

SUGGESTED SPECIFICATION

for

Service Entrance Automatic Transfer & Bypass-Isolation Switches

Division 16 - Electrical Standby Power Generator Systems

PART 1 GENERAL

1.01 Scope

- A. Furnish and install automatic transfer & bypass-isolation switch (ATB) system(s) with number of poles, amperage, voltage, withstand and close-on ratings as shown on the plans. Each service entrance automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All service entrance automatic transfer & bypass-isolation switches and controllers shall be the products of the same manufacturer.
- B. Furnish an enclosure for the ATB that is for service entry. It shall provide all the proper disconnecting, protection, grounding and bonding required for service entrance equipment.

1.02 Codes and Standards

The service entrance automatic transfer and bypass-isolation switches and controls shall conform to the requirements of:

- A. UL 1008 - Standard for Transfer Switch Equipment
- B. IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching Equipment
- C. NFPA 70 - National Electrical Code
- D. NFPA 99 - Essential Electrical Systems for Health Care Facilities
- E. NFPA 110 - Emergency and Standby Power Systems
- F. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
- G. NEMA Standard ICS10-1993 (formerly ICS2-447) - AC Automatic Transfer Switches
- H. UL 508 Industrial Control Equipment
- I. UL 891 According to this UL standard the equipment shall be labeled: "Suitable for use only as service equipment."

1.03 Acceptable Manufacturers

Service entrance automatic transfer & bypass-isolation switches shall be ASCO 7000 Series. Any alternate shall be submitted for approval to the consulting engineer at least 10 days prior to bid. Alternate bids must list any deviations from this specification.

ASCO Power Technologies, Florham Park, New Jersey 07932. 800-800-ASCO www.ascopower.com

PART 2 PRODUCTS

2.01 Mechanically Held Transfer Switch

- A.** The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators which include overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.
- B.** All transfer switch sizes shall use only one type of main operator for ease of maintenance and commodity of parts.
- C.** The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.
- D.** All main contacts shall be silver composition. Switches rated 800 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.
- E.** Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 800 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.
- F.** Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.
- G.** Where neutral conductors must be switched as shown on the plans, the ATB shall be provided with fully rated overlapping neutral transfer contacts. The neutrals of the normal and emergency power sources shall be connected together only during the transfer and retransfer operation and remain connected together until power source contacts close on the source to which the transfer is being made. The overlapping neutral contacts shall not overlap for a period greater than 100 milliseconds. Neutral switching contacts which do not overlap are not acceptable.
- H.** Where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor plate with fully rated AL-CU pressure connectors shall be provided.

2.02 Bypass-Isolation Switch

- A.** A two-way bypass-isolation switch shall provide manual bypass of the load to either source and permit isolation of the automatic transfer switch from all source and load power conductors. All main contacts shall be manually driven.
- B.** Power interconnections shall be silver-plated copper bus bar. The only field installed power connections shall be at the service and load terminals of the bypass-isolation switch. All control inter-wiring shall be provided with disconnect plugs.
- C.** Separate bypass and isolation handles shall be utilized to provide clear distinction between the functions. Handles shall be permanently affixed and operable without opening the enclosure door. Designs requiring insertion of loose operating handles or opening of the enclosure door to operate are not acceptable.

- D. Bypass to the load-carrying source shall be accomplished with no interruption of power to the load (make before break contacts). Designs which disconnect the load when bypassing are not acceptable. The bypass handle shall have three operating modes: "Bypass to Normal," "Automatic," and "Bypass to Emergency." The operating speed of the bypass contacts shall be the same as the associated transfer switch and shall be independent of the speed at which the manual handle is operated. In the "Automatic" mode, the bypass contacts shall be out of the power circuit so that they will not be subjected to fault currents to which the system may be subjected.
- E. The isolation handle shall provide three operating modes: "Closed," "Test," and "Open." The "Test" mode shall permit testing of the entire emergency power system, including the automatic transfer switches with no interruption of power to the load. The "Open" mode shall completely isolate the automatic transfer switch from all source and load power conductors. When in the "Open" mode, it shall be possible to completely withdraw the automatic transfer switch for inspection or maintenance to conform to code requirements without removal of power conductors or the use of any tools.
- F. When the isolation switch is in the "Test" or "Open" mode, the bypass switch shall function as a manual transfer switch.
- G. Designs requiring operation of key interlocks for bypass isolation or ATSS which cannot be completely withdrawn when isolated are not acceptable.

2.03 Microprocessor Controller

- A. The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.
- B. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to $\pm 1\%$ of nominal voltage. Frequency sensing shall be accurate to $\pm 0.2\%$. The panel shall be capable of operating over a temperature range of -20 to +60 degrees C and storage from -55 to +85 degrees C.
- C. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator's manuals.
- D. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.
- E. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:

<ol style="list-style-type: none"> 1. EN 55011:1991 2. EN 50082-2:1995 	Emission standard - Group 1, Class A Generic immunity standard, from which: <ul style="list-style-type: none"> EN 61000-4-2:1995 Electrostatic discharge (ESD) immunity ENV 50140:1993 Radiated Electro-Magnetic field immunity EN 61000-4-4:1995 Electrical fast transient (EFT) immunity EN 61000-4-5:1995 Surge transient immunity EN 61000-4-6:1996 Conducted Radio-Frequency field immunity
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3. IEEE472 (ANSI C37.90A) Ring Wave Test.

2.04 Enclosure

- A. The ATB shall be furnished in a Type 1 enclosure unless otherwise shown on the plans.
- B. The Service Entrance ATB 400 amperes or less, shall be furnished in a single enclosure including a service (utility source) disconnect circuit breaker and an emergency source feeder disconnect circuit, as well as the power transfer switch, grounding and bonding provisions.
- C. The Service Entrance ATB 600 amperes and above, shall be furnished in a multi-section switchboard as follows: a service equipment section containing the service (utility source) disconnect circuit breaker, grounding, and bonding provisions; plus, a second non-service section containing the power transfer switch and controls.
- D. All standard and optional door-mounted switches and pilot lights shall be 16-mm industrial grade type or equivalent for easy viewing & replacement. Door controls shall be provided on a separate removable plate, which can be supplied loose for open type units.
- E. A pressure disconnect link shall be provided to disconnect the normal source neutral connection from the emergency and load neutral connections for 4-mm wire applications. A ground bus shall be provided for connection of the grounding conductor to the grounding electrode. A pressure disconnect link for the neutral to ground bonding jumper shall be provided to connect the normal neutral connection to the ground bus.
- F. For those automatic transfer & bypass-isolation switches that are less than 1000 amperes, the connection between the normal disconnecting device and the ATB shall be made with the appropriate size cable. For those automatic transfer & bypass-isolation switches that are greater than 1000 amperes, the connection between the normal disconnecting device and the ATB shall be made with appropriate size bus. Bus shall be silver plated copper.

2.05 Disconnecting and Overcurrent Protection Device

- A. For those automatic transfer & bypass-isolation switches less than 1000 amps, the normal connection shall be provided with a thermal magnetic, 3 pole, molded case circuit breaker with current ratings as shown on the plan. It shall have a thermal magnetic trip unit.
- B. For those automatic transfer & bypass-isolation switches rated 1000 to 2000 amps, the normal connection shall be provided with a thermal magnetic, 3 pole, molded case circuit breaker with current ratings as shown on the plans. The circuit breaker shall be provided with a ground fault trip function when required by the National Electric Code. The circuit breaker shall trip open when the ground fault setting is exceeded.
- C. For those delayed transition transfer switches rated 3000 to 4000 amps the normal connection shall be provided with a stationary mount, insulated case circuit breaker with a solid state trip unit. The trip unit shall have adjustable long time, short time, instantaneous and ground fault trip settings. The circuit breaker shall trip open when the ground fault setting is exceeded.

PART 3 OPERATIONS

3.01 Controller Display and Keypad

A. A four line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:

1. Nominal line voltage and frequency
2. Single or three phase sensing
3. Operating parameter protection
4. Transfer operating mode configuration
(Open transition, Closed transition or Delayed transition)

All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

3.02 Voltage, Frequency and Phase Rotation Sensing

A. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout and trip setting capabilities (values shown as % of nominal unless otherwise specified):

<u>Parameter</u>	<u>Sources</u>	<u>Dropout / Trip</u>	<u>Pickup / Reset</u>
Undervoltage	N&E,3 ϕ	70 to 98%	85 to 100%
Overvoltage	N&E,3 ϕ	102 to 115%	2% below trip
Underfrequency	N&E	85 to 98%	90 to 100%
Overfrequency	N&E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below dropout

B. Repetitive accuracy of all settings shall be within $\pm 0.5\%$ over an operating temperature range of -20°C to 60°C .

C. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.

D. The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).

E. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.

F. The controller shall include a user selectable algorithm to prevent repeated transfer cycling to a source on an installation which experiences primary side, single phase failures on a Grounded Wye – Grounded Wye transformer which regenerates voltage when unloaded. The algorithm shall also inhibit retransfer to the normal (utility) source upon detection of a single phasing condition until a dedicated timer expires, the alternate source fails, or the normal source fails completely and is restored during this time delay period. The time delays associated with this feature shall be adjustable by the user through the controller keypad and LCD.

3.03 Time Delays

- A. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.
- B. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.
- C. Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.
- D. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
- E. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minute time delay in any of the following modes:
 - 1. Prior to transfer only.
 - 2. Prior to and after transfer.
 - 3. Normal to emergency only.
 - 4. Emergency to normal only.
 - 5. Normal to emergency and emergency to normal.
 - 6. All transfer conditions or only when both sources are available.
- F. The controller shall also include the following built-in time delays for optional Closed Transition and Delayed Transition operation:
 - 1. 1 to 5 minute time delay on failure to synchronize normal and emergency sources prior to closed transition transfer.
 - 2. 0.1 to 9.99 second time delay on an extended parallel condition of both power sources during closed transition operation.
 - 3. 0 to 5 minute time delay for the load disconnect position for delayed transition operation.
- G. All time delays shall be adjustable in 1 second increments, except the extended parallel time, which shall be adjustable in .01 second increments.
- H. All time delays shall be adjustable by using the LCD display and keypad or with a remote device connected to the serial communications port.

3.04 Additional Features

- A. A three position momentary-type test switch shall be provided for the **test/automatic/reset** modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.

- B. A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
- C. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATB is connected to the normal source and one contact closed, when the ATB is connected to the emergency source.
- D. LED indicating lights (16 mm industrial grade, **type 12**) shall be provided; one to indicate when the ATB is connected to the normal source (green) and one to indicate when the ATB is connected to the emergency source (red).
- E. LED indicating lights (16 mm industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.

The following features shall be built-in to the controller, but capable of being activated through keypad programming or the serial port only when required by the user:

- F. Provide the ability to select “commit/no commit to transfer” to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
- G. Terminals shall be provided for a remote contact which opens to signal the ATB to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.
- H. An Inphase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The Inphase monitor shall be specifically designed for and be the product of the ATB manufacturer. The Inphase monitor shall be equal to ASCO Feature 27.
- I. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.
- J. **Engine Exerciser** - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:
 - 1. Enable or disable the routine.
 - 2. Enable or disable transfer of the load during routine.
 - 3. Set the start time:
 - time of day
 - day of week
 - week of month (1st, 2nd, 3rd, 4th, alternate or every)
 - 4. Set the duration of the run.

At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.

- K. System Status** - The controller LCD display shall include a "System Status" screen which shall be readily accessible from any point in the menu by depressing the "ESC" key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position. For example,

***Normal Failed
Load on Normal
TD Normal to Emerg
2min15s***

Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator's manual, are not permissible.

- L. Self Diagnostics** - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.

- M. Communications Interface** – The controller shall be capable of interfacing, through an optional serial communication module, with a network of transfer switches, locally (up to 4000 ft.) or remotely through modem serial communications. Standard software specific for transfer switch applications shall be available by the transfer switch manufacturer. This software shall allow for the monitoring, control and setup of parameters.

- N. Data Logging** – The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:

1. Event Logging

1. Data and time and reason for transfer normal to emergency.
2. Data and time and reason for transfer emergency to normal.
3. Data and time and reason for engine start.
4. Data and time engine stopped.
5. Data and time emergency source available.
6. Data and time emergency source not available.

2. Statistical Data

1. Total number of transfers.
2. Total number of transfers due to source failure.
3. Total number of days controller is energized.
4. Total number of hours both normal and emergency sources are available.

- O. Communications Module** - A full duplex RS485 interface shall be installed in the ATB controller to enable serial communications. The serial communications shall be capable of a direct connect or multi-drop configured network. This module shall allow for the seamless integration of existing or new communication transfer devices. The serial communication interface shall be equal to ASCO Accessory 72A.

PART 4 ADDITIONAL REQUIREMENTS

4.01 Withstand and Closing Ratings

- A.** The ATB shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATB terminals with the type of overcurrent protection shown on the plans.
- B.** The ATB shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long-time ratings. ATB's which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.

4.02 Tests and Certification

- A.** The complete ATB shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.
- B.** Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
- C.** The ATB manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.
- D.** The transfer switch system must contain a disconnect device on the normal source as well as a disconnect link on the utility neutral and a disconnect link between neutral and ground. The ATB manufacturer shall be certified to NEC 230.70, 230.70(B), 230.75 and 230.95.

4.03 Service Representation

- A.** The ATB manufacturer shall maintain a national service organization of company-employed personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.
- B.** The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

Note Spec Writer: *The following section is optional and should be deleted if not used.*

PART 5 OPTIONAL FEATURES

5.01 POWER MANAGER

1. *Furnish Power Managers at locations shown to monitor all functions specified below.*
2. *The Power Managers shall be listed to UL 3111-1, CSA, CE Mark, and industrially rated for an operating temperature range of -20°C to 60°C.*
3. *The Power Manager shall be accurate to 1% measured, 2% computed values and display resolution to .1%. Voltage and current for all phases shall be sampled simultaneously to assure high accuracy in conditions of low power factor or large waveform distortions (harmonics).*
4. *The Power Manager shall be capable of operating without modification at nominal frequencies of 45 to 66 Hz and over a control power input range of 20 – 32VDC.*
5. *Each Power Manager shall be capable of interfacing with an optional communications module to permit information to be sent to central location for display, analysis, and logging.*
6. *The Power Manager shall accept inputs from industry standard instrument transformers (120 VAC secondary PT's and 5A secondary CTS.) Direct phase voltage connections, 800 VAC and under, shall be possible without the use of PT's.*
7. *The Power Manager shall be applied in single, 3-phase, or three & four wire circuits. A fourth CT input shall be available to measure neutral or ground current.*
8. *All setup parameters required by the Power Managers shall be stored in non-volatile memory and retained in the event of a control power interruption.*
9. *The following metered readings shall be communicated by the Power Manager, via serial communication, when equipped with optional serial communications module:*
 - a) *Current, per phase RMS and neutral (if applicable)*
 - b) *Current Unbalance %*
 - c) *Voltage, phase-to-phase and phase-to-neutral*
 - d) *Voltage Unbalance %*
 - e) *Real power (KW), per phase and 3-phase total*
 - f) *Apparent power (KVA), per phase and 3-phase total*
 - g) *Reactive power (KVAR), per phase and 3-phase total*
 - h) *Power factor, 3-phase total & per phase*
 - i) *Frequency*
 - j) *Accumulated Energy, (MWH, MVAH, and MVARH)*

The following energy readings shall be communicated by the Power Manager:

- a) Accumulated real energy KWH*
- b) Accumulated reactive energy KVAH*
- c) Accumulated apparent energy KVARH*

NOTE: For real and reactive energy reported values, separate total for energy flow from each source shall be stored, including the arithmetic sum.

10. Power Manager Input/Output Options.

- a) Power Managers shall be equipped with the following I/O:
 - 1) Provide (8) solid state status inputs.*
 - 2) Provide four (4) relay output contacts**

****Note Spec Writer:** The following section is optional and should be deleted if not used.*

The Power Manager shall flush mount to an enclosure.

- 1. The Power Managers shall be equipped with an optional continuous duty, long-life, 4 line x 20 character LCD backlit display to provide local access to the following metered quantities:
 - a) Current, per phase RMS and neutral (if applicable)*
 - b) Current Unbalance %*
 - c) Voltage, phase-to-phase and phase-to-neutral*
 - d) Voltage Unbalance %*
 - e) Real power, per phase and 3-phase total*
 - f) Apparent power, per phase and 3-phase total*
 - g) Reactive power, per phase and 3-phase total*
 - h) Power factor, 3-phase total & per phase*
 - i) Frequency*
 - j) Accumulated Energy, (MWH, MVAH, and MVARH)**
- 2. Displaying each of the Power Manager quantities shall be accomplished through the use of menu scroll buttons.*
- 3. For ease in operator viewing, the display shall remain on continuously, with no detrimental effect on the life of the Power Manager.*
- 4. Setup for system requirements shall be allowed from the front of the Power Manager. Setup provisions shall include:
 - a) CT rating (xxxxx: 5)*
 - b) PT rating (xxxxxxx:120) (if applicable; 24000V maximum)*
 - c) System type (single; three phase; 3 and 4 wire)*
 - d) Communication parameters**
- 5. Reset of the following electrical parameters shall also be allowed from the front of the Power Manager:
 - a) Real energy (MWH), apparent energy (MVAH) and reactive energy (MVARH).**
- 6. All reset and setup functions shall have a means for protection against unauthorized/accidental changes.*