



Chapter 3: Electrical Installation

3 Electrical Safety

		<ul style="list-style-type: none"> 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							
Option 1:	Main power	1-Phase	115VAC	20	60-Hz	20-amp breaker	Electrical Panel
Option 2:	ESO Relay power	1-Phase	115VAC	20	60-Hz	20-amp relay	Emergency Shut-Off
Equipment	Phase	Voltage	Amperage	Frequency	Fuse/Breaker Size	Location	
Vacuum Pump Motor	1-Phase	115VAC	8.8 <small>*(See note 1)</small>	60-Hz	15-amp breaker	VST Control Panel	
Control Valves	1-Phase	115VAC	1.0	60-Hz	5-amp fuse (3 each)		
24VDC Power supply	1-Phase	115VAC	4.0	60-Hz	4-amp fuse		
Pressure Sensor		24VDC			Protected by 24VDC power supply		
GREEN MACHINE Controller		24VDC			Protected by 24VDC power supply		

*Note 1: The 8.8 amp listed is only for the ½ HP, 115 VAC, 1-Phase, 60-Hz Leeson Motor.

Table 1: VST Control Panel Power 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 (115 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 (115 VAC and 24 VDC), the neutral, and the ground wires connected to the GREEN MACHINE will be disconnected when:
 - The Power Switch on the front of the VST Control Panel is turned OFF.
 - The station Emergency Shut-Off is activated.
 - The Safety Disconnect Switch at the GREEN MACHINE is opened.
 - 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 pump shut off in Section 5202.4.7.”



3.4 Electrical Components

Existing Components	VST Supplied Components	Contractor Supplied Components
115V Main Electrical Panel	Pre-wired VST Control Panel	115V 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)		

Table 2: Table of Electrical Components

3.5 Electrical Wiring Installation

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

Wires Required to install the GREEN MACHINE:

9 WIRES AND 1 CABLE FROM THE VST CONTROL PANEL TO THE GREEN MACHINE INTERNAL JUNCTION BOX

- 1 Vacuum Pump 115 VAC Hot
- 1 Common Neutral
- 1 Common Ground
- 1 Control Valve V1 115 VAC Hot
- 1 Control Valve V2 115 VAC Hot
- 1 Control Valve V5 115 VAC Hot
- 1 Safety Switch 115 VAC Hot
- 1 Safety Ground
- 1 Safety Switch Ground
- 1 Cable, 3 conductors, 18 AWG, twisted pair, shielded ground

IN ADDITION, THERE ARE 3 WIRES FOR THE 115 VAC OUTLET FROM THE ELECTRICAL DISTRIBUTION PANEL

- 1 Outlet 115 VAC Hot
- 1 Outlet Neutral
- 1 Outlet Ground

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.



3.5.2 OPTION 1: Power To The Vst Control Panel From The Main Electrical Distribution Panel.

Figure 3-2: Is an Electrical Overview Drawing for Reference for Option 1.

Figure 3-3: **Wiring the Supply Power to the GREEN MACHINE from a Main Electrical Distribution Panel:**

1. Make sure the 20-amp breaker used for the GREEN MACHINE inside the distribution panel is turned OFF and follow Lockout-Tagout safety procedures.
2. Install the 115 VAC power, the neutral, and the ground wires from the main distribution panel to the VST Control Panel.
3. Wiring:
 - L1 115 VAC Hot to Wire Number 02011
 - Neutral to Wire Number 02012
 - Ground to Ground

Wiring the VST Control Panel to the ESO Relay:

1. When activated, the ESO will turn OFF and disconnect power, the neutral, and ground from the GREEN MACHINE.
2. Two wires MUST BE INSTALLED from the VST Control Panel to the ESO relay or control system. The technician making these connections MUST BE CERTIFIED to work on this system.
3. Reference the ESO terminal block wire numbers.
4. Wiring:
 - 115 VAC to Wire Number 02011
 - 115 VAC Switch Leg to Wire Number 02032

3.5.3 OPTION 2: Power The Vst Control Panel From The Station Emergency Shut-Off (Eso) Relay.

Figure 3-4: Is an Electrical Overview Drawing for Reference for Option 2.

Figure 3-5: **Supply Power to the GREEN MACHINE from the ESO Relay:**

1. Make sure the ESO Relay is 20A or higher.
2. Install the 115 VAC power, the neutral, and the ground wires from the ESO Relay to the VST Control Panel.
 - ESO L1 115 VAC Hot to Wire Number 02011
 - ESO Neutral to Wire Number 02012
 - ESO Ground to Ground

Wiring the VST Control Panel ESO Relay Jumper:

1. Since the VST Control Panel power is wired to the station ESO Relay, a jumper MUST be installed inside the panel.
2. Install the jumper wire inside the VST Control Panel.
 - Wire Number 02011
 - To Wire Number 02032



3.5.4 Wiring the Electrical Components at the GREEN MACHINE Location.

Figure 3-6: Shows the Field Wiring from the VST Control Panel to the GREEN MACHINE Internal Junction Box: Vacuum Pump Motor, Pressure Sensor, Safety Power Switch

1. Wiring the Internal Junction Box
 - a. Install 6 wires from the VST Control Panel to the junction box
 - a. Vacuum Pump 115 VAC to wire number 02052
 - b. Vacuum Pump Neutral to wire number 02042
 - c. Control Valve V1 115 VAC to wire number 02062
 - d. Control Valve V2 115 VAC to wire number 02072
 - e. Control Valve V5 115 VAC to wire number 02074
 - f. 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 cable is supplied by the contractor
 - c. The cable must be 3-conductor, 18 AWG, twisted and shielded
 - 24 VDC (+) to wire number 02092
 - 4-20 mA SIGNAL to wire number 04052
 - 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
 - 115 VAC to wire number 02032
 - 115 VAC switch leg to wire number 02023
 - Ground to Ground

3.5.5 Wiring the Overfill Alarm Field Wiring

Figure 3-6: Shows the Overfill Alarm Field Wiring from the VST Control Panel to the Fuel Management System

1. The VST Control Panel supplies 24 VDC to an Overfill Alarm relay.
2. The Overfill Alarm output relay is a “dry” relay (N.O.) that shuts down the GREEN MACHINE when a UST reaches the Overfill Level volume during a fuel drop.
3. Install two wires from the VST Control Panel to the Fuel Management System Overfill Alarm (N.O.) 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.)
 - a. TLS-350 or equivalent Overfill Alarm Relay Circuit.
 - b. Connect to the COMM Bay, 4-Relay Module
 - 24 VDC (+) to wire number 02092
 - 24 VDC (0) to wire number 04051
 - OR
 - c. TLS-450 PLUS or equivalent Overfill Alarm Relay Circuit
 - d. Connect to the Module Bay, I/O Module
 - 24 VDC (+) to wire number 02092
 - 24 VDC (0) to wire number 04051



3.5.6 Wiring the VST Control Panel to the GREEN MACHINE

Figure 3-7: Wires from the VST Control Panel to the GREEN MACHINE Internal Junction Box Wiring Diagram.

1. This drawing is used 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. For Reference.

3.5.7 Wiring the Pressure Sensor

Figure 3-8: Wiring Diagram of the Pressure Sensor.

1. This drawing is used for wiring from the Internal Junction Box to the Pressure Sensor located inside the GREEN MACHINE cover.

3.5.8 Vacuum Pump Motor Wiring Diagram

Figure 3-9: Wiring Diagram of the Vacuum Pump Motor, 115 VAC, 1-phase, 50-Hz, 1725 rpm.

1. This is the Vacuum Pump motor wiring diagram and is used to reverse the motor direction if required.

3.5.9 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 3-3**), the Main Screen will show **GM DISABLED – ENTER CODE**. This means:

1. The VST Control Panel has power through the Distribution Panel or 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

Before turning OFF power the VST Control Panel, check to make sure there are no GREEN MACHINE Alarms. See **Figure 3-2**.

1. On the Main Screen, push the Faults & Alarms soft button. This will bring up the Alarms Screen.
2. All the items on the screen should be Green, indicating there are no alarms present.
 - a. Pressure Sensor Alarm
 - b. Vacuum Pump Alarm
 - c. Maint. Switch Alarm (Make sure the Maint. Switch on the front of the Control Panel is turned ON)
 - d. Overfill Alarm
3. If an Alarm is present, call Vapor Systems Technologies at 937-704-9333 for instructions.



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

Make sure the Carabiner Clip is installed on the VST Control Panel locking the Power Switch in the OFF position.

The power to the VST Control Panel will be turned ON AGAIN during the GREEN MACHINE Post Installation Start-Up.

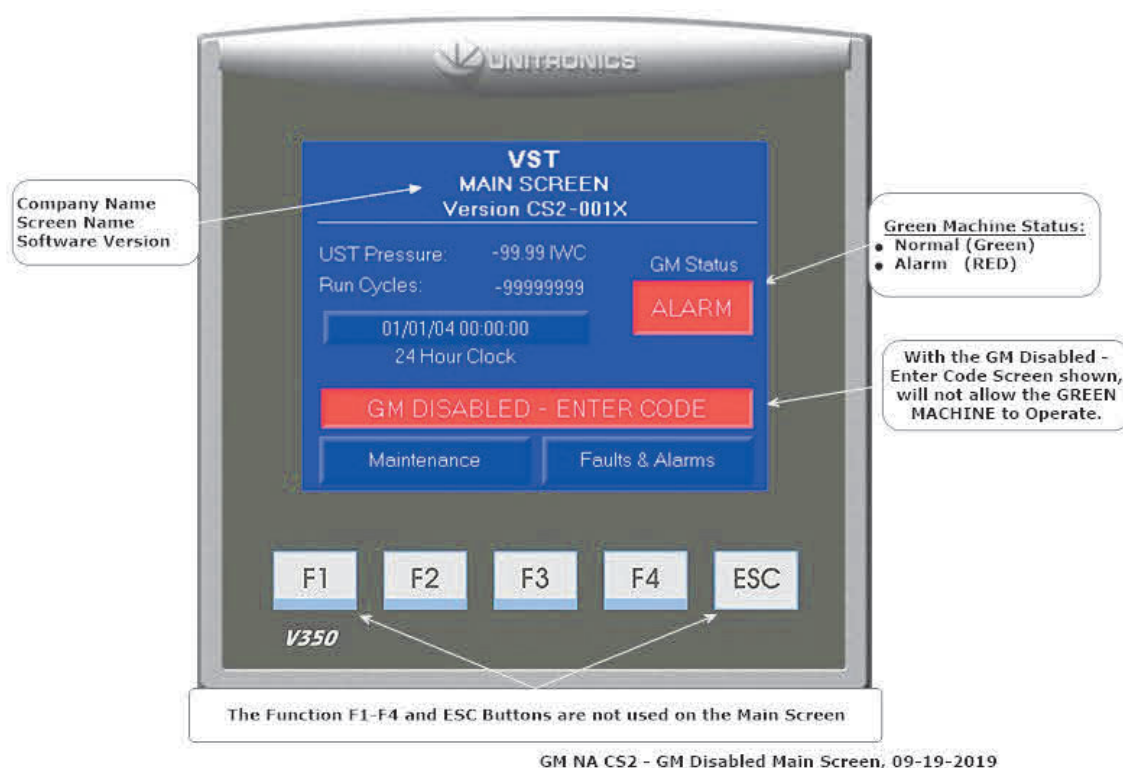


Figure 3-1: Control Panel PLC Main Screen - GM Disabled - Enter CODE Main Screen

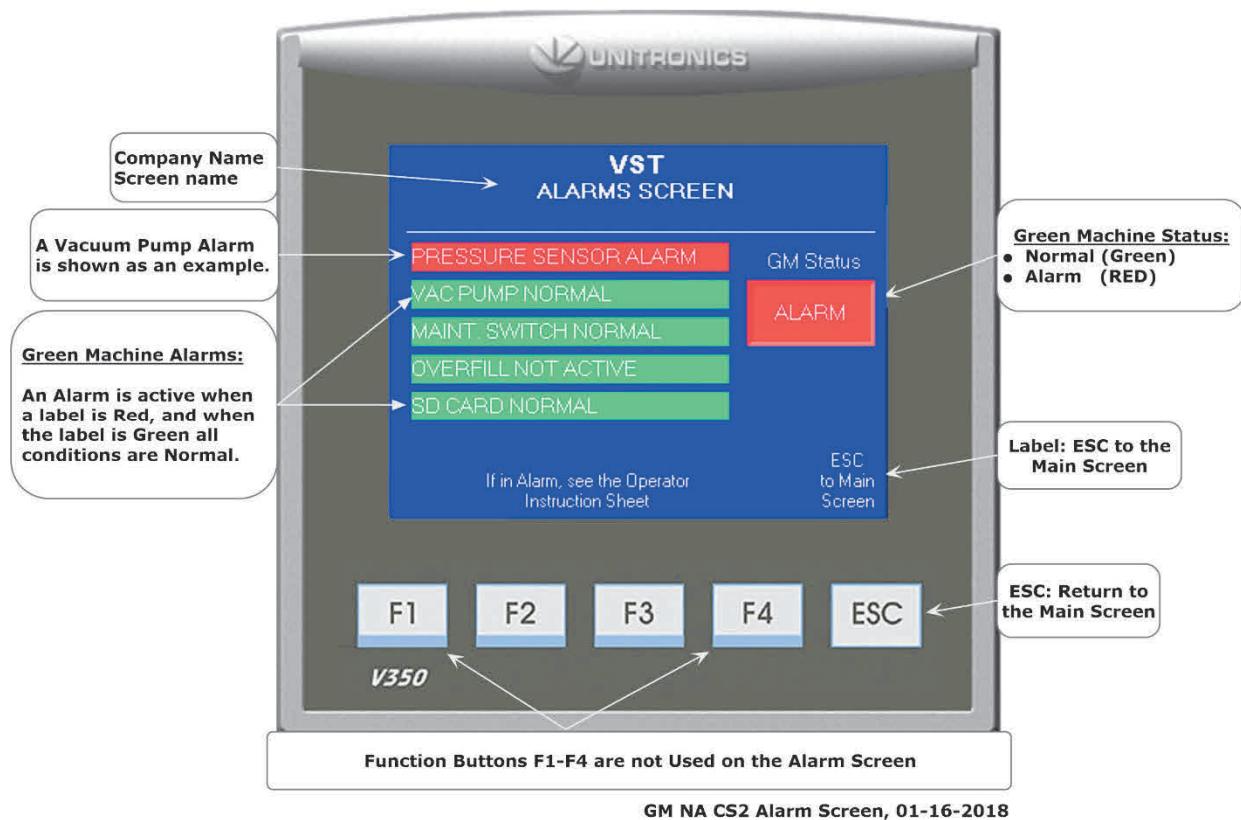


Figure 3-2: VST Control Panel PLC Alarm Screen

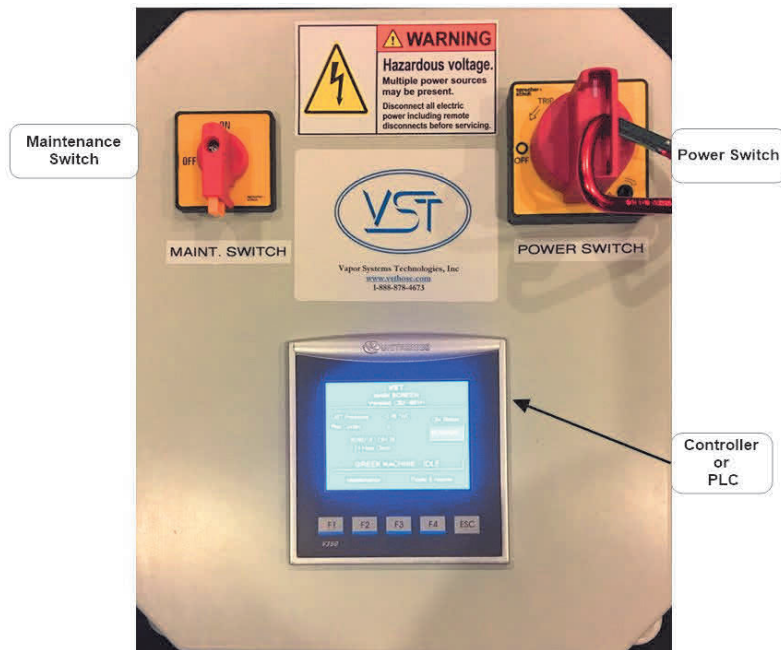


Figure 3-3: VST CS2 Control Panel w/Carabiner Clip Installed

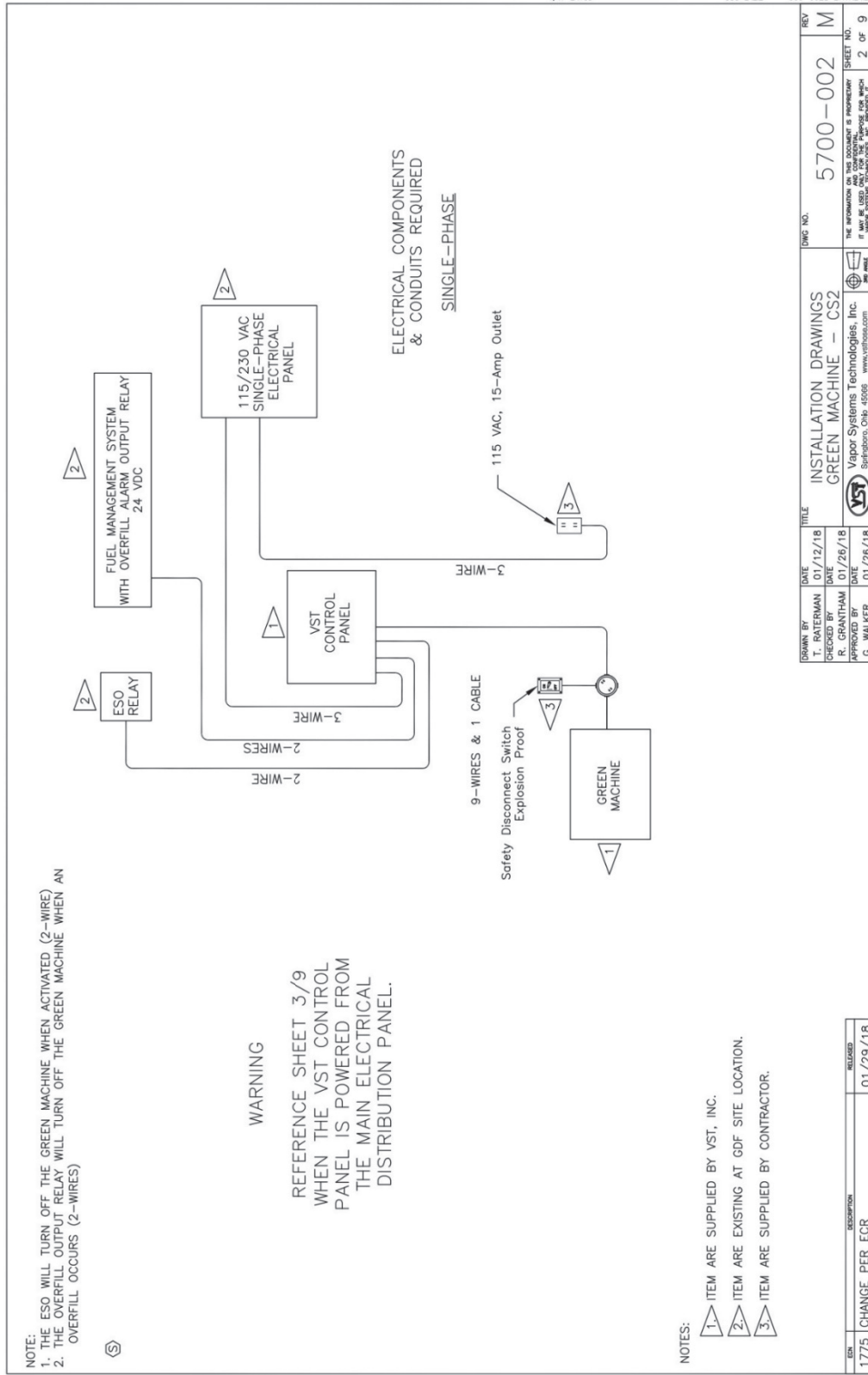
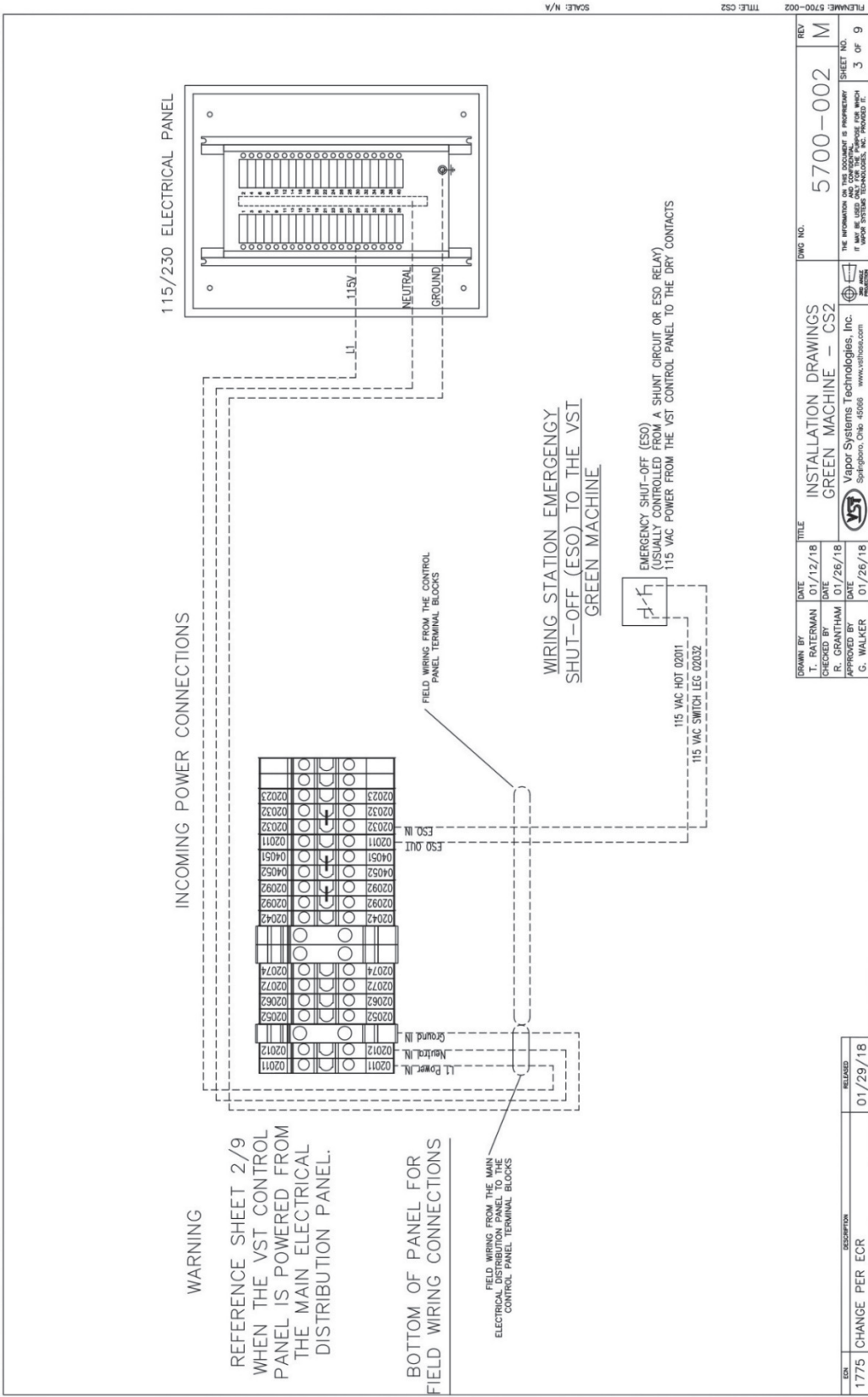


Figure 3-4: GREEN MACHINE Installation Overview Option 1





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DESIGNED BY	T. WATERMAN	CHECKED BY	R. GRANTHAM	APPROVED BY	C. WALKER
TITLE: INSTALLATION DRAWINGS GREEN MACHINE - CS2					
DWG NO. 5700-002					
SHEET NO. 3 OF 9					
THE INFORMATION ON THIS DOCUMENT IS PROPRIETARY TO VAPOR SYSTEMS TECHNOLOGIES, INC.					

Figure 3-5: The Control Panel Power and ESO Connections Option 1

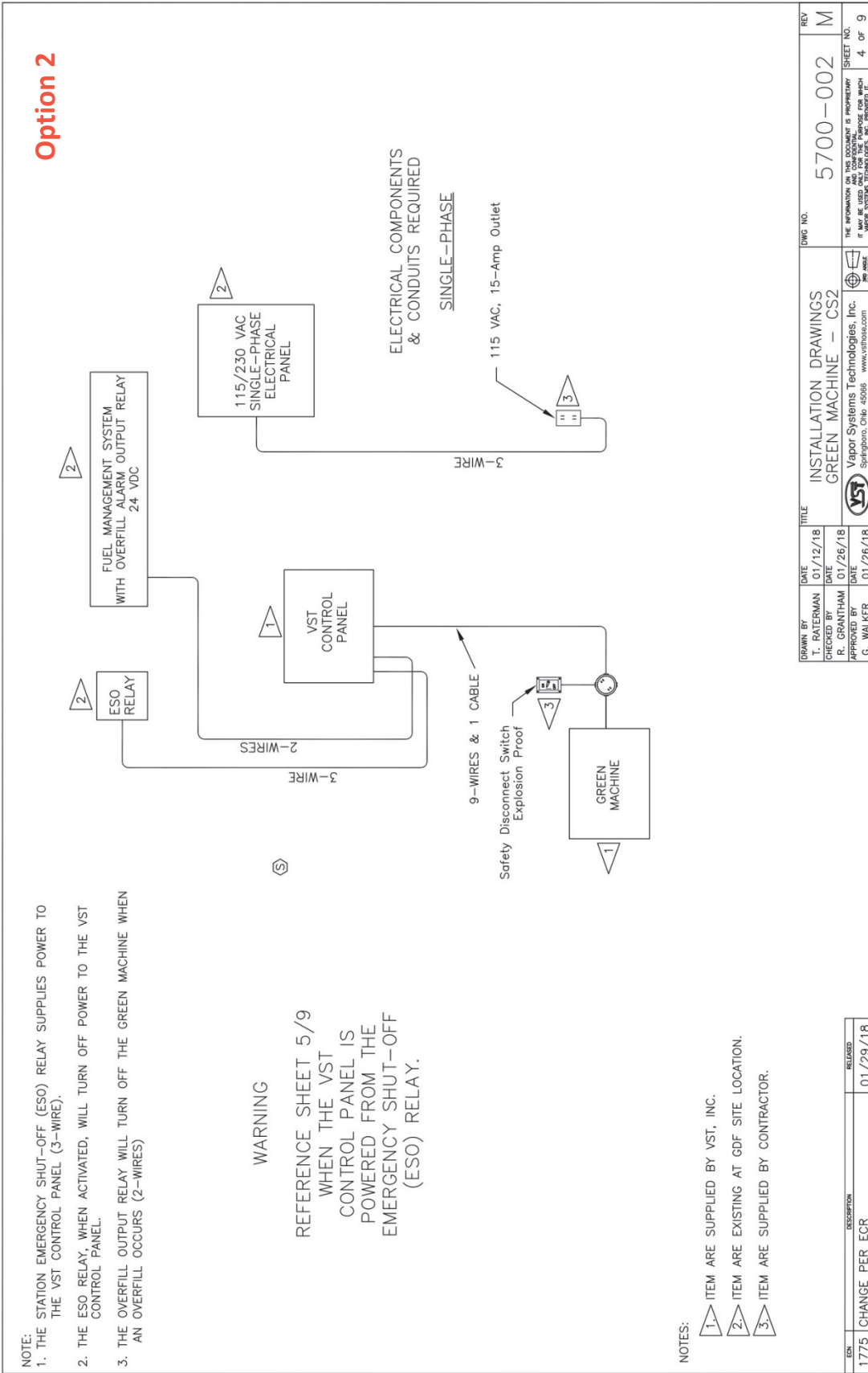
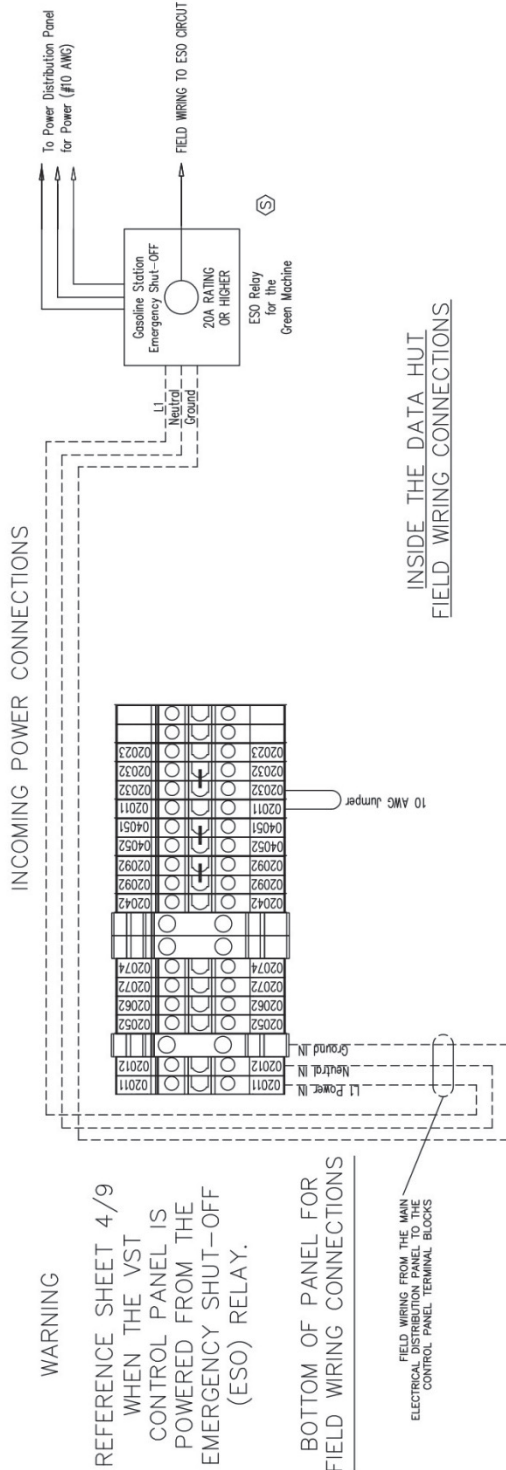


Figure 3-6: The GREEN MACHINE Installation Overview Option 2



Option 2



INSIDE THE DATA HUT
FIELD WIRING CONNECTIONS

WARNING
REFERENCE SHEET 4/9
WHEN THE VST
CONTROL PANEL IS
POWERED FROM THE
EMERGENCY SHUT-OFF
(ESO) RELAY.

**BOTTOM OF PANEL FOR
FIELD WIRING CONNECTIONS**

FIELD WIRING FROM THE MAIN
ELECTRICAL DISTRIBUTION PANEL TO THE
CONTROL PANEL TERMINAL BLOCKS

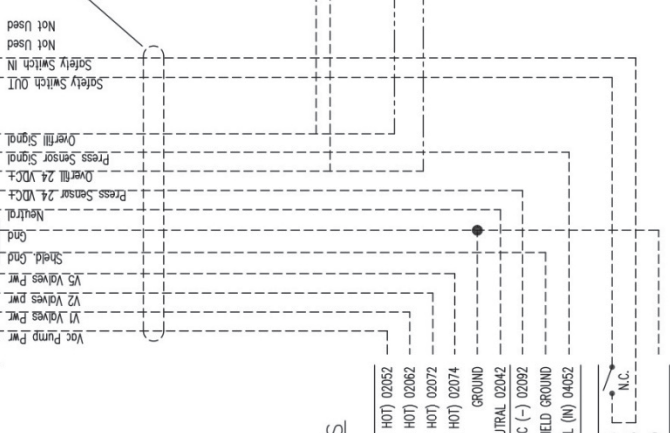
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BY	J. RALFMAN	DATE	GREEN MACHINE - CS2				
APPROVED BY	R. GRANTHAM	DATE	Vapor Systems Technologies, Inc.				
	G. WALKER	DATE	Springboro, Ohio 45066 www.vstusa.com				
DESCRIPTION	RELEASED					SHEET NO.	5 OF 9
1775 CHANGE PER ECR	01/29/18						

Figure 3-7: The Control Panel Power Connection Option 2

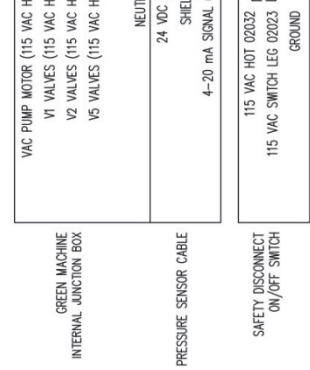


CONTROL PANEL CONNECTIONS

02011	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
02012	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
02052	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
02062	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
02072	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
02074	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
02042	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
02092	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
02092	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
02092	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
04051	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
02011	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
02032	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
02032	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
02032	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
02023	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○



AT THE GREEN MACHINE FIELD WIRING CONNECTIONS

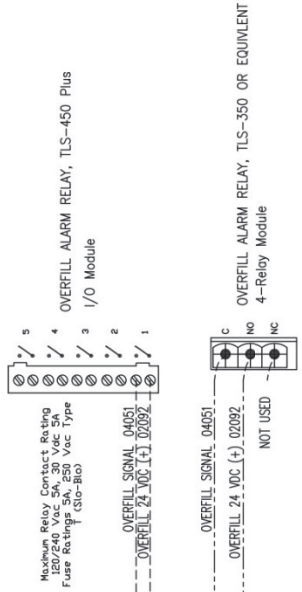


CONNECTING

- * GREEN MACHINE INTERNAL JUNCTION BOX
- * PRESSURE SENSOR
- * SAFETY DISCONNECT SWITCH
- * OVERFILL ALARM RELAY
- ** TLS-350 AND TLS-450
- ** TLS-450 PLUS

FIELD WIRING FROM THE CONTROL PANEL TERMINAL BLOCKS

INSIDE THE DATA HUT OVERFILL FIELD WIRING CONNECTIONS



DRAWN BY	DATE	TITLE	DWG NO.	REV
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G. WALKER	01/26/18			

Figure 3-8: The VST Control Panel Field Wiring

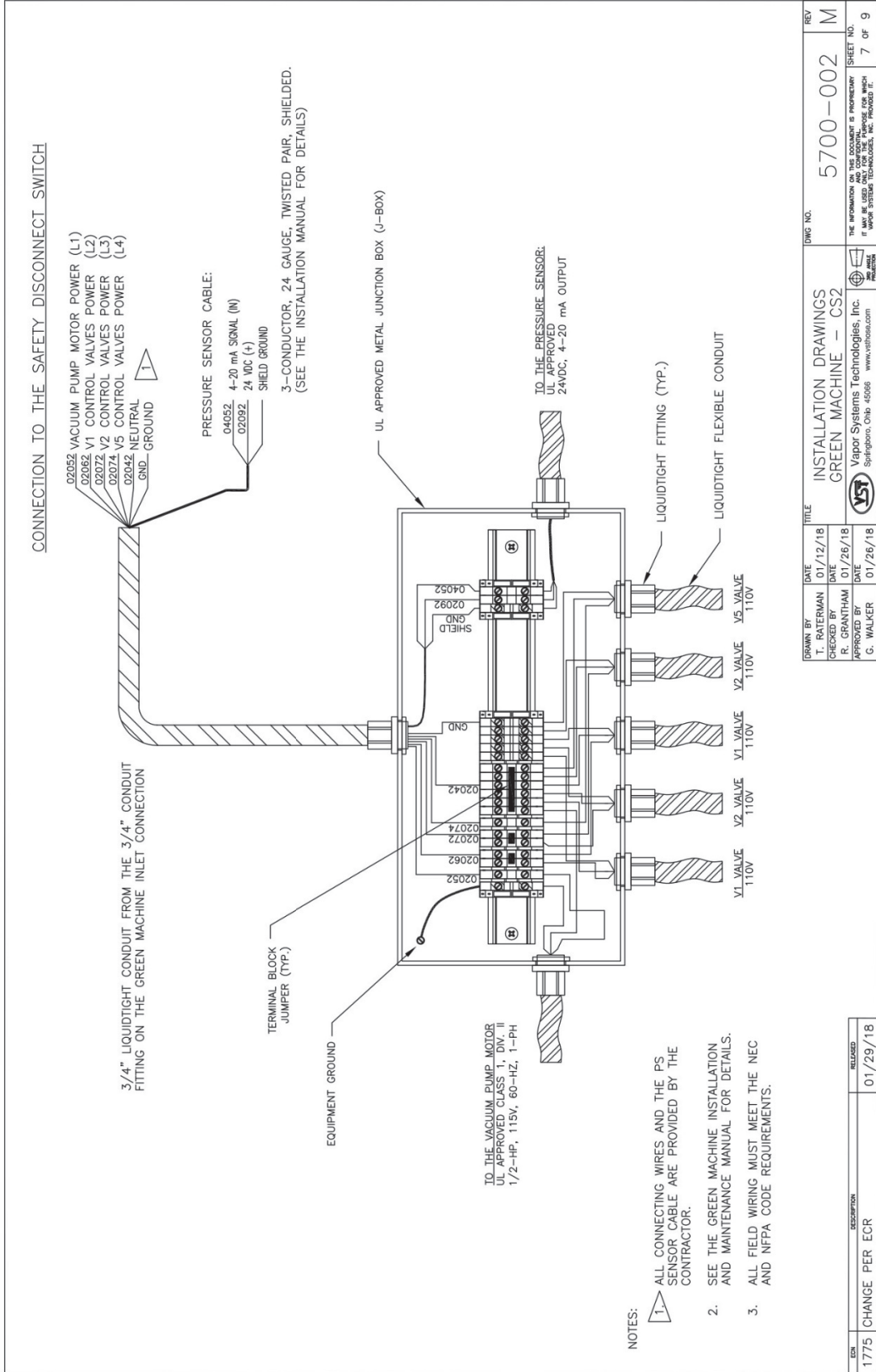


Figure 3-9: GREEN MACHINE Internal Junction Box Field Wiring

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CHECKED BY	R. GRANTHAM	DATE	01/26/18	
APPROVED BY	G. WALKER	DATE	01/26/18	
TITLE INSTALLATION DRAWINGS GREEN MACHINE - CS2				
DWG NO. 5700-002				
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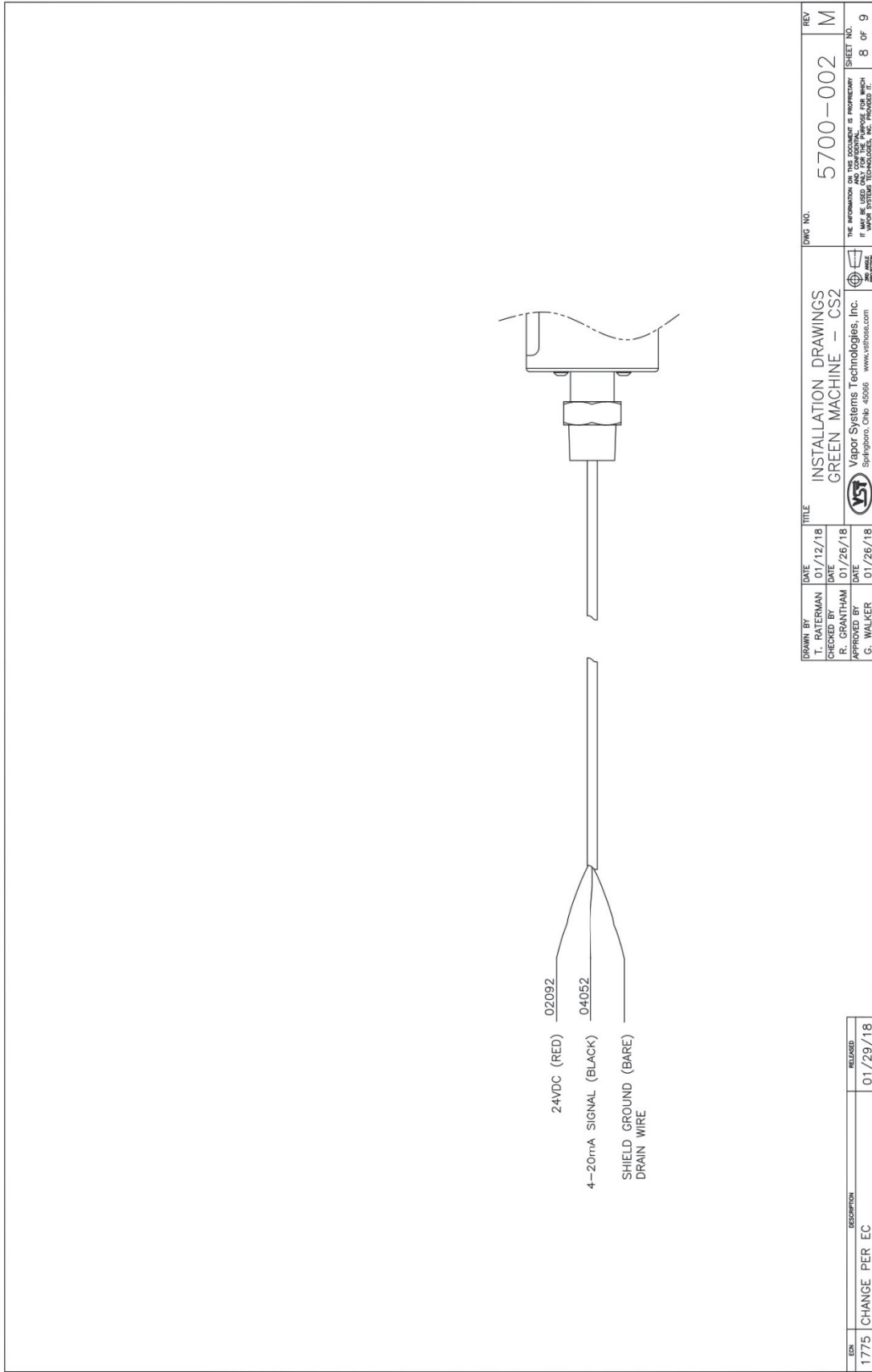


Figure 3-10: Pressure Sensor Wiring Diagram

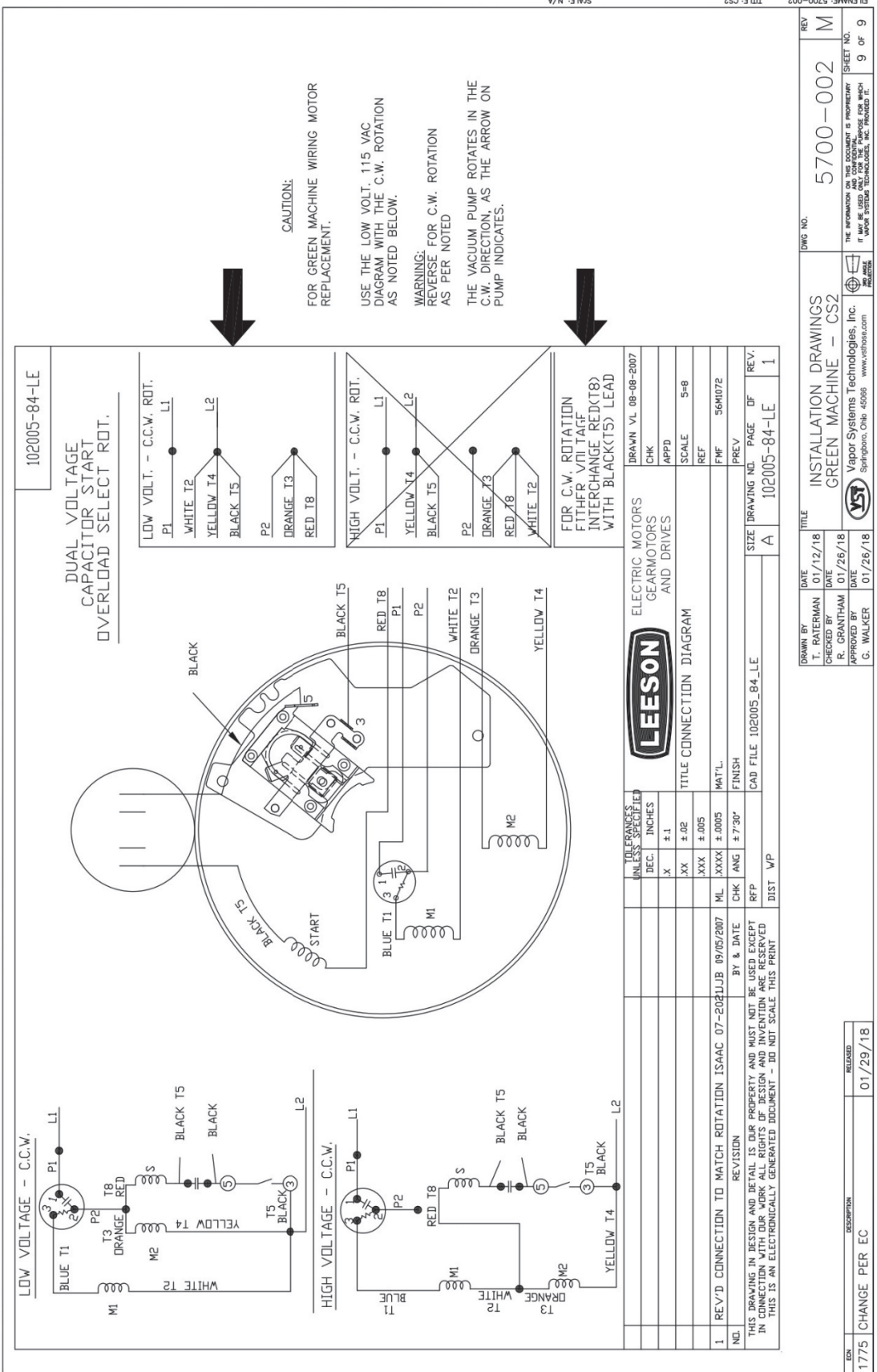


Figure 3-11: Vacuum Pump Motor Wiring Diagram