MODULE 4
METHODS OF CONTROL

Objectives

At the end of this module, participants will be able to:

- Identify the three types of control that should be used to achieve electrical safety.
- Identify the engineering, administrative and PPE electrical controls they use on their jobs as well as the controls they should be using.
- Identify facts and procedures relating to lockout/tagout.
- List the steps required to achieve an electrically safe condition.
- Recognize when a work permit is required to work on energized electrical circuits.
- Recognize the appropriate warning signs to alert employees to the danger of electricity.
- Recognize the appropriate PPE to use based on the calculated energy value of an energy source.
- Given a case study, determine the most appropriate method of control and necessary corrective action.

Time

80 minutes: 2:00 to 3:20 PM
Followed by a 10-minute break: 3:20-3:30 PM

Agenda

1. Introduction to the Hierarchy of Controls—Presentation and Activity (20 minutes)
2. Controls for Electrical Hazards—Activity and Videos (15 minutes)
3. Achieving an Electrically Safe Condition—Presentation and Video (15 minutes)
4. Warning Signs and PPE—Presentation and Videos (10 minutes)
5. Case Studies in Control—Activity (15 minutes)
6. Planning for Your Small Business—Activity (5 minutes)

RECOMMENDED PROCESS

1. Introduction to the Hierarchy of Controls—Presentation and Activity (20 minutes)

Cues	Content
	■ You will be covering Pages 1 through 8 in this segment. ■ Allocate time as follows. – 5 minutes on Pages 1 and 2 with most of the time spent on Page 2. – 15 minutes on Pages 3 through 8, with roughly 5 minutes spent on each type of control.
PPT 4-1	■ Show PPT 4-1 as participants return from break.
PPT 4-2	■ Start the class by showing PPT 4-2 as you refer participants to Page 1 in Module 4 of their Participant Guides. ■ Introduce the module with the following points. – In the previous two chapters, we have discussed how to recognize and evaluate electrical hazards. – Now we're going to talk about how to control hazards.
PPT 4-3 through PPT 4-5	■ Show PPT 4-3 through PPT 4-5 as you introduce the objectives to this module. ■ Refer participants to Page 2.
Question:	■ Ask participants: What is a control?
PPT 4-6	■ Get a few responses from participants, then show PPT 4-6 to introduce the definition of control. ■ Point out that there are three kinds of control.
PPT 4-7, animated	■ Show PPT 4-7 as you introduce the three types of controls. Note that this slide is animated so you can bring in each control as you introduce it.

- Refer participants to Pages 3 and 4.

PPT 4-8

- Show PPT 4-8 as you introduce the first type of control: engineering controls.
- Ask participants to give some examples of engineering controls.

PPT 4-9

- Get a few responses, then show PPT 4-9 to review examples of engineering controls for electrical safety.
- Refer participants to Page 5. Make the following points.
  - One important engineering control is to use the proper type and size of wiring for the job.
  - It is up to the leaders in an organization to make certain that workers are using the correct wires.

PPT 4-10

- Show PPT 4-10 to review tips for safe wiring.

PPT 4-11

- Show PPT 4-11 to illustrate proper wire size.
- Refer participants to Pages 6 and 7.

PPT 4-12

- Show PPT 4-12 as you introduce the second type of control: administrative controls.
- Ask participants to give some examples of administrative controls.

PPT 4-13

- Get a few responses, then show PPT 4-13 to review examples of administrative controls for electrical safety.
- Refer participants to Page 8.

PPT 4-14

- Show PPT 4-14 as you introduce the third type of control: PPE.
- Ask participants to give some examples of PPE controls.

PPT 4-15

- Get some responses, then show PPT 4-15 to review examples of PPE controls for electricity safety.

- After introducing all the controls, ask participants to share which controls their organizations use well and which could use improvement.
- Take comments and questions as long as you have time.
- To close, emphasize how important it is to use engineering controls as the first round of defense.

2. Controls for Electrical Hazards—Activity and Videos (15 minutes)

Cues	Content
	■ You will be covering Page 9 in this segment. You will also be showing two videos. Use the following process. – Show the first video of the huge arc blast (PPT 4-16). This will only take a few seconds. – Allow about 5 minutes for small groups to complete the activity on the page. – Allow about 10 minutes to debrief the activity as a large group. – Show the video of the controlled arc blast (PPT 4-18). This will only take a few seconds. ■ Refer participants to Page 9. Make the following points. – We've talked about controls. We've also discussed how to recognize and evaluate arc blast hazards. – Let's take some time to look at an arc blast and discuss how to control it.
PPT 4-16, Video Clip	■ Show PPT 4-16, which is a video that lasts about ten seconds. ■ Get participant responses to the video, then make the following comments. – Now you are going to identify controls that would prevent or lessen the impact of this type of blast. – Work in your small groups and, using Pages 3 through 8, identify controls that might prevent an arc blast like the one you've just seen. – Try to identify at least one control in each of the three control categories.

PPT 4-17

- Show PPT 4-17 while participants work. Call time as appropriate to help participants pace themselves.

Facilitator Note

- Another way to approach this activity is to divide the large group into three smaller groups, then assign one control category to each group. This approach is preferable if you are running short on time.
- When the small group work is done, call participants back together and lead a discussion in which participants share their answers.
- Although the answers will vary, here are some items you should expect to hear.
- Engineering controls:
  - Install circuit breakers.
  - De-energize the system before working on it.
  - Keep equipment well-maintained to avoid arcing.
- Administrative controls:
  - Provide training for employees who work with live parts.
  - Establish and observe approach boundaries.
  - Establish procedures for properly handling tools around live parts.
- PPE controls:
  - Require employees to wear the PPE that will appropriately protect them from arc blast.
  - Have and enforce a procedure that requires wearing appropriate PPE.
  - Perform routine inspections to ensure people are using their PPE.

- Refer participants back to the engineering controls box (top box) on Page 9.

Question:

- Ask participants: We have identified circuit breakers as an engineering control. How many of you think they are an effective control?

- Get some responses, then tell participants that they are now going to see a video that illustrates just how important circuit breakers are.

PPT 4-18, Movie Clip

- Now show PPT 4-18, which is a video clip that lasts about 30 seconds. Introduce the clip by saying this is an example of an arc blast with a circuit breaker.

Question:

- Ask participants: Which blast did the greatest harm?

PPT 4-19

- Get some responses, then show PPT 4-19 as you make the following comments.

  – It's pretty obvious that the blast with the circuit breaker did the least harm.

  – Let's look at the differences between the two blasts.

- Review the information on PPT 4-19.

- Close by emphasizing how important engineering controls are.

3. Achieving an Electrically Safe Condition—Presentation and Video (15 minutes)

Cues	Content
	■ You will be covering Pages 10 through 14 in this segment. You will also be showing a video clip. Allocate your time as follows. – About 10 minutes to cover Pages 10 through 13. – About 5 minutes for the video clip and Page 14.
Question:	■ Ask participants: What is the only sure-fire way to avoid electric shock?
	■ Get a few responses. The answer you are looking for is that the electricity must be shut off.
Question:	■ Ask participants: Is it enough to simply shut off the electricity, then proceed with the work?
	■ Get a few responses, then emphasize that the only absolute way you can be sure that the power will stay shut off is to perform a lockout/tagout.
	■ Refer participants to Page 10.
PPT 4-20	■ Show PPT 4-20 as you ask participants if they can define lockout/tagout.
	■ Get some responses, then provide the formal definition.
PPT 4-21	■ Show PPT 4-21 to present the definition of lockout.
PPT 4-22	■ Show PPT 4-22 to present the definition of tagout.
	■ As time permits, discuss the remaining points on Page 10.
Question:	■ When discussing the people involved, ask participants: Why should employees who have nothing to do with a certain machine be aware of the lockout/tagout procedures?

- Get a few responses, then point out that everyone at a worksite needs to know enough about lockout/tagout so that if they ever encounter a tag, they will know enough to leave it alone.

- Refer participants to Page 11 and make the following points.

  – There are actually two places in the OSHA standard that address lockout/tagout.

  – It is important to know the differences between these two so that you refer to the proper procedure when performing lockout/tagout.

PPT 4-23

- Show PPT 4-23 as you address the differences in the two procedures.

- Refer participants to Page 12. Tell them that you are now going to introduce them to a process for performing lockout/tagout under OSHA 29 CFR 1910.147(d).

- Review the steps on Page 12.

- Refer participants to Page 13. Tell them that these are the steps for performing lockout/tagout under OSHA 29 CFR 1910.333.

- Tell participants that the next video will show what a qualified person must do to safely turn off the electricity to achieve an electrically safe condition.

PPT 4-24, Video Clip

- Show PPT 4-24, which is the video clip. Tell participants they don't have to take notes during the video if they don't want to because the steps are listed for them on Page 13.

- After the video, ask participants if their organization uses a process similar to the one described in the video.

- Use as much time as possible to get responses and to comment on the different approaches people use.

- Before closing, tell participants that regardless of which lockout/tagout procedure they perform, they need to be aware if they have multiple lines that are troughed or buried in a bundle.

- Even though the line they are working on is de-energized, there could be crossover from the live lines that are troughed or buried with the de-energized line.
- The build-up from the crossover could be significant enough to cause electrocution.
- This condition is called "induction or induced current" and it's why it is important to keep testing the de-energized line regularly during service and maintenance.
- Answer participant questions regarding induction or induced current.
- Refer participants to Page 14 and tell them that there are two circumstances when the power might have to be left on.
  - The first instance is if the power is required for life saving or emergency equipment.
  - The second instance is if turning off the power disrupts operations to the point of being infeasible.
  - These instances are rare and, when they happen, a qualified person must do the work AND that qualified person must have an energized electrical work permit that is signed by an authorized person.
  - Here is an example of such a permit.
  - This one comes from NFPA 70E.
  - This form must be completed before any work can be done on live circuits.

4. Warning Signs and PPE—Presentation and Videos (10 minutes)

Cues	Content
	■ You will cover Pages 15 and 16, and show two short video clips in this segment. Allocate time as follows. – About 5 minutes for Page 15 and the first video clip. – About 5 minutes for Page 16 and the second video clip. ■ Refer participants to Page 15. Make the following points. – An important administrative control for electrical safety is to have warnings and signs when there is work being done on electrical circuits. – Although the sign can be a simple warning of electrical danger, the best warnings contain as much information as possible about the electrical hazard.
PPT 4-25	■ Refer participants to the first sign shown on Page 15. Show PPT 4-25 as you make the following points. – This sign adequately warns of electrical danger. – It's visible, it shows the universal sign for electricity, it warns of arc flash and shock hazard, and it advises safe work practices and PPE.
PPT 4-26	■ Refer participants to the last sign shown on Page 15. Show PPT 4-26 as you make the following points. – This sign is preferable because it contains additional information. – It shows the flash protection boundary requirements energy intensity, the hazard category and the approach limits. ■ Emphasize that signage is a critically important administrative control and they should ensure their organizations use signs to warn of electrical danger.

	■ Tell participants that you are now going to emphasize PPE controls.
PPT 4-27, Video Clip	■ Show PPT 4-27, which is a video clip that illustrates the difference between what happens to someone who wears PPE during an arc blast and someone who does not.
	■ When the video is complete, take questions and comments.
	■ Refer participants to Page 16 and say the following.
	– The video has illustrated the importance of using PPE.
	– However, determining the correct PPE for the job can be complicated and confusing.
	– The NFPA 70E standard has guidelines for using PPE based on the calculated value of incident energy.
	– Once a qualified person performs a Shock Hazard Analysis, PPE can be determined based on this chart.
PPT 4-28	■ Show PPT 4-28 as you review the chart on Page 16, then answer participant questions.
	■ Tell participants that you will now show them some examples of PPE.
Optional	■ If you brought in samples of PPE for participants to see, demonstrate them now. Otherwise, simply show the following pictures of PPE.
PPT 4-29	■ Show PPT 4-29 to illustrate fire resistant gloves.
PPT 4-30	■ Show PPT 4-30 to illustrate face, hands, arm and torso PPE.
PPT 4-31	■ Show PPT 4-31 to illustrate the full body protection.
PPT 4-32, Video Clip	■ Close this segment by showing PPT 4-32, which is a video clip that summarizes all the important control steps discussed in this module.

5. Case Studies in Control—Activity (15 minutes)

Cues	Content
	■ You will be covering Page 17 for the entire 15 minutes. ■ You will be facilitating four case studies, in which you will show some photos. Participants will identify controls for the various scenarios. Allocate time as follows. – Allow groups about 1 minute per slide to identify the controls. – Take about 2 minutes per slide to debrief the group's findings. ■ Ask participants if they are ready to look at some pictures and identify some controls for the situations they see. ■ Refer participants to Page 17. Ask the class to form small groups. ■ Introduce the case studies with the following. – I'm going to show you a series of four slides – Your job is to work in your group to identify the controls that should be used in each slide. – Use Pages 3 through 8 to guide you. – Write the controls you identify in the spaces provided on Page 17.
PPT 4-33	■ Show PPT 4-33, which is Case #1. Allow the groups one minute to identify controls for the situation on the slide. ■ When time is up, ask the group to share what they identified. Some responses you should get are: – **Engineering:** Use proper wiring practices. – **Engineering:** There is a possible need to sub-panel. – **Engineering:** Install cover once wiring is corrected.

- **Administrative:** Provide training for correct installation (OSHA 1910 and NFPA 70E).
- **Administrative:** Create and enforce procedures to ensure that the cover stays in place and closed.
- **PPE:** N/A

PPT 4-34 through PPT 4-36

- Repeat the above process with PPT 4-34 through PPT 4-36, which are Cases #2 through #4.
- Following are some of the controls participants should identify.

PPT 4-34

- Case #2, PPT 4-34:
  - **Engineering:** Ensure handsaw is working properly.
  - **Engineering:** Ensure tools are grounded and working properly.
  - **Administrative:** Improve housekeeping.
  - **Administrative:** Provide training on proper use of hand tools.
  - **PPE:** Provide face protection.
  - **PPE:** Provide fall protection.

PPT 4-35

- Case #3, PPT 4-35:
  - **Engineering:** Install plate cover for circuit box.
  - **Engineering:** Place proper lock on circuit box.
  - **Administrative:** Improve housekeeping.
  - **Administrative:** Have and enforce an electrical safety program
  - **PPE:** N/A

PPT 4-36

- Case #4, PPT 4-36:

- **Engineering:** Install face plate on unit.
- **Engineering:** Install permanent wiring.
- **Engineering:** Ensure that wiring is in good repair.
- **Engineering:** Ensure that wiring is appropriate for outdoor environment.
- **Engineering:** Ensure that there is a means of grounding for all structures and equipment.
- **Engineering:** Install permanent or portable Ground Fault Circuit Interrupters.
- **Administrative:** Improve housekeeping.
- **PPE:** N/A

■ When all four cases are complete, ask participants if the checklists helped them to identify controls for the problems in the photos.

■ Encourage participants to use their checklists frequently on the job.

6. Planning for Your Small Business—Activity (5 minutes)

Cues	Content
	■ You will be covering Page 18 in this segment. Allow 5 minutes.
PPT 4-36	■ Refer participants to Page 18. Show PPT 4-36 as you point out that this is another planning page.
	■ Allow participants a couple of minutes to write some ideas on Page 18.
	■ As time permits, have participants share some of their plans, barriers and ways to overcome the barriers.
10 Minute Break	Take a 10 minute break.