Power supply insurance solutions for fire protection

Sisteme de menținere a alimentării cu energie electrică pentru protecție la incendiu

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Abstract. *The study analyzes the benefits of implementing automatic transfer systems of the main electricity supply with one or more backup supplies in the event of a breakdown caused by a fire or other unforeseen events. Transfer switch using relays as phase failure protection is a gear switch control system with the main purpose of transferring load between a primary source (Public Utility) and a secondary power supply sources (Generator1 and Generator2) which are stand by power sources and eliminating frequent manual switching of change over device when there is power outage.*

Key words: backup supplies, fire, control system, maintenance

1. Introduction

The power supply insurance of the electrical installations serving buildings is very important, especially in buildings where a large number of people work (hospitals, hotels, commercial premises, public buildings, subways) [1].

Usually, the backup power sources (alternative) used are:

- accumulators;
- fixed or portable generators capable of operating independently;
- separate power supply that is independent from the main power supply with reduced risk of failure at the same time.

On the other hand, consideration may also be given to installing a duplicate power supply from a three-phase source, where possible [1].

A link between the main and back-up power sources is an important aspect in ensuring the continuity of the electrical energy supply. This connection can be

achieved through low voltage automatic transfer switch assemblies (ATS) that provide a reliable means of transferring the connection between the two sources.

Basically, an automatic transfer switch (ATS) is an intelligent, self-acting power switching device governed by dedicated control logic. The main purpose of an ATS is to ensure the continuous supply of electrical energy from one of two power sources to a connected load circuit (electrical equipment - lights, motors, computers, etc.). The automatic controller is usually microprocessor-based and constantly monitors the electrical parameters (voltage, frequency) of the primary and alternative power sources. Upon failure of the connected power source, the ATS will automatically transfer (switch) the load circuit to the other power source (if available). As a general rule, most automatic transfer switches seek connection to the primary power source (utility) by default and will connect to the alternate power source (motor-generator, backup utility) only when required (primary source failure) or when prompted to do so (operator command) (Fig.1) [2], [3], [4].

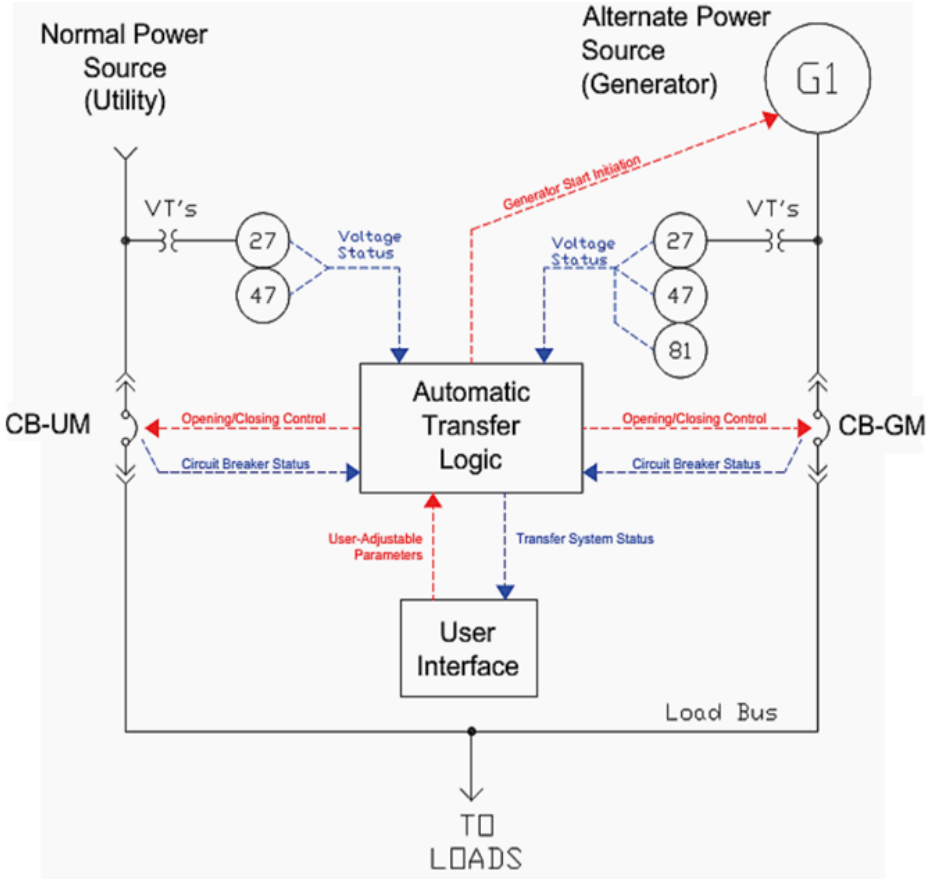

Fig.1. Automatic Transfer Scheme Detail [4]
CB-UM/GM – Circuit Breaker Utility/Generator Module, VT's – Voltage Transformers, 27 – Undervoltage indicator, 47 – Negative sequence voltage, 81 – Frequency indicator

When the primary source (utility) fails and the load is transferred to the generator or any other secondary power source, the ATS system also monitors the

main supply, and when power is restored, or the supply power characteristics return to normal, it transfers the load back to the main supply and sends signals to stopping the generator or simply interrupting any other secondary source of electricity supply [3].

A variety of arrangements using two or three power supplies are available [1]:

- *with two power sources:*

- main power source (mains) and backup generator;

- main source-main source (ensures redundancy in the distribution system and allows rapid restoration of service to the load if a failure of upstream equipment occurs). This configuration is suitable for dual power supply or redundant power supply.

- generator-generator: for the use of energy (remote installations) between two sets of generators, transfer switches are applied

- *with three power sources:*

- main source-generator-generator: this configuration additionally has a second connection to a generator considered as an emergency redundant backup that can be used during periods of bad weather or when the first generator is scheduled for maintenance. In this configuration, as a rule, the first generator is fixed, and the second is mobile and is installed only when necessary.

- main source-main source-generator: this configuration extends the redundancy provided by a dual main source configuration and includes an emergency standby generator source.

From the point of view of transfer types ATS switches ensures the transit of loads between the main and backup power sources with the options [1]:

- open: the switch interrupts the connection to one power source before making the connection to the other;

- closed: the switch makes the connection to the second power source before breaking the connection to the first source.

2. Use of ATS systems in case of damage caused by fires

The utility of these systems in case of breakdowns in the electrical power supply installation of the building's vital systems in emergency situations, such as the emergency lighting system, HVAC systems, security, and access control systems, etc., is very important and brings important benefits in the operation of these installations.

The concept of the utility of automatic transfer systems in case of emergencies caused by the occurrence of a fire consists in ensuring the continuous supply of the safety installations of the building if the main supply suffers a breakdown. You can also use the double feeding method and it is very efficient.

This method is based on a main supply which at a certain point, usually in the basement of the building, is divided into two supply routes, as far as possible from each other, so that if there is a fire in one part of the building, the main supply is damaged, the automatic transfer system switches the supply of all emergency

installations with the secondary supply from the other individual route, thus gaining reaction time and evacuation of the building in maximum safety conditions (Fig.2) [4].

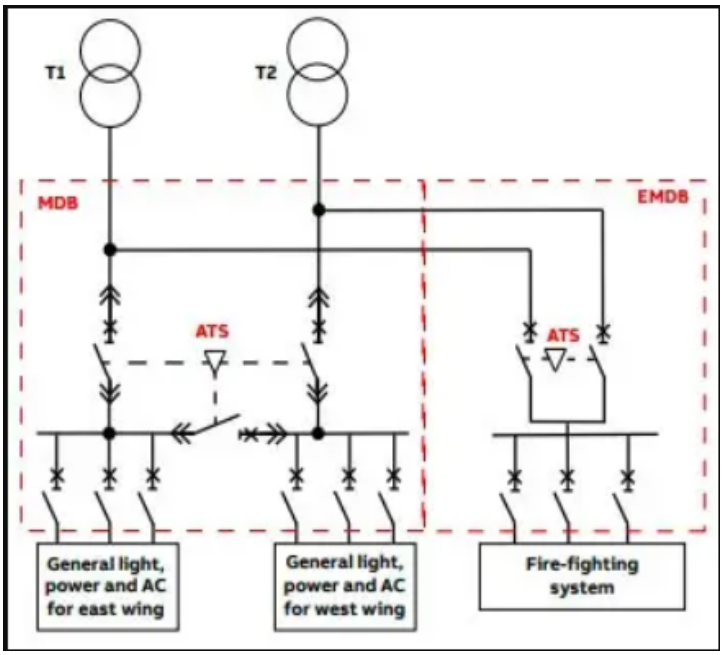

Fig. 2. ATS backing up supply for loads [4]
T1, T2 – Divided supply routes, MDB – Main Distribution Board,
EMDB – Emergency Main Distribution Board

Transfer switch needs can vary considerably from type to type,depending upon your structure's capacity and the purpose of the building.

The dimensioning of the transfer system must be done correctly in order to optimize its operation in the building installation and avoid malfunctions.

3. ATS types and maintenance

There are three general ATS types [4], [5]:

- Open transition (break-before-make): This breaks the load during the transfer between primary and secondary power. This is the most common type of ATS, however, it has the disadvantage of interrupting the supply even for a short period of time.
- Closed transition (make-before-break): When the load is affected, this type of ATS allows a transfer between two power sources without interruption during the transfer. This type of ATS is typically found in applications that require uninterruptible power supply to equipment.
- Delayed transition: This type of ATS operates similarly to the open transition type but affords a delay in load transition and is typically used in situations where residual voltages on inductive loads can dissipate before transition.

If an ATS works with a generator, they are independent. An ATS can be mounted in an electrical panel in a premises but is usually mounted on the generator housing. Fig. 3 highlights a typical ATS [4].

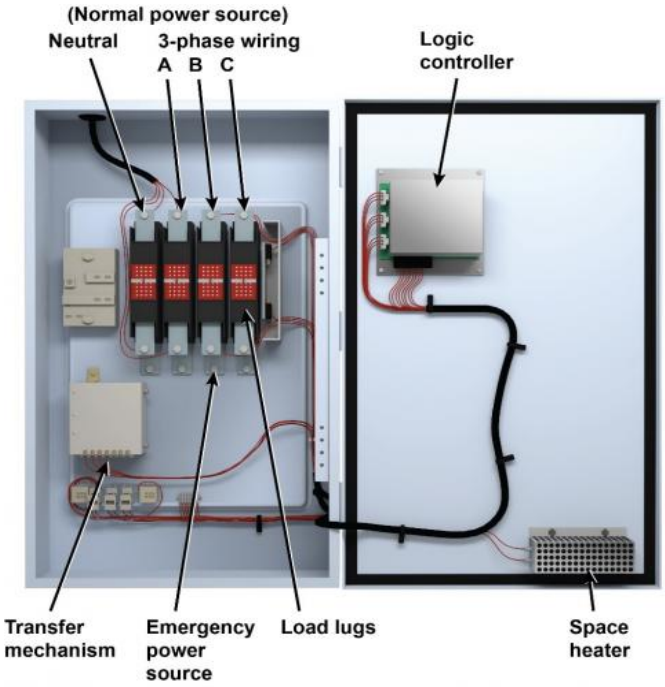

Fig. 3. Typical ATS configuration [4]

The example checklist in Table 1 [4] below provides recommended actions for ATS maintenance.

Maintenance must be performed periodically to ensure proper operation and to issue periodic installation inspection certificates.

Table 1

ATS Maintenance checklist

Component	Action	Maintenance Frequency		
		Monthly	Semi-Annually	Annually
ATS	Inspect all wiring, insulation, and connectors, look for crack's deformation, or discoloration due to excessive heat.	x		
	Check and replace any batteries if equipped.		x	
	Lubricate all mechanical parts as needed.			
	Conduct infrared (IR) thermography scan of connections and contacts; note areas of high heat conduction.			x

Component	Action	Maintenance Frequency		
		Monthly	Semi-Annually	Annually
	Check ATS operation to verify proper transfer from Emergency to Normal and back again. Initiate standby generator operation and run system for 1 hour under full building load.			x
	Performing inspection measurements of the installation to which the ATS is connected, checking electrical impedances and resistances.			x

4. Conclusions

In conclusion, automatic transfer systems are very beneficial in the operation of a building's installations, especially residential and office buildings, where the crowding of people speaks for itself in case of emergencies caused by fires.

These systems can ensure safe evacuation of buildings and at the same time ensure the quality of the energy supplied in the building to avoid possible failures caused by variations in the main power supply characteristics.

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