

***WMATA Silver Line*****LOW VOLTAGE EQUIPMENT
OPEN TRANSITION WITH TOUCHSCREEN
MAIN-TIE-TIE-MAIN: AUTOMATIC TRANSFER SCHEME****TABLE OF CONTENTS**

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GENERAL DESCRIPTION

I. General Description

This document describes the equipment's automatic transfer control system design intent, including the automatic sequences that occur upon power failure of the sources supplying the switchgear and the manual operations that can be performed by operations personnel.

For details on the equipment, including physical construction, wiring, nameplates, bill of material, etc. refer to the equipment drawing package.

II. HMI System Access

The HMI touchscreen is configured with security access features which allow only qualified personnel to access/operate the transfer system. For details of security access, refer to V.B.1.

III. START-UP INTO AUTOMATIC (REMOTE) OPERATION

1. Place the Local/Remote Selector Switch in the "Local" position.
2. Check that the Programmable Logic Controller (PLC) green run light is on - (located on PLC).
3. Check that the touchscreen is active and has no alert symbols near any elements.
4. Reset Overcurrent Trip Switches (SDE), and trip indicators on main and tie breakers.
5. Rack breakers completely into the "CONNECTED" position (if applicable).
6. Close and trip breakers using the Breaker Control Switches for the respective circuit breakers to verify breaker operation. Refer to IV.E for details of local operation of circuit breakers.
7. Check that normal voltages to mains are present, then close main breakers using Breaker Control Switches (not Open/Close pushbuttons on the breakers).
8. Press the "SYSTEM SETTINGS" button on the "SCREEN MENU" popup of the touchscreen to access the 'SYSTEM SETTINGS' screen. Modify any settings on this screen as required by user (Refer to V.B.7)

3. The re-close attempt happens only one time. When the re-close pulse occurs, a software latch is set which prohibits repeated close commands. This anti-pump latch is reset by any of the following:
 - The gear is switched to Local
 - The main closes and remains so for 20 seconds
 - The System Reset pushbutton is pressed
4. A 480V main re-close lockout (anti-pump latch) also initiates the power fail ride thru timer for that side of the SUBstation. If the re-close attempt fails (the main does not remain closed) and all other transfer permissives are met, it will operate as if an actual utility outage has occurred.
5. Before manually recovering from a main re-close lockout condition, the operator should switch the substation to Local.

V. DESCRIPTION OF SYSTEM CONTROLS

A. Switches/Pilot Lights

The PLC control scheme is equipped with the following switches/indicators used to control and display status of the automatic operation of the system.

1. **“Local/Remote”** – A switch that is used to toggle the system between automatic control by the PLC/SCADA and local control by an operator.
2. **“Remote”** – A white light that indicates that the PLC is operating in the automatic or normal mode. It will be illuminated any time the PLC is running and Local/Remote switch is in the “REMOTE” position. PLC will automatically control system per sections IV.B through IV.D of this document
3. **“Local”** – A blue light that indicates that the PLC is operating in the local mode or non-automatic mode. It will be illuminated any time the Local/Remote switch is in the “Local” position. Refer to IV.E for operation details.
4. **“Auto Fail”** – A red light that indicates that the PLC is placed into the “REMOTE” mode, however is not capable of performing any automatic transfer operations. If any breaker commanded to operate by the PLC fails to do so within 1 second this shall trigger an “Auto-Fail”. This applies to breaker commands in Local or Remote. This light will flash in a sequential pattern to help identify the particular issue. No additional automatic operations will occur once in “AutoFail” state. Refer to section VII (Troubleshooting) for further detail. In the event a breaker fails to operate, the “Auto Fail” light on the lineup will flash and the offending breaker will be highlighted on the HMI. System response to breaker failures are as follows:



- i) Main fail-to-open on automatic transfer aborts the attempt.
 - ii) Either tie fail-to-close on an automatic transfer causes the PLC to re-close the open main and then abort the sequence.
 - iii) Any fail-to-operate in manual is annunciated only.
5. **Tie breaker amber lights** – The presence of voltage on either side of each tie breaker is sensed and hardwired to two amber lights located above the tie breaker. These indicators are not dependent on the PLC system and are not part of PLC inputs or outputs.
6. **Breaker Control Switches (one per Main and Tie breaker)** – A two position breaker control switch is available for local operation of the respective device. (Refer to IV.E for local operation details). Note: Using switches to open breaker while in “REMOTE” mode will cause system to enter “Auto Fail”.
- To close breaker, move the respective switch to the “CLOSE” position. (Not allowed in “REMOTE” mode)
 - To open breaker, move the respective switch to the “TRIP” position.
7. **Breaker 86 Lockouts** – The main and tie breakers shall be equipped with integral protective trip devices which respond to over-current conditions. An external Ground Break system protects against ground fault conditions. If any protective trip occurs (a bell alarm lockout device on the breaker or an external Ground Break trip) an 86 lockout device operates. The PLC monitors this hand reset 86 lockout and will not close any main or tie if there is an active lockout on any of the four breakers.
- a. A main breaker 86 lockout will trip both the main and tie breaker in the given lineup.
 - b. A tie breaker 86 lockout trips the respective tie only.

B. Touchscreen

The PLC control scheme is equipped with a touch screen that is used to control the automatic operation of the system.




Available screens include:

1. **Login:** The Login screen (available via Screen Menu) allows the user to login to the system with the appropriate access level.

Name:

Password:

Current User: <none>

- To login to the system, type in username and password and press the Login button.



- To return to the home screen, press the Home button.



- To return to the last screen accessed, press the return button.



- User Administration:** The User Administration screen (available via Screen Menu) allows the user administrator to edit/add/delete user security.

SQUARE D		USER ADMINISTRATION		SYSTEM STATUS		
by Schneider Electric		SCREEN MENU		MODE:	SOURCE 1:	SOURCE 2:
				AUTO	NORMAL	NORMAL





USER ACCESS PRIVILEGES

Group:

User:

Pwd:

Confirm Pwd:

Security Access

Three users with passwords have been pre-defined ranging from ‘view only’ privileges to ‘administrative’ privileges. User names and passwords are case sensitive. Default passwords will be provided in a separate document which should be stored in a secure location separate from the SOO.

Pre-defined Users:

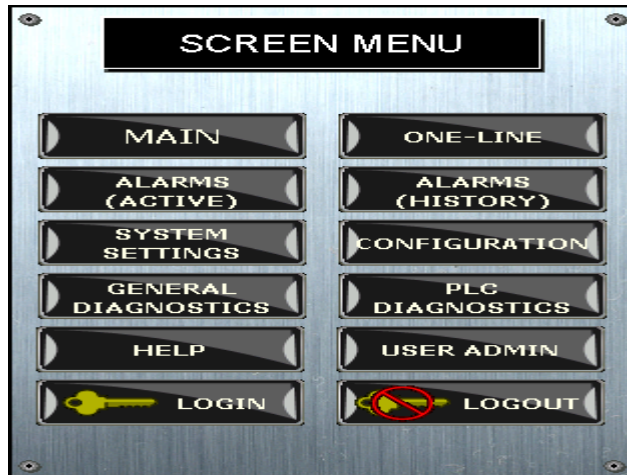
1. View Only (Level 1) – Pre-defined user is "supervision" (case sensitive). This login is only required for remote access to the HMI via the web. When viewing at the HMI locally, view only privilege is automatic and no login is required.

2. System Operation (Level 8) - Pre-defined user is "operator" (case sensitive). This login permits the user to change system parameters and/or operate the system utilizing the "transfer controls", "system timer setting controls", and "alarm history delete control" buttons.

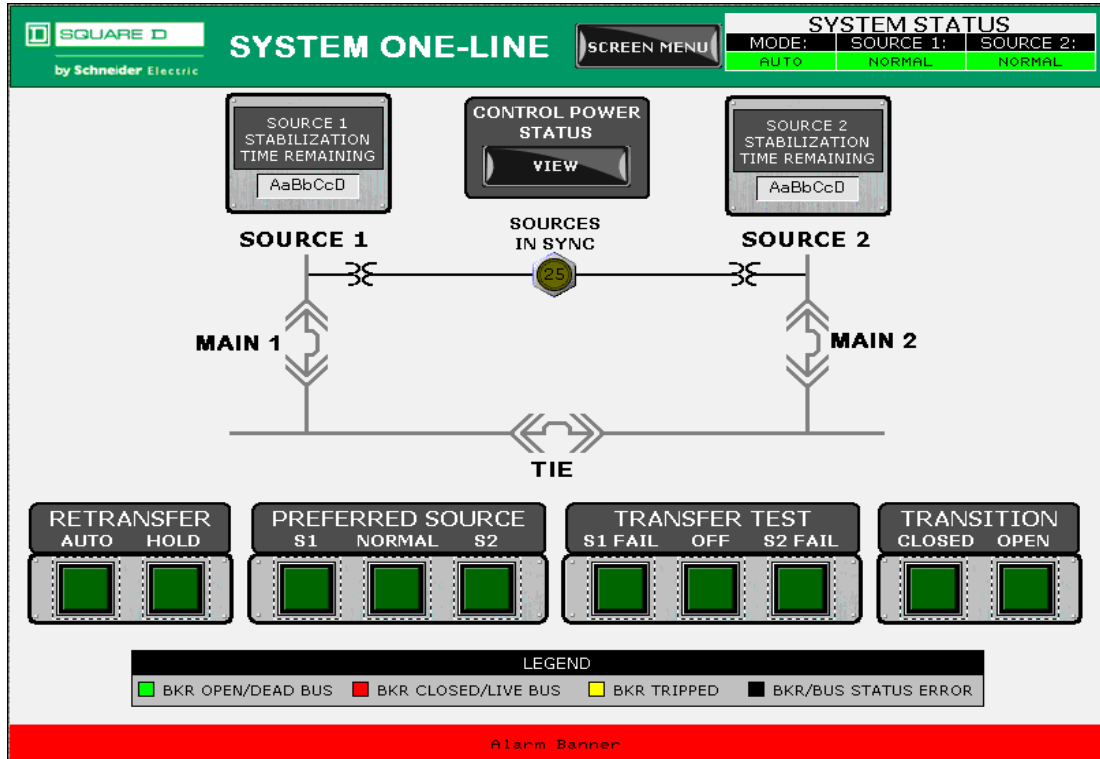
3. Administrative (Level 10) - Pre-defined user is "Admin" (case sensitive). This login permits the user to access the "HMI Configuration" or "PLC Clock Set" buttons on the configuration screen. This user also has access to the "User Admin" screen. The User Admin screen allows for managing users.

Based on the security level of the logged in user, inaccessible functions are indicated by a padlock symbol. Higher security levels automatically include privileges of any lower security levels. Example: Administrative user has privileges of a System Operation user.

- 3. **Screen Menu:** The **Screen Menu** screen contains direct automatic links to all other available screens.



4. **One-Line:** The ‘One-Line’ Screen provides an animated graphic of the switchgear Main – Tie – Main system configuration. This screen also displays the necessary status indications for the system, including breaker status, dead or energized bus, system settings, etc. The **Retransfer Mode**, **Preferred Source**, **Transfer Test**, and **Transition Mode** selections are also available here.



- Active One-Line Diagram** – This diagram depicts the powerflow of the system. The diagram changes color with respect to current state of the system. Refer to the on-screen Legend for description of breaker and bus status.
- “Retransfer” (SEMI-AUTO)** – A switch used to trigger automatic retransfer operations. It can be used to allow the user to perform the retransfer to normal when it “TEST” mode.
- “Preferred Source” (S1 – S2)** – This switch will select which source the PLC will return to when a retransfer is accomplished. If the switch is set to the S1 (S2) source, the loads will be configured to be supplied by the S1 (S2) source. This switch can be used to shift loads around by pressing the respective preferred source once desired. A popup screen will prompt verification to initiate transfer.
- “Transfer Test” (S1 Fail - OFF – S2 Fail)** – This switch is used to simulate a failure of a source. The **OFF** position fails neither source, the **S1 Fail** position simulates

failure of Source 1, and the **S2 Fail** position simulates failure of Source 2. When in the **S1 Fail** position, the PLC will perceive Source 1 as being lost. Transfers will proceed based on preferred source, retransfer, and transition selections. Refer to section IV.D for further detail.

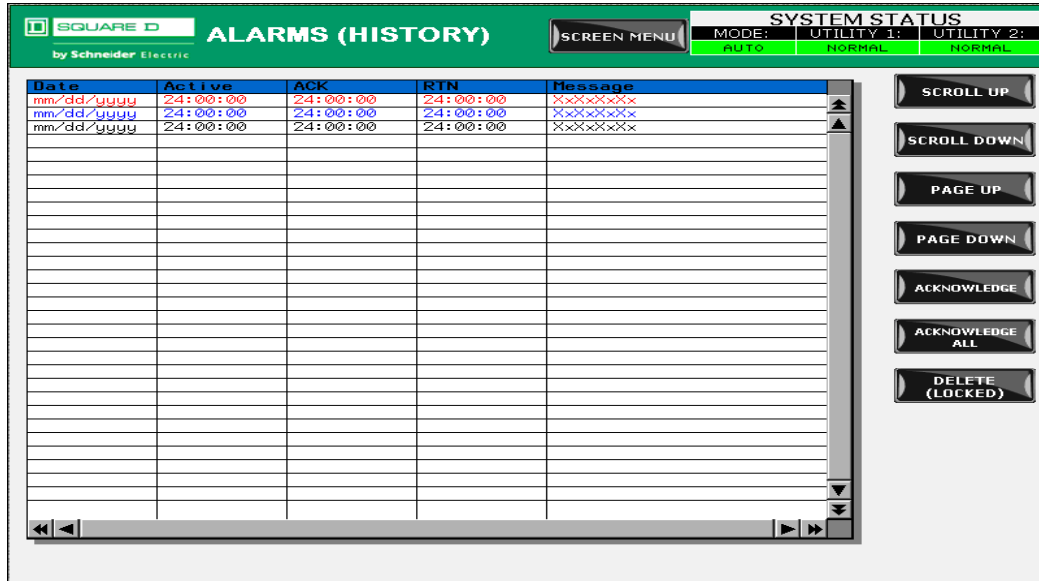
- e. **“Screen Menu”** – A button that opens the “Screen Menu” window as described in V.B.3.
 - f. A **Power Quality Meter** is provided at each 480V main to monitor and display utility source voltage, current and power. Data from this meter is available to the operator from its own front panel HMI display.
 - i) This PQM is a Modbus compatible device capable of communicating with SCADA
 - ii) Data from these PQM meters may or may not be monitored by the PLC but shall not be necessary for its operation of the transfer system. PQM meters shall be monitored remotely through SCADA system.
5. **Active Alarms:** The Active Alarms screen displays the system alarms associated with the PLC operation (i.e. breaker faults, breaker connection status, auto fail mode, etc.) that are currently active in “first-in, first-out”(FIFO) manner. The ‘alarm log’ screen list will include the Date, the Time of day, and the current State of the alarm and acknowledgement status (red indicates unacknowledged messages, blue indicates acknowledged messages).

SQUARE D by Schneider Electric
ALARMS (ACTIVE)
SYSTEM STATUS
MODE: AUTO | UTILITY 1: NORMAL | UTILITY 2: NORMAL

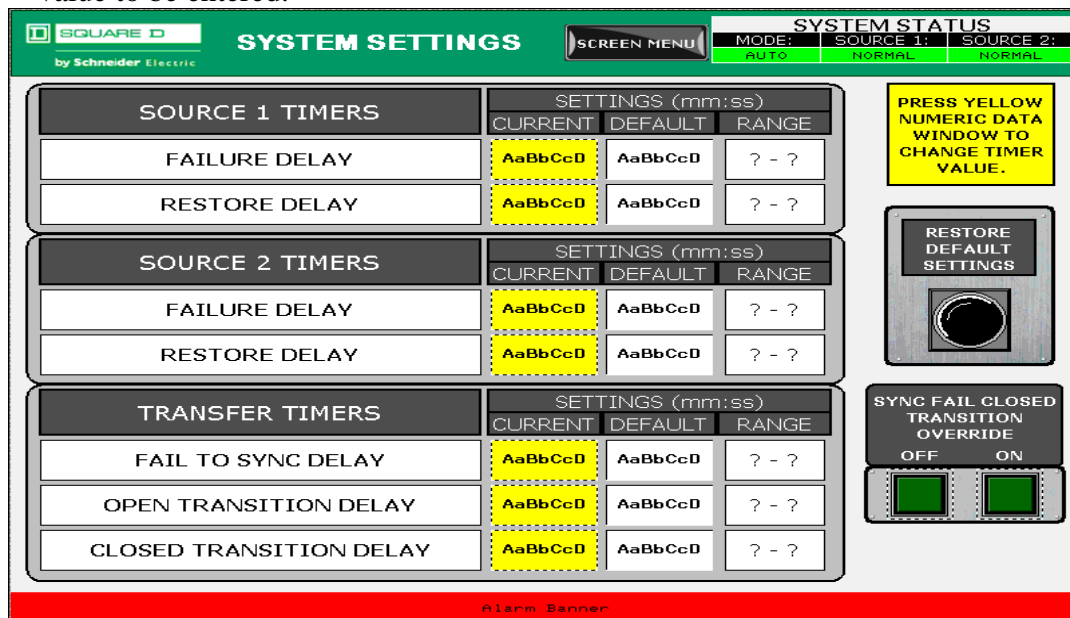
Date	Active	ACK	Message
mm/dd/yyyy	24:00:00	24:00:00	XXXXXXXXXX
mm/dd/yyyy	24:00:00	24:00:00	XXXXXXXXXX
mm/dd/yyyy	24:00:00	24:00:00	XXXXXXXXXX

AUTO FAIL STATUS
AUTO FAIL INDEX #
No Auto Fail Condition
12

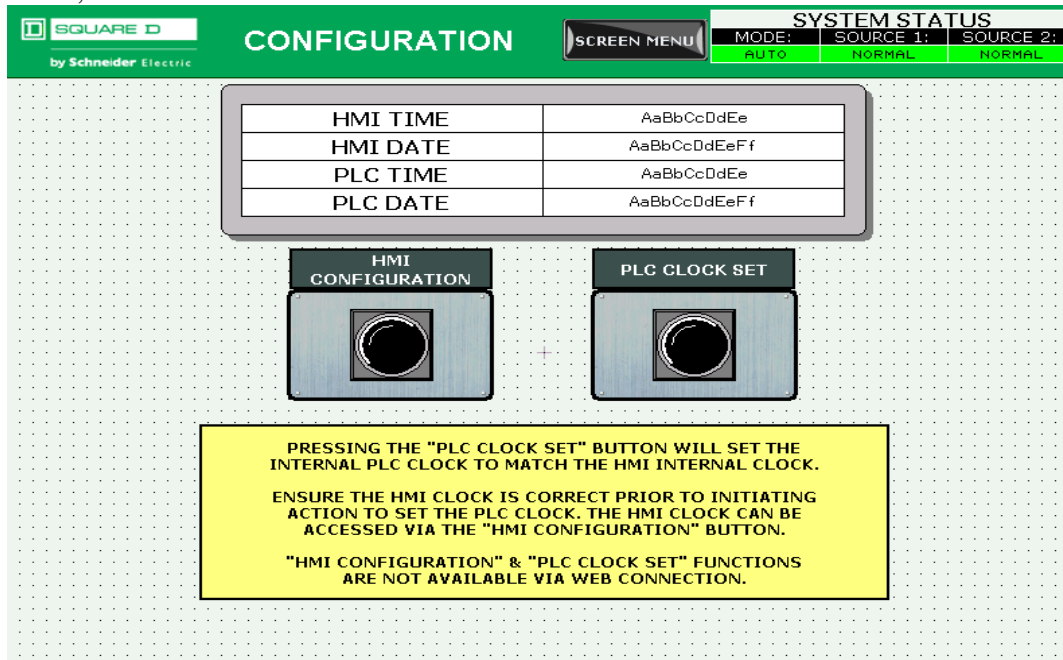
- Alarm History:** The Alarms History screen displays the most recent system alarms associated with the PLC operation (i.e. breaker faults, breaker connection status, auto fail mode, etc.). The 'alarm log' screen, will FIFO the alarms after the alarm list exceeds 100 alarms. The 'alarm log' screen list will include the Date, the Time of day, and the current State of the alarm.



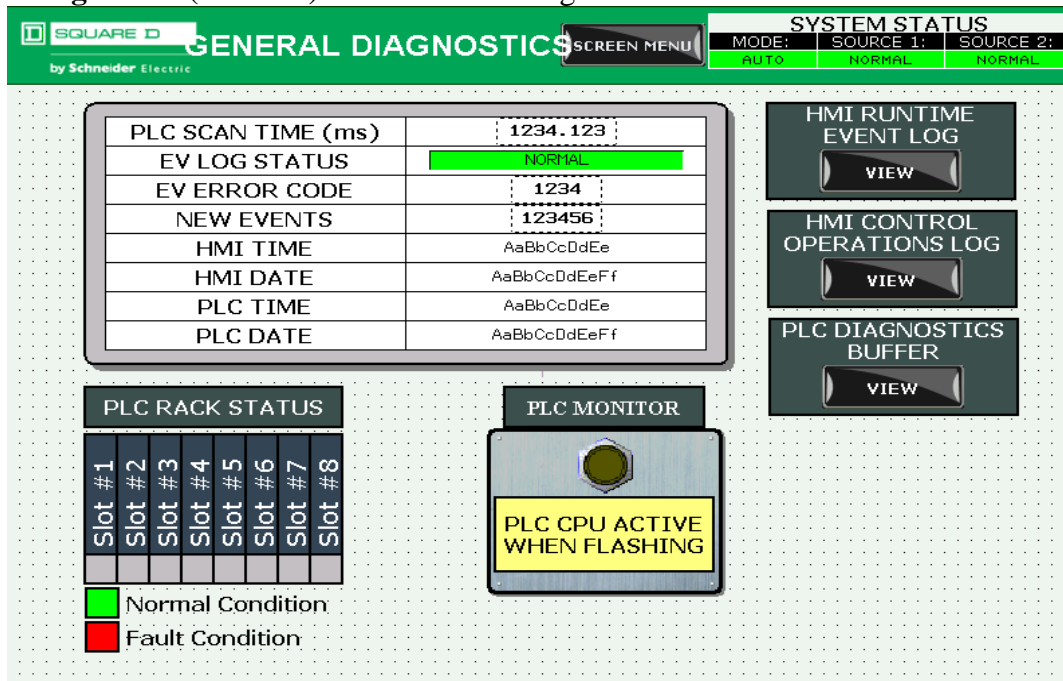
- System Settings:** The 'System Settings' screen contains touch pads for changing designated PLC program delay and timer settings. To modify delay settings, press the corresponding value, displayed in yellow. A data entry popup will appear to allow new value to be entered.



- 8. Configuration:** The Configuration screen is used to access the HMI configuration screen to set the HMI clock and adjust other HMI parameters, such as screen contrast, sync with PLC clock, etc.



- 9. Diagnostics (General):** The General Diagnostics screen



10. Diagnostics (PLC): The General Diagnostics screen is a screenshot of the PLC I/O Map screen. All indicating lights are shown illuminated for display purposes. PLC inputs and outputs are identified. I/O status can be viewed; light on indicates input or output state is high. Light off indicates input or output state is low. The Current PLC SFC (Sequential Function Chart) Step and Current PLC SFC Index # are available to direct a programmer to current section of program, for diagnostic purposes.

SLOT 2 INPUT MODULE		SLOT 3 INPUT MODULE		SLOT 4 OUTPUT MODULE		SLOT 5 OUTPUT MODULE	
MAIN 1 CLOSED	0	MAIN 2 CLOSED	0	CLOSE MAIN 1	0	CLOSE MAIN 2	0
MAIN 1 OPEN	1	MAIN 2 OPEN	1	OPEN MAIN 1	1	OPEN MAIN 2	1
MAIN 1 TRIPPED	2	MAIN 2 TRIPPED	2	AUTO MODE FAIL	2	SPARE	2
MAIN 1 RACKED-OUT	3	MAIN 2 RACKED-OUT	3	AUTO MODE	3	SPARE	3
MAIN 1 RACKED-IN	4	MAIN 2 RACKED-IN	4	CLOSE TIE	4	SPARE	4
MAIN 1 CTRL PWR	5	MAIN 2 CTRL PWR	5	OPEN TIE	5	SPARE	5
MAIN 1 27	6	MAIN 2 27	6	AUTO FAIL ALARM	6	SPARE	6
MAIN 1 47	7	MAIN 2 47	7	PLC ONLINE	7	SPARE	7
TIE CLOSED	8	25-SYNC CHECK	8	SPARE	8	SPARE	8
TIE OPEN	9	24VDC PS ALARM	9	SPARE	9	SPARE	9
TIE TRIPPED	10	DC UPS BATT ALARM	10	SPARE	10	SPARE	10
TIE RACKED-OUT	11	CTRL PWR ALARM	11	SPARE	11	SPARE	11
TIE RACKED-IN	12	SPARE	12	SPARE	12	SPARE	12
TIE CTRL PWR	13	SPARE	13	SPARE	13	SPARE	13
MODE SW.- AUTO	14	SPARE	14	SPARE	14	SPARE	14
MODE SW.- MAN	15	SPARE	15	SPARE	15	SPARE	15

SYSTEM STATUS: MODE: AUTO, SOURCE 1: NORMAL, SOURCE 2: NORMAL

CURRENT PLC SFC STEP: INITIAL STATE | CURRENT PLC SFC INDEX #: 1234



VII. Troubleshooting

If the scheme is not functioning as described in the Sequence of Operation, check the following items:

Condition	Possible Cause	Suggested Action
Control Power Loss	Inoperative fuse(s)	Identify and correct cause of overload or fault. Replace fuse(s).
	Circuit breaker off/tripped	If off, turn on. If tripped, identify and correct cause of overload or fault. Reset the circuit breaker.
	UPS battery low	Loss of control power feeding UPS battery, refer to Inoperative fuses or Circuit breaker off/tripped Replace UPS battery
Circuit breaker springs not charged	Control Power loss	Refer to above "Control Power Loss" condition
HMI indicates source inactive, but source is available	Control Power loss	Refer to above "Control Power Loss" condition
	Test Transfer switch not in "OFF" position	Return the Test Transfer Switch to the "OFF" position.
	Power quality monitors not satisfied	Refer to other meters or voltage monitors to determine if voltage is within the limits of the voltage and frequency relays, including proper phase rotation.
Normal source lost, but transfer did not occur	Main circuit breaker tripped because of fault	The trip indicator on each circuit breaker will note the type of fault that occurred. Identify and correct cause of overload or fault. Reset circuit breaker.
	System not in Remote mode.	Verify the local/remote switch is in the "REMOTE" position, and white "REMOTE" light is on. Return switch to "REMOTE" position.
	Power quality monitors not satisfied	Refer to other meters or voltage monitors to determine if voltage is within the limits of the voltage and frequency relays, including proper phase rotation.
	Alternate not available	System will not transfer to an unavailable source for both local and remote modes. Check utility availability or generator functionality.
Auto Fail light is flashing(refer to AutoFail light device description, V.A.3)	Breaker was manually opened or tripped while in Remote mode	Identify and correct cause of overload or fault. Reset circuit breaker. Turn the local/remote switch to Local and back to Remote to reset system from Remote mode fail.
	Other(Refer to Flash Code table below)	Consult Event and Alarm Log screens for most recent events. Contact technical support if necessary.
Source transferred "without reason"	Control Power loss	Refer to above "Control Power Loss" condition
	Power quality monitors not satisfied	Refer to other meters or voltage monitors to determine if voltage is within the limits of the voltage and frequency relays, including proper phase rotation.
	Temporary voltage loss or sag	If recording voltage meters are not installed, consult with the utility to find out if a momentary outage occurred. A voltage dip below the set point of the power monitor may result in transfer operation.
Closed transition system followed open sequence	Open Transition Mode selected	Return the Transition mode to the "Closed" position via one line screen.
	Control Power loss	Refer to above "Control Power Loss" condition
	Sync-check relay not satisfied	Refer to other meters or voltage monitors to determine if source synchronization is within the limits of the sync check relay. Sources are not synchronized. Consult with power supplier.



FLASH CODES

If the “AUTO FAIL” light is flashing, the following table lists the flash sequences that annunciate the particular issue that has occurred.

Flash Code	Fault Description
1 flash	Main 1 failed to Trip or Open upon PLC command
2 flashes	Main 1 failed to Close upon PLC command
3 flashes	Main 2 failed to Trip or Open upon PLC command
4 flashes	Main 2 failed to Close upon PLC command
5 flashes	Tie failed to Trip or Open upon PLC command
6 flashes	Tie failed to Close upon PLC command
7 flashes	Main 1 External Operation while in “REMOTE” mode
8 flashes	Main 2 External Operation while in “REMOTE” mode
9 flashes	Tie External Operation while in “REMOTE” mode
10 flashes	PLC Hardware failure
11 flashes	Breaker status disagreement. (Auxilliary or cell position on Main 1, Tie, or Main 2 breakers)
16 flashes	PLC program in abnormal sequence path