SUGGESTED SPECIFICATION

for

Automatic Delayed – Transition Transfer Switches

Division 16 - Electrical
Standby Power Generator Systems

PART 1 GENERAL

1.01 Scope

A. Furnish and install delayed transition transfer switches (DTTS) with number of poles, amperage, voltage, withstand and close-on ratings as shown on the plans. Each DTTS shall consist of a power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer.

B. The DTTS shall transfer the load in delayed transition (break –before-make) mode. Transfer is accomplished with a user – defined interruption period in both directions adjustable from 1 second to 5 minutes in at least 15 increments.

1.02 Codes and Standards

The delayed transition transfer 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 Controlgear; 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

1.03 Acceptable Manufacturers

Delayed transition transfer switches shall be ASCO 4000 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.

PART 2 PRODUCTS

2.01 Mechanically Held Transfer Switch

A. The transfer switch unit shall be electrically operated and mechanically held. The electrical operator shall be a solenoid mechanism, momentarily energized. The transfer switch unit shall include both electrical and mechanical interlocks to prevent both sets of main contacts from being closed at the same time. Main operators which include overcurrent disconnect devices OR do not include electrical and mechanical interlocks will not be accepted.

B. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality 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 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 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 or Ethernet connectivity 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 ± 1% of nominal voltage. Frequency sensing shall be accurate to ± 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. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:

1. EN 55011:1991 Emission standard - Group 1, Class A

2. EN 50082-2:1995 Generic immunity standard, from which:

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

3. IEEE472 (ANSI C37.90A) Ring Wave Test.

2.03 Enclosure

A. The DTTS shall be furnished in a Type 1 enclosure unless otherwise shown on the plans.

B. All standard door mounted switches and indicating lights described in section 3 shall be integrated into flush – mounted, interface membrane or equivalent in the enclosure door for easy viewing % replacement. The panel shall include a manual locking feature to allow the user to lockout all membrane mounted control switches to prevent unauthorized tampering. The membrane panel shall be suitable for mounting by others when furnished on open type units.

PART 3 OPERATION

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 communications interface 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):

Parameter	Sources	Dropout / Trip	Pickup / Reset
Undervoltage	N&E,3ϕ	70 to 98%	85 to 100%
Overvoltage	N&E,3ϕ	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 ± 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 the communications interface port.

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.

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 delay for Delayed Transition operation:

1. 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 communications interface port.

3.04 Additional Features

A. Membrane-type switches shall be provided for the ***test*** and ***retransfer to normal*** functions. The test position will simulate a normal source failure. The retransfer to normal position shall bypass the time delays on 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 two contacts, closed when the DTTS is connected to the normal source and two contacts closed, when the DTTS is connected to the emergency source.

D. LED indicating lights shall be provided; one to indicate when the DTTS is connected to the normal source (green) and one to indicate when the DTTS is connected to the emergency source (red).

E. LED indicating lights 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.

F. A membrane switch shall be provided on the membrane panel to test all indicating lights when pressed.

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

G. 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.

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 DTTS 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 when a non-automatic version of the user interface membrane is furnished.

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. Key Locking Feature – The control switches on the interface membrane shall be capable of being locked via password protected screens on the controller LCD display to prevent unauthorized tampering. A red LED indicator shall be illuminated on the interface membrane when the membrane controls are locked.

The following feature shall be built - into the controller, but capable of being activated through keypad programming or the communications interface port.

Note: The transfer switch will operate in a non-automatic mode with this feature activated.

L. Terminals shall be provided for a remote contact which opens to signal the DTTS 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 the communications interface port.

M. 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

N. 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.

O. 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.

P. Communications Interface – The controller shall be capable of interfacing, through an optional communications interface module, with a network of transfer switches. It shall be able to connect via an RS-485 Serial communication module (up to 4000 ft. direct connect or multi-drop configuration), an Ethernet connectivity module (over standard 10baseT Ethernet networks) or remotely through PSTN dial-up modem communications. This module shall allow for seamless integration of existing or new communication transfer devices. 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. The transfer switch shall also be able to interface to 3rd party applications using ModbusRTU and ModbusTCP open standard protocols. The communication interface module shall be equal to ASCO Accessory 72A (RS-485 Serial), ASCO Accessory 72E (10BaseT Ethernet), or ASCO Accessory 92A (PSTN dial-up modem).

Q. 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.

PART 4 ADDITIONAL REQUIREMENTS

4.01 Withstand and Closing Ratings

A. The DTTS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the DTTS terminals with the type of overcurrent protection shown on the plans.

B. The DTTS 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. DTTSs 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 DTTS 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 DTTS 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.

4.03 Service Representation

A. The DTTS 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

A. *Furnish Power Managers at locations shown to monitor all functions specified below.*

B. *The Power Manager shall be listed to UL 3111-1, CSA, CE Mark, and industrially rated for an operating temperature range of -20°C to 60°C.*

C. *The Power Manager shall be accurate to 0.25% of measured and computed values and display resolution to 0.25%. 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).*

D. *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 – 32 VDC.*

E. *The Power Manager shall accept inputs from industry standard instrument transformers (120 VAC secondary PT's and 5A secondary CT's.) Direct phase voltage connections, 600 VAC and under, shall be possible without the use of PT's.*

F. *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.*

G. *All setup parameters required by the Power Manager shall be stored in non-volatile memory and retained in the event of a control power interruption.*

H. *Each Power Manager shall be capable of interfacing to a communications network to permit information to be sent and received by a central location for display, analysis, logging, and control.*

I. *The Power Manager shall have an embedded 4-wire RS-485 serial interface for stand alone applications. Additionally, 4-wire RS-485, 2-wire RS-485, and Ethernet communications shall also be available via an optional communications interface module. One communications module shall allow for connections from both a Transfer Switch and Power Manager simultaneously to the communications network.*

J. *The Power Manager shall be able to interface to 3rd party applications using the ModbusRTU and ModbusTCP open standard protocols. Communications interface modules shall be used as needed to provide the RS-485 or Ethernet Connection. This connection shall allow for monitoring of metered readings, event logs, and status inputs, as well as control of status outputs and setpoint acknowledgements.*

K. *The following metered readings shall be communicated by the Power Manager*

over the communications network interface. All readings shall provide indication of which source is being measured.

1. *Current, per phase RMS and neutral (if applicable)*
2. *Current Unbalance %*
3. *Voltage, phase-to-phase and phase-to-neutral (if applicable)*
4. *Voltage Unbalance %*
5. *Real power (KW), per phase and 3-phase total*
6. *Apparent power (KVA), per phase and 3-phase total*
7. *Reactive power (KVAR), per phase and 3-phase total*
8. *Power factor, 3-phase total & per phase*
9. *Frequency*
10. *Accumulated Energy, (MWH, MVAH, and MVARH)*

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

1. *Accumulated real energy KWH*
2. *Accumulated reactive energy KVAH*
3. *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.

M. *Power Managers shall be equipped with the following hardwire Input/Output Options:*

1. *Provide one dedicated solid state status input to indicate transfer switch position if used to monitor a transfer switch.*
2. *Provide eight solid state status inputs.*
3. *Provide four relay output contacts. Relay outputs shall be Form C dry contacts, UL/CSA rated 1A@30Vdc, 0.5A@125Vac resistive load.*

N. Provisions for external DC Power Supply – An optional provision shall be available to connect an external 24 VDC power supply to allow the LCD and the door mounted control indicators to remain functional when both power sources are dead. This option shall be equivalent to ASCO accessory 1G.

O. *Power Manager shall be equipped with protective programmable setpoints. These setpoints shall be able to be used to annunciate an alarm or trigger an output relay on the following conditions.*

1. *KW overload pre-alarm*
2. *KW overload alarm*
3. *Over voltage*
4. *Under voltage*
5. *Over frequency*
6. *Under frequency*
7. *Reverse/Under power*
8. *Reverse VARS*
9. *Reverse over current*
10. *Negative sequence over current*
11. *Negative sequence voltage*
12. *Digital Inputs(1:8)*

P. *Each programmable setpoint shall allow the user to select:*

1. *The parameter*
2. *The trip level*
3. *The reset level*
4. *The trip time delay*
5. *The reset time delay*
6. *The alarm type or digital output*
7. *Whether acknowledgement of the alarm is required*

Q. *The Power Manager shall have a Device 86 feature that can latch an output relay closed whenever a setpoint configured to that relay is tripped. The relay shall only open when the reset conditions have been met, and the alarm is acknowledged by an operator.*

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

A. *The Power Manager shall flush mount to an enclosure.*

B. *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:*

1. *Current, per phase RMS and neutral (if applicable)*
2. *Current Unbalance %*
3. *Voltage, phase-to-phase and phase-to-neutral (if applicable)*
4. *Voltage Unbalance %*
5. *Real power (KW), per phase and 3-phase total*
6. *Apparent power (KVA), per phase and 3-phase total*
7. *Reactive power (KVAR), per phase and 3-phase total*
8. *Power factor, 3-phase total & per phase*
9. *Frequency*
10. *Accumulated Energy, (MWH, MVAH, and MVARH)*

C. *Displaying each of the Power Manager quantities shall be accomplished through the use of menu scroll buttons.*

D. *For ease in operator viewing, the display shall remain on continuously, with no detrimental effect on the life of the Power Manager.*

E. *Setup for system requirements shall be allowed from the front of the Power Manager. Setup provisions shall include:*

1. *CT rating (xxxxx:5)*
2. *PT rating (xxxxxxx:120) (if applicable; 24000V maximum)*
3. *System type (single; three phase; 3 and 4 wire)*
4. *Source to be monitored (Normal, Emergency, Load, Other)*
5. *Nominal Values (kW capacity, voltage, current, frequency)*
6. *Communication parameters*

F. *Reset of the following electrical parameters shall also be allowed from the front of the Power Manager:*

1. *Accumulated real energy KWH*

2. *Accumulated reactive energy KVAH*
3. *Accumulated apparent energy KVARH*

G. *The Power Manager shall have the ability to display entries from the Setup log on the LCD display. It shall also have the ability to clear the Setup log database from the display.*

H. *The Power Manager shall have the ability to display entries from the Event log both locally on the LCD display and remotely over the communications interface. It shall also have the ability to clear the Event log database from the display.*

I. *All reset and setup functions shall have a means for protection against unauthorized/accidental changes.*

5.02 *Control Relay Interface Board*

A. *An optional plug-in relay board shall be furnished which mounts on the back of the membrane interface board. The relay board shall contain four relays with form C contacts rated 2A @ 30Vdc, 0.5A@125Vac.*

B. *The function of relays RL1 through RL3 is as follows:*

1. *RL1 energized if emergency source acceptable output is active.*
2. *RL2 energized if normal source acceptable output is active.*
3. *RL3 energized if load disconnect signal output is active.*

C. *The function of RL4 shall be capable of being configured via DIP switches on the control relay board, as shown:*

4. *position 1 on relay energized if normal source acceptable output is active*
5. *position 2 on relay energized if emergency source acceptable output is active*
6. *position 3 on relay energized if extended parallel output is active (for Closed Transition Switches only).*
7. *position 4 on relay energized if ATS locked out output is active (for Closed Transition Switches only).*
8. *position 5 on relay energized if fail to sync / load disconnect output is active (for Closed or Delayed Transition Switches only).*

D. *Multiple conditions can be used to energize RL4 by activating more than one switch. For example, if both positions 1 and 2 are on, the relay will be energized if either the normal or emergency source is acceptable.*

5.03 Provisions for External DC Power Supply *– An optional provision shall be available to connect an external 24 VDC power supply to allow the LCD and the door mounted control indicators to remain functional when both power sources are dead. The option shall be equivalent to ASCO accessory 1G.*