White Paper

Application and Design Factors for Automatic Transfer and Bypass-Isolation Switches Part 1 of 2

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Part 1 of 2

This document is the first of a two-part series about automatic transfer and bypass-isolation switch operation and design. Part 1 describes reasons for implementing a comprehensive transfer switch maintenance program, the role of testing in such programs, and the how bypass-isolation transfer switches support effective maintenance and testing. Part 2 describes the features of automatic transfer and bypass-isolation switches that provide effective performance and serviceability.

Introduction

A program of periodic testing, preventive maintenance, and scheduled service is necessary to assure reliability of automatic transfer switches (ATSs), engine-generator sets, and the connected distribution and ancillary equipment that comprise an emergency power system. Such a program is necessary to provide continuity of electrical power during disruptions of the normal power supply. It also minimizes disruptions of power caused by failures within the wiring system.

Because emergency power systems are infrequently called upon to provide power, periodic testing is required. Periodic testing exercises the equipment at regular intervals to help assure proper system operation during an emergency. Periodic exercising is the most important part of any regular program of preventive maintenance. This is particularly true in installations such as hospitals, nursing homes, and other health care facilities, where many of the loads are vital to human life.

Periodic testing also contributes to the preparedness of an emergency power system by allowing maintenance personnel to train in operating procedures. Preventive maintenance and scheduled service corrects any degradation in equipment before failure occurs. For additional information regarding the components of an effective transfer switch maintenance program, read the ASCO white paper entitled, "Maintaining Automatic Transfer Switches for Reliability and Longevity." For information regarding the selection of qualified service providers, review the ASCO white paper entitled, "Identifying Qualified Service Providers to Optimize Power Reliability."

In addition to healthcare sites, maintenance programs should be implemented for all facilities where emergency power systems exist. This is particularly true where life hazards and substantial financial losses are real possibilities. Such facilities may include airports, water treatment plants, data centers, continuous flow industrial processes, correctional facilities, and high-rise office buildings.

Periodic testing and inspection are forms of preventive maintenance that are required by many federal agencies and by city and state governments. National codes and standards frequently require periodic testing. For example:

- The National Electrical Code (NFPA 70), Article 700 (Emergency Systems), and Article 701 (Legally Required Standby Systems) require periodic testing and maintenance.[1]

- NFPA 99 (Health Care Facilities Code) requires testing of the "Essential Electrical System" (EES) generator sets under load, including transfer of all EES loads, 12 times a year with testing intervals between 20 and 40 days.[2] Written records of inspection, performance, exercising periods, and repairs must be maintained and made available for inspection by the authority having jurisdiction.

- NEMA standard ICS 10-2005, Industrial Controls and Systems, Part 1: Electromechanical AC Transfer Switches, recommends a maintenance program that includes "periodic testing, tightening of connections, inspection for evidence of overheating and excessive contact erosion, removal of dirt and dust, and replacement of contacts when required".[3]

Servicing transfer switches, when required, is a part of all maintenance programs. The maintenance must be conducted so as to minimize downtime and maintain safety. It is desirable that the transfer switches be capable of being readily serviced.

Depending on the type of load, it may not be possible to de-energize it for long periods, if at all. Such situations can lead to reduced preventive maintenance and to complex repair procedures. To overcome this, provision should be made so that testing, preventive maintenance, and service can be completed safely without interrupting power to these loads. For these applications, maintenance personnel should be able to test the entire emergency power system (engine generator, distribution, and transfer equipment) and to inspect, maintain, and service all of the equipment, especially the ATS, without interrupting power to the loads.

Bypass-Isolation Switches

For those applications where power interruption and downtime cannot be tolerated during ATS preventive maintenance and service, a bypass-isolation transfer switch is the solution. An integrated automatic transfer bypass-isolation switch within a common enclosure provides the following advantages:

1. *Performs as a standard ATS when in the Automatic mode.* As shown in Figure 1, both bypass switch contacts are open and the isolation contacts are closed in the Connected mode. This is the Automatic mode. In this mode the switch will operate identically to a standard ATS that is not equipped with bypass-isolation features.

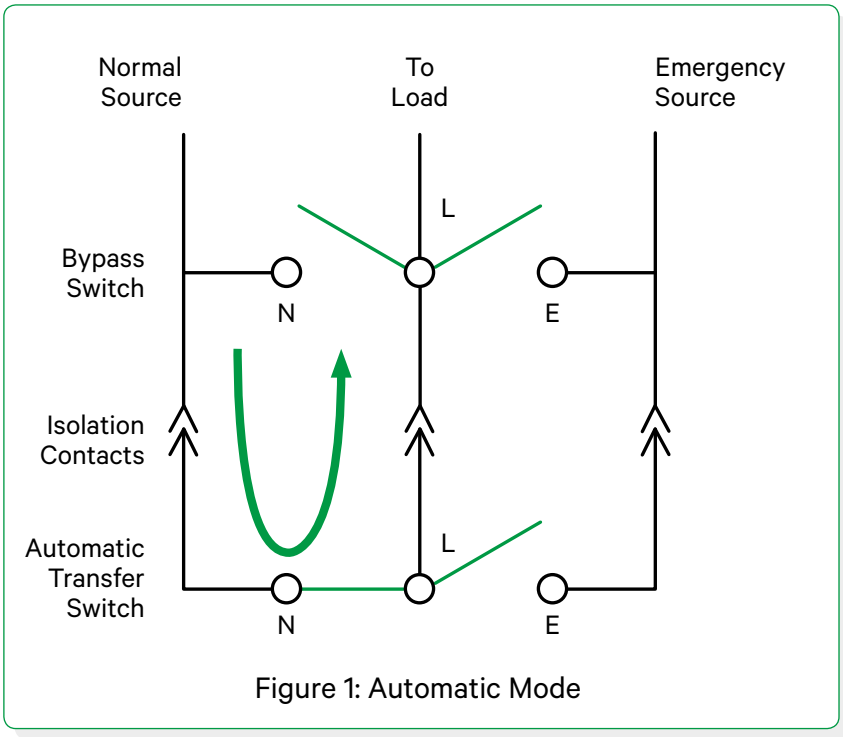

Figure 1: Automatic Mode

2. *Shunts the service, when needed, around the transfer switch without interrupting power to the load.* When the bypass-isolation mechanism is in the Bypassed to Normal mode, the closed transfer switch contacts are shunted by the normal bypass contacts as shown in Figure 2. The flow of load current then divides between the bypass and transfer contacts. This assures there will be no power interruption to the load when the transfer switch is isolated for testing and/or service.

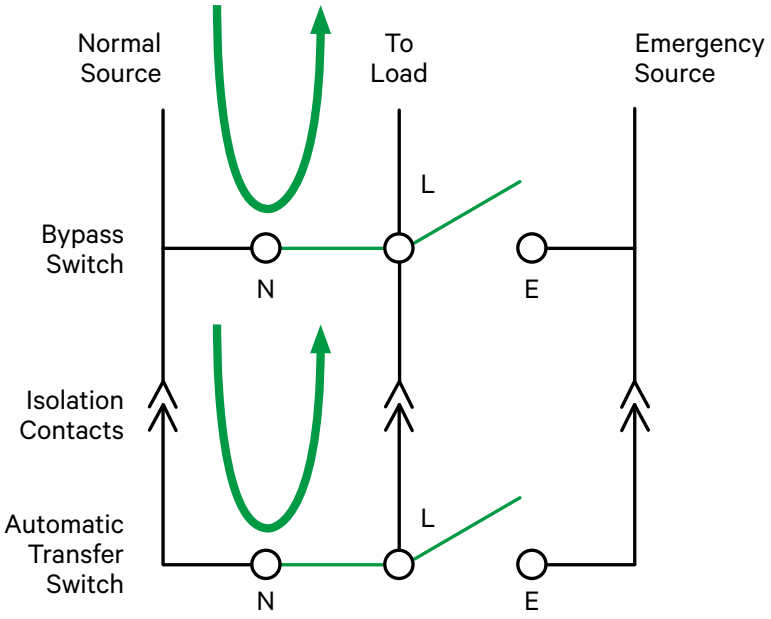

Figure 2: Bypassed to Normal Mode

3. *Allows the transfer switch to be electrically tested and operated without interrupting power to the load.* With the bypass-isolation mechanism in Test mode, the transfer switch is disconnected from both power sources and the load and the normal bypass contacts carry the full load, as shown in Figure 3. The transfer switch operating circuits remain connected to the controls through secondary disconnects to allow electrical operation testing without interrupting the load.

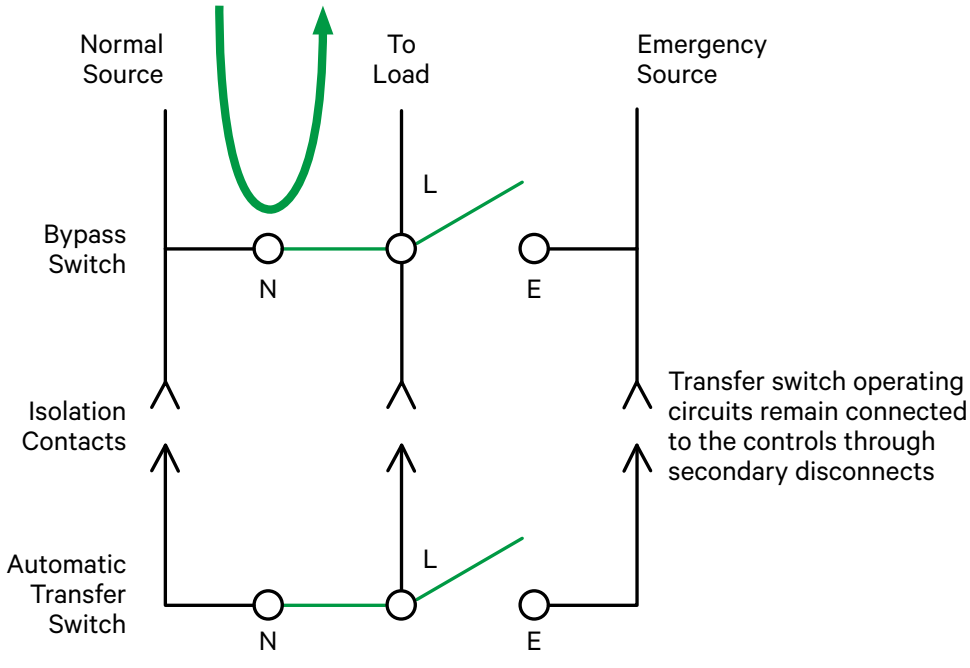

Figure 3: Test Mode

4. *Electrically isolate the transfer switch from power sources, the load, and the controls to permit inspection and maintenance of the transfer switch and, if necessary, allow complete removal of the transfer switch without interrupting the load.* With the bypass-isolation mechanism in Isolated mode, the ATS is completely isolated as shown in Figure 4. The load continues to be fed through the normal bypass contacts. With draw-out capability, the transfer switch can now be completely removed without interrupting the load.

   In this mode, the bypass switch has a dual function. In addition to bypass, it also operates as a manual backup transfer switch. Such operation is described under the section entitled “Dual Function” in Part II of this series.

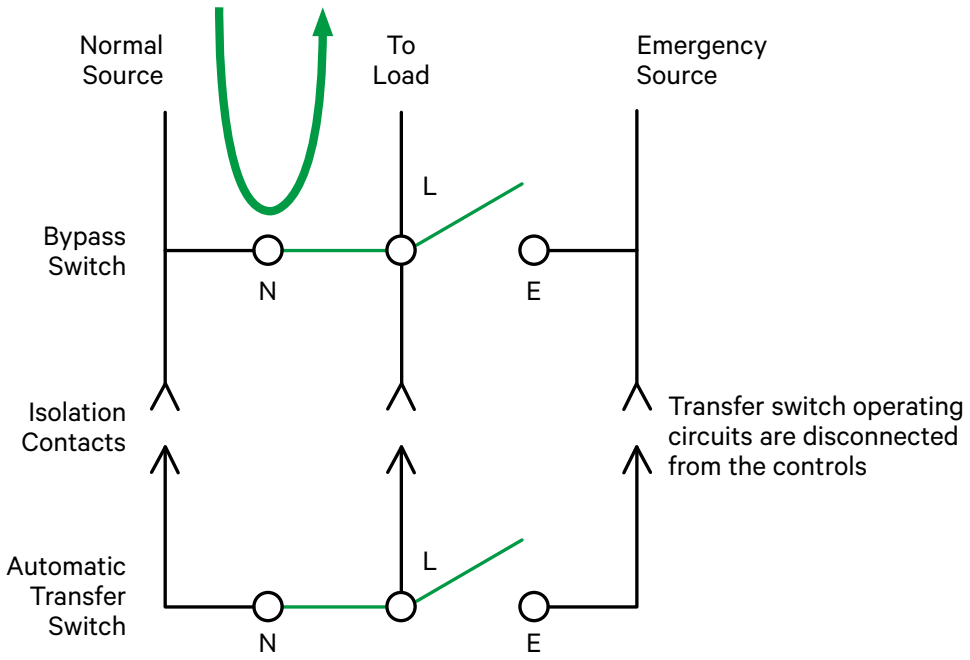

Figure 4: Isolated Mode

Although the foregoing illustrations show bypassing of the load to the normal source, the transfer switch can be bypassed to either the normal or emergency source without interrupting power to the load, provided bypassing is always made to the source already feeding the load through the transfer switch prior to its isolation. Prior to isolating the transfer switch, when the transfer switch is feeding the load from the emergency source, bypassing will be made to the emergency source thus allowing the same four functions as described above to be performed.

References

1. National Fire Protection Association, NFPA 70 - National Electrical Code, Fourteenth Edition, 2017. Quincy. Massachusetts. 2016
2. Health Care Facilities Code, NFPA 99, 2015 Edition. National Fire Protection Association, Quincy, Massachusetts
3. Industrial Control and Systems, Part 1: Electromechanical AC Transfer Switch Equipment. National Electrical Manufacturers Association, Rosslyn, Virginia

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