

**White Paper**

**Isolating Power Sources to Service  
Power Control Switchgear**

## Isolating Power Sources to Service Power Control Switchgear

Safe work practices for de-energizing equipment are necessary for the successful maintenance, upgrade, repair, and decommissioning of generator paralleling equipment and power control switchgear. To complete this work, it is imperative that the design of both the equipment and a facility's electrical system are fully known so that impacts to related devices and operations can be fully understood before service commences. This document provides an overview of safety considerations for this work and guidance for isolating equipment from power sources.

### Necessity of Electrical Safety Practices

Government regulations require lockout and tagout practices to protect workers from electrical hazards. In the United States, federal regulations for lockout/tagout are set forth in 29 CFR 1910.147, which are administered and enforced by the Occupational Health and Safety Administration. Additional regulations exist at state and local levels. Many of the requirements are based on Sections 110 and 130 of the NFPA 70E: Standard for Electrical Safety in the Workplace.

Noncompliance with regulations and standards could result in harm to people and damage to property. When these occur, individuals and organizations could face significant regulatory penalties as well as civil liability for damage. However, the most important reason to follow prudent lockout/tagout and electrical safety practices is to prevent injury to people. Implementing adequate safeguards to mitigate risks from energized equipment is the best way to avoid mishaps that could injure people and damage property.

### Risk Assessment for Electrical Hazards

Primary risks from energized equipment include electric shock and arc flash events. In order to protect workers from these hazards, the potential for their occurrence in the workplace must be known. These should be ascertained by performing a risk assessment of electrical hazards throughout a facility. In the 2015 edition of NFPA 70E, Article 110.1(G) requires that employers conduct risk assessments for workplace electrical hazards as follows:

*Risk Assessment Procedure. An electrical safety program shall include a risk assessment procedure that addresses employee exposure to electrical hazards. The procedure shall identify the process to be used by the employee before work is started to carry out the following:*

- 1. Identify hazards*
- 2. Assess risks*
- 3. Implement risk control according to a hierarchy of methods*

The content of this paper is provided for informational purposes only. The information cannot be used to substitute proper review of safety standards and regulations, proper evaluation of site conditions, or proper implementation of appropriately designed electrical safety and maintenance programs and procedures. A qualified electrical safety expert should be consulted prior to designing and implementing work practices for de-energizing and servicing electrical equipment.



Based on the results of an assessment, procedures for safely working on or near a facility’s electrical equipment should be developed.

When servicing power control equipment, work procedures should be provided to workers before a service event. In addition, one-line drawings should be provided describing all of the power sources that could feed the switchgear. A detailed description of the functions of the generator paralleling and power control gear and all related equipment should also be provided so that the impacts of de-energizing the switchgear can be fully understood and anticipated.

For facilities where an appropriate risk assessment has been performed, specific information and requirements should be labeled on the equipment. These labels identify the equipment, specify the incident energy that could be present at a specific distance from the device, and describe the PPE that will be required to work around the opened and energized equipment. The labels also provide boundary distances to protect people from various electrical hazards. An example label is shown in Figure 1.

In some cases, workers could arrive at a site to find that a risk assessment has not been completed. In that instance, NFPA 70E guidance may be used to establish suitable boundaries limiting risk of shock, and for donning appropriate personal protective equipment. Work should not start unless the required safety measures can be implemented.

## Understanding the Impacts of De-Energizing Switchgear

To develop adequate procedures, the design of the power control switchgear must be known and understood. More specifically, all parties involved in planning, authorizing, and executing service should identify all of the power control devices in the system, event sequences that are implemented by the system, and the relationship of each device to other equipment elements within and outside of the switchgear. In particular, the identity and function of PLC-controlled devices should be reviewed. These should be evaluated together with their potential to cause operations of devices elsewhere in the switchgear or upstream or downstream of the system. Plans for placing these in manual mode, where available, or otherwise preventing them from initiating unanticipated action should be incorporated into service procedures.

Many facility and switchgear systems are designed for concurrent maintainability, meaning that they provide alternate power pathways so that important or critical loads can operate when primary switchgear is de-energized. Because the systems that support these capabilities vary widely, it is impossible to summarize a single approach for establishing alternate power paths. Nevertheless, service organizations need to ensure that facility procedures for establishing and controlling any alternate power paths are well understood before service commences.

<b>⚠ DANGER</b>	
<b>ARC FLASH and SHOCK HAZARD</b>	
<b>PNL 3</b>	
<b>14 cal/cm<sup>2</sup></b>	Incident Energy at 18 in
<b>82 in</b>	Arc Flash Boundary
<b>480 VAC</b>	Shock Hazard
<b>00</b>	Class Glove with Leather Protectors
<b>42 in</b>	Limited Approach (Fixed Circuit)
<b>12 in</b>	Restricted Approach
<b>PPE REQUIRED</b>	
AR long sleeve shirt & AR pants or AR coverall and/or AR flash suit, AR flash suit hood, AR gloves, hard hat, safety glasses/goggles, hearing protection, leather footwear	
<b>WARNING:</b> Power system changes will invalidate the information on this label	

**Figure 1: Labels such as the one above provide important safety information for service personnel.**

## Working Safely Near Switchgear

After assessing the hazards that may be present and assembling the correct PPE and equipment, technicians must work on critical power equipment according to facility-specific procedures or employer-provided guidance that complies with the applicable NFPA and regulatory requirements. In general, this work involves the following steps:

- Donning PPE and using insulated tools
- Isolating power sources
- Verifying absence of energy

The following narrative provides guidance for completing these actions when working on power control switchgear. It assumes that the workers have reviewed and understood up-to-date facility one-line drawings to identify sources of power that energize the equipment they are servicing. It also assumes that workers have been adequately trained, appropriately qualified, and properly equipped in accordance with regulatory requirements and industry standards.

Paralleling switchgear configurations vary widely because they typically serve sophisticated backup power systems that feature any number of power sources and power control apparatus. Within ASCO's own product lineup, two types of paralleling and power control switchgear are available. One is based on contactor technology similar to that used in automatic transfer switches. As a result, work practices similar to those for ATSs are used to isolate and lockout this type of gear. Guidance for de-energizing ATS equipment will be addressed in a separate document and are excluded from this overview.

The second and more common type is traditional paralleling switchgear that can control many power sources and offers many different power control features. Because the features presented by this type of gear vary by manufacturer, this paper describes a generic approach for de-energizing ASCO gear. Analogous procedures would be necessary to service switchgear from other manufacturers, subject to a review of the specific features associated with their design as well as those of the electrical system in which they were installed.



**Figure 2: On this ASCO SERIES 300 equipment, setting the Generator Controls to “Lockout/Reset” and actuating and locking the Emergency Stop button is one method for isolating generators from the distribution equipment.**

Before commencing work, the switchgear control systems should be placed in manual mode, where available, to prevent unplanned operations. Thereafter, technicians must isolate power control switchgear from power sources, then confirm that emergency power sources are not energizing the equipment. This can be done either by inspecting each generator to confirm that it is not operating; or by donning suitable PPE, then using a volt meter to verify an absence of energy on the main bus inside the switchgear. Generator 1 can then be isolated by (1) actuating and locking the emergency stop button on the generator; (2) setting the Generator Control to “Lockout/Reset”, then actuating and locking the corresponding generator emergency stop button (Figure 2); or (3) opening and locking the generator output or “skid” breaker. All lockouts must be conducted in conformance with the provisions of an adequate lockout/tagout program.

Following the isolation of Generator 1, absence of voltage can be confirmed by (1) checking that a common shutdown alarm is visible for Generator 1 on the switchgear annunciator, (2) checking that the voltage indicator for the main bus displays zero voltage, and (3) verifying absence of voltage on the main bus using a volt meter. The process must be repeated for every power source feeding the switchgear.

In the most sophisticated applications, it is possible that power switchgear controls more than just an emergency power system. In those instances, facility-specific procedures should be developed and implemented to isolate all of the normal and emergency sources that feed the switchgear so that service activities may be undertaken safely.

## Summary

Adequate lockout and tag out practices are required to safely protect personnel from electrical hazards that could be presented by generator paralleling and power control switchgear. This paper provides a generic approach for isolating power control equipment from electrical power sources. Service of this equipment should occur only under an electrical safety program that meets or exceeds applicable regulations and industry standards. Nonetheless, work should not be undertaken without developing a complete understanding of every associated power control device, its potential effect on other elements of the electrical system, and its potential impact to site operations.

Installation, maintenance, repair, and decommissioning of generator paralleling and power control switchgear should be provided only by organizations that employ properly qualified technicians working under safety programs that meet or exceed regulatory requirements and industry standards. ASCO Power Services employs technicians that are fully trained and qualified to provide these services under a safety program that complies with those requirements and standards. Additional information about selecting service providers is presented in ASCO's white paper entitled, *Identifying Qualified Service Providers to Optimize Power Reliability*.

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