Cutler-Hammer

The Power Sheet

Consulting Engineer Edition

TRANSFER SWITCH BASICS

INTRODUCTION

Transfer switches are an essential part of an emergency electrical system. The purpose of this newsletter is to define the functions and characteristics of transfer switches. Think ***EATON CUTLER-HAMMER*** when specifying transfer switches!

OPEN – CLOSE TRANSITION

The transition of a transfer switch refers to whether the two sources of electrical power are ever connected to the load at the same time.

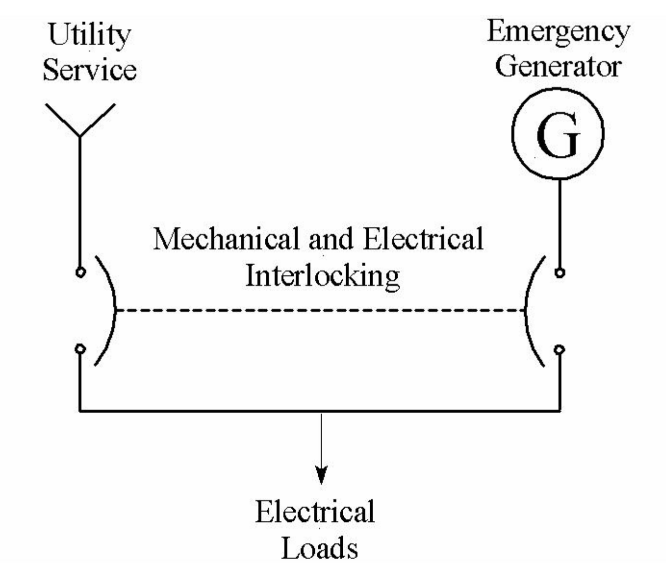

FIGURE 1—Transfer Switch Diagram

OPEN TRANSITION – Referring to Figure 1, two sources of electricity are available to the facility loads. Open transition means these two sources are **never** connected to the load at the same time. Either the utility source or the emergency generator is connected, but never both.

The advantages to open transition are:

- Simple control therefore less costly
- Only a short interruption in electrical power (typically less three cycles)

The disadvantages are:

- Lights flicker
- Computers may reset on power interruption
- Motors may deenergize due to a loss in control voltage

CLOSED TRANSITION – Again referring to Figure 1, both sources of electrical power are connected at the same time. This occurs when the power is switched from one source to the other. The "baton" is passed from the utility source to the emergency generator.. Meaning the transfer switch, for a short time, connects both the utility source and the emergency generator to the facility load at the same time.

Obviously this is not an issue during a utility power outage because this source is not available. However in "brown out" conditions (when the utility voltage drops) and in test conditions, the source are connected. The sources are in parallel for a maximum of 100msec.

The advantages of closed transition are:

- Seamless transfer from utility power to the emergency generator (when both sources are available).

Think *CUTLER-HAMMER*
when specifying transfer switches!

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- No flicker of lights
- No resetting of computers
- Motors remain energized

Disadvantages of closed transition are:

- More complex control, therefore higher cost

When an emergency generator is connected in parallel with utility power, protective relays (synchronization check, phase reversal) maybe needed. The local electric power utility may have requirements.

One note: on a loss of utility power source, the facility electric power is still interrupted until transfer to the emergency generator

BYPASS ISOLATION

Bypass Isolation transfer switches allow for the maintenance of the automatic transfer system by providing a fully functional manual bypass.

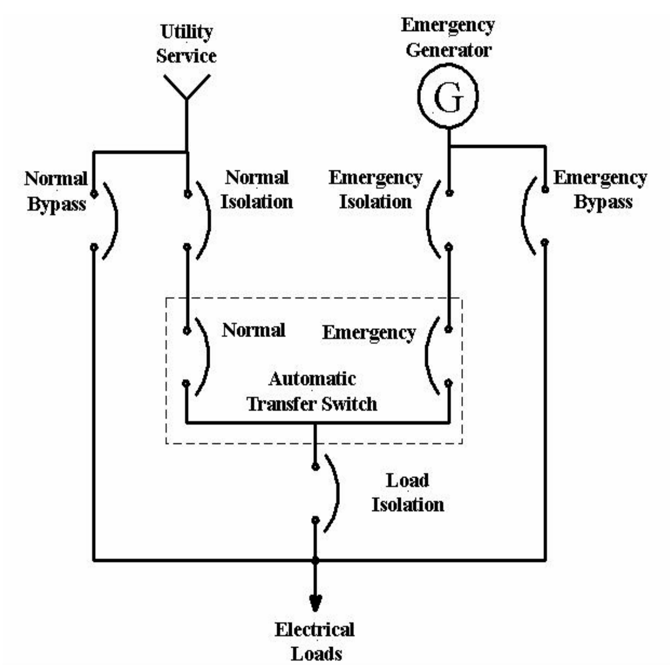

FIGURE 2 — Bypass/Isolation Transfer Switch Diagram

Figure 2 is a schematic diagram of a Bypass Isolation transfer switch. Note the bypass switches are in parallel with the automatic transfer switch. Further, the isolation switches disconnect the automatic transfer switch from both line side power and load side power.

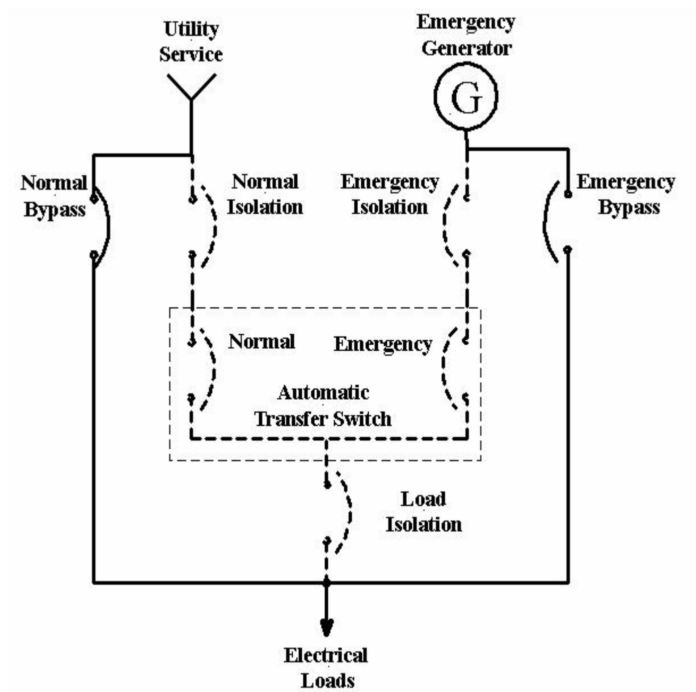

FIGURE 3 — Bypass/Isolation Transfer Switch, Bypass/Isolation Mode

This **"isolation"** feature allows for maintenance and repair of the transfer switch while not interrupting power to critical loads. Figure 3 shows the power flow when the transfer switch is in the bypass/isolation mode. As shown, the automatic transfer switch section is free of electric power and can be safely worked on.

Figure 4 is the transfer switch in normal operation. The utility, generator, and load switches all are closed and the bypass switches are open. The load switch also is closed. Therefore, the automatic transfer switch is the normal operating configuration with power connected to the load.

The added flexibility of a Bypass-Isolation Transfer Switch makes this application ideal to critical systems where periodic maintenance and testing, while not interrupting electric service, is required.

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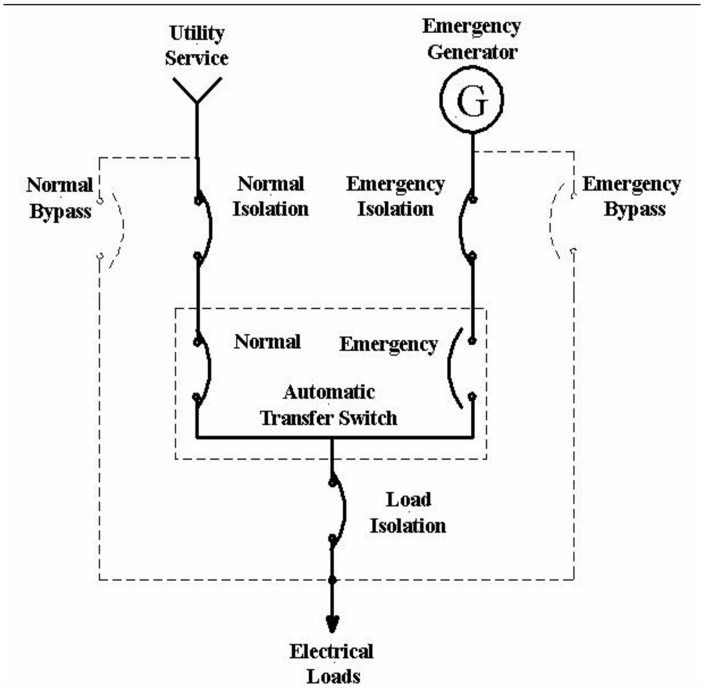

FIGURE 4 — Bypass/Isolation Transfer Switch, Normal Mode

CONTACTOR VS. BREAKER

Transfer switches have devices used for switching that are used to "Make" and "Break" electrical circuits. These devices are classified as either "Contactor" or "Circuit Breaker". But what does this really mean?

Both Contactor and Circuit Breaker transfer switches will redirect power flow to the needed electrical circuit.

However, the **UL Rating**, which defines testing requirements, is different. Although physically a transfer switch "contactor" and a transfer switch "circuit breaker" may look the same, the UL testing requirements are completely different. This rating needs differentiation in the electrical design where coordination and electrical system integrity are considered.

All transfer switches are tested and manufactured to **UL 1008** standards regardless of using contactors or circuit breakers. Further, the UL 1008 standard is a **minimum standard** to which all transfer switches must comply. This standard requires only a 3 cycle a **withstand rating.**

However, an other specification is the **Extended Short Circuit** rating, which measures the how long a device can remain closed under a full fault condition (as defined by **UL 489**). Circuit breakers are tested beyond the UL 1008 standard to this UL 489 standard.

Although this rating seems insignificant, upstream coordination is greater when transfer switches have a short cycle rating long enough to endure a fault (without damage) while carrying the fault current.

This allows ***downstream protective devices to clear the electrical fault before the transfer switch breaks electrical power to the entire electrical network.*** Hence, a significant coordination advantage of "circuit breaker" transfer switches over "contactor" transfer switches.

In contrast, contactor type transfer switches are not tested to the UL 489 standard and do not have a short time rating. **Therefore, downstream coordination is achieved using a circuit breaker transfer switch rather than a contactor type transfer switch.**

An additional note: the only difference between Molded Case Switches and Molded Case Breakers (both use in Transfer Switches) is Molded Case Breaker have a trip unit identical to those in panelboards or switchboards. Therefore, the instantaneous, long delay, and short delay are fully adjustable to coordinate with downstream devices.

MANUAL, NON– AUTOMATIC, and AUTOMATIC TRANSFER SWITCH OPERATION

The three mode of operation available when specifying transfer switches are: Manual, Non-Automatic, and Automatic.

MANUAL — As the name says, the operation is completely manual. An operator physically needs to initiate the transfer of electrical power from the utility to the emergency generator. This system is ideal for the following:

- Knowledgeable personnel capable and comfortable with transferring electrical power.
- Non-critical systems where temporary (up to 2 hours) interruption of electrical power is acceptable.

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- Generally, small system where the loads are non-critical to life safety.

NON-AUTOMATIC — This is similar to Manual Operation. However rather than physically pulling a lever to initiate a transfer, an electro-mechanical system is included in the transfer switch to transfer power initiated by simply pushing a button.

This offers the following advantages over MANUAL operation:

- Easier operation—Less complex for maintenance personnel
- Remote Operation—The transfer can be initiated from a remote location

However, the decision to transfer power to an emergency generator is still made by a facility operator. Therefore should the faculty electrical power be non-critical to life/safety, this transfer system provides adequate integrity.

AUTOMATIC — This method of transfer continuously monitors the incoming utility power for integrity as defined by used parameters. Voltage and frequency tolerance are defined in the **Cutler-Hammer IQ** microprocessor based transfer control.

Should the utility feed fall outside these parameters for a user defined time, the microprocessor control will automatically start the emergency generator. After the generator proves reliable electrical power (within user defined voltage, frequency, and time parameters), the transfer switch automatically redirects power to the emergency generator.

After the utility power reenergizes and proves reliable electric power (again for user defined voltage, frequency, and time parameters) the **Cutler-Hammer IQ** microprocessor retransfers the electric power from the emergency generator to the utility feed.

MANUAL TRANSFER UNDER LOAD

A significant advantage of Cutler-Hammer transfer switches is the ability to manual transfer under load. In the rare case of malfunction, all Cutler-Hammer transfer switches are able to be transferred to or from utility power using a manual transfer override. This gives added reliability to Cutler-Hammer transfer switches.

CUTLER-HAMMER TRANSFER SWITCH PRODUCTS

- Choice of Automatic, Non-Automatic, and Manual operation
- Microprocessor based Cutler-Hammer IQ Automatic control
- Molded case switch or Molded case breaker transfer switch components
- Standard or Bypass/Isolation configuration
- **Available from 30 Amps to 4000 Amps**
- Ability to parallel with utility power for peak load shaving applications
- **Service Entrance Rated**

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See the specially designed Eaton Electrical Consulting Engineer Web Site at http://www.eatonelectrical.com/crp