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Closed Transition Automatic Transfer Switch

Introduction

Traditional automatic transfer switch (ATS) uses open transition principle, "break before make" transfer. Therefore, momentary disruption of electrical power will occur when generator is tested to simulate normal electrical power loss. Closed transition transfer switch (CTTS) can avoid momentary power loss by using transition principle of "make before break" during some transfers. The switch logic in the CTTS determines if both source voltages and frequencies, and the phase relationship between the sources, are within acceptable limits. If all conditions are correct, the switch contacts are allowed to make an overlap (make before-break) transfer. Note that CTTS reverts to open transition mechanism if the conditions are not met and normal power is disrupted.

Closed transition transfer switches are gaining popularity for many critical facilities. Advantages of CTTS are as follows:

1) *Emergency power system can be tested without interrupting power to loads and power can be retransferred to the utility after a failure without interrupting power to loads.*
2) *Stress on the downstream load is reduced due to smooth transition between sources.*
3) *Reluctance of emergency power system testing is eliminated since test can be performed without disturbing the loads.*
4) *Inrush currents associated with motor starting and transformer switching are eliminated during closed transition transfers.*
5) *The restart time associated with metal halide and other HID lighting is eliminated during closed transition transfers.*
6) *Reduce stress on UPS system and their batteries.*
7) *Avoidance of installation of large load bank as required by the NIH Design Requirement Manual (DRM) for generators 1.5 MW or larger.*

CTTS finds widespread use in hospitals, data centers and critical facilities where load is sensitive to momentary power loss when transferring between two acceptable sources, i.e. periodic testing. Peak load shaving and load demand reduction may also necessitate the use of CTTS in certain facilities.

Design Considerations

Utility Coordination: When CTTS is used, it causes the short-term paralleling of two sources of power for a brief duration. As a result, current flow between the sources may occur due to difference in voltages among the phases. This current is limited only by the impedance of the interconnection between the sources. The serving utility will normally require that the transition be automatically supervised by synchronism-check relays, and that breaker interlocking controls are provided to limit the time duration of the parallel operation 100 ms (6 cycles) or less.

Specifications and settings: Paralleling two sources of power may result in a surge of current from the source with higher voltage to the source with the lower voltage at the instant of sources' interconnection. This surge of current will occur since sync check systems allow for the sources to be a few degree out of phase at closure. Magnitude of surge current is limited only by the impedance of the sources and the current-carrying capacity of the cable or bus connecting them. If the surge current is excessive, it will trip the breaker or, in more extreme cases, damage equipment. Therefore, transfer switch size, breaker size and trip settings must take into account this surge current.

Short Circuit Rating: Paralleling sources of power must consider fault current contributions for each of these sources. Since CTTS only parallel the sources of power for very short duration, short circuit ratings may consider contribution from only one of the sources if installation is supervised. It is imperative that systems are designed with interlocks that prevent the inadvertent and indefinite paralleling of sources. Some of the safety features include:

1) *Manually initiated transfers must be automatically interlocked to prevent utility sources from being paralleled for an excessive amount of time.*
2) *Closed-transition switchgear should be designed with a non-defeatable safety circuit timing relay, which will cause source disconnection within a predetermined time if the sources are manually paralleled, or the closed-transition interlocking scheme fails to perform.*
3) *Shunt-trip circuit breaker on the emergency feeder should be specified to force the emergency feeder to open in cases of a failed closed transition.*
4) *All alarm conditions shall be annunciated to local as well as remote control station.*

Conclusion

In addition to above mentioned design considerations, system designer must consider the types of CTTS used based on the facility requirements i.e. fast closed-transition transfer switches, closed-transition transfer switches with active synchronizing, soft closed-transition transfer switches and sub-cycle transfer devices.

References and Further Reading

1. A common definition for Zero Energy Buildings, September 2015 (U.S department of Energy).
2. Zero energy Buildings: A critical Look at the Definition, National Renewable Energy laboratory (NREL). http://www.nrel.gov/docs/fy06osti/39833.pdf
3. ASHRAE Journal September 2009, Getting to Net Zero. http://www.nrel.gov/docs/fy09osti/46382.pdf