White Paper

Transition Modes for Automatic Transfer Switches - Part 2

ASCO Power Technologies®

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When selecting an Automatic Transfer Switch (ATS), it is necessary to specify the load transition mode that will best meet the needs of the application. The load transition mode indicates the sequence and timing of the operations that will transfer load between power sources.

Load transition modes can be categorized by whether they transfer between sources with or without power interruption to the load. ***Open Transition*** and ***Delayed Transition*** switching produce short-duration power interruptions each time load is transferred from one source to another. These modes were described in Transition Modes for Automatic Transfer Switches - Part 1. Two additional transition modes complete transfers without power interruption, and are known as ***Closed Transition*** and ***Soft Load*** transition modes. The following narrative provides additional detail about these two modes.

CLOSED TRANSITION

In order to transfer between two sources without interrupting power to the load, the power sources must be momentarily paralleled. Because both sets of electrical contacts in the transfer mechanism remain closed simultaneously, the switching sequence is termed ***closed transition***, also known as ***make-before-break***. In ASCO ATSs, the entire process of closing on the alternate source and then opening the contacts for the original source requires less than 100 milliseconds (ms), depending on the capacity of the ATS. The sequence is shown in Figure 6 below.

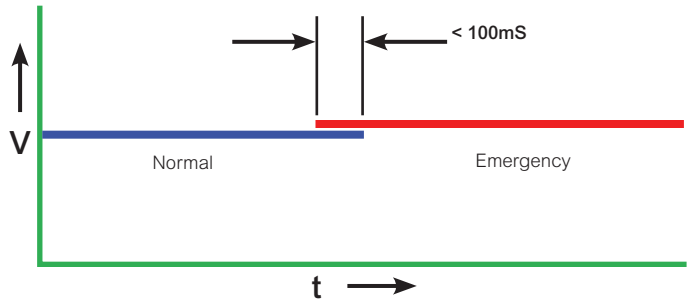

Figure 6: Closed Transition Sequence

For closed transition switching, the rotating shafts in the switching mechanism operate in a different sequence from the Delayed Transition sequence described in Part 1. During closed transition transfers, the Emergency contact closes before the Normal contact opens, as shown in Figure 7.

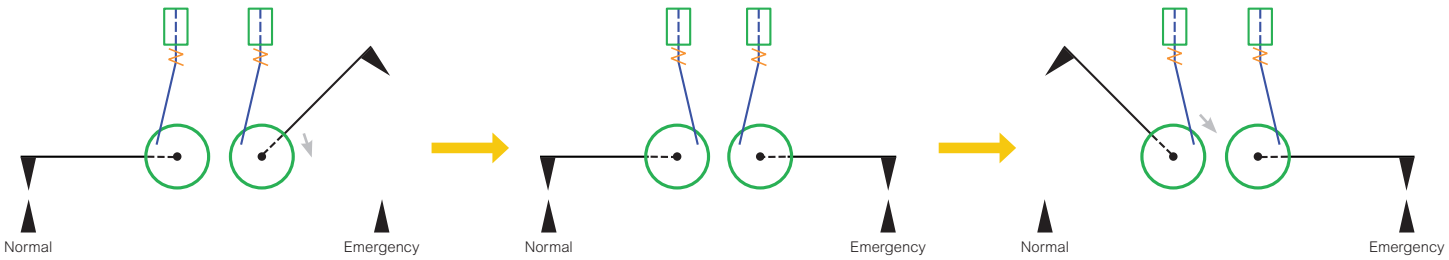

Figure 7: Load transfer using a closed transition transfer mechanism

Closed transition switches are typically used where load equipment would be disrupted or damaged by even a momentary interruption in power. For example, the operation of some types of digital equipment, such as computers and medical imaging devices, can be disrupted by the very short interruption in power associated with ***open transition*** switches. Hospitals and data centers are two types of mission-critical facilities where closed transition switches are used. When specifying closed transition switches, it's important to consider the following information:

- There is variable susceptibility of digital equipment to negative impacts from momentary power disruption. As a result, the required degree of protection can be provided by Uninterruptible Power Supplies (UPS) and/or backup power systems equipped with one or more closed transition ATSs. However, it is important to distinguish between the intended function of each of these systems. A UPS stores energy that can be temporarily used even when none of the power sources can supply electricity. A closed transition ATS ensures that loads will be switched without interrupting power to the load, provided that at least one of the power sources is operational. A closed transition switch will not prevent power interruption to the load when both primary and secondary power sources fail.
- Closed transition switches are used where load transfers between power sources are frequently ***planned***. For instance, a facility may have a policy of switching to Emergency in advance of events that could result in utility outages, such as thunderstorms, or periods of extreme regional demand, such as heat waves. A facility could also enter into an agreement with a utility company to reduce demand upon request. In addition, facilities may routinely transfer between sources to complete scheduled testing of standby power systems. In these cases, load is transferred between two live sources. Closed transition switching avoids nuisance interruptions associated with these planned load transfers.
- Closed transition switching is only feasible where there are two live power sources. If utility power fails, momentary interconnection of two live sources is impossible, and load transfer can only occur using an ***open transition*** sequence. Modern closed transition ATSs can provide open transition switching when Normal power fails. For this reason, closed transition switches must be designed to close on and withstand the same fault currents as the open transition switches that would be used in the same application.
- Transfer switches should be located close to the loads they serve. For less-common applications involving load-side transformers, open transition switching can result in high inrush currents that trip overcurrent protection devices. Using a closed transition ATS can avoid this effect.
- Because closed transition switching is completed using two live sources, in-phase monitoring is necessary to avoid the effects and potential damage of interconnecting two out-of-phase sources. Refer to the Part 1 of this paper for additional detail.
- Without undertaking proper coordination measures, connecting two sources of electrical power for a sustained timeframe can be dangerous. Consequently, utility companies maintain strict guidelines for coordinating the parallel connection of utility and on-site power systems. (ASCO 7000 Series closed transition switch controls incorporate multiple protections to avoid extended source parallel connections.) While utility companies routinely permit the use of closed transition switching, the requirements of the local utility must be understood before selecting and deploying closed transition ATSs.

SOFT LOAD TRANSITION

Like closed transition switches, ***Soft Load*** ATSs parallel two live sources. However, soft load transition occurs over a longer user-selected timeframe for any of a variety of purposes. Before reviewing applications, however, it is important to understand how this type of transition differs from a closed transition mode.

Illustrating source voltage during a soft load transition produces a graph similar to the one shown for closed transition switching. The only variance is the length of time that may be specified, which is limited only by the amount of available fuel for the Emergency source. The source voltage sequence is shown in Figure 8. The sequence of contact opening and closure is identical to that shown in Figure 7 above.

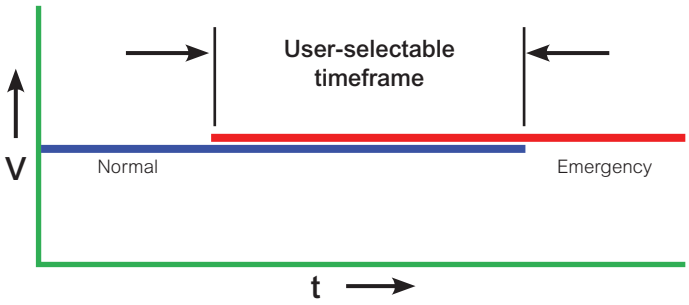

Figure 8: Source voltage during Soft Load Transition

In soft load transfer mode, ATS controllers operate the transfer switch mechanism in a ***make-before-break*** sequence used for closed transition switching. However, they also use the ATS controller to monitor and adjust the operation of the engine-generator. When soft load transitions occur, the controller slowly increases the amount of power delivered by the Emergency source through adjusting the engine's governor and generator's voltage regulator. The amount of power provided by each source during a soft load transfer is best understood using the graph in Figure 9.

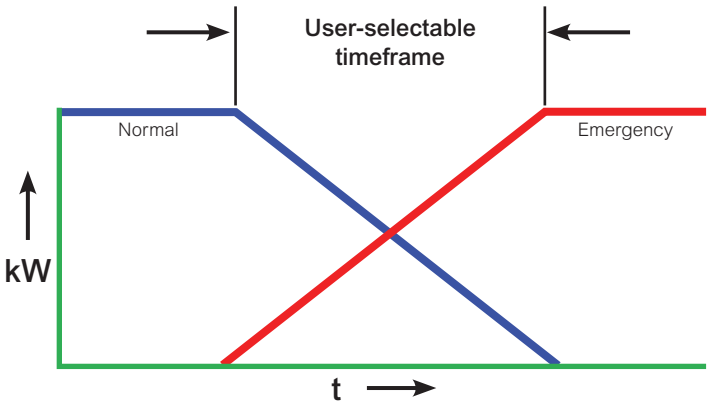

Figure 9: Source power (kW) during Soft Load Transition

Using protective functions required by utilities, soft load transition switches can (1) transfer load between acceptable utility and backup power sources with virtually no voltage or frequency transients and without block loading the generator, (2) transfer sources without interrupting power to loads, (3) maintain parallel use of both sources, (4) import or export power from or to an electric utility, and (5) employ peak-shaving techniques to reduce utility costs. Like a closed transition switch, a soft load ATS will use an open transition sequence if an unplanned utility outage occurs.

SUMMARY

Part 1 of this paper explained that ***Open Transition*** switching is the simplest transition mode, and provides reliable load transfer switching for a wide range of applications. However, the associated momentary disconnection and reconnection of power can cause large inrush current if active or inductive loads are present downstream of the ATS. These can be managed by introducing equipment-specific delays using transfer switch accessories, or by using a ***Delayed Transition*** ATS to delay reconnection of circuits serving active or inductive equipment.

For applications where even momentary power interruptions cannot be tolerated, a transfer mode that provides uninterrupted power must be selected. ***Closed Transition*** and ***Soft Load*** switches transfer loads between power sources without power interruption. While closed transition switches momentarily parallel two live sources, soft load switches also increase generator power while simultaneously reducing utility demand. Using either mode requires coordination with the local utility to avoid negative consequences from paralleling two live sources. Qualified representatives of ATS manufacturers should be consulted for application-specific information.

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