+ or -) 10 percent

• OSHA revised the existing requirement of standard to state that employers must be able to demonstrate that they maintained ventilation long enough to ensure for a safe atmosphere within the enclosed space.

§§1910.269(x) and 1926.968
Underground Work/Lines - Attendants

• Attendant with first aid and CPR training must be on surface, except:
  
  • Attendant may enter briefly to provide nonemergency assistance
  
  • No attendant allowed for brief entries involving inspection, housekeeping, reading, and similar activity, unless there our outside space hazards (e.g. Vehicle Traffic)
  
• Reliable communications maintained among all employees

§§1910.269(t)(3) and 1926.965(d)
Underground Work/Lines - Protection Against Faults

- De-energize cables with abnormalities (leaking oil, broken sheaths, swollen joints)
  - Except for significant service-load conditions
  - Employer must protect employees through some other effective manner if a fault could occur

- De-energize cables where work could cause fault
  - Except for significant service-load conditions
  - Employers must protect employees through some other effective manner if a fault could occur

§§1910.269(t)(7) and 1926.965(h)
Substations

- When Substation fences are altered they shall be insulated, grounded or bonded as necessary to protect employees from hazardous differences in electric potential.


- When to guard energized substation components:
  - Exposed live parts 50 - 150 V < 2.4 m (~8 ft.) above ground
  - Live parts 151 - 600 V < 2.4 m (~8 ft.) above ground and guarded only by location
  - Live parts > 600 V unless:
    - In metal-enclosed enclosures
    - Installed at a sufficient height

§§1910.269(u)(4) and 1926.966(e)
Miscellaneous Revisions

• **Medical services and first aid** – (b) first aid training: when personnel exposed to 50 volts or greater, they shall be trained in first aid/CPR
  - Field work – two or more employees at a work location shall be trained prior to work being performed
  - Fixed work locations – number of trained personnel shall be sufficient to ensure response to electrically injured within 4 minutes
  - For non-qualified line clearance tree trimming – only one person need trained if others are trained within 3 month of hire.
  - First aid kits/supplies shall be inspected with frequency to ensure they are properly sufficient, but at least once per year.

• **Line clearance tree trimming operations** – (5) (iv) Gasoline-engine power saws: section 1910.266 prohibits the “drop starting” of power chain saws

• **Underground electrical installations** – (t) (7) (ii) – If work performed within a manhole or vault could cause a fault in a cable, the employer shall de-energize that cable before any employee work in the manhole or vault, except when service-load conditions and lack of feasible alternatives require that the cable remain energized. In that case, the employee may enter the manhole or vault provided that the employer protects them form the possible effects of failure using shields or other devices that are capable of containing the adverse effects of a fault.
Revised Enforcement Dates

The general rule compliance became effective immediately with the listed exceptions:

- **Information Transfer** – June 30, 2015 (for Host & Contractor)
  - After April 30, 2015 Hosts must provide contact employers with required information with exception of maximum switching/transient voltages

- **Job Briefing** (information to employer in charge) – June 30, 2015

- **Minimum Approach Distances** –
  - For 5.1 kV or more – April 1, 2015
  - For 72.6 to 169 kV – January 31, 2016
  - For 169 kV or more – January 31, 2016

- **Incident energy estimates** - March 31, 2015

§§1910.269(l)(8)(vi) and 1926.960(g)(6)
Revised Enforcement Dates

• **Flame Resistant Clothing** – April 1, 2015
  • This applies to both upper and lower body protection

• **Other Arc-rated Protection** – April 1, 2015
  • This includes other PPE as dictated by arc risk assessment
  • Until August 31, 2015 for equipment rated >8 cal/cm²

• **Fall Protection in Aerial Lifts** – April 1, 2015
  • Line clearance tree trimming (full fall restraint) – December 31, 2015 (if engaging in testing and evaluation of equipment)
Revised Enforcement Dates

- **Fall Protection in elevated locations on Poles, Towers, and similar structures** – May 31, 2015

- **Underground Installations/Work in Manholes and Vaults (protection against UG faults)** – February 28, 2015

- **Affected Personnel Training** – In Effect, with exception of listed areas

The State of Indiana, Occupational Safety and Health Division (IOSHA) has confirmed that they will be following these federal dates for rule enforcement
Compliance Recommendations

1) **Conduct and/or revisit your system’s Electric Arc Risk assessment and FR protection:**
   - Evaluate in context to changes to system and Appendix C guidance
   - Evaluate your FR rated clothing and other affected PPE
   - Evaluate your work approach/procedures in context to findings
   - Apply this information to all work involving faults (manholes/vaults)

2) **Review full Fall Protection approach while working at heights:**
   - Review use of equipment in critical areas
   - Review condition and specifications of current equipment under applicable ASTM standards
   - Replace any defective or older equipment (non-locking snaps)
Compliance Recommendations

3) Design and Implement an approach to the Information Transfer and enhanced Job briefing requirements –
   • Incorporate needed necessary information for existing system conditions under (a) (4) into daily crew leader information
   • Implement approach and documentation for required information transfer to all contractors and subcontractors performing work under standard
   • Implement two-way communication system for contractors to report work hazard information back to host employer
   • Evaluate other safety related information and procedures which should be included in this exchange (e.g. LO/TO, grounding)

4) Review your internal safety rules and procedures in context to the revised rules and modify to accommodate affected areas (e.g. MAD, grounding, rubber gloves/sleeves, energized work)
Compliance Recommendations

5) Review Minimum Approach Distances in context to energized work activity and train affected personnel on how to apply changes (Appendix B)

6) Review the specific amended rule(s) and all critical associated written Appendix and guidance:
   - Appendix B – Working on Exposed Energized Parts (MAD)
   - Appendix C – Protection from Hazardous Differences in Electric Potential (Grounding)
   - Appendix E – Protection from Flames and Electric Arcs (Arc Assess)
   - Appendix F – Work-Positioning Equipment Inspection Guidelines (Fall)

7) Continue to comply adequately with the requirements of revised 1910.269 and incorporate specifics from Subpart V!
Questions???

Thank you for your attention!