EFCOG Best Practice #252

Facility: (DOE Complex)

Best Practice Title:

Hazard Identification & Risk Assessment Figures, Tables & Charts

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Brief Description of Best Practice: Provides a method to determine if a source of electrical energy is hazardous to perform a risk assessment.

Why the best practice was used: 10 CFR 851.21 requires contractors to establish procedures to identify existing potential workplace hazards and assess the risk of injury and illness to workers.

What are the benefits of the best practice: Contractors can use this information to produce consistent hazard identification and risk assessment results.

What problems/issues were associated with the best practice: New Best Practice; The revision process to the DOE-HNBK-1092-2013 causes some delay in implementing the most current information being developed within the complex. As we add to the figures, tables, and flow charts the ESTT can update the best practice to include the new classifications and tools as needed.

How the success of the Best Practice was measured: New Best Practice; Many DOE sites currently use the Hazard Identification & Risk Assessment tools as they reside in the very outdated DOE-HNBK-1092-2013 and are incorporated within their Electrical Safety Programs.

Description of process experience using the Best Practice: New Best Practice

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1. HAZARD IDENTIFICATION AND RISK ASSESSMENT

Hazard identification and risk assessment is a crucial factor in electrical safety. OSHA and NFPA 70E provide methods that electrical safety planners and workers use to identify specific electrical hazards in the workplace.

A DOE site may have additional or unique electrical hazards that are not addressed in national consensus standards and codes. In these instances, DOE contractors have developed procedures and processes that address these hazards. One example uses Modes of Work on electrical equipment. This process estimates the likelihood of injury or damage to health by evaluating how the worker is interacting with the equipment. As the Mode of Work increases the likelihood of injury or damage to health to workers increases. Each site should incorporate an approved process that is task-based.

1.1 Hazard Identification and Risk Assessment Process:

- Identify Scope of Work/Tasks to be Performed. (Define the Scope of Work)
- Document Hazards Associated with Each Task Utilizing the Modes of Work. (Identify Hazards)
- Estimate Likelihood and Severity Based on the Scope of Work and Identified Hazards .
- Identify and Document Risk Control Measures (Develop Controls)
- Verify and Validate Risk Assessment and Control Measures (Prior To Performing Work)
- Continue Real-Time Reevaluation of Risk Assessment and Control Measures (Perform Work)
- Measure and Monitor (Feedback & Improvement)

1.2 Identify Hazards Related to Scope of Work

In accordance with 10 CFR 851.21, contractors must establish procedures to identify existing and potential workplace hazards and assess the risk of associated workers injury and illness. The specific criteria for identifying and analyzing hazards is required in accordance with 10 CFR 851.21(a)(1) - (8).

1.3 Identify Scope of Work/Tasks to be Performed

For an activity-level hazard analysis of an electrical task, the work to be performed should be broken down into discrete tasks by experienced personnel who have performed the work before or with the workers and subject matter expert (SME) during a walk-down of the scope of work.

1.4 Document Hazards Associated with Each Task Utilizing Modes of Work

The Modes of Work process should be used to separate specific work tasks since the electrical hazards, risks, and controls vary between modes. As the Modes of Work increases, the likelihood of injury or damage to health to workers increases. The modes of work are further explained in Section 1.2.

Modes of Work:

Mode 0 – Electrically Safe Work Condition

Mode 1 – Establishing an Electrically Safe Work Condition

Mode 2 – Energized Diagnostics and Testing

Mode 3 – Energized Work

NOTE: Equipment operation is not a mode of work but may expose workers to electrical hazards. Therefore, this task should also be separated, and a risk assessment performed to develop controls, if necessary.

Refer to Figure 1-3 Hazard Assessment Tables and Recommended Controls, to identify the source of electrical energy that the worker will potentially encounter for each individual task. This is known as the Hazard Category and is represented by the leading value (X) in the category.

1.5 Estimate Likelihood and Severity Based on the Job Scope and Identified Hazards

Risk determination can be evaluated for electrical work based on the source of energy hazard class (severity), how the worker is interacting with the equipment (modes of work), conditions that increase risk and impact from environmental conditions. Initial risk determination is to be performed by trained, qualified, and authorized workers. The following risk matrix (Table 1-1) can be used in conjunction with evaluating equipment, environmental, and work/worker conditions. The result of this evaluation will provide the risk determination.

Table 1-1. Risk Matrix for Electrical Work

	Likelihood of Occurrence				
Severity / Class	**Frequent**	**Probable Mode 3**	**Occasional Mode 2**	**Improbable Mode 1 and Equipment Operation**	**Remote**
Catastrophic X.4 and X.5	**HIGH**	**HIGH**	**HIGH**	**MODERATE**	**MODERATE**
Critical X.3	**HIGH**	**HIGH**	**MODERATE**	**MODERATE**	**LOW**
Moderate X.2	**HIGH**	**MODERATE**	**MODERATE**	**LOW**	**LOW**
Negligible X.0 and X.1	**MODERATE**	**LOW**	**LOW**	**LOW**	**LOW**

Notes:
1. Likelihood of occurrence can either increase or decrease based on equipment, work, worker, and environmental conditions.
2. Severity can increase based on environmental conditions. The exception is Class X.0 and X.1, where only extreme environmental conditions could increase the severity of the injury.
3. All Hazard Classes in Mode 0 are considered to be Low Risk

The Hazard Classification System (Table 1-2) identifies the five hazard classes. The hazard class is represented by the lagging value (x) in the Hazard Classification System nomenclature (X.x). The severity of the hazard increases as the Hazard Class increases. Use Hazard Assessment Tables and Recommended Controls figures 1-3 to analyze the severity of the electrical hazard that the worker will potentially encounter for each individual task being performed.

Table 1-2. Hazard Classification System

Hazard Class	Description	Color
X.0	No hazard, no controls, no training	**Blue**
X.1	Minimum hazard, no injury, no control, minimum training	**Green**
X.2	Can injure or kill, controls, some PPE	**Yellow**
X.3	Will injure or kill, controls, PPE	Red
X.4	Very serious, many controls, avoid work	Maroon

NOTE: The Condition of the Environment/Work/Worker have the potential to increase the severity of the electrical hazard, demonstrated in the examples below. See EFCOG BP #192 *Risk Assessment* for more information.

- A worker is exposed to a shock hazard in a wet environment. The severity of the shock hazard would increase as the environmental conditions decrease the body's contact impedance.
- A worker, in a confined space, is interacting with equipment in a manner that could increase the likelihood of exposure to an arc flash hazard. The severity of the incident energy available may increase depending on assumptions of the incident energy analysis (e.g., working distance, 2 second rule, reliability of upstream overcurrent protection device, open space work).

The following Risk Evaluation Flow charts can be used to assist in evaluating risk based on the Modes of Work and Hazard Classes.

Figure 1-1. Risk Evaluation Flow Chart – Hazard Class X.0 and X.1

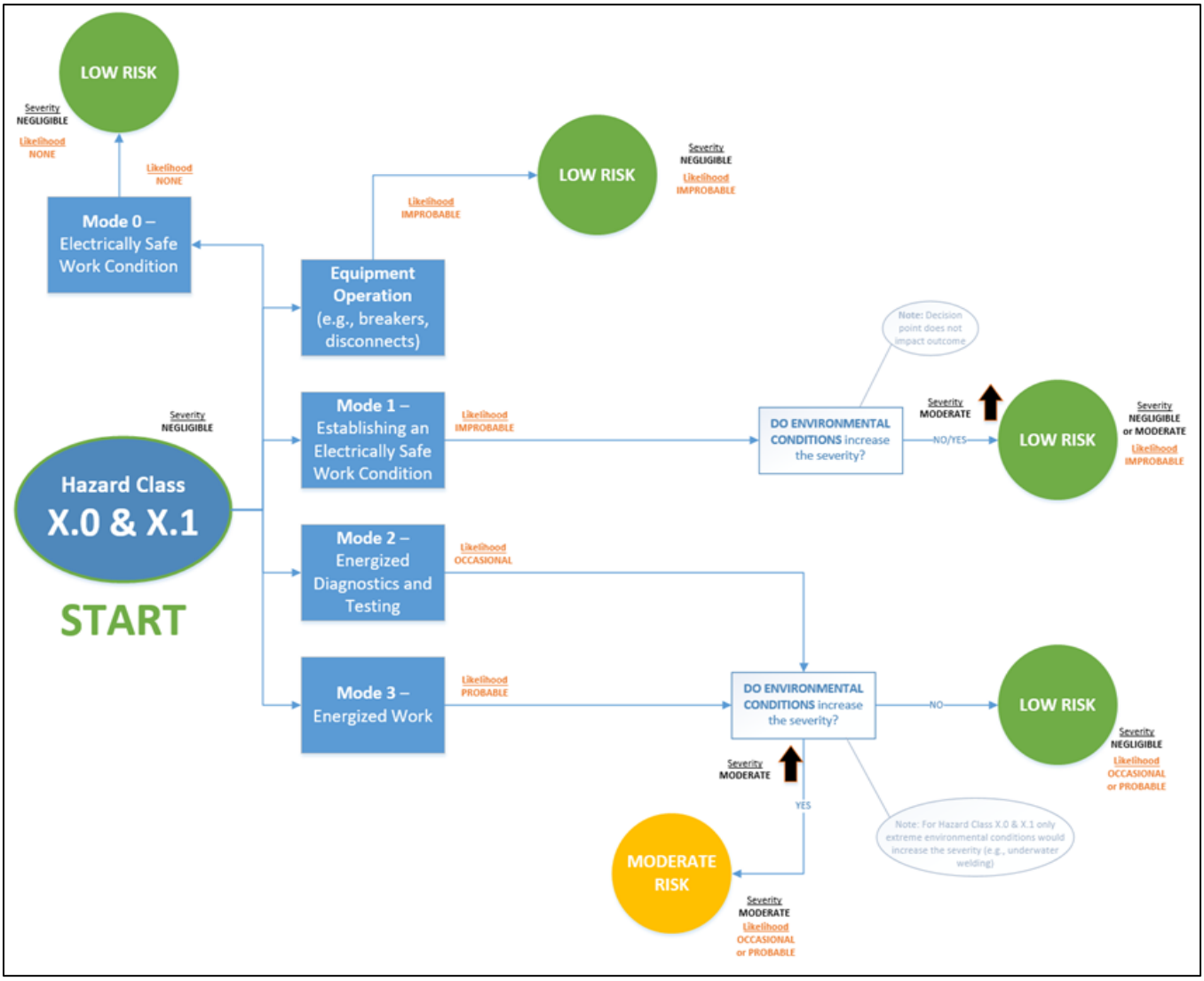


Figure 1-2. Risk Evaluation Flow Chart – Hazard Class X.2

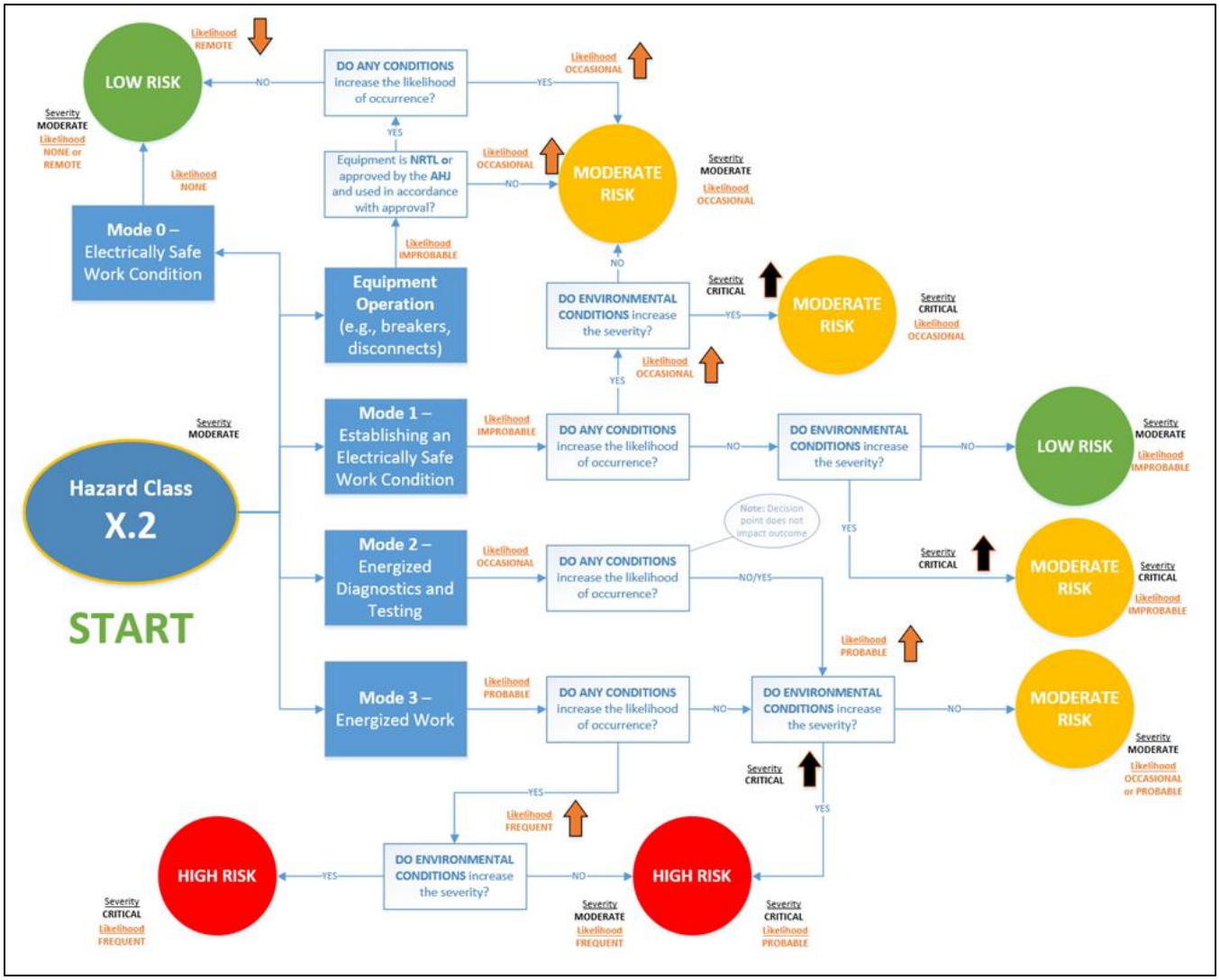


Figure 1-3. Risk Evaluation Flow Chart – Hazard Class X.3

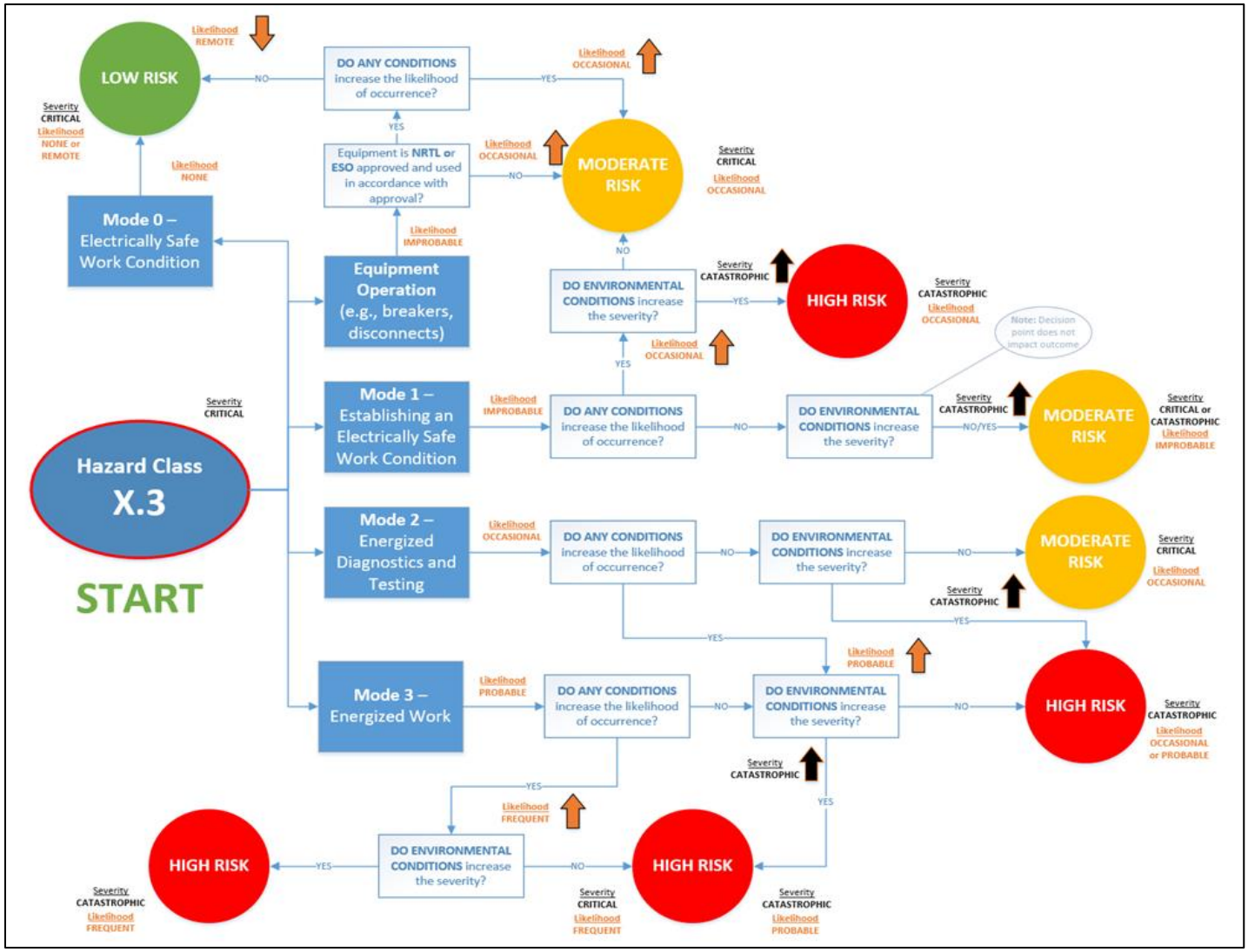
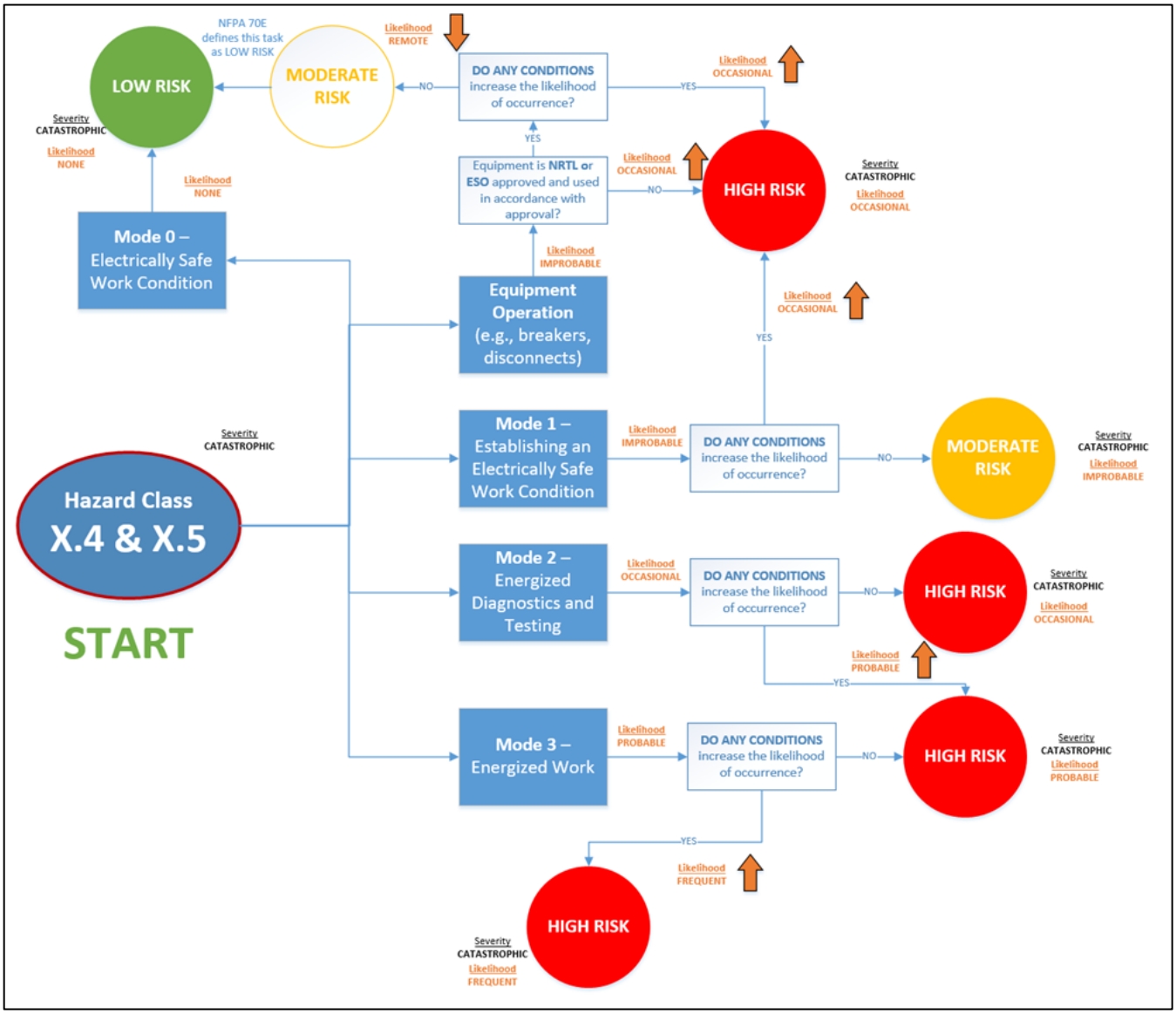


Figure 1-4. Risk Evaluation Flow Chart – Hazard Class X.4 and X.5



1.6 Identify and Document Risk Control Measures (Develop Controls)

The risk determination level is documented and used to determine if additional protective measures are required. One basis for determining whether additional protective measures are required is known as the "As Low as Reasonably Practicable" (ALARP) principle. If ALARP has not been met, then risk controls are implemented from a hierarchy of risk control methods to reduce the risk to such a level.

Per NFPA 70E, Article 110, Section 110.5(H), *Risk Assessment Procedure*, risk control methods need to be implemented in accordance with the risk control hierarchy.

Hierarchy of Risk Control Methodology

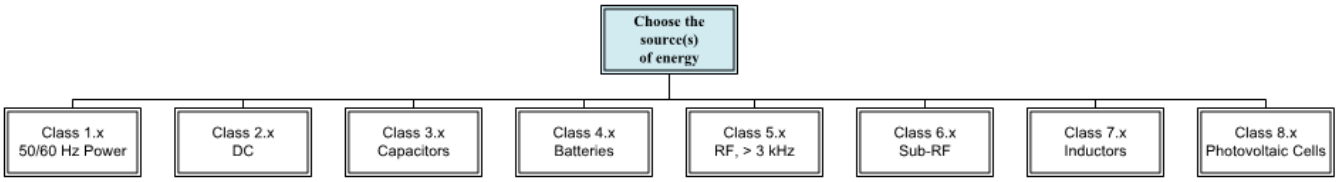
1. ELIMINATE the hazard.
2. SUBSTITUTE with other materials, processes, or equipment.
3. Incorporate **ENGINEERED CONTROLS**.
4. Increase the **AWARENESS** of potential hazards by using signage, warnings, and barricades.
5. Utilize **ADMINISTRATIVE CONTROLS**.
6. Establish measures to ensure the appropriate selection, use, and maintenance of **PERSONAL PROTECTIVE EQUIPMENT**.

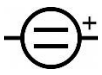
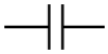
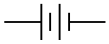
The first three risk control measures (1-3) are the most effective and should always be considered prior to incorporating the last three risk control measures (4-6). A combination of risk control measures may be necessary to reduce the risk to as low as reasonably practicable. Use the control tables based on the hazard assessment charts from Table 1-3, Hazard Class Assessment and Recommended Controls Table for the Complete Hazard Classification System of Eight Major Classes of energy Figure 1-6 to incorporate ADMINISTRATIVE CONTROLS including required training, working alone, working with a second person (two-person rule), or working with a safety watch. PERSONAL PROTECTIVE EQUIPMENT is selected based on Shock and Arc Flash Assessments as defined by NFPA 70E.

Table 1-3. Hazard Class Assessment and Recommended Controls (Color)

Color		Hazard Class	Description
	Light Blue and White	NA	Decision point
	Blue	X.0	No hazard, and no engineering or administrative controls are needed
	Green	X.1	Little to no hazards, few, or no, engineering, or administrative controls are needed
	Yellow	X.2	Injury or death could occur by proximity or contact; often the hazard is shock or contact burn. Engineering controls are necessary for operation (e.g., listing or equipment approval), and administrative controls are necessary for electrical work in this class
	Red	X.3	Injury or death could occur by proximity or contact; often the hazard is shock, contact burn, or arc-flash burn; engineering controls are necessary for operation (e.g., listing or equipment approval), and administrative controls are necessary for electrical work in this class
	Maroon	X.4, X-5	Highest level of risk; significant engineering and administrative controls are necessary to manage the hazard in these classes
	Gray	3.1c	Takes the user outside of electrical safety controls, as the primary hazard is chemical explosion

Figure 1-6. Complete Electrical Hazard Classification System Showing Eight Major Classes of Energy



Class 1.x	Class 2.x	Class 3.x	Class 4.x	Class 5.x	Class 6.x	Class 7.x	Class 8.x
							
50/60 Hz power	DC	Capacitors	Batteries	RF	Sub-RF	Inductors	Photovoltaic Cells
See Fig. 1-7	See Fig. 1-8	See Fig. 1-9, Fig. 1-10	See Fig. 1-11	See Fig. 1-12	See Fig. 1-13	Future Updates	Future Updates

NOTE: Throughout the following charts and tables, threshold numbers are ≤ and >, unless indicated otherwise. For example, ≤50 V is not an AC shock hazard, >50 V is an AC shock hazard.

1.7 Verify and Validate Risk Assessment and Control Measures (Prior To Performing Work)

An electrical job safety plan and pre-job brief meeting are the opportunities to verify and validate that the risk assessment and risk control measures adequately reduce the risk to ALARP. This is also an opportunity to evaluate conditions (equipment, environmental, work, and worker) that could increase risk and incorporate any additional controls that may be necessary.

1.8 Continue Real-Time Reevaluation of Risk Assessment and Control Measures (Perform Work)

Reevaluate the risk assessment and risk control measures ("TAKE2 4U"). TAKE2 4U, explained: when returning from a break or upon completion of a task, take two minutes (TAKE 2) to reevaluate any change in conditions (equipment, environment, the work, and the worker)that could increase risk to the worker (4U). Pause work, as appropriate, to incorporate additional risk control measures.

1.9 Measure and Monitor (Feedback & Improvement)

Upon completion of the work activity, reconvene with the workers, managers, and SMEs. Discuss lessons learned, near misses, unidentified issues, and other areas for improvement. Consider sharing lessons learned and operating experiences with the complex using the DOE OPEXShare tool.

1.10 Modes of Work

Under normal operation of Nationally Recognized Testing Laboratory (NRTL) Listed or approved electrical equipment, the user/operator is protected by engineering controls, including insulation, enclosures, barriers, grounds, and other methods to prevent injury. When engineering controls are not yet in place, not approved, or removed for diagnostics, maintenance, or repair, the work activity falls into one of the following categories:

Mode 0 – Electrically Safe Work Condition

Mode 1 – Establishing an Electrically Safe Work Condition

Mode 2 – Energized Diagnostics and Testing

Mode 3 – Energized Work

NOTE: There are some work activities that may expose a worker to an electrical hazard but do not fall into one of the modes of work categories (e.g., operating a circuit breaker, racking a circuit breaker, inserting (stabbing), or removing (pulling) a motor control center (MCC) bucket, performing penetrations, trenching, or digging, operating electrical equipment, using a power tool, plugging, and unplugging electrical equipment). These activities may require controls as determined by a risk assessment.

1.10.1 **MODE 0 – Electrically Safe Work Condition**

An electrically safe work condition is a state in which an electrical conductor or circuit part has been: (1) disconnected from energized parts; (2) locked/tagged (or equivalent), in accordance with established standards; (3) tested to verify the absence of voltage; and (4) temporarily grounded for personnel protection, if determined necessary. In accordance with NFPA 70E, all work on hazardous electrical systems is to be performed in an electrically safe work condition, unless it can be demonstrated that establishing an electrically safe work condition is not feasible or introduces additional hazards.

1.10.2 **MODE 1 – Establishing an Electrically-Safe Work Condition**

To achieve Mode 0, a worker conducts Mode 1 work. If the Mode 1 process exposes the worker to any hazard, the activity should be covered by work control procedures, and a risk assessment should be performed. The work is energized electrical work, as covered by Mode 1, until an electrically safe work condition is achieved (Mode 0). To establish an electrically safe work condition, use the following steps:

1. Determine all sources of electrical supply to the equipment in the scope of work.
2. Check applicable drawings, diagrams, and identification tags, including equipment specific LOTO procedures.
3. Turn off equipment.
4. Don correct PPE and establish barricades, as necessary, for access control.

5. Open the disconnecting means (e.g., plug, breaker, or disconnect device).
6. Visually verify that the plug is fully removed, all blades of the disconnecting devices are fully open, or that draw-out type circuit breakers are withdrawn to the fully disconnected position, when possible.
7. Test the controls and attempt to restart the equipment, if applicable.
8. Apply LOTO devices, ensure that the plug is in total control of the worker, or use other engineering controls (such as capture key control systems) that are permitted by LOTO regulations.
9. If stored electrical energy exists (e.g., capacitors), or the DC voltage is greater than 1000 V, discharge or remove the stored energy remotely or by using ground sticks and then apply grounds to the normally energized conductors (see Annex R of NFPA 70E).
10. If grounds have not been applied and the voltage is less than 1000 V, use a correctly rated voltmeter to test each normally energized conductor or circuit part to verify it is de-energized.

    Note: for high- voltage or large capacitive systems using a correctly rated voltmeter may not be a safe procedure. Correct procedures for these cases are covered in Article 360 and Annex R of the 2021 NFPA 70E.
11. Prior to lifting or breaking neutral conductor(s), test each individual neutral conductor with a clamp-on ammeter. If current is detected work should be paused and the circuit investigated.

    CAUTION: This technique should be used with caution since current will only flow on the neutral conductor if one or more of the circuits sharing the neutral has a load energized at the time the measurement is taken. If the load on the other circuits are “off” during the measurement, the current detector will not indicate a shared neutral even though the load could be switched “on” later.
12. Where neutral conductors must be separated or removed or lifted from a terminal, measure for absence of voltage to ground immediately after the conductors have been lifted. Guard, isolate, or insulate each neutral conductor individually prior to removing PPE since the testing for current as provided in 11. above can only detect a shared neutral when load on other circuits is “on”.

    CAUTION: In rare cases, the neutral may have been tapped from a different panel.

NOTES:

- Don PPE again to reconnect the neutral conductors or re-terminate the neutral conductor, if necessary.
- If voltage is found after lifting a neutral conductor, stop work, notify your supervisor, and develop a plan to determine the circuit supplying the voltage. After opening additional circuits or the main disconnecting switch/circuit breaker for the panel, recheck for voltage.

13. If the possibility of induced voltages exists, apply grounding or temporary protective grounds to the conductors or circuit parts before touching them. (Refer to EFCOG Position Paper 2018-08)

1.10.3 **MODE 2 – Energized Diagnostics and Testing**

In Mode 2, measurements, diagnostics, testing, and observation of equipment functions are conducted with the equipment energized and with some, or all, of the normal protective barriers removed and interlocks bypassed. Verification of an electrically safe work condition with a voltage-rated instrument is covered by the Mode 1 process and is not considered Mode 2.

Work is considered Mode 2 if instruments are used to contact the energized conductors. If any portion of the worker's body enters the Restricted Approach Boundary, appropriate shock PPE shall be worn. If an arc flash risk assessment shows that an arc could occur during the process and any portion of the worker's body enters the Arc Flash Boundary the appropriate arc flash PPE should be worn.

An approved work control document may be required (see individual tables in Section 1.11). Authorization by the worker's safety-responsible line manager is required. Some examples of Mode 2 operations are:

- Making voltage measurements with a meter on energized components.
- Diagnostics and troubleshooting of energized circuits.
- Working on experimental facilities that operate in this mode.

1.10.4 **MODE 3 – Energized Work**

Mode 3 operations involve physically moving energized conductors and parts, or moving parts that are exposed, as defined by NFPA 70E.

Mode 3 work in hazard classification categories above X.0 and X.1 should be treated as hazardous electrical energy that should only be permitted when justified per NFPA 70E. Tasks performed in this mode should be conducted under close supervision and control. Work control with an approved Energized Electrical Work Permit (EEWP) is required by NFPA 70E. An EEWP should contain the information as outlined in NFPA 70E Article 130.

Mode 3 work involving equipment with electrical hazards (Hazard Classes X.2 and above) is permitted only if:

- Additional or increased hazards would exist due to establishing an electrically safe work condition.
- Equipment design or operational limitations make it infeasible to perform the work in a de-energized state.
- Work on batteries where appropriate controls are documented and are used to protect the worker against battery hazards.
- Work on power generation, control, transformation, transmission, and distribution lines and equipment that fall under the scope of 10 CFR 851 and 29 CFR 1910.269, *Electric Power Generation, Transmission, and Distribution*. See EFCOG BP# 243 Electrical Utility Energized Work

Permit (EUEWP) for more information related to Energized work in Utility or Utility-like installations.

An EEWP typically includes, but not be limited to:

- A description of the circuit and equipment to be worked on and their location.
- Justification for why the work cannot be performed in a- de-energized condition.
- A description of the safe work practices to be employed.
- Results of the shock risk assessment.
- Determination of shock protection boundaries.
- Results of the arc flash risk assessment.
- The arc flash protection boundary.
- The necessary PPE to safely perform the assigned task.
- Means employed to restrict the access of unqualified persons from the work area.
- Evidence of completion of a job briefing, including a discussion of any job-specific hazards.
- Energized work approval (authorizing or responsible management, safety officer, owner, etc.).

1.11 Hazard Classification Tables and Recommended Controls

The hazard classification charts cover eight broad categories: 50/60 hertz (Hz), AC, DC, capacitors, batteries, sub-radiofrequency (Sub-RF), radiofrequency (RF), inductors, and photovoltaic. The eight major categories (figure 1-6) are broken down in the hazard classification charts into individual classes. These classes, taken collectively, represent the electrical hazards found in electrical equipment. All classes should be considered when identifying the hazards associated with any piece of electrical equipment. A single piece of equipment may have multiple electrical hazard classifications, and the combination of hazards should be addressed by appropriate safety-related work practices.

To aid hazard identification, each chart has cross-reference notes in the upper right-hand corner. For example, the DC chart has cross-reference notes to capacitance, inductance, Sub-RF, battery, and 50/60 Hz hazard charts. Consulting manuals and schematics and speaking with factory service representatives and electrical SMEs are ways to ensure that all hazards are fully understood and that all pertinent classes are taken into consideration. Guidance on how to apply and use the hazard classification charts are provided below. They are general, and there may be exceptions to each one:

- If these guidelines and the equipment are not understood, an SME should be consulted.
- All equipment gets its power from 50/60 Hz (Classes 1.x) or batteries (Classes 4.x). Thus, all equipment starts with one of those classes.
- Most small appliances, hand tools, and portable laboratory equipment plugs into Class 1.2. In general, if it can be carried, it most likely uses 120 to 240 V.

- Larger facility and laboratory equipment may use up to 480 V (Class 1.3). Often, if it is a large motor, or consumes significant power, it may be Class 1.3.
- All electronic equipment, and much laboratory equipment, convert facility power into DC. All DC power supplies have some capacitance. Thus, DC power supplies have hazards in Classes 2.x and 3.x. Both should be evaluated.
- All uninterruptible power supplies (UPS) have hazards in Classes 4.x as well as 1.x since they usually are tied into facility power (input) and produce facility type power (output).

The colors used in each hazard class box are organized by increasing hazard: blue, green, yellow, red, and maroon.

1. Light blue and white boxes are not hazard classes but are decision points.

2. A blue class (X.0) indicates no hazard, and no engineering or administrative controls are needed.

3. A green class (X.1) indicates little to no hazards, few, or no, engineering, or administrative controls are needed.

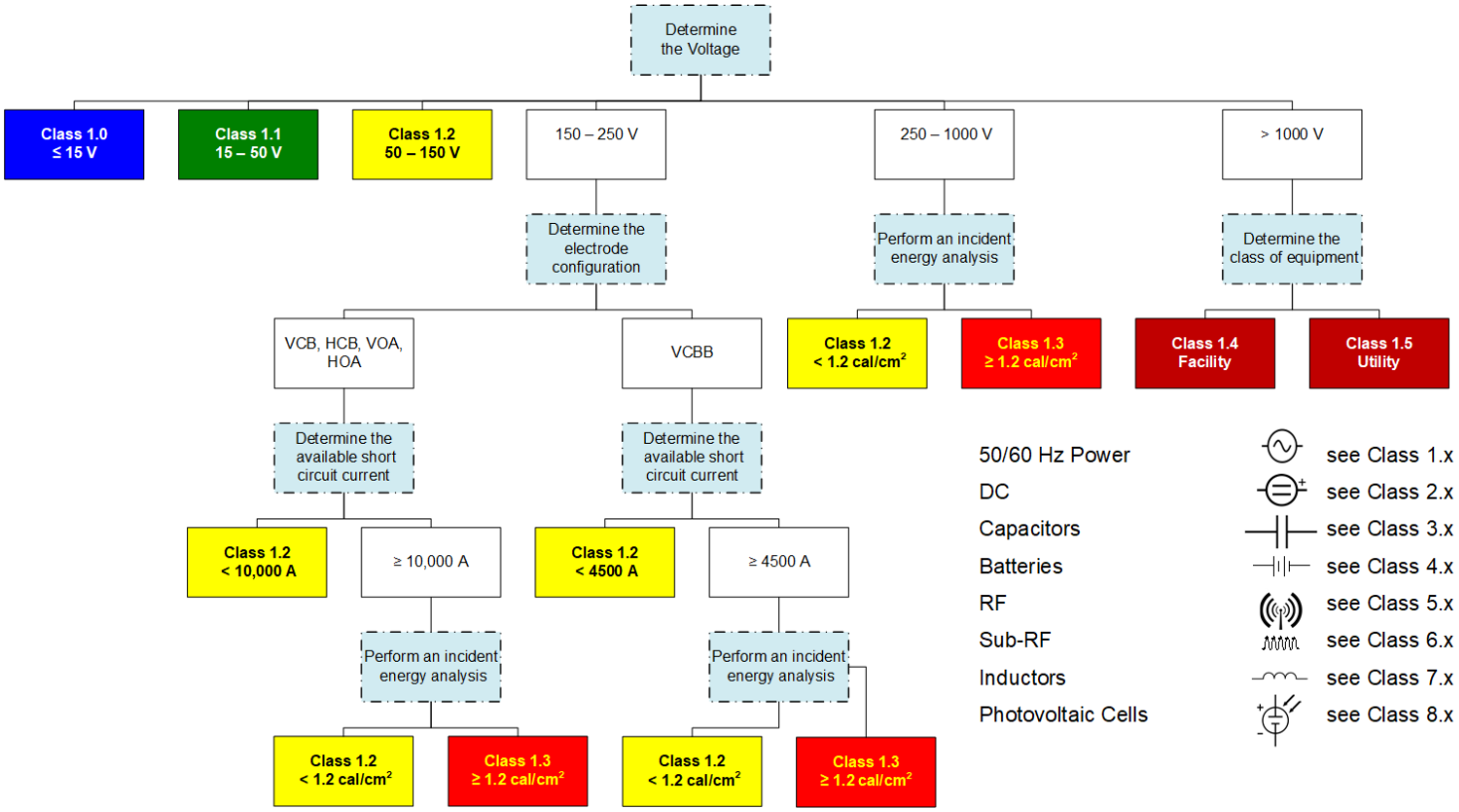
4. A yellow class (X.2) indicates injury or death could occur by close proximity or contact; often the hazard is shock or contact burn. Engineering controls are necessary for operation (e.g., listing or equipment approval), and administrative controls are necessary for electrical work in this class.

5. A red class (X.3) indicates injury or death could occur by proximity or contact; often the hazard is shock, contact burn, or arc-flash burn; engineering controls are necessary for operation (e.g., listing or equipment approval), and administrative controls are necessary for electrical work in this class.

6. Maroon class (X.4 and X.5) is the highest level of risk; significant engineering and administrative controls are necessary to manage the hazard in these classes.

7. Gray, class 3.1c, takes the user outside of electrical safety controls, as the primary hazard is chemical explosion.

Figure 1-7. Hazard Class 1.x, for 50/60 Hz



Notes on use:

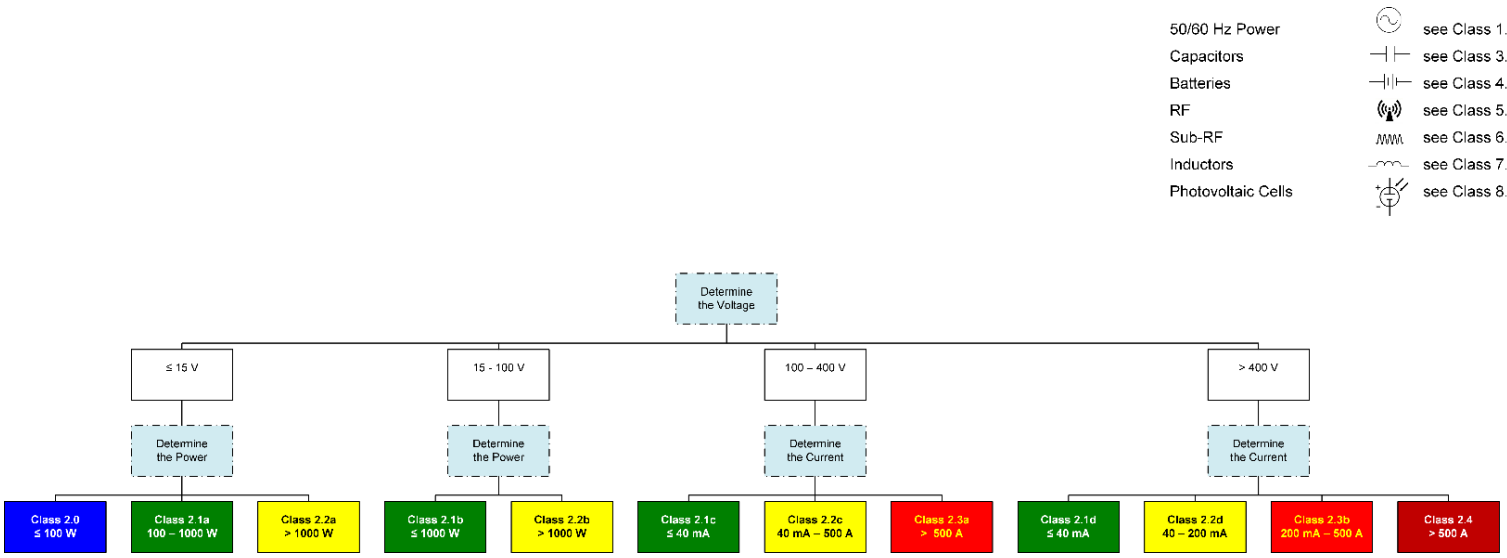
1. The voltage is the root mean square (RMS) voltage.
2. For current limited 50/60 Hz circuits (≤5 milliampere [mA]), use hazard Class 6.x, Sub-RF.
3. For equipment (150 - 250 V) that has a gap distance between conductors of <1/2 inch use <2000 A of available short circuit current as recommended by Institute of Electrical and Electronic Engineers (IEEE) 1584-2018.

Table 1-4. Control Table for Work in Hazard Class 1.x

Hazard Class and Category	Mode	Risk (Section 4.5.1)	Electrical Worker(s)	Training Required	Work Control	Personal Protective Equipment
1.0 ≤15 V	All	Low	Alone	None	None	None
1.1 15–50 V	All	Low	Alone	Non-Energized	None	None
1.2a,b 50 - 150 V or 150 - 1000 V, <1.2 cal/cm²	0	Low	Alone	Non-Energized[1]	None	None
	1	Low	Alone	Energized	YES	Shock Risk Assessment[2]
		Moderate	Two Person	Energized	YES	Shock Risk Assessment[2]
		High	Safety Watch	Energized	YES	Shock Risk Assessment[2]
	2	Moderate	Two Person[3]	Energized	YES	Shock Risk Assessment[2]
		High	Safety Watch	Energized	YES	Shock Risk Assessment[2]
	3[4]	Moderate	Two Person	Energized	YES, EEWP	Shock Risk Assessment[2]
		High	Safety Watch	Energized	YES, EEWP	Shock Risk Assessment[2]
1.3 150 - 1000 V, 1.2 - 40 cal/cm²	0	Low	Alone	Non-Energized[1]	None	None
	1	Moderate	Two Person	Energized	YES	Shock and Arc-Flash Risk Assessments[2]
		High	Safety Watch	Energized	YES	Shock and Arc-Flash Risk Assessments[2]
	2	Moderate	Two Person	Energized	YES	Shock and Arc-Flash Risk Assessments[2]
		High	Safety Watch	Energized	YES	Shock and Arc-Flash Risk Assessments[2]
	3[4]	High	Safety Watch	Energized	YES, EEWP	Shock and Arc-Flash Risk Assessments[2]
1.4 150 - 1000 V, >40 cal/cm² or >1000 V Facility	0	Low	Alone	Non-Energized[1]	None	None
	1	Moderate	Two Person	Energized	YES	Shock and Arc-Flash Risk Assessments[2]
		High	Safety Watch	Energized	YES	Shock and Arc-Flash Risk Assessments[2]
	2	High	Safety Watch	Energized	YES	Shock and Arc-Flash Risk Assessments[2]
	3[4]	High	Safety Watch	Energized	YES, EEWP	Shock and Arc-Flash Risk Assessments[2]
1.5 >1000 V Utility	0	Low	Alone	Non-Energized[1]	YES	None
	1	Moderate	Two Person	Lineman	YES	Shock and Arc-Flash Risk Assessments[5]
		High	Safety Watch	Lineman	YES	Shock and Arc-Flash Risk Assessments[5]
	2	High	Safety Watch	Lineman	YES	Shock and Arc-Flash Risk Assessments[5]
	3	High	Safety Watch	Lineman	YES	Shock and Arc-Flash Risk Assessments[5]

1. LOTO training is required for any worker who places a personal locking device to control hazardous energy while performing work.
2. Perform shock and/or arc-flash risk assessment(s) using methods covered in NFPA 70E.
3. Mode 2 in Class 1.2 may be performed alone, if proper dielectric gloves are worn, or if other approved protective equipment is used.
4. This mode of work should be avoided.
5. Determine PPE using methods covered in OSHA 1910.269.

Figure 1-8. Hazard Class 2.x, DC



Notes on use:

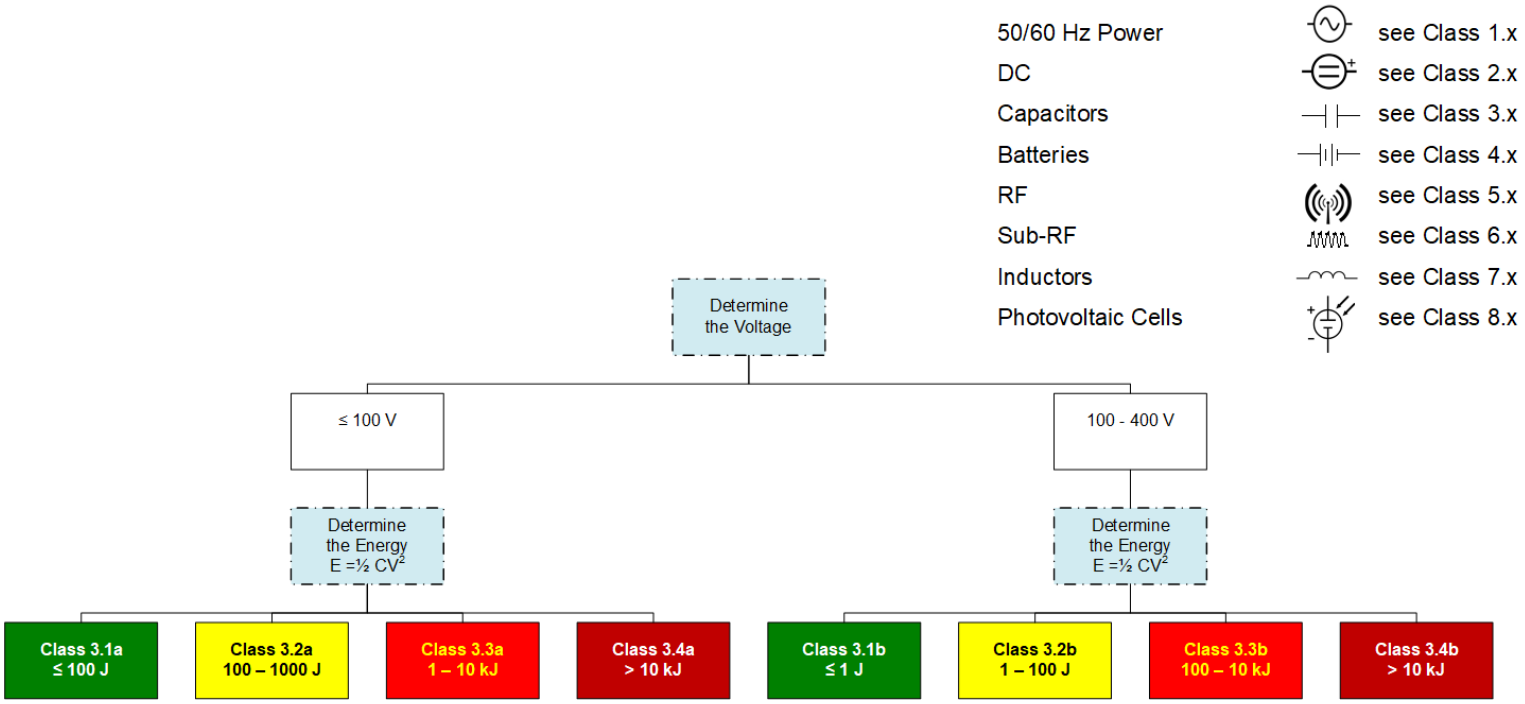
1. The voltage is the DC voltage.
2. Power is available short-circuit power.
3. Current is available short-circuit current.

Table 1-5. Control Table for Work in Hazard Class 2.x

Class	Mode	Risk (Section 4.5.1)	Electrical Worker(s)	Training	Work Control	PPE
2.0 ≤15 V, ≤100 W	All	Low	Alone	None	None	None
2.1a,b,c,d ≤100 V, ≤1 kW or >100 V, ≤40 mA	All	Low	Alone	Non-Energized	None	None
2.2a,b ≤15 V, >1 kW or 15 - 100 V, >1 kW	0	Low	Alone	Non-Energized[1]	None	None
	1	Low	Alone	Energized, DC[2]	None	Insulated tools, gloves, eye protection
		Moderate	Two Person[3]	Energized, DC[2]	YES	Insulated tools, gloves, eye protection
		High	Safety Watch	Energized, DC[2]	YES	Insulated tools, gloves, eye protection
	2	Moderate	Two Person[3]	Energized, DC[2]	YES	Insulated tools, gloves, eye protection
		High	Safety Watch	Energized, DC[2]	YES	Insulated tools, gloves, eye protection
	3[4]	Moderate	Two Person	Energized, DC[2]	YES, EEWP	Insulated tools, gloves, eye protection
		High	Safety Watch	Energized, DC[2]	YES, EEWP	Insulated tools, gloves, eye protection
2.2c 100 - 400 V, 40 mA - 500 A	0	Low	Alone	Non-Energized[1]	None	None
	1	Low	Alone	Energized, DC[2]	YES	Shock Risk Assessment[5]
		Moderate	Two Person[3]	Energized, DC[2]	YES	Shock Risk Assessment[5]
		High	Safety Watch	Energized, DC[2]	YES	Shock Risk Assessment[5]
	2	Moderate	Two Person[3]	Energized, DC[2]	YES	Shock Risk Assessment[5]
		High	Safety Watch	Energized, DC[2]	YES	Shock Risk Assessment[5]
	3[4]	Moderate	Two Person	Energized, DC[2]	YES, EEWP	Shock Risk Assessment[5]
		High	Safety Watch	Energized, DC[2]	YES, EEWP	Shock Risk Assessment[5]
2.2d >400 V, 40 - 200 mA	0	Low	Alone	Non-Energized[1]	None	None
	1	Low	Alone	Energized, DC[2]	YES	Shock Risk Assessment[5]
		Moderate	Two Person	Energized, DC[2]	YES	Shock Risk Assessment[5]
		High	Safety Watch	Energized, DC[2]	YES	Shock Risk Assessment[5]
	2	Moderate	Two Person[3]	Energized, DC[2]	YES	Shock Risk Assessment[5]
		High	Safety Watch	Energized, DC[2]	YES	Shock Risk Assessment[5]
	3[4]	Moderate	Two Person	Energized, DC[2]	YES, EEWP	Shock Risk Assessment[5]
		High	Safety Watch	Energized, DC[2]	YES, EEWP	Shock Risk Assessment[5]
2.3a 100 - 400 V, >500 A	0	Low	Alone	Non-Energized[1]	None	None
	1	Moderate	Two Person	Energized, DC[2]	YES	Shock and Arc-Flash Risk Assessments[5]
		High	Safety Watch	Energized, DC[2]	YES	Shock and Arc-Flash Risk Assessments[5]
	2[6]	Moderate	Two Person	Energized, DC[2]	YES	Shock and Arc-Flash Risk Assessments[5]
		High	Safety Watch	Energized, DC[2]	YES	Shock and Arc-Flash Risk Assessments[5]
	3[4]	High	Safety Watch	Energized, DC[2]	YES, EEWP	Shock and Arc-Flash Risk Assessments[5]
2.3b >400 V, 200 mA - 500 A	0	Low	Alone	Non-Energized[1]	None	None
	1	Moderate	Two Person	Energized, DC[2]	YES	Shock Risk Assessment[5]
		High	Safety Watch	Energized, DC[2]	YES	Shock Risk Assessment[5]
	2[6]	Moderate	Two Person	Energized, DC[2]	YES	Shock Risk Assessment[5]
		High	Safety Watch	Energized, DC[2]	YES	Shock Risk Assessment[5]
	3[4]	High	Safety Watch	Energized, DC[2]	YES, EEWP	Shock Risk Assessment[5]
2.4 >400 V, >500 A	0	Low	Alone	Non-Energized[1]	None	None
	1	Moderate	Two Person	Energized, DC[2]	YES	Shock and Arc-Flash Risk Assessments[5]
		High	Safety Watch	Energized, DC[2]	YES	Shock and Arc-Flash Risk Assessments[5]
	2[4]	High	Safety Watch	Energized, DC[2]	YES	Shock and Arc-Flash Risk Assessments[5]
	3[4]	High	Safety Watch	Energized, DC[2]	YES, EEWP	Shock and Arc-Flash Risk Assessments[5]

1. LOTO training is required for any worker who places a personal locking device to control hazardous energy while performing work.
2. DC = Training on unique electrical hazards in the laboratory including DC sources, capacitors, inductors, transients, magnetic forces, potential gradients, and induced voltages and currents, as applicable.
3. Mode 2 in Classes 2.2a, b, and c may be performed alone, if proper dielectric gloves are worn, or if other approved protective equipment is used.
4. This mode of work should be avoided.
5. Perform shock and/or arc-flash risk assessment(s) per NFPA 70E.
6. DO NOT move probes while energized.

Figure 1-9. Hazard Class 3.x, Capacitors, ≤400 V



Notes on use:

1. Voltage is peak of the AC RMS or DC maximum charge voltage on the capacitor.
2. Energy is maximum energy stored in the capacitor as determined by $E = ½ CV^2$.
3. The hazards for less than 100 V, Classes 3.2a, 3.3a, 3.4a, are energy deposited through a short circuit, such as tools and jewelry.
4. The hazards for 100 - 400 V, Classes 3.2b, 3.3b, 3.4b, are energy deposited through a short circuit, and a shock hazard.
5. Class 3.4b has an added hazard of mechanical damage due to high currents and strong pulsed magnetic forces during a short circuit.

Table 1-6. Control Table for Work in Hazard Class 3.x (≤400 V)

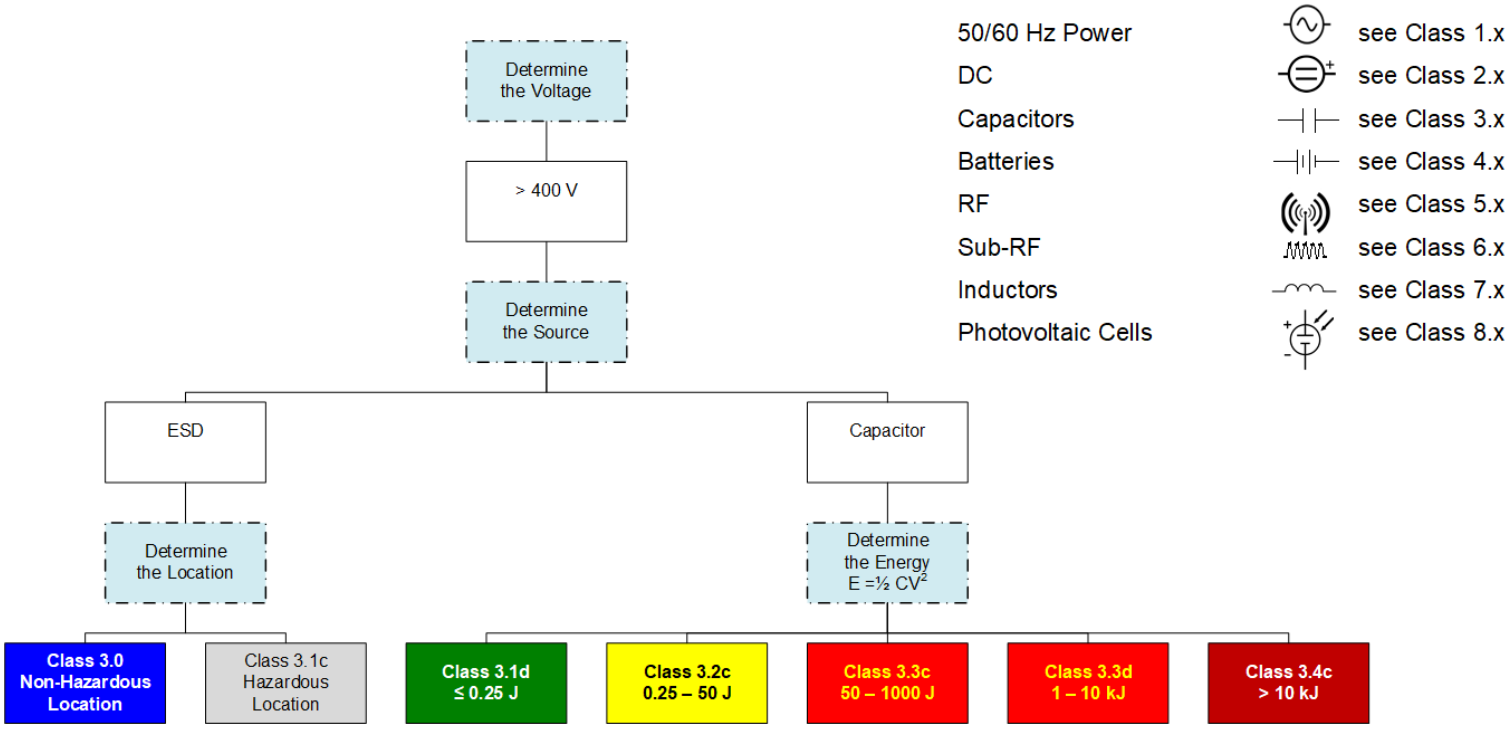
Class	Mode	Risk (Section 4.5.1)	Electrical Worker(s)	Training	Work Control	PPE	Energy Removal
3.1a ≤100 V, ≤100 J	All	Low	Alone	Non-Energized	None	None	NA
3.1b 100 - 400 V, ≤1 J	All	Low	Alone	Non-Energized	None	None	NA
3.2a ≤100 V, 100 J - 1 kJ	0	Low	Alone	Non-Energized[1]	None	None	
	1	Low	Alone	Energized, DC[2]	YES	Eye, No Jewelry	Hard Ground Stick
		Moderate	Two Person[3]	Energized, DC[2]	YES	Eye, No Jewelry	Hard Ground Stick
		High	Safety Watch	Energized, DC[2]	YES	Eye, No Jewelry	Hard Ground Stick
	2	Moderate	Two Person[3]	Energized, DC[2]	YES	Eye, No Jewelry	
		High	Safety Watch	Energized, DC[2]	YES	Eye, No Jewelry	
	3[5]	Moderate	Two Person	Energized, DC[2]	YES, EEWP	Eye, No Jewelry	
		High	Safety Watch	Energized, DC[2]	YES, EEWP	Eye, No Jewelry	
3.2b 100 - 400 V, 1 - 100 J	0	Low	Alone	Non-Energized[1]	None	None	
	1	Low	Alone	Energized, DC[2]	YES	Shock Risk Assessment[4]	Hard Ground Stick
		Moderate	Two Person[3]	Energized, DC[2]	YES	Shock Risk Assessment[4]	Hard Ground Stick
		High	Safety Watch	Energized, DC[2]	YES	Shock Risk Assessment[4]	Hard Ground Stick
	2	Moderate	Two Person[3]	Energized, DC[2]	YES	Shock Risk Assessment[4]	
		High	Safety Watch	Energized, DC[2]	YES	Shock Risk Assessment[4]	
	3[5]	Moderate	Two Person	Energized, DC[2]	YES, EEWP	Shock Risk Assessment[4]	
		High	Safety Watch	Energized, DC[2]	YES, EEWP	Shock Risk Assessment[4]	
3.3a ≤100 V, 1 - 10 kJ	0	Low	Alone	Non-Energized[1]	None	None	
	1	Moderate	Two Person	Energized, DC[2]	YES	Eye, No Jewelry	Soft Ground Stick
		High	Safety Watch	Energized, DC[2]	YES	Eye, No Jewelry	Soft Ground Stick
	2	Moderate	Two Person	Energized, DC[2]	YES	Eye, No Jewelry	
		High	Safety Watch	Energized, DC[2]	YES	Eye, No Jewelry	
	3[5]	High	Safety Watch	Energized, DC[2]	YES, EEWP	Eye, No Jewelry	
3.3b 100 - 400 V, 100 J - 10 kJ	0	Low	Alone	Non-Energized[1]	None	None	
	1	Moderate	Two Person	Energized, DC[2]	YES	Shock Risk Assessment[4]	Soft Ground Stick
		High	Safety Watch	Energized, DC[2]	YES	Shock Risk Assessment[4]	Soft Ground Stick
	2	Moderate	Two Person	Energized, DC[2]	YES	Shock Risk Assessment[4]	
		High	Safety Watch	Energized, DC[2]	YES	Shock Risk Assessment[4]	
	3[5]	High	Safety Watch	Energized, DC[2]	YES, EEWP	Shock Risk Assessment[4]	
3.4b 100 - 400 V >10 kJ	0	Low	Alone	Non-Energized[1]	None	None	
	1	Moderate	Two Person	Energized, DC[2]	YES	N/A to be done remotely	Remotely
		High	Safety Watch	Energized, DC[2]	YES	N/A to be done remotely	Remotely
	2[6]	High	Safety Watch	Energized, DC[2]	YES	N/A to be done remotely	
	3[5]	High	Safety Watch	Energized, DC[2]	YES, EEWP	N/A to be done remotely	
3.4b 100 - 400 V, >10 kJ	0	Low	Alone	Non-Energized[1]	None	None	
	1	Moderate	Two Person	Energized, DC[2]	YES	N/A to be done remotely	Remotely
		High	Safety Watch	Energized, DC[2]	YES	N/A to be done remotely	Remotely
	2[6]	High	Safety Watch	Energized, DC[2]	YES	N/A to be done remotely	
	3[5]	High	Safety Watch	Energized, DC[2]	YES, EEWP	N/A to be done remotely	

1. LOTO training is required for any worker who places a personal locking device to control hazardous energy while performing work.
2. DC = Training on unique electrical hazards in the laboratory including DC sources, capacitors, inductors, transients, magnetic forces, potential gradients, and induced voltages and currents, as applicable.
3. Mode 2 in Classes 3.2a and b may be performed alone if proper dielectric gloves are worn or if other approved PPE is used.
4. Perform shock risk assessment per NFPA 70E, keep hands outside of Restricted Approach Boundary or wear appropriate dielectric PPE.
5. This mode of work should be avoided.
6. This mode of work should be avoided or done remotely.

Notes on use:

1. PPE "Eye" means proper eye protection, either goggles or a face shield, for higher energies.
2. PPE "No Jewelry" means no jewelry on the hands (e.g., rings, watches) and no dangling jewelry or other objects (e.g., badge).
3. Column "Energy Removal" is the method used to discharge lower-energy capacitors or apply a safety ground on higher-energy capacitors.
4. "Energy Removal" remotely means using engineering methods to discharge and verify the capacitors without worker exposure (e.g., a capacitor remote discharge system).
5. Performing Mode 2 remotely means using sensors and instruments that are placed during a Mode 0 condition, then observed from a safe location during Mode 2 work.

Figure 1-10. Hazard Class 3.x, Capacitors, >400 V



Notes on use:

1. Voltage is peak of the AC RMS or DC maximum charge voltage on the capacitor.
2. Energy is maximum energy stored in the capacitor as determined by $E = ½ CV^2$.
3. The hazards for greater than 400 V, Classes 3.2c, 3.3c, 3.3d, 3.4c are energy deposited through a short circuit, a shock hazard with a strong reflex action for Class 3.2c, and serious tissue injury and/or death for 3.3c and above.
4. Class 3.3d and 3.4c have the added hazards of mechanical damage due to high currents and strong pulse magnetic forces during a short circuit.
5. For Class 3.1c, the hazard is not electrical; refer to an explosive or hazardous location SME to manage the hazard.

Table 1-7. Control Table for Work in Hazard Class 3.x (>400 V)

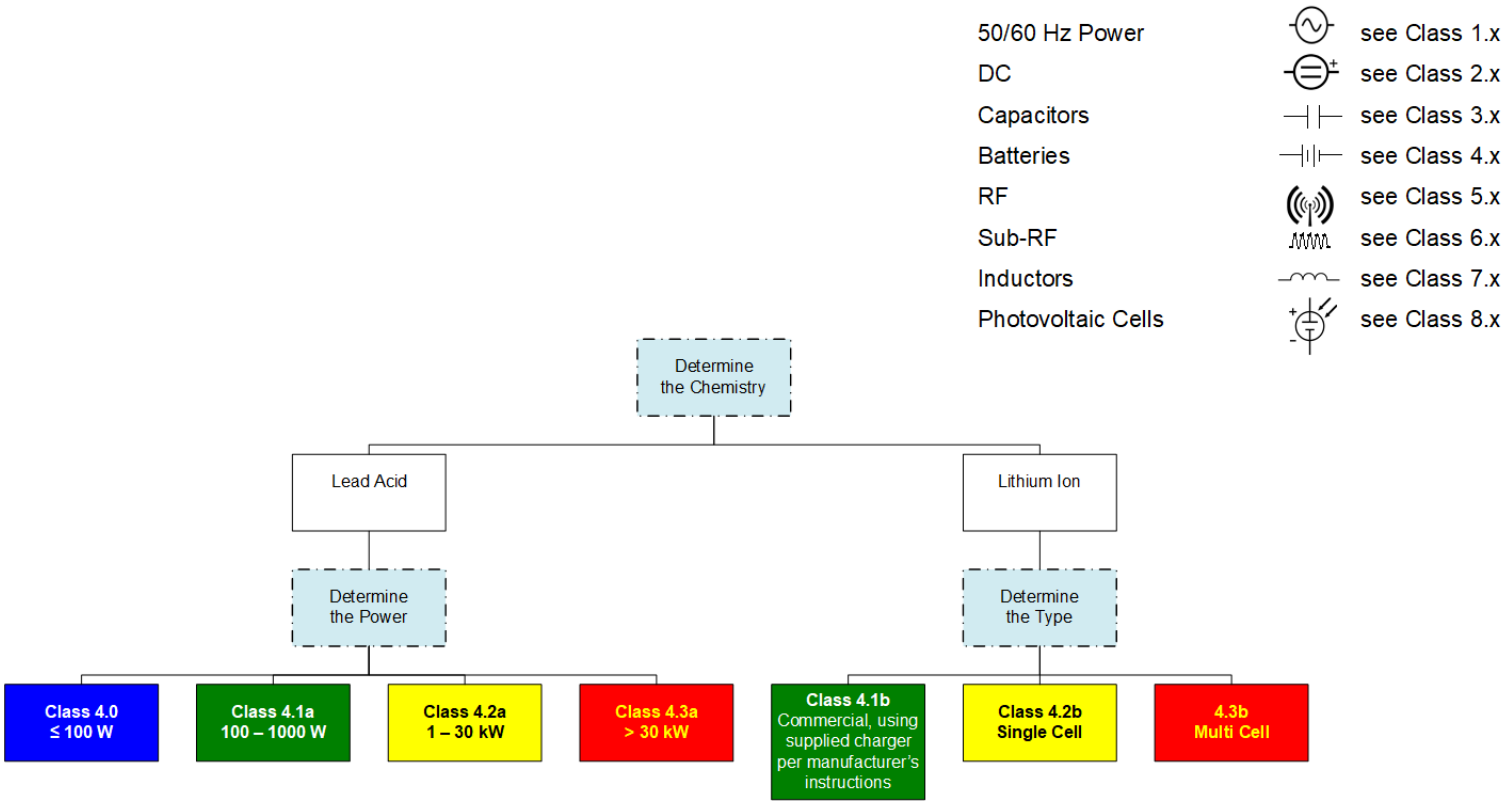
Class	Mode	Risk (Section 4.5.1)	Electrical Worker(s)	Training	Work Control	PPE	Energy Removal
3.0–ESD	All	Low	Alone	None	None	None	
3.1c–ESD Haz Loc	All	To Be Determined, refer to explosive safety SME.					
3.1d >400 V, ≤0.25 J	All	Low	Alone	Non-Energized	None	None	
3.2c >400 V, 0.25 - 50 J	0	Low	Alone	Non-Energized[1]	None	None	
	1	Low	Alone	Energized, DC[2]	YES	Shock Risk Assessment[4]	Hard Ground Stick
		Moderate	Two Person	Energized, DC[2]	YES	Shock Risk Assessment[4]	Hard Ground Stick
		High	Safety Watch	Energized, DC[2]	YES	Shock Risk Assessment[4]	Hard Ground Stick
	2	Moderate	Two Person	Energized, DC[2]	YES	Shock Risk Assessment[4]	
		High	Safety Watch	Energized, DC[2]	YES	Shock Risk Assessment[4]	
	3[5]	Moderate	Two Person	Energized, DC[2]	YES	Shock Risk Assessment[4]	
		High	Safety Watch	Energized, DC[2]	YES, EEWP	Shock Risk Assessment[4]	
3.3c >400 V, 50 - 1000 J	0	Low	Alone	Non-Energized[1]	None	None	
	1	Moderate	Two Person	Energized, DC[2]	YES	Eye, Ear, Shock Risk Assessment[4]	Hard or Soft Ground Stick
		High	Safety Watch	Energized, DC[2]	YES	Eye, Ear, Shock Risk Assessment[4]	Hard or Soft Ground Stick
	2[6]	Moderate	Two Person	Energized, DC[2]	YES	N/A to be done remotely	
		High	Safety Watch	Energized, DC[2]	YES	N/A to be done remotely	
	3	Do not do this mode of work.					
3.3d >400 V, 1 - 10 kJ	0	Low	Alone	Non-Energized[1]	None	None	
	1	Moderate	Two Person	Energized, DC[2]	YES	Eye, Ear, Shock Risk Assessment[4]	Soft Ground Stick
		High	Safety Watch	Energized, DC[2]	YES	Eye, Ear, Shock Risk Assessment[4]	Soft Ground Stick
	2[6]	Moderate	Two Person	Energized, DC[2]	YES	N/A to be done remotely	
		High	Safety Watch	Energized, DC[2]	YES	N/A to be done remotely	
	3	Do not do this mode of work.					
3.4c >400 V, >10 kJ	0	Low	Alone	Non-Energized[1]	None	None	
	1	Moderate	Two Person	Energized, DC[2]	YES	N/A to be done remotely	Remotely
		High	Safety Watch	Energized, DC[2]	YES	N/A to be done remotely	Remotely
	2[6]	High	Safety Watch	Energized, DC[2]	YES	N/A to be done remotely	
	3	Do not do this mode of work.					

1. LOTO training is required for any worker who places a personal locking device to control hazardous energy while performing work.
2. DC = Training on unique electrical hazards in the laboratory including DC sources, capacitors, inductors, transients, magnetic forces, potential gradients, and induced voltages and currents, as applicable.
3. Mode 2 in Classes 3.2a, and b may be performed alone, if proper dielectric gloves are worn, or if other approved protective equipment is used.
4. Perform shock risk assessment per NFPA 70E, keep hands outside of Restricted Approach Boundary or wear appropriate dielectric PPE.
5. This mode of work should be avoided.
6. This mode of work should be avoided or done remotely.

Notes on use:

1. PPE “Eye” means proper eye protection, either goggles or a face shield, for higher energies.
2. PPE “No Jewelry” means no jewelry on the hands (e.g., rings, watches) and no dangling jewelry or other objects (e.g., badge).
3. Column “Energy Removal” is the method used to discharge lower-energy capacitors; or apply a safety ground on higher-energy capacitors.
4. “Energy Removal” remotely means using engineering methods to discharge and verify the capacitors without worker exposure (e.g., a capacitor remote discharge system).
5. Performing Mode 2 remotely means using sensors and instruments that are placed during a Mode 0 condition, then observed from a safe location during Mode 2 work.

Figure 1-11. Hazard Class 4.x, Batteries and Battery Banks



Notes on use:

1. Power is the short circuit available power from the battery.
2. There can be no Mode 0 or 1 for batteries, as they are always energized.
3. Additional PPE is necessary for vented lead-acid batteries, depending on the work activity (e.g., chemical PPE).
4. Although all work on Class 4.2 (e.g., automotive batteries) is energized work, some of this work (e.g., jump starting cars) is commonly done by the public. Caution should be used, however, and appropriate training and controls in place.
5. Some class 4.2 batteries (e.g., desktop UPS batteries) may have adequate engineering controls, such as recessed terminals, to reduce the need for administrative controls.
6. For greater than 100 V DC, use hazard Classes 2.x to categorize the shock hazard.
7. For batteries and battery systems other than lead acid and lithium ion, use hazard Classes 2.x to categorize the shock hazard.

Table 1-8. Control Table for Work in Hazard Class 4.xa – Lead Acid Batteries

Class	Mode	Risk (Section 4.5.1)	Electrical Worker(s)	Training	Work Control	PPE
4.0 ≤100 W	All	Low	Alone	None	None	None
4.1a 100 - 1000 W	All	Low	Alone	Non-Energized	None	No Jewelry
4.2a 1 - 30 kW	2	Moderate	Two Person	Non-Energized and Batteries	YES	Eye, No Jewelry
		High	Safety Watch	Energized and Batteries	YES	Eye, No Jewelry
	3	Moderate	Two Person	Non-Energized and Batteries	YES	Eye, No Jewelry
		High	Safety Watch	Energized and Batteries	YES	Eye, No Jewelry
4.3a >30 kW	2	Moderate	Two Person	Energized and Batteries	YES	Eye, No Jewelry
		High	Safety Watch	Energized and Batteries	YES	Eye, No Jewelry
	3	High	Safety Watch	Energized and Batteries	YES	Eye, No Jewelry, Special Battery Tools

Notes on use:

1. For greater than 100 V DC, use hazard Classes 2.x to categorize the shock hazard.
2. For battery banks greater than 100 V DC, break up bank for energized work, when possible.

Table 1-9. Control Table for Work in Hazard Class 4.xb - Lithium-Ion Batteries

Class	Mode	Electrical Worker(s)	Training	Work Control	PPE
4.1b Commercial	While charging	Alone	None	Charge per manufacturer's instructions using the supplied charger.	None
4.2b[1] Single Cell	While charging	Alone	Non-Energized, Batteries	YES	None
4.3b[1] Multi Cell	While charging	Alone	Non-Energized, Batteries	YES	Containment, monitor temperature using thermocouples.

1. Ensure, through AHJ equipment approval that the batteries and battery packs have integral protection and that the charging circuit is matched to the battery or battery pack.

Notes on use:

1. For greater than 100 V DC, use hazard Classes 2.x to categorize the shock hazard.
2. For battery banks greater than 100 V DC, break up bank for energized work, when possible.

Figure 1-12. Hazard Class 5.x, RF Circuits 3 kHz to 100 (megahertz) MHz (f is in MHz)

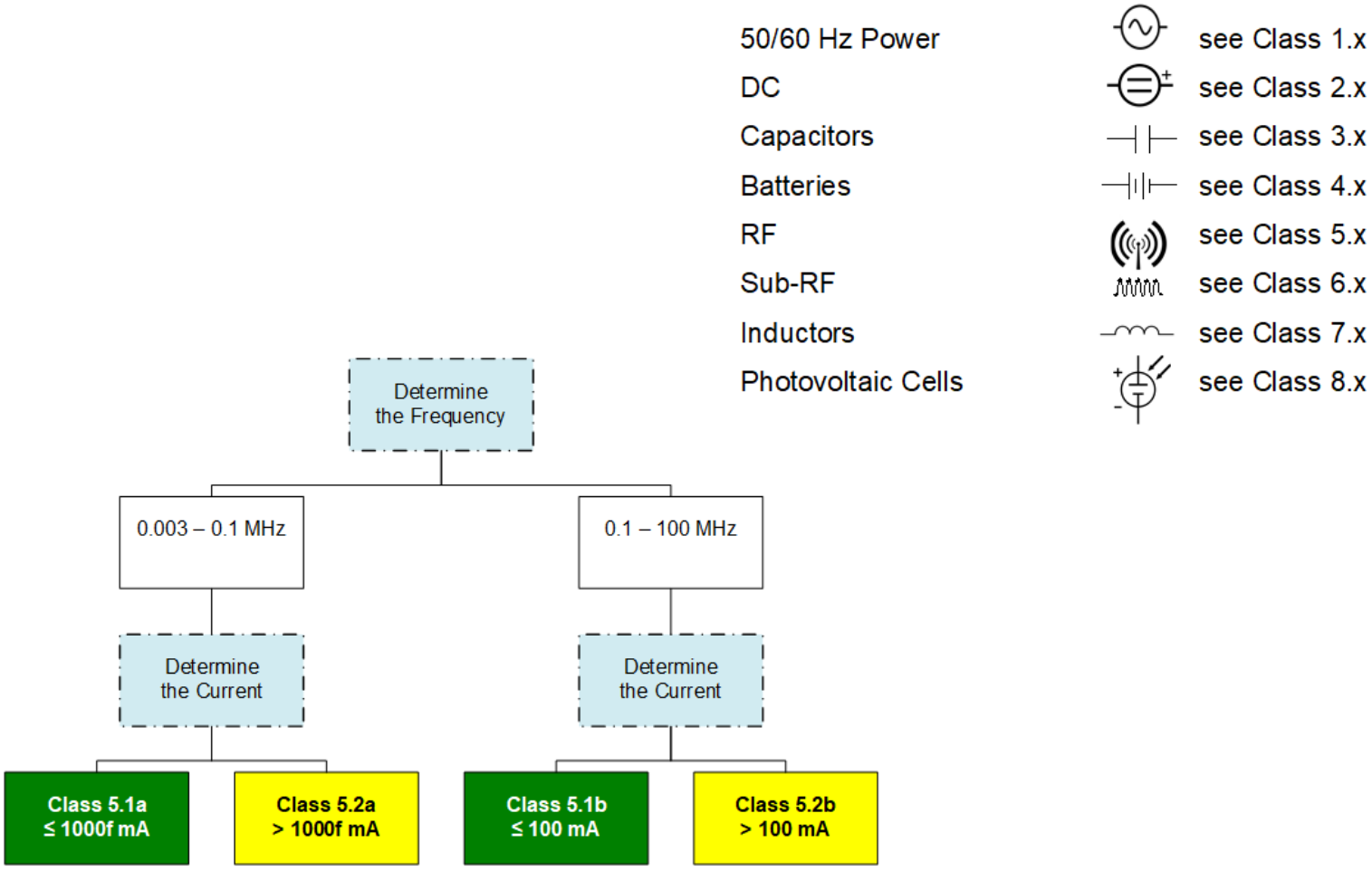


Table 1-10. Control Table for Work in Class 5.x

Class	Mode	Electrical Worker(s)	Training	Work Control	PPE
5.1a 0.003 - 0.1 MHz, ≤1000 f mA	All	Alone	None	None	None
5.1b 0.1 - 100 MHz, ≤100 mA	All	Alone	None	None	None
5.2a 0.003 - 0.1 MHz, >1000 f mA	0	Alone	Non-Energized and RF	None	None
	1	To be determined	Energized and RF	Perform RF hazard analysis based on IEEE/ANSI C95.1	
	2				
	3				
5.2b 0.1 - 100 MHz, >100 mA	0	Alone	Non-Energized and RF		
	1	To be determined	Energized and RF		
	2				
	3				

Notes on use:

1. Frequency (f) in the chart is measured in MHz
2. Classes 5.x and control Table ONLY address the RF shock hazard. They do NOT address the exposure to electromagnetic fields. IEEE/ANSI C95.1 covers the exposure to electromagnetic fields.
3. RF = Training on shock, burn, and exposure to non-ionizing radiation hazards, including static electric and magnetic fields, Sub-RF and RF, as applicable electromagnetic fields, and infrared radiation.
4. The RF hazard classification chart in Fig. 1-12 determines if the RF source can put out sufficient current to be a shock/burn hazard. However, it does not consider the body impedance, which is necessary to determine if the source can drive these currents into the body. The tools for body impedance modeling are too detailed to put into this document.

Figure 1-13. Hazard Class 6.x, Sub-RF Circuits (1 Hz to 3 kHz)

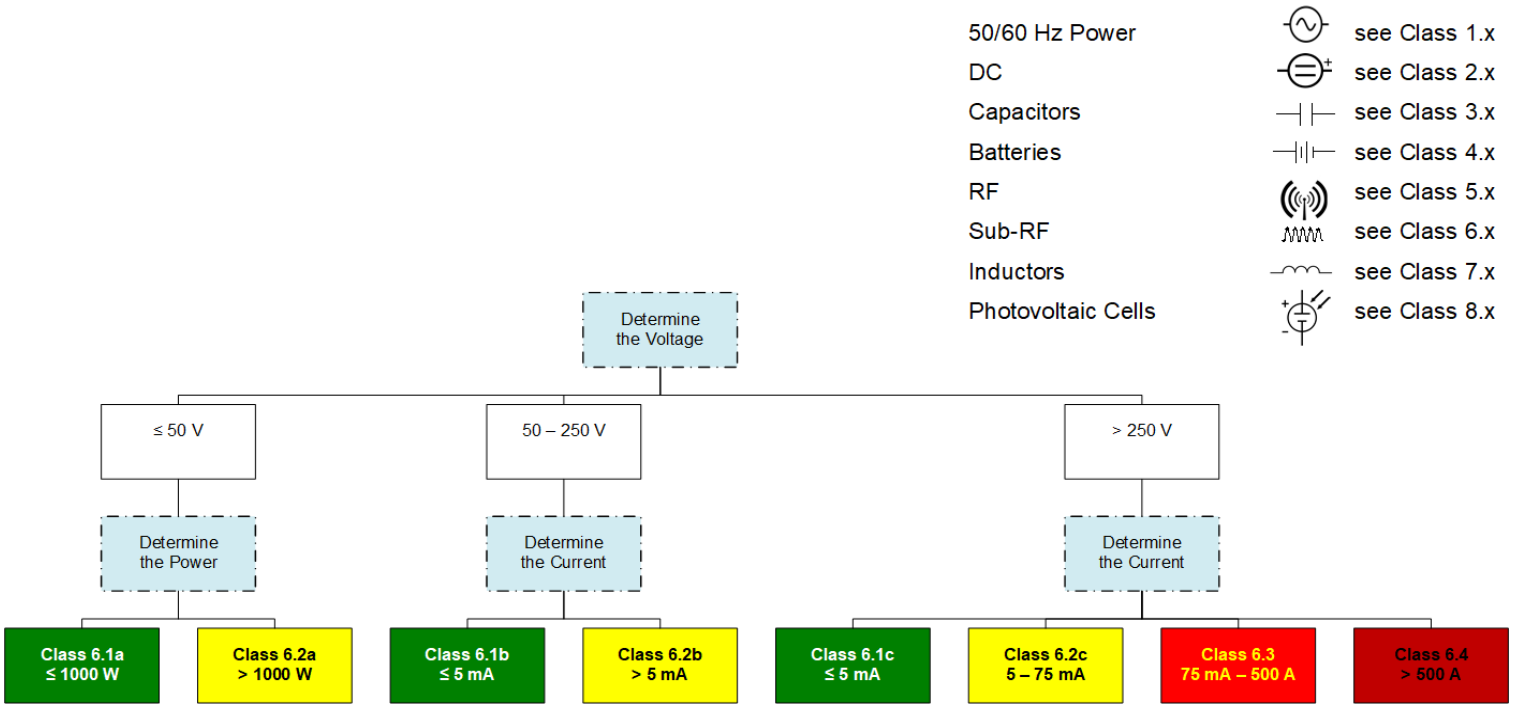


Table 1-11. Control Table for Work in Hazard Class 6.x

Class	Mode	Risk (Section 4.5.1)	Electrical Worker(s)	Training	Work Control	PPE
6.1a,b,c ≤50 V, ≤1 kW or >50 V, ≤5 mA	All	Low	Alone	Non-Energized	None	None
6.2a ≤50 V, >1 kW	0	Low	Alone	Non-Energized[1]	None	None
	1	Low	Alone	Energized, RF[2]	YES	Insulated tools, gloves, eye protection
		Moderate	Two Person	Energized, RF[2]	YES	Insulated tools, gloves, eye protection
		High	Safety Watch	Energized, RF[2]	YES	Insulated tools, gloves, eye protection
	2	Moderate	Two Person[3]	Energized, RF[2]	YES	Insulated tools, gloves, eye protection
		High	Safety Watch	Energized, RF[2]	YES	Insulated tools, gloves, eye protection
	3[4]	Moderate	Two Person	Energized, RF[2]	YES, EEWP	Insulated tools, gloves, eye protection
		High	Safety Watch	Energized, RF[2]	YES, EEWP	Insulated tools, gloves, eye protection
6.2b,c 50 - 250 V, >5 mA or >250 V, 5 - 75 mA	0	Low	Alone	Non-Energized[1]	None	None
	1	Low	Alone	Energized, RF[2]	YES	Shock Risk Assessment[5]
		Moderate	Two Person	Energized, RF[2]	YES	Shock Risk Assessment[5]
		High	Safety Watch	Energized, RF[2]	YES	Shock Risk Assessment[5]
	2	Moderate	Two Person[3]	Energized, RF[2]	YES	Shock Risk Assessment[5]
		High	Safety Watch	Energized, RF[2]	YES	Shock Risk Assessment[5]
	3[4]	Moderate	Two Person	Energized, RF[2]	YES, EEWP	Shock Risk Assessment[5]
		High	Safety Watch	Energized, RF[2]	YES, EEWP	Shock Risk Assessment[5]
6.3 >250 V, 75 mA - 500 A	0	Low	Alone	Non-Energized[1]	None	None
	1	Moderate	Two Person	Energized, RF[2]	YES	Shock Risk Assessment[5]
		High	Safety Watch	Energized, RF[2]	YES	Shock Risk Assessment[5]
	2[6]	Moderate	Two Person	Energized, RF[2]	YES	Shock Risk Assessment[5]
		High	Safety Watch	Energized, RF[2]	YES	Shock Risk Assessment[5]
	3[4]	High	Safety Watch	Energized, RF[2]	YES, EEWP	Shock Risk Assessment[5]
6.4 >250 V, >500 A	0	Low	Alone	Non-Energized[1]	None	None
	1	Moderate	Two Person	Energized, RF[2]	YES	Shock and Arc-Flash Risk Assessments[5]
		High	Safety Watch	Energized, RF[2]	YES	Shock and Arc-Flash Risk Assessments[5]
	2[4]	High	Safety Watch	Energized, RF[2]	YES	Shock and Arc-Flash Risk Assessments[5]
	3[4]	High	Safety Watch	Energized, RF[2]	YES, EEWP	Shock and Arc-Flash Risk Assessments[5]

1. LOTO training is required for any worker who places a personal locking device to control hazardous energy while performing work.
2. RF = Training on shock, burn, and exposure to non-ionizing radiation hazards, including static electric and magnetic fields, Sub-RF and RF, as applicable electromagnetic fields, and infrared radiation.
3. Mode 2 in Classes 6.2a and b may be performed alone, if proper dielectric gloves are worn, or if other approved protective eq uipment is used.
4. This mode of work should be avoided.
5. Perform shock or arc-flash risk assessment(s) per NFPA 70E.
6. DO NOT move probes while energized.