

# Chapter 3: Electrical Installation

## 3 Electrical Safety



- The GREEN MACHINE uses lethal voltages and operates in areas where gasoline vapor may be present.
- Serious injury or death from electrical shock, fire, or explosion may result if the power is ON during installation, testing, or maintenance.
- Be sure to use Lock-Out/Tag-Out procedures when working on or installing the GREEN MACHINE or while working on electrical components.
- When performing maintenance, always power OFF electrical components connected to the GREEN MACHINE. **The GREEN MACHINE can start automatically.**
- Do not use tools that can generate sparks if there is risk of flammable or explosive vapors being present.
- Read and understand all materials related to installing, testing, and operating the GREEN MACHINE prior to installation.

### 3.1 Electrical Requirements

VST Control Panel Power Requirements						
VST CONTROL PANEL – POWER SOURCES						
Equipment	Phase	Voltage	Amperage	Frequency	Fuse/Breaker Size	Location
ESO Relay power	1-Phase	120VAC	20	60-Hz	20-amp relay	Emergency Shut-Off
Vacuum Pump Motor	1-Phase	120VAC	8 to 10	60-Hz	15-amp breaker	VST Control Panel
Control Valves	1-Phase	120VAC	1.0	60-Hz	5-amp fuse	
24VDC Power supply	1-Phase	120VAC	1.0	60-Hz	2-amp fuse	
Pressure Sensor		24VDC			Protected by 24VDC power supply	
GREEN MACHINE PLC		24VDC			Protected by 24VDC power supply	

Table 1: VST Control Panel Requirements

### 3.2 Electrical Installation

- The VST Control Panel and the GREEN MACHINE Internal Junction Box arrive from the factory pre-wired and completely tested.
- The Electrical Contractor is responsible for supplying all additional wires, conduits, fittings, seal-offs, outlets, and the Safety Disconnect Switch required to install the GREEN MACHINE and meet regulation requirements and standards.
- All wiring must be gasoline and oil resistant.
- A LOCKABLE SAFETY DISCONNECT-SWITCH MUST BE INSTALLED BY THE GREEN MACHINE:
  - Must be wired per included drawings.
  - Should be installed within eye-sight of the GREEN MACHINE for safety reasons.
  - Must not be installed within 3 feet of the GREEN MACHINE.
  - Consult the NEC for restrictions, location, and type of disconnect.
- The GREEN MACHINE is installed in a Class I, Division 2 hazardous location and therefore requires electrical seal-offs when connecting to ordinary, non-hazardous electrical locations. Consult the NEC and NFPA for installation instructions.
- All wiring (120 VAC and 24 VDC) to be TFFN or THHN with 600V insulation.
- The contractor is responsible for sizing the wire, cable, and conduit according to the NEC.
- All power wires connected to the GREEN MACHINE will be disconnected when:
  - The station Emergency Shut-Off is activated.
  - The Safety Disconnect Switch at the GREEN MACHINE is turned off.
  - Power is turned OFF to the VST Control Panel at the electrical distribution panel.
- CAUTION: SAFETY PRECAUTION
  - BE SURE THE GREEN MACHINE BREAKER INSIDE THE ELECTRICAL PANEL IS LOCKED OUT/TAGGED OUT PRIOR TO THE INSTALLATION.

### 3.3 Electrical Installation Code Requirements

- According to NFPA 30:

“Electrical wiring and electrical utilization equipment shall be a type specified by and be installed in accordance with NFPA 70. Electrical wiring and electrical utilization equipment shall be approved for the locations in which they are installed.”
- All electrical wiring and electrical utilization equipment must be installed to meet federal, state, and local codes.
- Flexible electrical conduit connections to the GREEN MACHINE may be required by local jurisdictions to meet code requirements.
- Following such procedures may be required by local, state, and national authorities.
  - You must install the GREEN MACHINE in accordance with the National Electric Code (NEC), NFPA 70, and with the Automotive and Marine Service Station Code (NFPA 30A).
  - According to NFPA 30A:

“Electrically energized vapor-recovery equipment shall be directly connected to and controlled by the Emergency Shut Off (ESO) in Section 5202.4.7.”
  -

### 3.4 Electrical Components

Existing Components	VST Supplied Components	Contractor Supplied Components
120V Main Electrical Panel	Pre-wired VST Control Panel	120V Outlet (For maintenance and testing)
Fuel Management System (TLS-350/450) or other	Pre-wired GREEN MACHINE Internal Junction Box	Lockable Safety Disconnect-Switch
Overfill Alarm Output Relay (4-Relay Module)		All conduit, wire, cable, fittings, and seal-offs, and any other electrical material to complete the electrical installation
Emergency Shut-Off (ESO)		Emergency Shut-Off (ESO) Relay if needed (20A, SPDT)

**Table 2: Table of Electrical Connections**

### 3.5 Electrical Wiring Installation

**SAFETY PRECAUTION: PRIOR TO STARTING ANY ELECTRICAL WORK, BE SURE TO USE LOCK OUT / TAG OUT PROCEDURES.**

Install the VST Control Panel			
Drill holes in Control Panel for conduit			
Control Panel must be installed inside GDF, ideally near the Tank Gauge System (TLS, etc.)			
Emergency Shut-Off (ESO) Connection			
Power Control Panel from ESO Relay			
Wires to be Run			
ITEM	NUMBER	DESCRIPTION	
Power to VST Control Panel			
1	02011	LINE IN (120 VAC)	
2	02012	NEUTRAL	
3	GND	GROUND	
Control Panel to GREEN MACHINE™ Junction Box			
1	02054	VACUUM PUMP POWER (120 VAC)	* SEE TABLE 1 BELOW
2	02071	V1 VALVES (120 VAC)	
3	02072	V2 VALVES (120 VAC)	
4	02080	V5 VALVES (120 VAC)	
5	GND	GROUND	
6	02012	NEUTRAL	* SEE TABLE 1 BELOW
7	2 Wire Shielded Cable with Drain Wire		
	03030	PRESSURE SENSOR (24 VDC)	
	04040	PRESSURE SENSOR 4-20 mA SIGNAL	
	SHLD GND	SHIELDED GROUND	

Control Panel to Safety Disconnect Switch		
1	02011	SAFETY SWITCH HOT (120 VAC)
2	02020	SAFETY SWITCH LEG
3	GND	GROUND
Control Panel to Tank Gauge System (Veeder-Root TLS, etc.)		
1	2 Wire Shielded Cable with Drain Wire	
	05050	OVERFILL SIGNAL
	03030	OVERFILL (24 VDC)
	SHLD GND	SHIELDED GROUND
(Optional) Main Electrical Panel to GREEN MACHINE™ Area		
1	N/A	LINE IN (120 VAC)
2	N/A	NEUTRAL
3	GND	GROUND
Final Check		
When the breaker in the distribution panel is on, the PLC screen is on		
The status bar at the bottom of the screen says: <b>GM DISABLED – ENTER CODE</b>		
Navigate to the Alarms Screen by pressing the button labeled “Faults and Alarms”		
All items on the Alarms Screen are green. If there is an alarm, contact VST		

### Wires Required to install the GREEN MACHINE:

Wire Size	Distance
10 AWG	100 ft.
8 AWG	200 ft.
6 AWG	300 ft.
4 AWG	500 ft.

**Table 3: Recommended Motor Wire Size for ½ HP Motor**

#### 3.5.1 Installing the VST Control Panel:

- The contractor must drill holes in the VST Control Panel for all wiring connections.
- Install the VST Control Panel only inside the GDF. The location may vary within the GDF given the allowable space.
- When possible, place the VST Control Panel as close to the Fuel Management System as possible.
- After the Control Panel is installed and power applied to the panel, **Figure 3-1** shows the Main Screen with the GM DISABLED – ENTER CODE label, which will be discussed later in this Chapter.

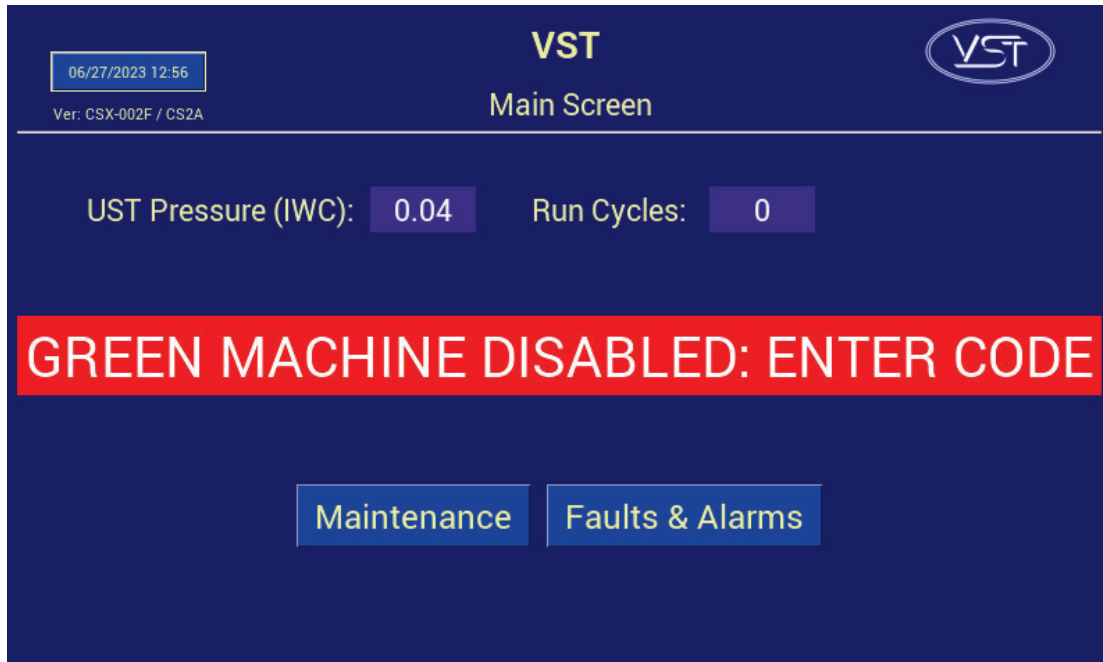


Figure 3-1: Main Screen with GREEN MACHINE DISABLED: ENTER CODE

### 3.5.2 Power The VST Control Panel from The Station Emergency Shut-Off (ESO) Relay.

Reference the Electrical Drawing Packet associated with your Control Panel Revision.

See [www.vsthose.com/education-gm3-cs2a-usa/](http://www.vsthose.com/education-gm3-cs2a-usa/)

#### Supply Power to the GREEN MACHINE from the ESO Relay:

1. Make sure the ESO Relay is 20A or higher.
2. Install the 120 VAC power and neutral wires from the ESO Relay to the VST Control Panel.
  - ESO L1 120 VAC Hot to Wire Number 02011
  - ESO Neutral to Wire Number 02012
3. Ground Wire connects to Main Distribution Panel

### 3.5.3 Wiring the Electrical Components at the GREEN MACHINE Location.

**Reference the Electrical Drawing Packet associated with your Control Panel Revision.**

See [www.vsthose.com/education-gm3-cs2a-usa/](http://www.vsthose.com/education-gm3-cs2a-usa/)

1. Wiring the internal Junction Box
  - a. Install 6 wires from the VST Control Panel to the Junction Box
    - Vacuum Pump 120 VAC to wire number 02054
    - Vacuum Pump Neutral to wire number 02012
    - Control Valve V1 120 VAC to wire number 02071
    - Control Valve V2 120 VAC to wire number 02072
    - Control Valve V5 120 VAC to wire number 02080
    - Ground to Ground
  
2. Pressure Sensor Cable
  - a. Install 1-Pressure Sensor Cable from the VST Control Panel to the Internal Junction Box.
  - b. The shielded cable is a Belden 88760 (or equivalent) 18 AWG stranded (19x30) TC conductors, plenum, FEP insulation, twisted pair, overall Beldfoil® shield (100% coverage), 20 AWG stranded TC drain wire, FEP jacket.
  - c. The shielded cable is supplied by the contractor.
  - d. The cable is connected to the VST Control Panel:
    - 24 VDC (+) to wire number 03030
    - 4-20 mA SIGNAL to wire number 04040
    - Shielded ground (Lead wire is a bare ground)
  
3. Safety Disconnect Switch
  - a. Install 2 wires from the VST Control Panel to the Safety Disconnect Switch
    - 120 VAC to wire number 02011
    - 120 VAC switch leg to wire number 02020
    - Ground to Ground

### 3.5.4 Wiring the Overfill Alarm Field Wiring

Reference the Electrical Drawing Packet associated with your Control Panel Revision.

See [www.vsthose.com/education-gm3-cs2a-usa/](http://www.vsthose.com/education-gm3-cs2a-usa/)

1. The VST Control Panel supplies 24 VDC to an Overfill Alarm relay.
2. The Overfill Alarm output relay is a "dry" relay (N.C.) that shuts down the GREEN MACHINE when a UST reaches the Overfill Level volume during a fuel drop.
3. Install a two-wire shielded cable from the VST Control Panel to the Fuel Management System Overfill Alarm (NO and C) output relay. Refer to the Fuel Management System Installation Manual for connecting and configuring the correct relay.
  - a. Install 1-Fuel Management Overfill Cable to the VST Control Panel
  - b. The shielded cable is a Belden 88760 (or equivalent) 18 AWG stranded (19x30) TC conductors, plenum, FEP insulation, twisted pair, overall Beldfoil® shield (100% coverage), 20 AWG stranded TC drain wire, FEP jacket.
  - c. The shielded cable is supplied by the contractor.
  - d. Install the shielded cable from the VST Control Panel to the Fuel Management System Overfill Alarm (NO and C) output relay. Refer to the Fuel Management System Installation Manual for connecting and configuring the correct relay. Programming of the Overfill Relay will be completed by a certified technician.
    - Connect to the Power Bay, 4-Relay Module
  - e. The shielded cable is connected to the VST Control Panel: **See Figure 3-5**
    - 24 VDC (+) to wire number 03030 to NO (normally open) on the TLS Output relay
    - Overfill Signal to wire number 05050 to C (common) on the TLS Output relay
    - Shielded drain (bare) to ground

#### 3.5.4.1 TLS 350 Overfill Wiring

1. Look in the Power Bay of the TLS-350, check for an available relay port. If no ports are open, an additional Output relay board will be required. The GREEN MACHINE **CAN NOT** share an Overfill Relay port with a 115V Veeder-Root Overfill Annunciator because it will damage the GREEN MACHINE panel.
2. Select an open port and connect wires to NO and C connectors on the relay board. Program the TLS-350 output relay to **Normally Closed**, to **open the contacts on an overfill condition**. Connect the TLS-350 Normally Open to 03030 on the GM Panel and terminal Common to 05050. **See Figure 3-2.**

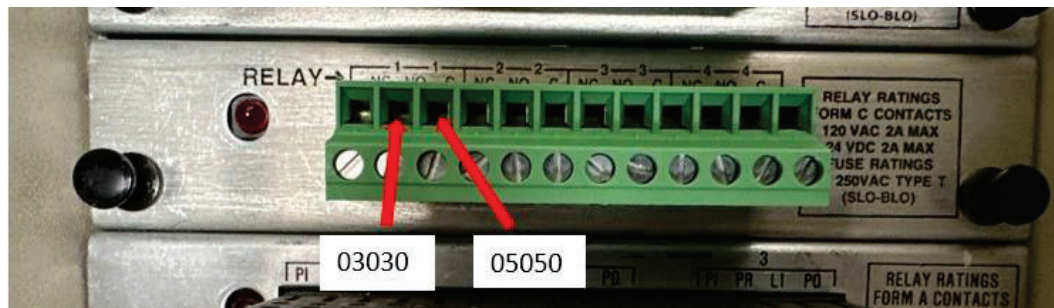


Figure 3-2: Veeder-Root TLS-350 Output Relay

### 3.5.4.2 TLS-450 PLUS GREEN MACHINE Overfill Wiring

1. Open Printer Bay and then the display door of the TLS-450 PLUS. T-15 Torx bit required.
2. Inspect I/O module in the TLS Power Bay, look at middle connector. If no relay ports are available in the I/O module, proceed to step 5. See **Figure 3-3 & 3-4**

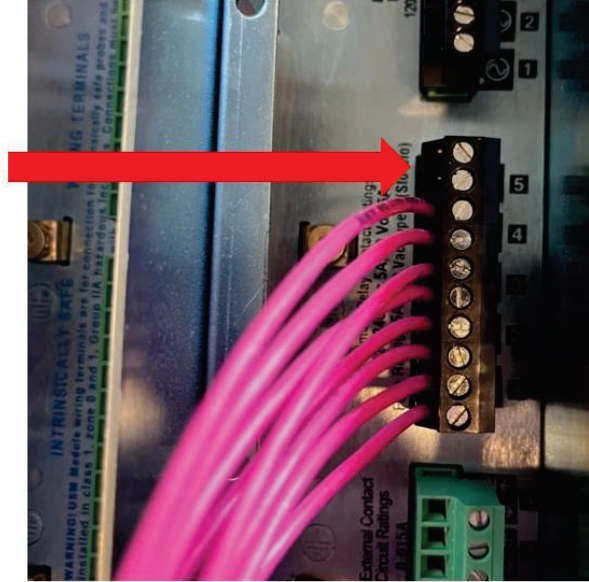


Figure 3-3: Open R5 Relay Port



Figure 3-4: No relays available in I/O module



3. Install two wires rated for 24 VDC or higher from the R5 terminals to the 03030 and 05050 in the GREEN MACHINE Control Panel. **REMEMBER – DO NOT try to share an existing overfill relay if it's present, high voltage will damage the panel.** Most standard overfill alarms use 115 VAC. High voltage or Belden style wire is acceptable. See Figure 3-5 & 3-6.

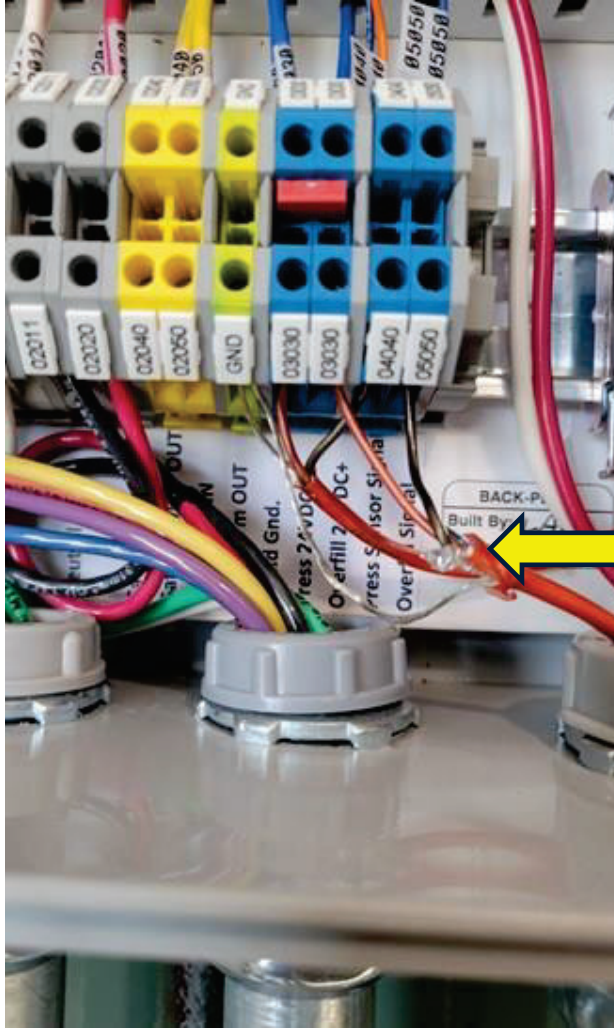


Figure 3-5: GREEN MACHINE Control Panel Connections

(NOTE: Control Panel Component may not be in the position as shown depending on the Control Panel revision. Always refer to the wire numbers.)

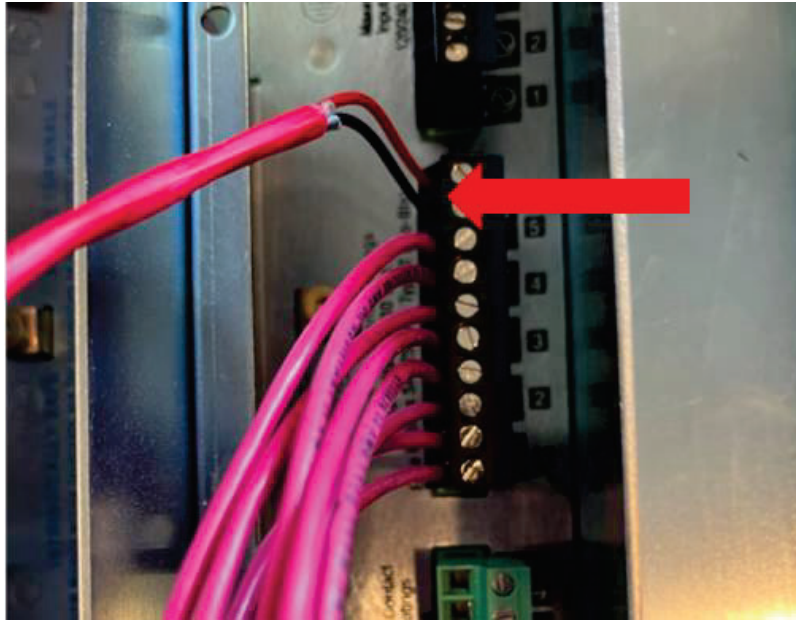


Figure 3-6: GREEN MACHINE Overfill Connection

4. Program TLS-450 PLUS output relay for **Normally Closed**, opposite of most typical overfill alarm circuits. Test R5 overfill alarm relay manually or pull a probe and simulate an overfill. Confirm panel shows Overfill Alarm. Alarm will time out in 2 hours. The Overfill Alarm can also be manually reset in the Maintenance Screen.
5. Alternative installation – Use alternate R7 relay in Communications Bay area. Remove two screws to expose R7 relay and TLS-450 power connector. Install GREEN MACHINE wire at Relay R7 as shown in **Figures 3-7 & 3-8**.



Figure 3-7: Communication Bay Panel Screws

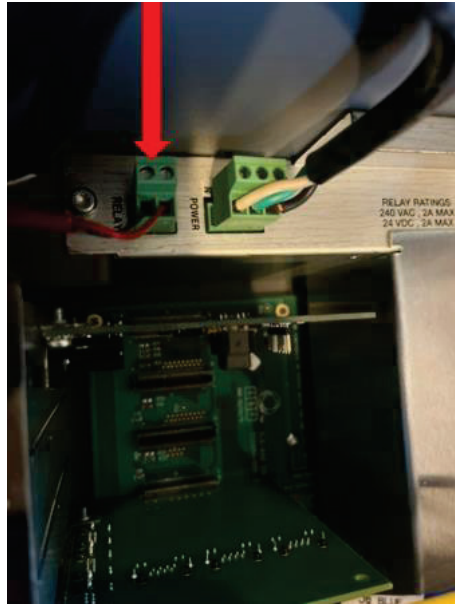


Figure 3-8: R7 Relay location showing GM overfill wire connected at R7 terminals

6. Program R7 relay to **Normally Closed** and assign to all gasoline tanks, opposite of typical External Overfill alarm wiring. Test R7 Overfill Alarm relay manually or pull a probe and simulate an overfill. Confirm panel shows Overfill Alarm. Alarm will time out in 2 hours. The Overfill Alarm can also be manually reset in the Maintenance Screen.

### 3.5.5 Wiring the VST Control Panel to the GREEN MACHINE

Reference the Electrical Drawing Packet associated with your Control Panel Revision.

See [www.vsthose.com/education-gm3-cs2a-usa/](http://www.vsthose.com/education-gm3-cs2a-usa/)

- Refer to page 7 of the Electrical Drawing Packet for wiring from the VST Control Panel to the Internal Junction Box for the Vacuum Pump Motor, the 5 Control Valves, and the Pressure Sensor.

### 3.5.6 Wiring the Pressure Sensor

Reference the Electrical Drawing Packet associated with your Control Panel Revision.

See [www.vsthose.com/education-gm3-cs2a-usa/](http://www.vsthose.com/education-gm3-cs2a-usa/)

- Refer to page 8 of the Electrical Drawing Packet for wiring from the Internal Junction Box to the Pressure Sensor located inside the GREEN MACHINE cover.

### 3.5.7 Applying Power to the VST Control Panel

After all the wiring connections listed below are completed and checked, power can be turned ON at the VST Control Panel. The following items have been installed and wired:

1. VST Control Panel
2. Emergency Shut-Off Relay
3. Overfill Alarm Relay
4. GREEN MACHINE Internal Junction Box
5. Pressure Sensor
6. Safety Disconnect Switch
7. Outlet

After power is turned ON to the VST Control Panel (See Figure 3-1), the Main Screen will show **GREEN MACHINE DISABLED – ENTER CODE**. This means:

1. The VST Control Panel has power through the ESO Relay.
2. The GREEN MACHINE cannot operate because Testing & Start-Up has not been completed.
3. The GREEN MACHINE cannot be started by the Electrical Contractor.
4. **See Figure 3-1:** VST Control Panel PLC Main Screen – GM Disabled – Enter CODE Main Screen

On the Main Screen, push the Faults & Alarms button. This will bring up the Alarms Screen.

All the items on the screen should be green, indicating there are no alarms present. **See Figure 3-9.**

#### **GREEN MACHINE ALARMS**

- Vac Pump Alarm
- Panel Power Alarm
- Overfill Alarm
- Digital Storage Alarm
- Pressure Sensor Alarm

If an Alarm is present, call Vapor Systems Technologies at 937-704-9333 for instructions.

Once all Alarms are green and there are no Alarms present:

1. Turn off power to the VST Control Panel and leave for the Start-Up Contractor.

**CAUTION: TURN OFF POWER TO THE VST CONTROL PANEL AT THIS TIME.**

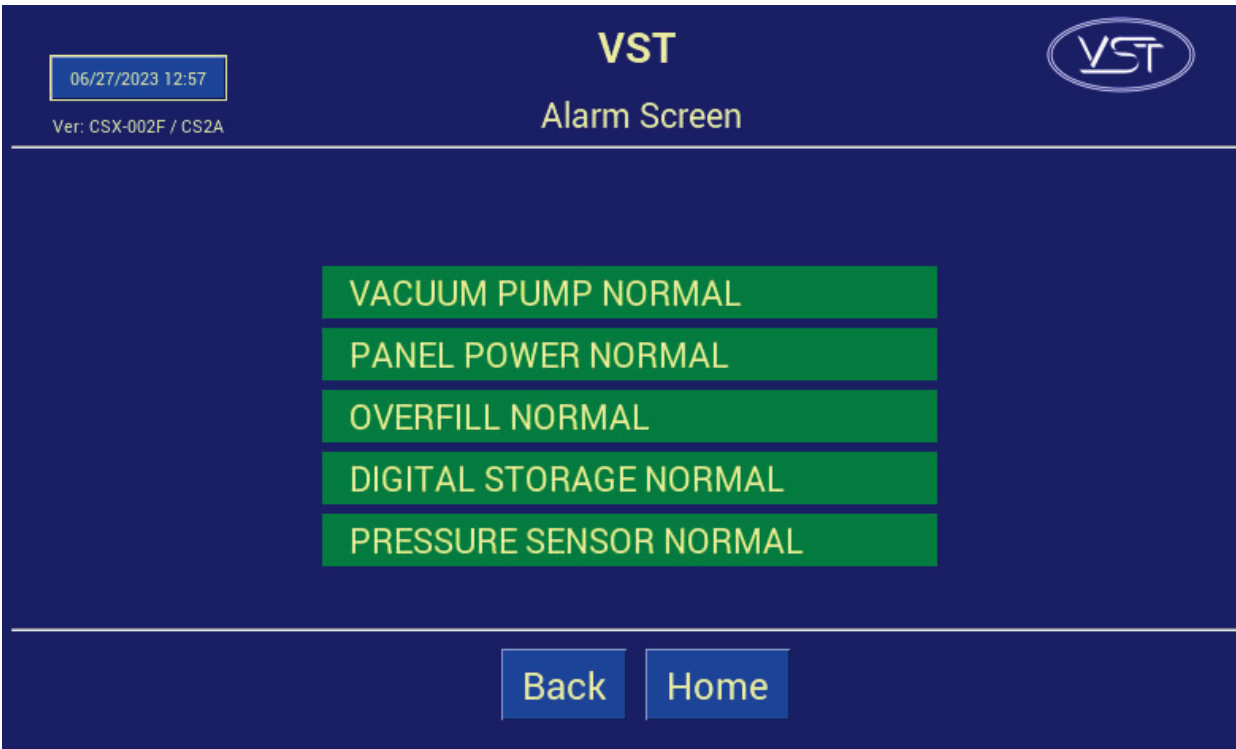


Figure 3-9: VST Control Panel PLC Alarm Screen