

SUGGESTED SPECIFICATION
for
ASCO 7000 Series Soft Load Transfer Switch

Spec writer please note: This switch will interconnect one emergency generator to the utility. It cannot be used for controlling multiple generators or having multiple soft load systems control a single generator. This usually necessitates obtaining approval from the local distribution utility company. The generator set must be equipped with an automatic isochronous governor and solid state voltage regulator with analog aux. controls, each suitable for parallel with utility operation. If voltage regulator only supports raise/lower contacts, the voltage regulator must be capable of independent VAR/PF control (relay accessory required for voltage matching.)

Division 16 - Electrical
Power Systems

PART 1 GENERAL

1.1 Scope

- A.** Furnish and install a soft load transfer switch (SLTS) with number of poles, amperage (4000 amps maximum), voltage and withstand/close-on ratings as shown on the plans. All components, testing, and services specified or required for a complete operable system shall be included and shall be the product of the same manufacturer.

1.2.1 General Design Requirements:

- A.** The SLTS shall consist of a power transfer switch, transfer switch (TS) controller, soft load controller (SLC) and graphical user interface (GUI), one utility power manager transducer (PMT) and one generator power manager transducer. The SLTS shall provide soft load transfer between the utility and generator source with the following selectable operating modes:
- 1) **Soft Load Transfer Mode:** Allows the load to be completely isolated from the utility using a programmed soft load transfer/retransfer sequence to or from the generator.
 - 2) **Maintained Parallel Base Load:** This mode setting maintains parallel connection of the generator with the utility until a local or remote signal terminates this condition. The generator will operate at the base load level set by the user on the GUI.
 - 3) **Maintained Parallel Import / Export:** Similar to the Maintained Parallel Base Load mode except it allows programmable settings of the amount of KW being supplied by the utility and generator.

Note: An open transition, emergency standby transfer shall always be automatically selected in the event the either source connected to the load becomes unacceptable while in any of above three modes.

- B.** The TS controller shall retain master control of the Power Transfer Switch for all transfer functions, including conventional open transition, closed transition and soft load transfer operations. It shall initiate a soft load transfer either by manual input from the transfer mode selector switch located on the front panel, or automatically based on control signal input from the soft load controller (SLC). Upon loss of a power source, or loss of the serial communications signal within the soft load system, the TS controller shall automatically assume control of the power switching operation and provide a conventional open transition transfer (no overlap during load transfer).
- C.** The soft load controller (SLC) shall handle the user interface for all control and protective function settings and shall be programmable through an LCD with touch-screen. The SLC shall also handle the following functions:
- 1) Communications between all control and protective devices (TS controller, Generator Power Manager Transducer, and Utility Power Manager Transducer) in the soft load transfer system.
 - 2) Transmission of all alarm conditions, synchronization of power sources, voltage matching, VAR/power factor control, and generator loading/unloading control algorithms.
 - 3) Generation of analog voltage signals and a pulse width modulated signal to drive external speed control, and voltage regulator.
 - 4) Communications over an Intranet, the Internet, or Modbus RTU based systems via Ethernet or RS485.
- D.** All screen displays, operating labels, and operator's manual shall be available in English and Spanish at a minimum.

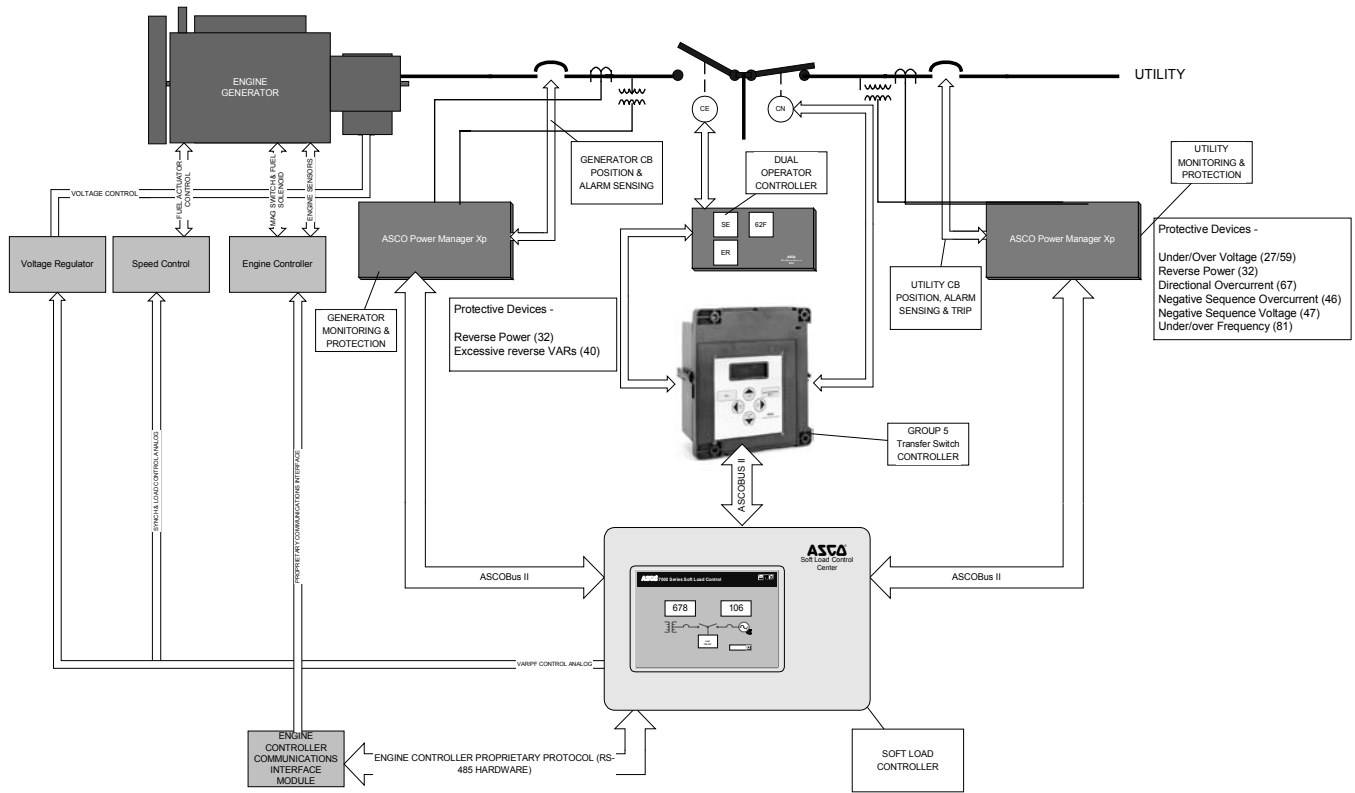
E. Utility Power Manager Transducer (PMT)

The Utility PMT shall monitor the utility power parameters and provide protective relaying functions, including relay outputs for external circuit breaker tripping control. The utility power parameters and alarming information shall be serially communicated to the SLC for control and display. These functions shall be internal to the PMT and shall not be dependent on the SLC except for set up.

F. Generator Power Manager Transducer (PMT)

The Generator PMT shall monitor the generator power parameters and provide protective relaying functions; relay outputs for generator circuit breaker control and system alarm conditions. The generator power parameters and alarming information shall be serially communicated to the SLC for control and display. These functions shall be internal to the PMT and shall not be dependent on the SLC except for set up.

G. Soft Load System Block Diagram.



1.3 Related Sections

- A. Section 16XXX: Generators
- B. Section 16XXX:

1.4 Application Codes and Standards

- A. IEC 60947-6-1 Low-voltage Switchgear and Controlgear; Multifunction equipment; Automatic Transfer Switching Equipment.
- B. IEEE Standard 446 – IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
- C. National Fire Protection Association (NFPA). NFPA - 70 - National Electrical Code
- D. NFPA -110 - Emergency and Standby Power Systems
- E. NFPA - 99 - Essential Electrical Systems for Health Care Facilities.
- F. NEMA Standard ICS10-1993 (formerly ICS2-447) - AC Automatic Transfer Switches
- G. UL 1008 – Standard for Transfer Switch Equipment
- H. UL 508 Industrial Control Equipment
- I. UL 891 Dead Front Switchboards for circuit breaker versions

1.5 Manufacturer's Qualifications

The Automatic Soft Load Transfer Switch 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.

PART 2 - PRODUCTS

2.01 Power Transfer Switch

- A. The power transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, solenoid mechanism. Main operators that include over-current disconnect devices; linear motors or gears shall not be acceptable.
- 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 600 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 600 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.
- J. 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 Transfer Switch (TS) Controller

- A. The transfer switch 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 with the soft load controller.
- 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 controller 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 controller 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:
 - 1) IEEE472 (ANSI C37.90A) Ring Wave Test.
 - 2) ENC55011 1991 Class A Conducted and Radiated Emission.
 - 3) EN61000-4-2 Electrostatic Discharge Immunity, Direct Contact & Air Discharge.
 - 4) EN61000-4-3 Radiated Electromagnetic Field Immunity.
 - 5) EN61000-4-4 Electrical Fast Transient Immunity.
 - 6) EN61000-4-5 Surge Immunity.
 - 7) ENV50141 HF Conducted Disturbances Immunity.

2.03 Transfer Switch (TS) 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 open transition and closed transition operational parameters. 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

All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or operator's manual.

2.04 Transfer Switch (TS) Controller - 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
Under-voltage	N&E, 3 ϕ	70 to 98%	85 to 100%
Over-voltage	N&E, 3 ϕ	102 to 115%	2% below trip
Under-frequency	N&E	85 to 98%	90 to 100%
Over-frequency	N&E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below dropout

Note: The (TS) Controller and both Power Manager Transducers are all continuously monitoring the normal and emergency sources. The above settings are applicable to emergency standby, open transition transfers only in the event the source connected to load becomes unacceptable. An unacceptable source would be when their measured values are below the dropout or above the trip settings listed above.

- 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.
- D. Source differential sensing shall be provided for all soft load (load is simultaneously connected to both sources) operating modes. The TS controller shall enable transfer/re-transfer between live sources in the soft load modes only when the two sources have a maximum voltage differential of 5 %, frequency differential of 0.2 Hz and the sources are within 5 electrical degrees.
- E. The controller shall be capable 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).
- F. Source status screens shall be provided on the LCD display described below for both normal & emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.
- G. The controller shall include a synchronizing check function to ensure phase, voltage and frequency matching of both power sources. This function shall inhibit paralleling the sources until the voltage is within ± 5 %, the frequency to within ± 2 % Hz and the phase angle difference reduces to 5 degrees and is approaching zero.

2.05 Transfer Switch Controller - 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. An adjustable time delay of 0 to 6 seconds to override momentary emergency source outage to delay all retransfer signals during initial loading of engine generator set.
- D. Two time delay modes (which are independently adjustable) shall be provided on re-transfer too 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.
- E. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
- F. 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.

- G.** The controller shall also include a built-in 1 to 5 minute time delay on failure to synchronize normal and emergency sources prior to soft load transfer.
- H.** All TS Controller time delays shall be adjustable in 1-second increments by using the LCD display and keypad located on the enclosure door. The time delay value displayed on the LCD or remote device shall be the remaining time until the next event occurs.

2.06 Transfer Switch and Controller – Additional Features

- A.** 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.
- B.** Auxiliary contacts, rated 10 amps, 250 Vac shall be provided consisting of one contact, closed when the transfer switch is connected to the normal source and one contact closed, when the transfer switch is connected to the emergency source.
- C. 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 Emergency
0 min 15s
- D. 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.

The following features shall be built-in to the controller, but capable of being activated through keypad programming 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. Engine Exerciser** - The controller shall provide an integral 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)
 - 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.

2.07 Soft Load Controller (SLC)

- A.** The soft load control functions shall be provided by a single board microcomputer.
- B.** The SLC shall include a built in 6.5 inch 16 color, Graphic User Interface with touch screen for viewing & setting all programmable parameters in the SLC. It shall be capable of operating over a temperature range of –20 to +60 degrees centigrade.
- C.** The Graphical User Interface shall use windows-based menus to provide complete monitoring, control and configuration of the soft load transfer system. Folders shall be provided to monitor the Utility, Generator and Engine as follows:
 - 1) A simulated analog synchroscope shall be provided to illustrate the relative phase relationships of the utility and generator sources to the user.
 - 2) A digital and bar graph display, showing power in both kW and percent of total load, shall be provided for utility and generator sources.
 - 3) Real, reactive and apparent power, average line voltage, average phase current, frequency and power factor shall be displayed for each power source.
 - 4) Active displays shall indicate source acceptability, circuit breaker and transfer switch positions.
 - 5) A set-up folder shall provide user configuration of the system, including operating modes, functions and set points.
 - 6) Screens shall contain six levels of security to protect against unauthorized viewing or tampering of sensitive data.
 - 7) An event and setup log shall be provided which captures the following information:
 - Protective relay status
 - Transfer switch events
 - Power source status
 - Engine Start/Stop
 - Modes of operation
 - Alarms
 - Parameter setting changes
 - Communication status

The log shall be capable of storing up to 999 entries with documentation of with time and date stamp and user I.D, when applicable.
 - 8) A summary screen shall be provided for the protective functions to allow the viewing of the status of all protective functions and output contacts on one screen.
 - 9) Help screens shall be provided to guide the user through any questions encountered while viewing the screens or operating the system.

- D. The SLC shall be capable of communications over the Intranet, the Internet, or ModbusRTU based systems using Ethernet or RS485. The SLC shall have embedded HTML pages to eliminate the need for separate software. The HTML pages shall be accessible using standard browser software resident on the Internet and/or Intranet. E-mail messages shall be capable of being generated whenever programmed events occur.
- E. The SLC shall contain the following inputs and outputs:
- 1) Analog output for governor control: fully adjustable up to +/- 9.0 Vdc; or 10.0 Vpk, 500 Hz pulse width modulated (PWM).
 - 2) Analog output for voltage regulator control: 0 Vdc to +/- 9 Vdc.
 - 3) Three relay contact outputs, form C, rated 1 amp @ 30 Vdc, 0.3 amp @ 110 Vdc, 0.5 amp @ 125 Vac to provide the following control and indication:
 - a. Shunt for voltage regulator output
 - b. Control of alarm horn
 - c. Indication that soft load controller is active
 - 4) One 10Base T, 10 Mbps Ethernet port with an RJ45 connector for TCP/IP communications.
 - 5) Two RS485 ports and two RS232 ports for future use to support Spectrum 550 communications.
 - 6) Provisions shall be provided for future support for CAT CCM interface.

2.08 Utility and Generator Power Manager Transducers (PMTs)

- A. The Utility and Generator PMTs shall each be integral devices capable of monitoring all the power parameters for both power sources required by the GUI screens described in paragraph 2.07(C).
- B. The following protective functions shall be provided for programming (in any combination) by the user:
- 1) Phase directional over current (device 67) for detection of a fault on the system that could lead to loss of the utility service.
 - 2) Reverse power (device 32) for installations where utility requires back feed detection and for generator protection.
 - 3) Negative sequence over current (device 46) for unbalanced current detection.
 - 4) Negative sequence voltage (device 47) to provide for permissive operation on closing to prevent connecting the generator to a single phased, three phase bus.
 - 5) Under/over frequency (device 81) for detecting islanding during parallel operations.
 - 6) Under/over voltage (devices 27/59) for use in the event of a generator islanding due to a loss of utility or fault related tripping during paralleling operations.

Note: The over/under voltage and frequency protection included on the PMTs shall be supplemental to the parameters monitored in the TS controller and shall be used for external breaker tripping control.
 - 7) Excessive reverse VAR for loss of excitation (device 40)
 - 8) Device 86 lockout capable of collecting one or more protective functions and signalling the output relays on the PMT to trip an external breaker connected to the utility source or lockout the generator breaker.

- 9) kW overload pre-alarm
 - 10) kW overload alarm
 - 11) Under Power for low forward power utility protection.
- C.** Eight digital inputs shall also be provided which can be programmed and displayed on the GUI.
- D.** Up to (12) protective functions and/or status inputs shall be capable of being programmed in the SLC controls using the GUI. If the Power Manager trips an external breaker as a result of a protective function, the system control shall log the reason for the trip and set the system alarm. Provisions for acknowledgement or automatic reset of all of these functions shall also be provided for the user to select. Provisions shall be provided to silence and, after corrective action, reset the alarm.
- E.** Four relay outputs rated 1 amp @ 30 Vdc, 0.5 amp @ 125 Vac shall be provided for circuit breaker tripping control and alarming when programmed by the GUI.
- F.** Measurement accuracy of all power parameters and response shall be as noted in Appendix A.

2.09 Annunciation

- A.** The following items shall be annunciated using discrete Industrial Grade LED indicators or on the LCD of the Graphical User Interface as shown below:

	Type of Annunciation	Color
Load Connected to Normal	LED	Green
Load Connected to Gen.	LED	White
Normal Source Accepted	LED	Green
Emergency Source Accepted	LED	Red
ATS Locked Out	LED	Amber
Fail to Sync	LED	Amber
Extended Parallel Alarm	LED	Red
Engine Running	LCD Display	Animation
Generator circuit breaker closed	LCD Display	Green
Utility circuit breaker closed	LCD Display	Green
Utility & Generator kW, total VARs, total P.F. and Freq.	LCD Display	Black
Utility and Generator Phase A volts, amps	LCD Display	Black
Utility and Generator Phase B volts, amps	LCD Display	Black
Utility and Generator Phase C volts, amps	LCD Display	Black
Utility and Generator Avg. Line Voltage, Avg. Current and Total kVA	LCD Display	Black

2.10 Enclosure and Exterior Controls / LEDs

- A. The Soft Load Transfer Switch shall be furnished in a Type 1 enclosure unless otherwise shown on the plans.
- B. All standard and optional door-mounted switches and pilot lights shall be industrial grade type LEDs for easy viewing & replacement. Door controls shall be provided on a separate removable plate, which can be supplied loose, for open type units. Controls shall consist of the following:
 - 1) Indicating LEDs:
 - a) Load connected to Normal
 - b) Load connected to Emergency
 - c) Utility accepted
 - d) Generator accepted
 - e) Extended Parallel Time
 - f) Failure to synchronize
 - g) TS Controls Locked Out (with push to reset button)
 - 2) Control switches:
 - a) Mode Selector Switch with three positions: Soft Load Transfer Mode (momentary); Auto; Transfer Preset Mode
 - 1. Soft Load Transfer – a load transfer shall be initiated in the soft load transfer mode in this position, regardless of the settings in the SLC, unless the transfer preset mode is set to “none”. The time in the parallel position will be the “Gen load/unload ramp time” setting in the SLC.
 - 2. Automatic – this shall be the normal setting for automatic soft load transfer operation. The selected operating mode and parameters for soft load operation shall be initiated based on the timer, scheduler or kW demand settings in the SLC.
 - 3. Transfer Preset Mode - shall manually initiate a soft load transfer using the selected operating mode and parameters for soft load operation in the SLC.
 - b) Bypass Time Delay
 - c) Alarm Reset Button
 - d) Closed Transition Bypass (momentary pushbutton).

PART 3 - DESCRIPTION OF OPERATION

3.01 The Soft Load Transfer Switch shall provide soft load transfer between utility and generator source with the following selectable operating modes:

- Soft Load Transfer Mode
- Maintained Parallel Base Load
- Maintained Parallel Import / Export

3.02 Operation (Soft Load Transfer mode)

- A.** With the soft load transfer switch in the normal position (load connected to utility), the SLC shall wait for a transfer signal. The SLC speed control and voltage regulator output bias shall be held to its null setting.
- B.** A soft load transfer shall be initiated manually through the mode selector switch on the front panel or automatically from the graphical user interface screen settings. When the “Soft Load Transfer Mode” is selected on the mode selector switch, the TS controller shall ignore any other modes or settings selected on the graphic user interface display menu.
- C.** The engine shall be signaled to start through the engine start contact on the TS controller.
- D.** After nominal voltage and frequency set points are satisfied, the SLC shall provide the necessary output voltage to drive an external voltage regulator to match generator voltage to the utility and an analog output to the engine controller to achieve phase synchronism between the sources. The frequency of the generator shall be held to within +/-0.2Hz during synchronizing.
- E.** The TS controller shall close the CE contacts (see block diagram in paragraph 1.2.1.G) paralleling the utility and generator when the synchronizing parameters specified in paragraph 2.04G are satisfied. The SLC shall immediately switch to load control mode and adjust the load on the generator to match the initial load set point. Frequency is now held constant by the parallel connection to the utility.
- F.** The SLC outputs shall be used to control kW loading (at a preset ramp) and power factor. The loading and power factor control algorithm shall be calculated by the SLC using serially communicated power data from the Power Manager Transducers. The load ramp and power factor shall be controlled, using a closed loop method, according to set points in the SLC.
- G.** The SLC shall gradually increase generator load from an initial loading set point, until the utility power decreases to a set value (or until the generator reaches a maximum allowable power set point).
- H.** When the utility power set point is reached, the utility switch shall be opened and the speed output will be held to its null setting.
- I.** The system shall have a similar soft load operation when transferring from the generator to the utility.

3.03 Operation (Base Load Mode)

- A.** With the soft load transfer switch in the normal position (load connected to utility), the SLC shall wait for a transfer signal. The SLC speed control and voltage regulator output bias shall be held to its null setting under this condition.
- B.** A base load mode operation shall be initiated manually through the mode selector switch on the front panel or automatically from the graphical user interface screen settings. Automatic operation can also be enabled to work under a time and date schedule or kW demand peak.
- C.** The engine shall be signaled to start through the engine start contact on the TS controller.
- D.** After nominal voltage and frequency set points are satisfied, the SLC shall provide the necessary output voltage to drive an external voltage regulator to match generator voltage to the utility and an analog output to the engine controller to achieve phase synchronism between the sources. The frequency of the generator shall be held to within +/-0.2Hz during synchronizing.
- E.** The TS controller shall close the CE contacts (see block diagram in paragraph 1.2.1.G) paralleling the utility and generator when the synchronizing parameters specified in paragraph 2.04G are satisfied. The SLC shall immediately switch to load control mode and adjust the load on the generator to match the initial load set point. Frequency is now held constant by the parallel connection to the utility.
- F.** The SLC outputs shall be used to control kW loading (at a preset ramp) and power factor. The loading and power factor control algorithm shall be calculated by the SLC using serially communicated power data from the Power Manager Transducers. The load ramp and power factor shall be controlled, using a closed loop method, according to set points in the SLC.
- G.** The SLC shall gradually increase generator load from an initial loading set point, until its load reaches the generator kW set point.
- H.** Once the generator kW set point is reached, the soft load system shall maintain parallel controlling the generator VR and governor. Base load mode allows load fluctuations to be carried by the utility, while maintaining the base load values on the generator. Base load mode operation allows for power to be imported or exported from the utility source, based on the kW load versus the kW base load set point.
- I.** The system shall have a similar operation when unloading the generator.

3.04 Operation (Import/Export Mode)

- A.** With the soft load transfer switch in the normal position (load connected to utility), the SLC shall wait for a transfer signal. The SLC speed control and voltage regulator output bias shall be held to its null setting under this condition.
- B.** An import/export load mode operation shall be initiated manually through the mode selector switch on the front panel or automatically from the graphical user interface

screen settings. Automatic operation can also be enabled to work under a schedule or kW demand peak.

- C. The engine shall be signaled to start through the engine start contact on the TS controller.
- D. After nominal voltage and frequency set points are satisfied, the SLC shall provide the necessary output voltage to drive an external voltage regulator to match generator voltage to the utility and an analog output to the engine controller to achieve phase synchronism between the sources. The frequency of the generator shall be held to within +/-0.2 Hz during synchronizing.
- E. The TS controller shall close the CE contacts (see block diagram in paragraph 1.2.1.G) paralleling the utility and generator when the synchronizing parameters specified in paragraph 2.04G are satisfied. The SLC shall immediately switch to load control mode and adjust the load on the generator to match the initial load set point. Frequency is now held constant by the parallel connection to the utility.
- F. The SLC outputs shall be used to control kW loading (at a preset ramp) and power factor. The loading and power factor control algorithm shall be calculated by the SLC using serially communicated power data from the Power Manager Transducers. The load ramp and power factor shall be controlled, using a closed loop method, according to set points in the SLC.
- G. The SLC shall gradually increase generator load from an initial loading set point, until the utility power decreases to a set value (or until the generator reaches a maximum allowable power set point).
- H. Once the utility kW import/export set point is reached (or until the generator reaches a maximum allowable power set point), the soft load system shall maintain parallel, controlling the generator VR and governor. Import/export mode allows load fluctuations to be carried by the generator while maintaining the import/export settings.
- I. The system shall have a similar operation when unloading the generator.

3.05 Additional notes on operation:

- A. When both sources are paralleled and any external source breaker is signalled to trip, the transfer switch main contacts connected to the source with the tripped breaker shall also be signalled to open & the condition shall be alarmed on the GUI.
- B. If the normal source is restored after failure with load connected to emergency and the emergency source is available, a soft load transfer to normal shall be completed regardless of what mode was selected from the SLC menu. If the Transfer Preset Mode is selected on the mode selector switch is activated, operation will be as selected from the SLC menu. I.E if Base Load mode was selected, the SLC shall synchronize both sources and return to that mode.

- C. The operation of the SLC shall be relinquished to the TS controller if either power source fails and standard open transition transfer shall be initiated.
- D. The SLTS shall be capable of automatically soft load transferring or paralleling when a utility demand set point is exceeded. It shall automatically retransfer to the utility when the total (utility plus generator) demand falls below a dropout set point for a preset time.

PART4 - ADDITIONAL REQUIREMENTS

4.01 Withstand and Closing Ratings

- A. The Soft Load Transfer Switch shall be rated to close on and withstand the available RMS symmetrical short circuit current at the switch terminals with the type of over-current protection shown on the plans.
- B. The Soft Load Transfer Switch shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle and long-time ratings. Transfer Switches that 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 Soft Load Transfer Switch 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 Soft Load Transfer Switch 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 Soft Load Transfer Switch 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.

PART 5 INSTALLATION ASSISTANCE

The manufacturer of the Soft Load Transfer Switch shall provide the services of satisfactory trained technician to provide installation assistance.

5.1 It shall be the responsibility of the installing contractor to verify that the following items have been completed and are ready to perform as specified before the arrival of the factory technician.

- A. Inspect for obvious shipping damage.
- B. The Soft Load Transfer Switch is securely installed and grounded.
- C. All power cables have been terminated.
- D. Install customer control wiring to external equipment including engines, batteries, associated motor control, etc.
- E. The engine generator set is installed and ready to run.
- F. Associated motor controls, plumbing, building utilities are complete and operational.

Note: Sufficient building load must be available at start-up procedures to properly test and qualify soft loading control operations. Available building loads must equal 100% of engine-generator set tested. Should building loads be less than 100% of the engine-generator set tested, load banks shall be required on-site at additional cost to installing contractor.

- G. The Factory Technician shall perform the following service onsite.
 - 1) Verify contractor connections, control power availability, and visually inspect relay settings.
 - 2) With the engine generator supplier's technical representative controlling the engine, verify that the switchgear and control equipment are fully operational and perform per the sequence of operation specified. Equipment or services shall be provided by the engine generator set supplier.
 - 3) With the engine generator supplier's technical representative controlling the engine, demonstrate all functions of the control system, both automatic and manual, to the satisfaction of the approving engineer.
 - 4) Provide documentation in the form of function checklists and recorded data for each section to the approving engineer.
 - 5) Provide plant operators with instruction on the plant operating procedures and major component maintenance after acceptance by the approving engineer.

Appendix A.

Utility and Generator Power Manager Transducer Accuracy Specifications

- Frequency: 50.0 Hz or 60.0 Hz
- Current input: $2\% < I_{FULLSCALE} < 125\%$
- Sensing type: True RMS up to and including the 21st harmonic.

PARAMETER		ACCURACY (% full scale)	DISPLAY	
			Resolution	Range
	full scale			
Current (I)	5.000 A	0.25%	0.25%	0 - 29,999 ¹
Voltage (V)	120 V	1.00%	1.00%	0 - 59,999 ²
	600 V	0.25%	0.25%	0 - 59,999 ²
Active Power (per element)	600 W	1.00%	0.25 %	0 - 29,999 ³
	3000W	0.25%	0.10 %	0 - 29,999 ³
Reactive Power (per element)	600 VAR	1.00 %	0.25 %	0 - 29,999 ³
	3000 VAR	0.25%	0.10 %	0 - 29,999 ³
Apparent Power (per element)	600 VA	1.00%	0.25 %	0 - 29,999 ³
	3000 VA	0.25%	0.10 %	0 - 29,999 ³
Active Energy (kWh)		1.00% of reading	0.10 %	-1,999,999,999 to 1,999,999,999
Reactive Energy (KVARH)		1.00% of reading	0.10 %	-1,999,999,999 to 1,999,999,999
Apparent Energy (KVAH)		1.00% of reading	0.10 %	-1,999,999,999 to 1,999,999,999
Power Factor (PF)		1.00%	0.01 PF	-0.0 to 1.00 to +0.0
Frequency (Hz)		0.25%	0.1 Hz	40 to 100 Hz

1. Reads in kA (i.e., 10.00KA) for currents over 9,999 A.
2. Reads in kV (i.e., 10.0KV) for voltages over 9,999 V.
3. Reads in MW, MVAR, MVA for readings over 9,999 K.