Optimizing Performance of Fast Transfer Schemes

1.0 INTRODUCTION

The sequential fast transfer method for plant auxiliary motor buses has been practised and applied for many years. This method affords the advantages of a sequential transfer, while still maintaining plant operational continuity. The applied relay for verification of an acceptable phase angle is a *high-speed sync check relay*.

2.0 ABSTRACT

This Application Note explores the requirements of the sequential fast transfer and the nature of commercially available sync check relays for the task.

3.0 ISSUES

Figure 1 illustates a simplied typical transfer scheme in a utility power plant application.

FIGURE 1 Motor Bus Simple One Line Diagram

3.1 Parallel Transfer

Bus transfers can be sequential or parallel. A parallel transfer involves the paralleling of the two sources to the bus. The chief disadvantage is the availability of dual source fault current, and the high reactive currents that can result from angular difference between the two sources. The two sources may be loosely connected by a transmission system external to the plant. In addition, the plant may become asynchronous to the external system during full load rejection.

3.2 Sequential Transfer

Sequential transfers eliminate this problem by disconnecting one source before connecting the second. The available sequential methods are the fast, in phase and residual methods. Sequential transfers address the problems that are inherent to parallel transfer, but may cause other concerns. The sequential transfer system must have relaying capable of supervising the transfer process to insure the transient ratings of the connected bus equipment are not exceeded.

If the fast or in phase transfer are not possible, due to bus decay dynamics or phase angle between the bus and the auxiliary source at the time of the transfer, some load may need to be shed before completing the transfer residually.

3.3 Fast Transfer Dynamics

The fast transfer involves a rapid measurement of the phase angle between the previous source and the new source to the auxiliary bus. ANSI/IEEE standard C50.41 states that the resultant volts/hertz between the bus and the new source shall not exceed 1.33 volts/hertz. This value will be the resultant of the phase angle between and the volt/hertz of each of the two sources at the instant of transfer. The Sync Check Relay is used to detect the appropriate conditions for a fast transfer.

3.4 Sync Check Relay Characteristics

Electromechanical and most static sync check relays introduce a delay in opening in the event a rapidly moving phase angle between the bus and the auxiliary passes out of the set limit. This is due to physical inertia of electromechanical relays, or the filtering and output relay characteristics of most static relays.

The great majority of sync check relays are designed for static (network tie verification) or slow dynamic (oncoming generator) conditions. Plant auxiliary transfers typically entail much faster dynamics, as can be seen in Figure 2.

Transfer schemes utilizing slow responding sync check relays may only respond to the steady state conditions present before the event that causes a transfer.

3.5 Desirable Relay Characteristics

To facilitate the accurate initiation or blocking of sequential fast transfers, a high speed sync check relay is required to respond to the varying and rapid dynamics of the plant auxiliary bus. Sudden severe or, equally important, cumulative damage to the rotating equipment and auxiliary transformer can take place when the phase angle is too great, and slow responding sync check relay does not block the transfer at values greater than the setting.

a. Phase angle and residual voltage of a large motor with high-inertia load change.

b. Phase angle of small, low-inertia, heavily loaded motor drops quickly and falls rapidly in and out of phase with supply.

FIGURE 2 Bus Characteristics

4.0 PROTECTION SCHEME

The Beckwith Electric M-0245 High Speed Sync Check Relay provides the ability to determine acceptable phase angle between the bus and the new source in 1 cycle. This is 1 cycle maximum delay after enabling the relay, which is done when the bus is isolated from all sources, so determination of the phase angle can be made. This measurement time is true for a frequency difference between the bus and auxiliary source as great as 5 hertz. This is due to the patented phase measuring technique and power FET output. A typical application using a High Speed Sync Check relay in a fast transfer scheme is illustrated in Figure 3.

The relay is enabled by the primary source lockout relay or breaker early “b” contact. This is supervised by other permissives. The time window for the transfer is limited by a delay on energizing time delay relay. This establishes a short time window after the primary breaker opens for the sequential fast transfer to occur. If the fast transfer is not completed during this window, it must be blocked and an alternative scheme, such as In Phase or Residual, should be implemented to complete the transfer.

5.0 APPLICATION AREAS

The M-0245 High Speed Sync Check Relay may be applied as a component of a comprehensive transfer system that addresses the fast, in phase and residual schemes. The M-0245 can also be used in combination with an undervoltage relay to implement the fast and residual transfer methods.

Retrofit opportunities include existing plants employing conventional sync check relaying to supervise the fast transfer, or in plants where the present fast transfers are unsupervised by a high speed sync check relay.

The M-0245 addresses the Relay Engineers need for accurate, high speed synchronism verification after the primary source breaker is opened.

25	High Speed Sync Check Relay (M-0245)	SU	Start Up
27	Undervoltage Relay	SUP	Supervisory Contact
43	Manual Switch	T	Trip
52	Circuit Breaker	TC	Trip Coil
86	Lockout Relay	TDOE	Time Dealy on Energizing
B	Bus	TDR	Time Delay Relay
CC	Closing Coil	UA	Unit Auxiliary
G	Generator	a	“a” auxiliary contact
PR	Protective Relays (Generator Trip)	b	“b” auxiliary contact
SI	Seal-In Relay		

FIGURE 3 Typical Fast and Residual Transfer Application

6.0 BENEFITS

The intent of the sequential fast transfer to maintain the service of the plant auxiliaries without damaging the motors and transformers associated with the bus.

7.0 CONCLUSIONS

The M-0245 High Speed Sync Check Relay, when applied in either of the two systems outlined in section 5.0, facilitates the precise initiation or blocking of the sequential fast transfer. The hardware for the task has been developed and is readily available for both new and existing installations.

8.0 REFERENCES

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