Buckeye Power Sales
Quality Equipment Solutions Since 1947

The U.S. is seeing expanding demand for standby generator systems. This growing demand reflects the Commercial, Residential, and Industrial sectors' intolerance of any power interruption and a Utility Grid that, in many areas, does not deliver the required level of reliability with minimal to no outages. In most cases, the Grid remains the primary power source, with engine-driven generator systems, both diesel- and gas-powered, as the most common backup secondary power. It is important to transfer power easily and safely between the primary and secondary power sources. Some applications, such as residential, use manual transfer, but most industrial and Commercial standby power systems use Automatic Transfer Switches (ATS). There are numerous types of ATSs, but this sheet covers Programmed Automatic Transfer Switches. This information sheet discusses what a programmed Automatic Transfer Switch is, when it is the required type of ATS, and the benefits of programming an ATS's switching functions as power is transferred between primary and secondary sources.

1.0 TYPES OF ATS:

An ATS is two sets of switches. One switches the load to the primary power supply, and the other switches the load to the secondary power supply. Different types of ATS transition loads between primary and secondary power. For the different types, see information sheet "Why Break before Make Contacts on Automatic Standby Generator Systems" for more details. This sheet mentions transition and explains how the control of transitioning the load between the primary and secondary power supplies can be programmed using predetermined transfer criteria.

ATSs, whether Break before Make or Make before Break, can both fall under the category of programmed-transition ATS. Programming determines when the transfer occurs, not just the automatic transition sequence when the primary goes offline or comes back online. See the information sheet Understanding Transition Delays of an ATS (particularly for motor loads).

Figure 1

Programmable Adjustments Offered for ATSs

Item	Programmable Transition	Programmable Adjustment Range	Comments
1	Under Voltage Trip	Adjust range < - 5% to - 10%	The sensor monitors steady-state voltage, usually within ±2.5 %. The adjustment range is dependent on the tolerance of the connected electrical load.
2	Over Voltage Trip	Adjust range > + 5% to + 10%	
3	Under Frequency Trip	Adjust range < - 2.5% to - 5%	The sensor monitors frequency changes as load is applied. In a 60 Hz system, the frequency should be maintained within ±0.55 %. The adjustment range depends on load transition time and output.
4	Over Frequency Trip	Adjust range > + 2.5% to + 5%	
5	Transfer to Secondary Source	Adjust range several minutes	Transfer to the secondary source may be delayed to allow residual voltage and magnetic field decay.
6	Return to Primary Source	Adjust range several minutes	Returning power to the primary source will depend on the reliability of the local primary source

Figure 2

Codes and Regulations Governing ATS Selection & Application

Item	Code/Standard	Description	Relevance to ATS Selected
1	UL 1008 - Standard for Safety	Product safety testing requirements for transfer switches	UL-Listed ATS required for NEC® compliance
2	National Electric Code®	Equipment installation standards	NEC compliance required to satisfy electrical inspections by local authorities
3	NFPA 110 Standard for Emergency and Standby Power Systems	Standard for backup power systems at facilities with regulated life safety systems	Drives periodic testing and reporting of backup power systems
4	NFPA 99 Healthcare Facilities	Standards for backup power systems in hospitals, surgery centers, and outpatient facilities	Drives backup power system design

The installation information provided in this information sheet is informational in nature only, and should not be considered the advice of a properly licensed and qualified electrician or used in place of a detailed review of the applicable National Electric Codes and local codes. Specific questions about how this information may affect any particular situation should be addressed to a licensed and qualified electrician.

2.0 THE BENEFITS OF PROGRAMMED TRANSITION ATSs:

A programmed transition ATS is utilized to manage power transitions smoothly and safely between primary and backup sources. The events that trigger an interruption of the primary power source are not always one-and-done; often, power drops in and out several times before a permanent, stable primary power source is restored. The codes applicable to ATS selection and application are detailed in ***Figure 2***.

When transition between power sources occurs only when the primary source totally drops out, and the transition back happens immediately after the primary source is restored, it does not protect the connected load from a primary source that could switch frequently on and off. The effects of frequent switching of electrical loads are numerous, including:

2.1 CIRCUIT OVERLOAD:

Rapidly switching loads can exceed the circuit's capacity, causing breakers to trip frequently.

2.2 WEAR AND TEAR:

Frequent on-off cycles can prematurely wear out electrical devices and components.

2.3 SAFETY HAZARDS:

Increased risk of short circuits and potential fire hazards due to overheating wires.

2.4 POWER FLUCTUATIONS:

This behavior can create unstable power conditions that affect sensitive electronics.

2.5 EFFECTS SEQUENCE STARTING OF ELECTRIC MOTORS:

Many industrial and commercial standby applications have loads comprising many electric motors. To avoid excessive current draw when starting these motors, stagger/sequence starting systems are used to reduce the total current drawn. Frequent switching within time periods shorter than the sequence-starting interval can cause starting issues.

3.0 PROGRAMMED TRANSITION ATSS USED TO IMPROVE POWER RELIABILITY:

By selecting a programmed transition ATS, a generator system designer can improve a facility's power reliability. Consider the following advantages:

3.1 IMPROVED CONTROL OF TRANSITIONING BETWEEN THE PRIMARY AND SECONDARY POWER SUPPLIES:

They allow a delay between disconnecting from one power source and connecting to another, preventing electrical surges..

3.2 PROTECTION OF THE CONNECTED EQUIPMENT LOAD:

The delay helps residual voltage decay, reducing the risk of damage during reconnection.

3.3 IMPROVED MONITORING OF THE SYSTEM:

These systems can be programmed to monitor voltage and frequency, ensuring a stable power supply.

3.4 IMPROVED RELIABILITY OF STANDBY SYSTEMS TO CRITICAL INSTALLATIONS:

They are essential in emergency power supply systems, maintaining continuity for critical infrastructure.

4.0 ELEMENTS OF PROGRAMMED TRANSITION ATSS:

Programming parameters within the ATS monitor all phases in a three-phase system, set the times to transition between power supplies, and determine when the ATS returns the load to the utility source after an outage. ***Figure 1*** details all the programmable components. The following parameters can be programmed:

4.1 PROGRAMMING VOLTAGE AND FREQUENCY SENSING/SETTINGS

The ATS controller continuously monitors all three phases of the utility source. Critical threshold settings include:

- **Undervoltage pickup:** Usually 80-85% of nominal voltage. Below this threshold, the ATS initiates transfer to the generator.
- **Overvoltage pickup:** Above 110% of nominal voltage to protect connected loads from sustained overvoltage.
- **Under Frequency Pickup:** This monitors the stability of the Utility supply and is set at 95% (57Hz on a 60Hz system)
- **Single-phase sensing:** To protect three-phase electric motors from damage, it is programmed to sense loss of a phase.

4.2 PROGRAMMING TIME DELAY SETTINGS

Proper time-delay monitoring of the power supply prevents nuisance transitions when the power is unstable.

- **Time delay to engine start (TDES):** 1-6 seconds. Allows momentary utility dips to recover before the generator is started.
- **Time delay to transfer (TDTD):** 0-30 seconds ensures the generator has reached rated voltage, frequency, and output.
- **Time delay to retransfer (TDRE):** 5-30 minutes ensures the utility is stable and not tripping in and out.
- **Engine cool-down time:** 5-15 minutes to run unloaded after retransfer for gradual engine cooling before shutdown.

4.3 TRANSFER LOGIC

Retransfer programming determines when and how the ATS returns the load to the utility source after an outage. Options include immediate retransfer upon utility restoration, time-delayed retransfer to verify stability, and programmed retransfer windows that avoid transferring during peak demand periods. For closed-transition ATS units, the retransfer sequence includes automatic synchronization verification before the momentary parallel operation.

To fulfill our commitment to be the leading supplier in the power generation industry, the Buckeye Power Sales team ensures they are always up-to-date with the current power industry standards as well as industry trends. As a service, our Information Sheets are circulated on a regular basis to existing and potential power customers to maintain their awareness of changes and developments in standards, codes and technology within the power industry.

Buckeye Power Sales
Quality Equipment Solutions Since 1947

ULTIMATE SERVICE ASSOCIATES
CRITICAL POWER SERVICES. NATIONWIDE.

CANAL WINCHESTER, OH
8155 Howe Industrial Parkway
Canal Winchester, OH 43110
(614) 751-4515
(866) 889-2628

CINCINNATI, OH
4992 Rialto Road
West Chester, OH 45069
(513) 755-2323
(800) 368-7422

CLEVELAND, OH
8465 Tower Drive
Twinsburg, OH 44087-0394
(330) 425-9165
(800) 966-2825

TOLEDO, OH
2550 Tracy Road, Unit 502
Northwood, OH 43619
(855) 638-2728

CHICAGO, IL
1308 Marquette Drive
Romeoville, IL 60446
(630) 914-3000

ROCKFORD, IL
6203 Material Ave.
Lover Park, IL 61111
(779) 208-8766

FORT WAYNE, IN
7525 Maplecrest Road #221
Fort Wayne, IN 46835
(855) 638-2721

INDIANAPOLIS, IN
1707 S. Franklin Road
Indianapolis, IN 46239
(317) 271-9661
(800) 632-0339