White Paper

Connecting Closed Transition Transfer Switches to Utility Services

ASCO Power Technologies®

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Automatic transfer switches (ATS) are available with differing transfer sequences for specific applications. While open transition and delayed transition switches offer reliable performance, they also interrupt power flow to loads during each transfer. Alternatively, *Closed Transition Transfer Switches* (CTTS) transfer loads without interrupting power when both power sources are available and each presents acceptable characteristics. The following narrative provides important application information for this type of switch. A transfer switch is shown in Figure 1.

Figure 1: Three Pole, 1000 Amp 7000 SERIES CTTS in a Type 1 Enclosure

REASONS TO INSTALL A CTTS

Closed Transition load transfer involves momentary paralleling of Normal and Emergency power sources when both power sources are live and within acceptable parameters. This avoids the brief power interruptions associated with *Open Transition* switching. Closed Transition transfer is completed by closing an electrical contact to engage the alternate source before opening a contact to disconnect the original source. The graphs in Figure 2 and Figure 3 show the event sequence for each transition type.

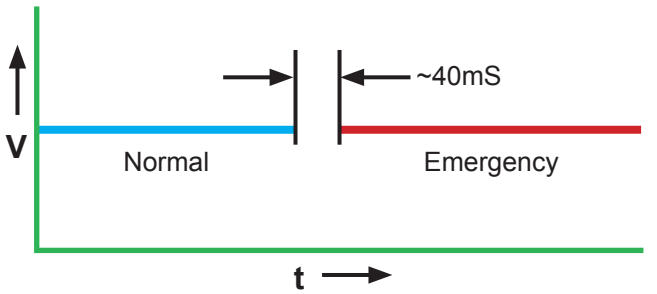

Figure 2: Open Transition Transfer

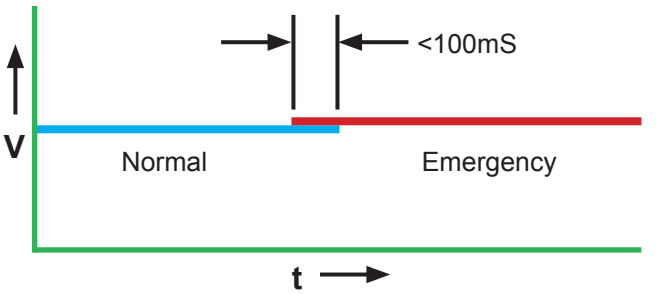

Figure 3: Closed Transition Transfer

Reasons to use a CTTS include the desire to avoid momentary interruptions that can affect operation of sensitive load equipment. Consequently, CTTS is often used at healthcare facilities, where backup power equipment is periodically tested according *NFPA 110: Standard for Emergency and Standby Power Systems*. In this application, a hospital can avoid repeated momentary disruptions that can affect the operation of expensive, complex, and sensitive medical equipment.

In data centers, CTTS can be used to avoid power interruptions that could impact the reliable operation of important revenue-generating equipment. Avoiding these interruptions can help facilities that rely on battery UPS and energy storage systems. By avoiding power interruptions, UPS and battery systems are not subject to the wear-and tear associated with repeated short-duration charge cycles.

CTTS OPERATION

The essential characteristic of CTTS switches is the contact sequence used to “overlap” the connection of two power sources for a brief time interval. As a result, the load remains continuously connected during (1) system testing, (2) programmed automatic emergency power system exercise periods, (3) re-transfers to the normal source, and (4) restoration of the normal source following a utility outage. The following conditions must be present for closed transition to occur:

- Both power sources must be present
- The voltage differential between power sources cannot exceed 5%
- Frequency differential cannot exceed 0.2 Hertz
- Phase angle difference cannot exceed five electrical degrees

To ensure that these conditions are met, CTTS’ use a controller to monitor these parameters. The controllers and solenoid-driven transfer mechanism are fast enough to successfully connect and disconnect the power sources when they comply with the above referenced requirements. If the conditions cannot be met, CTTS switches either (1) do not transfer, (2) revert to open transition operation, or (3) transfer via delayed transition. The preference for one of these alternate actions is set by the user.

Figure 4 below shows three configurations for one pole of a transfer mechanism. In the top diagram, normal contacts are closed and current flows from the Normal source through the transfer mechanism to the downstream loads. During a transfer, the emergency contacts close and electricity momentarily flows from both the Normal and Emergency sources to the loads. Because power to the loads is continuous, load equipment operates without disruption. To complete the transfer, the Normal contacts subsequently open and the loads are supplied with electricity solely from the Emergency source.

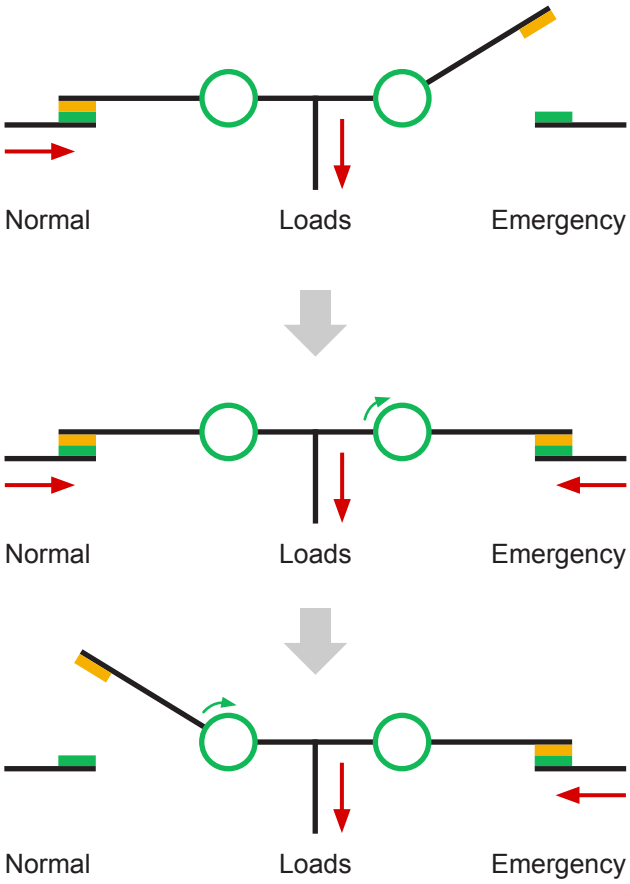

Figure 4: CTTS Transfer Sequence

To comply with typical utility requirements, the two power sources cannot be connected for more than 100 milliseconds (mS) under normal operation. This requires parts and components that move very quickly. Because larger ampacity switches use parts with larger mass, their mechanisms are more difficult to switch within required timeframes. For this reason, any manufacturer should provide test data showing their CTTS terminates parallel operation within acceptable time limits.

DESIGN SAFEGUARDS

To ensure that sources are not paralleled for unacceptable timeframes, ASCO CTTS designs include several important features. First, the ATS controller issues a signal to the set of main contacts that were closed last, as shown in Figure 5. This occurs automatically if sources are paralleled for some interval greater than the time delay specified in controller software. After attempting to break the overlap, the controller inhibits further automatic operation and indicates the inhibited status on its display panel. Automatic operation remains inhibited until the feature is reset by an operator.

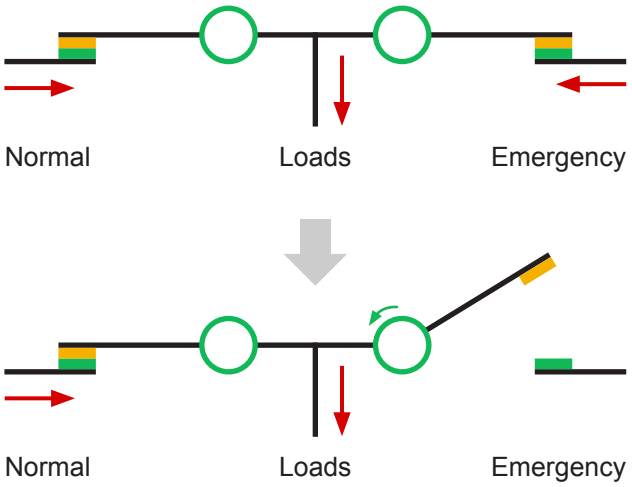

Figure 5: Controllers ensure that CTTS transfer mechanism opens a contact if extended interconnection occurs.

If the controller cannot open contacts to break the overlap, an upstream circuit breaker is signaled to disconnect one of the power sources. In ASCO switches, an independent, backup safety circuit provides a relay contact that issues a shunt trip to open either the Normal or Emergency feed circuit breaker. The extended parallel alarm timer for this relay contact is settable from 0.1 to 1 second. This action disconnects one power source to terminate the interconnection before undesirable power conditions occur. The preferred breaker is selected by the user. Figure 6 illustrates the sequence.

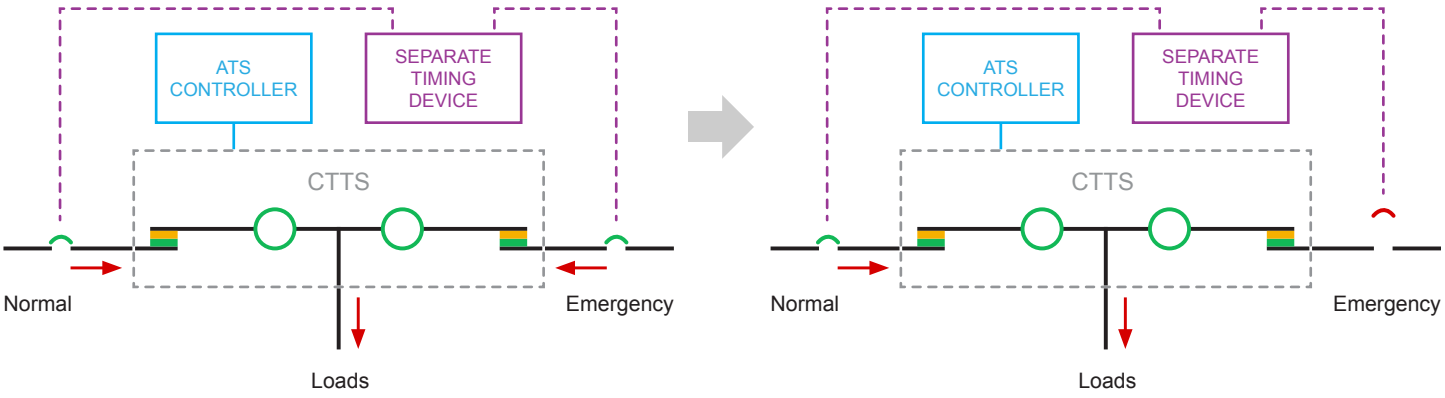

Figure 6: If a controller fails to break the overlap, a separate timing device opens an upstream breaker to prevent extended paralleling.

UTILITY REQUIREMENTS

Utilities typically require and approve an overlap of less than 100 mS. When this criterion is met, utility policies may authorize installation of CTTS equipment without further approvals. In other instances, users must obtain approval to install a CTTS directly from utility officials. This usually requires that the user submit factory test results showing that the selected model does not allow paralleling to extend beyond the utility's criterion. To obtain utility requirements for installing CTTS equipment, the best approach is to contact the organization that oversees a utility's protective relay equipment. Where required, CTTS equipment should not be installed without direct utility approval.

SUMMARY

Closed Transition Transfer Switches switch loads between two energized sources without undesirable power interruptions. These ATS' revert to open transition operation when one power source is unacceptable or unavailable. If the sources fail to synchronize within a set timeframe, the switch will either avoid transfer, transfer via open transition, or employ delayed transition, as set by the user.

Because inadequately controlled paralleling can result in undesirable power conditions, CTTS controllers will attempt to open either of the normal or emergency transfer switch contacts to terminate the interconnection. If the contact fails to open, a redundant stand-alone device should open an upstream breaker to achieve the same outcome.

Utilities typically accept CTTS equipment that limits interconnection intervals to less than 100 mS. However, policies and criteria can vary from utility to utility. Consequently, users should consult utility officials before installing any equipment that parallels power sources, including CTTS equipment.

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