MOSSER CONSTRUCTION, INC.
122 S. Wilson Ave
Drawer D
Fremont, OH 43420
Phone (419) 334-3801

LETTER OF TRANSMITTAL

Date	8/29/2019	**MCI Job No.**	119006
Item	002	**Spec Section**	N/A
Re:	ODOT 193002		
	Fort Washington Way Pump Station		
	City of Cincinatti, OH		

TO: ODOT District 8

505 South State Route 741

Lebanon, OH45036

Attn: Marvin M. Lennon

We Are Sending You: [x] Attached [ ] Under separate cover via _____ the following items:

[ ] Shop Drawings [ ] Prints [ ] Plans [ ] Samples [ ] Specifications

[ ] Copy of Letter [ ] Change Order [ ] _____

Firm Name	Copies	Drawing No.	Description
Mosser	1	N/A	Mosser OM Manual and Emergency Flood Plan

These Are Transmitted As Checked Below:

[ ] For Approval [ ] Approved As Submitted [ ] Submit _____ Corrected Copies For Field Use

[x] For Record [ ] Approved As Noted [ ] Resubmit _____ Copies For Approval

[ ] As Requested [ ] Returned For Correction [ ] Tentative Delivery _____ Please Confirm

[ ] For Review & Comment [ ] Not Approved [ ] For Deposit Refund Of _____

[ ] For Bids Due _____ [ ] Plans and Specifications Returned Herewith

Remarks: Please see attached Mosser O&M Manual and Emergency Flood Plan for your records. Weekly site inspection sheet will be submitted in future submittal. Plan is effective starting September 1, 2019.

Copy To: File

Job Supt.: Ed Fisher

SIGNED: Nicholas P. Stuys

Project Manager

MOSSER CONSTRUCTION, INC.

MCI Job No.: 7376.01

Project: Heatherdowns Booster Pump Station Renovations – Phase II
City of Toledo, Ohio

Prime Contractor: Mosser Construction, Inc.

Submittal Type / Required Number of Copies

Product Data
Shop Drawings
Samples for Verification
Warranties
Test Reports

Submittal Stamp Page

Submittal No.: 002 **Date:** 8/29/2019

Item(s): Mosser OM Manual and Emergency Flood Plan **Quantity:** 1

Specification Section(s): N/A

Drawing Number(s): N/A

Mosser Construction Stamp

Reviewed to be in General Conformance with our interpretation of the Contract Documents. This review does not relieve the Subcontractor or Supplier of their responsibility for deviations omissions or errors not conforming to the contract drawings and specifications. The Subcontractor or Suppler shall verify all dimensions, quantities, and field conditions and shall be responsible for coordination with other trade contractors.

Supplier/Subcontractor: Mosser

Spec Section: N/A Submittal #: 002

Date: 8/29/2019 By: NPS Prev. Sub #: N/A

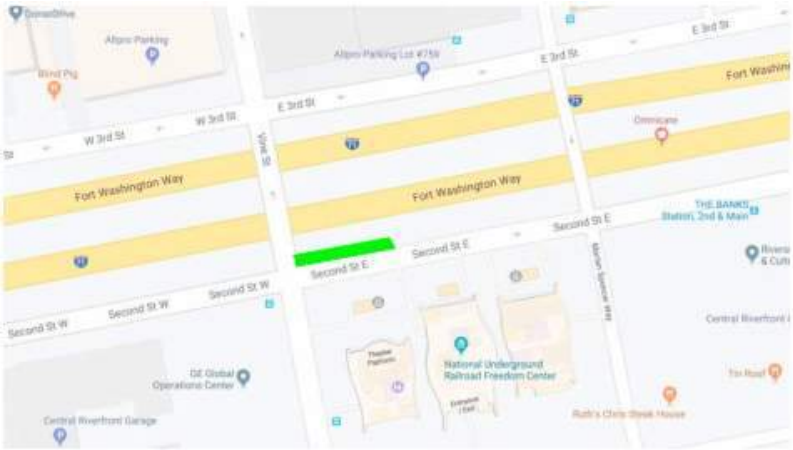
MOSSER CONSTRUCTION, INC.

APPROVER'S STAMP

APPROVER'S STAMP

Fort Washington Way Pump Station:

O+M Manual and Emergency Flood Control Plan



Address: 2nd Street between Vine Street and Walnut Street, Cincinnati, OH 45202

Fort Washington Way Pump Station Rehab

State Project Number: 193002

Mosser Project Number: 119006

Table of Contents

Emergency Contact Information:

Below is the contact information for all staff members from each party involved listed from primary contact to secondary contact and so on.

Mosser Construction, Inc. - Personal			
Name	*Title*	*Phone*	*Email*
Nick Steyer	Project Manager	Office: (419) 355-3266 Cell: (567) 207-7353	nsteyer@mossergrp.com
Ed Fisher	Superintendent	Cell: (419) 461-0868	efisher@mossergrp.com
ODOT District 8 - Personal			
Name	*Title*	*Phone*	*Email*
Justin Kemp	Hamilton County TA	Office: (513) 933-6120 Cell: (513) 520-3329	Justin.kemp@dot.ohio.gov
Chuck Hecht	District 8 Roadway Services Manager	Office: (513) 933-6523 Cell: (513) 309-2268	Chuck.hecht@dot.ohio.gov
Marvin Lennon	Project Engineer	Office: (513) 933-6129 Cell: (513) 320-54136	marvin.lennon@dot.ohio.gov
Charles Rowe	Senior Project Manager/Design Build Coordinator	Office: (513) 933-6596	charles.rowe@dot.ohio.gov
Allied Technical Services, Inc - Personal			
Name	*Title*	*Phone*	*Email*
Emergency Contact	Emergency Contact	1-877-987-8677	N/A
Doug Sayre	Project Manager	Office: (513) 793-0499 Cell: (513) 607-6100	doug.sayre@alliedtechnicalservicesinc.com
Lykins Energy Solutions – Personal			
Name	*Title*	*Phone*	*Email*
Emergency Contact	Emergency Contact	1-800-875-8820	N/A
Terry Murray	Sales Representative	(513) 641-0150	tmurray@lykinsenergy.com
Steve Krebs	Sales Representative	(513) 641-0150	skrebs@lykinsenergy.com

INTRODUCTION

Purpose:

To define the roles and responsibilities of all parties involved in the maintenance and operation of the Fort Washington Way Pump Station and also to implement an emergency procedure that is followed during a possible flooding event along Fort Washington Way (I-71). The current Fort Washington Way Pump Station is not suitable to handle excessive flooding situations due to (2) of their (4) total submersible pumps being inactive. This reduces the pump station's pumping capabilities from 47,000 gpm down to just 17,000 gpm.

Parties Roles/Responsibilities:

- *Mosser Construction, Inc.* – Primary contractor responsible for the operation and maintenance of the pump station beginning September 1, 2019.

- *ODOT District 8* – Owner of Fort Washington Way Pump Station and responsible for all road closures in the event of the Ohio River flooding.

- *Allied Technical Services, Inc.* – Subcontractor of Mosser Construction responsible for weekly inspections of the Fort Washington Way Pump Station along with providing emergency on-site staff for the duration of an Ohio River flooding event.

- Lykins Energy Solutions – Fuel company Mosser Construction, Inc. will purchase all off-road diesel fuel from in order to refuel the CAT generator located in Lot B used for emergency power for the Fort Washington Way Pump Station.

Events/Tasks:

A. Weekly Pump Station and Generator Inspections
B. Refueling of Pump Station Generator Located at Lot B
C. Emergency Flood Plan

A. WEEKLY PUMP STATION AND GENERATOR INSPECTIONS

Description:

Allied Technical Services, Inc. is responsible for weekly general inspections of the Fort Washington Way Pump Station and accompanying generator beginning the week of September 1, 2019. General inspections will be conducted each week. Results will be reported to Mosser Construction, Inc. within 24 hours of inspection. Weekly inspections will be conducted for 53 consecutive months, resulting in a grand total of 230 general inspections. All inspections will be paid under the pay item "690E99550 SPECIAL – Special-MISC.: Operation and Maintenance, MONTH" for all 53 months.

Procedure:

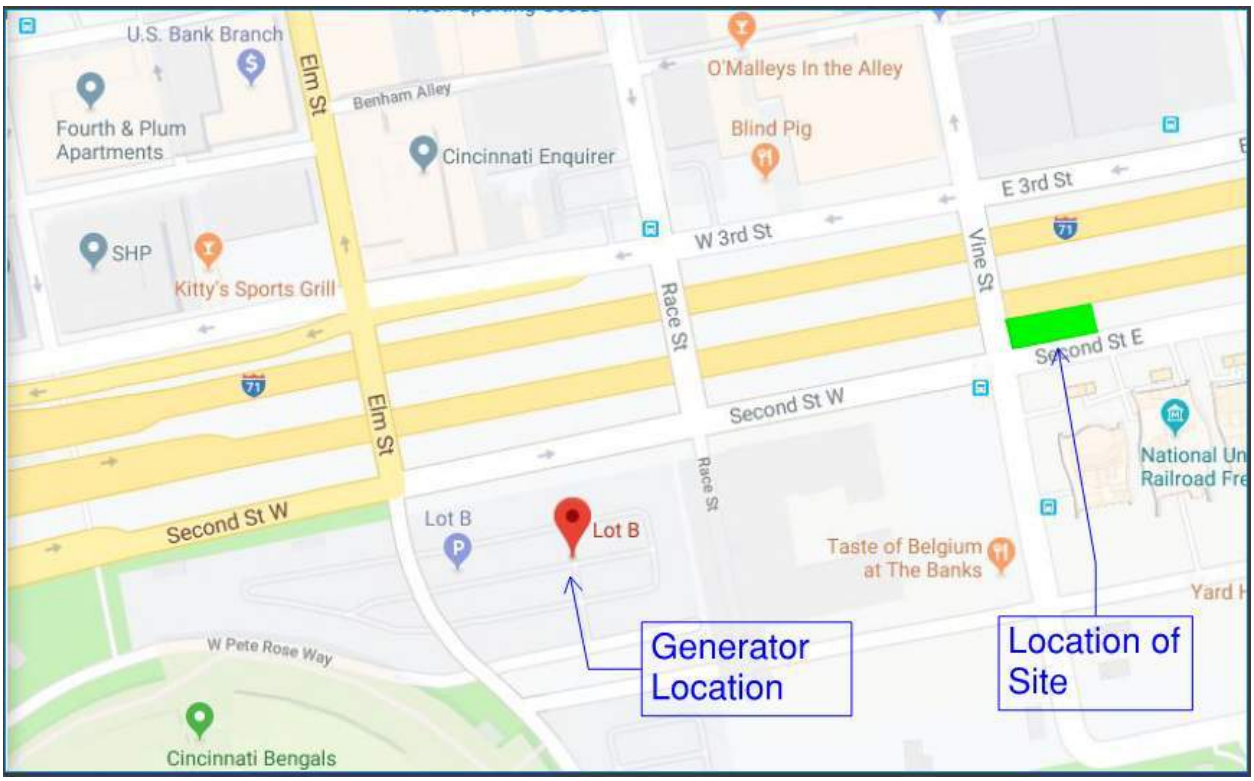
1. Allied Technical Services, Inc. will send a qualified technician to perform a general inspection of the Pump Station and Generator each week. All inspections will be in accordance with the 2003 Pump Station O & M Manual.
2. Technician is to follow all appropriate safety requirements.
3. Technician to perform a visual inspection of all hatches, hatch locks, and hinges
4. Technician to ensure ventilation is running properly.
5. Technician to record observations in regards to the Control Room conditions:
    a. Alarms
    b. Flooding
    c. Loss of Panel Power
    d. Damage
    e. Etc.
6. Technician is to record below data weekly:
    a. Current Wet Well Level
    b. Sluice Gate Position
    c. Alarm Status
    d. Pump Status
    e. Air Quality Monitor Status
    f. Generator Status – including fuel level
        i. CAT Generator Serial Number "9FG02278" located at Lot B (West Entrance to Transit Center)
7. Technician is to perform a control panel check
8. Technician is to sample pump status
9. Technician is to calibrate Air Quality Equipment per Manufacturer's Specification's as needed. (See attached 2003 Pump Station O & M Manual) The current MSA equipment isn't functional so portable air monitoring equipment will be utilized until the new equipment is installed.
10. If any maintenance work is required, Allied Technical Services, Inc. will provide an estimated cost for repairs to Mosser Construction, Inc. prior to work being performed. If these estimated costs are approved by ODOT, the work will be tracked and paid via Force Account.
11. Allied Technical Services, Inc. will switch to performing all inspections, maintenance, and operation in accordance with 2020 Pump Station O&M Manual once directed to do so by Mosser Construction, Inc.

B. Refueling of Pump Station Generator Located at Lot B

Description:

Mosser Construction, Inc. in conjunction with Allied Technical Services, Inc. will ensure that the Fort Washington Way Pump Station generator located at Lot B (West Entrance to Transit Center) will maintain a fuel level of 75% full at all times. Lykin Energy Solutions will provide all off-road diesel to refuel the CAT generator serial number "9FG02278".

Location:



Procedure:

1. Allied Technical Services, Inc. will inspect the CAT generator fuel levels during their weekly inspections.
2. Allied Technical Services, Inc. will immediately notify Mosser Construction, Inc. anytime that the fuel level of the CAT generator falls below 75%.
3. Mosser Construction, Inc. will contact Lykins Energy Solutions and setup refueling of the generator as soon as possible.
4. Mosser Construction, Inc. will then submit reimbursement pricing to ODOT District 8 via Force Account.

C. EMERGENCY FLOOD PLAN

Description:

Mosser Construction, Inc. in conjunction with Allied Technical Services, Inc. are to implement a flood control plan in the event that the Ohio River reaches a stage of 483.0 feet. At this time the Fort Washington Way Pump Station will become operational in order to avoid flooding of Fort Washington Way (I-71). All costs incurred during a flooding event will be documented and paid via Force Account.

Procedure:

1. Allied Technical Services, Inc. will monitor local weather and Ohio River water levels daily. If a river level of 483.0 feet is reached, Allied Technical Services, Inc. will contact and alert Project Manager, Nick Steyer, of Mosser Construction immediately.
2. Mosser Construction, Inc. will notify and alert an ODOT District 8 emergency contact listed above of the situation. ODOT will be responsible for all road closures due to excessive flooding along Fort Washington Way (I-71).
3. The pump station is manually activated during a flooding event, thus requiring on-site staff during the duration of the flood event. Allied Technical Services, Inc. will provide all on-site staff and equipment.
4. If the pump station is unable to keep up with the flood demands or if there is partial/complete pump station failure during period of pumping, Allied Technical Services, Inc. will be responsible for supplying and operating additional pumps in order to remove excess water. In this event, notify Mosser Construction, Inc. immediately.
5. All costs incurred by Allied Technical Services, Inc. during a flooding event shall be documented and submitted to Mosser Construction, Inc.
6. Mosser Construction, Inc. will then submit incurred costs for approval and payment to ODOT via Force Account.
7. Allied Technical Services, Inc. will switch to performing all inspections, maintenance, and operation in accordance with 2020 Pump Station O&M Manual once directed to do so by Mosser Construction, Inc.

ATTACHMENTS

Attached for reference:

- 2003 Design and Operation Of Stormwater Pumping Station: Fort Washington Way
- Technical Controls Manual: EG Controls Fort Washing Way Dated 2000

Starting on September 1, 2019, all site inspections, maintenance, and operation will be in accordance with the 2003 Pump Station O&M Manual.

Mosser Construction, Inc. will direct Allied Technical Services, Inc. when it is time to switch to performing all inspections, maintenance, and operation in accordance with the 2020 Pump Station O&M Manual.

DESIGN AND OPERATION OF STORMWATER PUMPING STATION

Fort Washington Way

January 2003

Table of Contents

EXECUTIVE SUMMARY

The old pumping station was designed with a dry well below flood level and with the motors in an above-ground building above flood level. The head losses in the discharge piping from the station to the Ohio River were three feet. The level of the top of the ground was approximately the same as the new Second Street, EL. 512.6 (156.24).

The new pumping station is designed with submersible pumps and electric controls, all below ground. The head losses in the discharge piping from the station to the Ohio River are three feet. The level of Second Street is 512.6 (156.24).

This report recommends that the three openings into the wet well be sealed and the entry point for the power cables into the control room be checked to ensure that that opening is sealed. Both the wet well and the control room are, then, sealed concrete boxes in the ground, with the only point of entry for water being from Second Street.

The storm flow from Fort Washington Way will flow to the Ohio River by gravity. The invert of the main storm sewer from the highway into the station is 146.532 (480.74). The invert of the discharge piping from the station is 146.297 (479.98). The elevation of the highway at the shoulder at the lowest point is 149.208 (489.52).

Sinee there are some three feet of losses through the outlet piping to the river, then the maximum level of river water for gravity flow is approximately 147.828 (485.00). The station would come on line if there is flow from the highway and the river is rising to this level. The station wet well, under pumping, is held at 146.597 (480.96).

If the river was to rise to the level of Second Street, it would start to flood over into the highway, and the station would have nowhere to pump the floodwater. Since there are three feet of losses in the outlet piping, then the maximum level of river level against which the station can pump is 509.6 (155.326). This was exactly the case for the old station.

The new stormwater pumping station is equivalent or better than the old pumping station.

PART A – THE ORIGINAL PUMPING STATION

Introduction

The plans for the original pumping station were prepared in 1957 and the station was constructed shortly thereafter. A diagrammatic cross-section of the original station is shown on Figure A-8 to allow comparison with the elevations of the new pumping station. The pumping station motor floor was at EL.515.0 (156.972) and the wet well slab was at EL. 472.0 (143.866).

The Pumps – Hydraulics, Capacities and Operation

The original pumping station consisted of a total of five (5) pumps. The low flow pump was a Fairbanks – Morse Figure 5413W Trash Pump. This was the first pump that would be started when the pumping station was activated. There were four storm flow pumps, each a Fairbanks – Morse Figure 5710W pump suitable for submersion. The fifth pump was a small sump pump that was used to pump out the sump as the pumping station shutdown after usage. The motors for these pumps (except the sump pump) were located on the upper floor of the station in a dry room with a floor elevation of EL. 515.0 (156.972).

From the pump data provided on the contract drawings for the original pumping station, a pump curve for the storm pumps has been created. The probable curve is presented on Figure A–1.

Estimated Storm Flow Pump Curve for the Original Pump Station

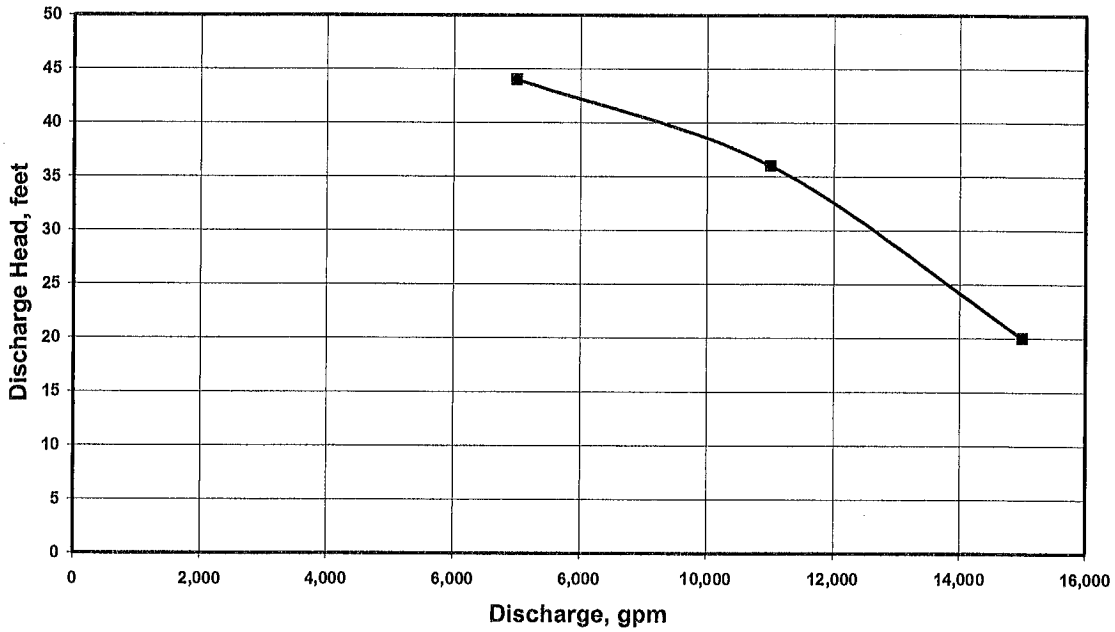


Figure A-1

The total rated capacity of the original pumping station as noted on the drawings was as follows:

Low Flow Pump (Pump No. 1)	700 gpm @37 feet	700 gpm
Storm Flow Pumps (Pumps Nos. 2 to 5)	4 @ 11,000 gpm @36 feet	44,000gpm
	Total	44,700gpm
	Total	99.6cfs

The centerline of the discharge piping was at EL 500.00 (152.400). As a result of the elevation of the discharge pipe, the capacity of the station was not affected by the elevation of the Ohio River until the river was at flood elevation. The head losses in the downstream piping system have been estimated to be in the range of three (3) feet at the anticipated design flows. Therefore, when the elevation of the Ohio River was higher than EL. 497.0 (151.486), which is the centerline elevation of the discharge pipes less the 3 feet of loss, the river elevation would have begun to affect the discharge capacity of the original pumping station.

When the pumping station was activated during a large rainfall event, the elevation of the water in the wet well was designed to range from EL. 476.0 (145.085) to EL. 481.0 (146.609) based on the indicated pump start and stop elevations. The design start and stop elevations for the storm pumps were as follows:

Pump Number	Pump On Elevation (ft.)(m)	Pump Off Elevation (ft.)(m)
2	476.0 (145.085)	475.0 (144.780)
3	480.0 (146.304)	479.0 (145.999)
4	480.6 (146.487)	479.5 (146.152)
5	481.0 (146.609)	480.0 (146.304)

As can be seen from this table, the pumping station start/stop elevations were set to have the lead pump do most of the pumping with the three non – lead pumps being activated only during high water levels in the wet well. Therefore, for the purposes of this report, it is considered that the water level in the wet well was maintained at elevation 480.0 (146.304), which would be typical during high flow events.

Pumping Station Capacity, or Design Flow

Using the estimated pump curve and estimated head losses in the discharge piping, the pumping station would have had a capacity of 39,000 gpm or 87 cfs if the river elevation had ever reached EL. 512.6 (156.240), the maximum flood elevation considered for the Ohio River at the time of pumping station design and construction. The pump curves for this scenario are presented on Figure A-2. The original pumping station was designed to pass the 50-year storm flow from the highway side.

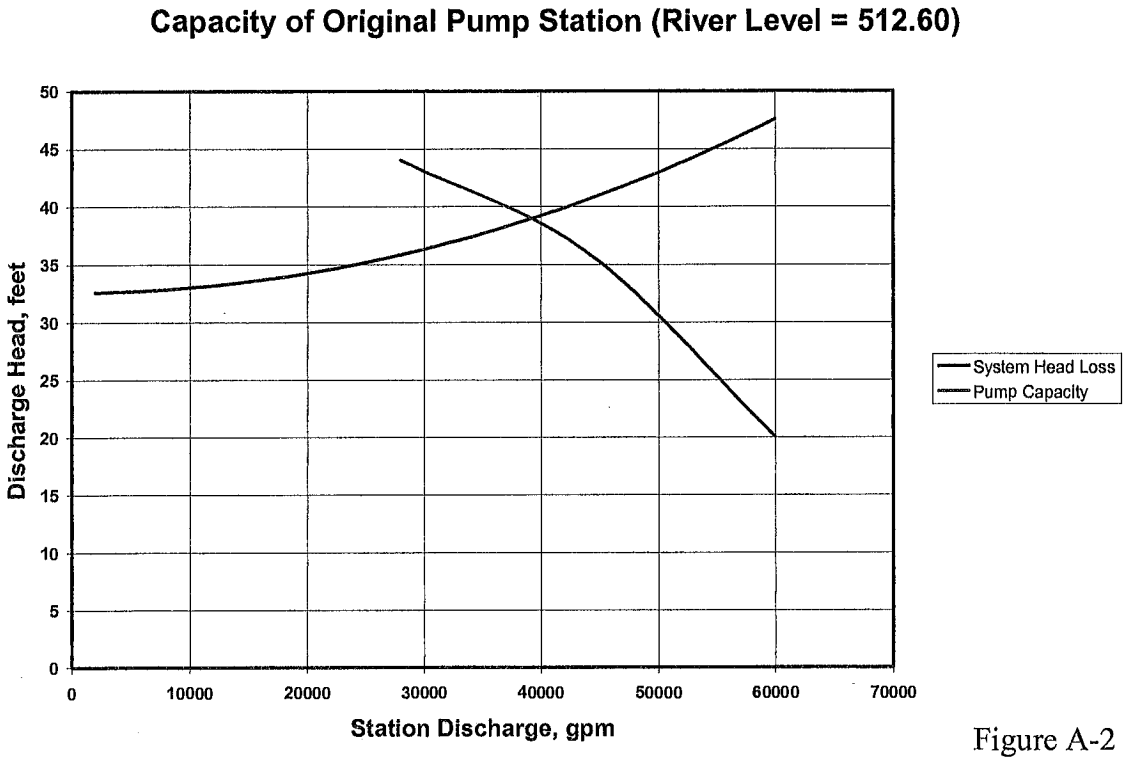


Figure A-2

Pumping Station Operating Events since Construction in the late 1950's

It is understood that the pumping station was activated twice during its term of service to pump stormwater. The station was checked regularly by MSD personnel to ensure that the equipment was functioning properly.

PART B – THE NEW STORMWATER PUMPING STATION

General

The new stormwater pumping station has been constructed within the raised portion of land between the south retaining wall of the new Fort Washington Way and the north retaining wall of the proposed Riverfront Transit Center (RTC), to be located beneath the new Second Street. This wall is also the floodwall that runs the length of Fort Washington Way to protect the highway from groundwater and flood flows in those events when the river level rises. The pumping station is located to the east of Vine Street. The new pumping station replaces the original station and diversion chamber that was located at the intersection of Pete Rose Way and Stadium Drive. The original station has been taken out of service and demolished.

Ohio River Flood Levels (COE)

The flood stage levels used for the design of Fort Washington Way were the US Army Corps of Engineers (COE) values, as follows and as shown on Figure A-3:

Frequency	Stage Elevation (ft.) (m)	
1	470.67	143.460
2	476.07	145.106
5	482.37	147.026
10	486.57	148.307
25	491.67	149.861
50	495.27	150.958
100	498.47	151.934
500	505.07	153.945

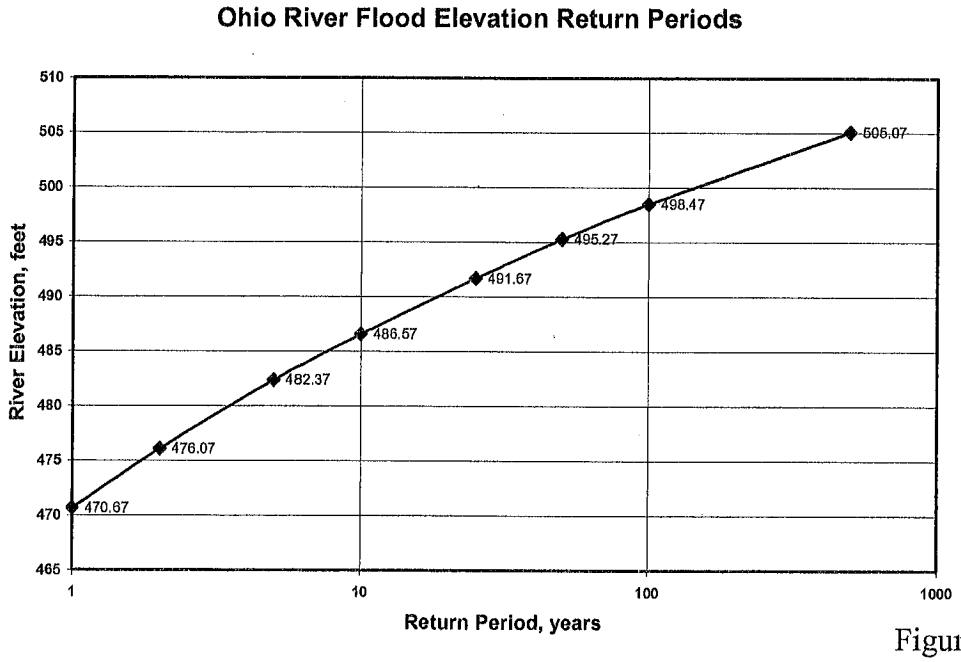


Figure A-3

The FHWA requires that the Highway be protected from the 50-year flood.
The ODOT requires that the Highway be protected from the 50-year storm plus three (3) feet.
The Preliminary Design Report for Fort Washington Way in February 1998 states that the pumping station would be designed to discharge the 50-year storm with the Ohio River at the 100-year return period flood elevation of 151.934 (498.47).

Pumping Station Layout

The new pumping station is located entirely below grade, with some 1.2 meters (4 feet) of soil above it for landscaping with the new Fort Washington Way. The wet well, with a floor slab elevation of EL 141.830(465.3), houses four stormwater pumps and a sump pump. These pumps are from Pumpex, Inc. and are three (3) EBARA ABS Model C2573 submersible pumps, one (1) EBARA ABS Model D0922 pump and one (1) sump pump EBARA Model No. 80DLFMU62.2. The pumps operate to maintain the level of water in the wet well below the level of the top of the low flow channel at elevation 147.900 (485.24). This allows the water level to be sufficiently low to allow the 50-year flow to flow over the top of the low flow channel. In this way, Fort Washington Way is protected from flooding. The design start and stop elevations for the pumps are as follows:

Pump Number	Pump On Elevation (m) (ft.)	Pump Off Elevation (m) (ft.)
Sump Pump	142.430 (467.3)	142.130 (466.3)
1	143.200 (469.8)	142.930 (468.9)
2	144.800 (475.1)	144.400 (473.8)
3	145.000 (475.7)	144.500 (474.1)
4	145.200 (476.4)	144.800 (475.1)

The total rated installed capacity of the new storm pumping station is as follows:

Low Flow Pump (Pump No.1)	2,000 gpm @ 30 feet	2,000 gpm
Storm Flow Pumps (Pump Nos. 2, 3 and 4)	15,000 gpm @ 30 feet	45,000 gpm
	Total	47,000 gpm
	Total	104.7 cfs

The pump curve for the storm flow pumps is shown on Figure A-4.

The sump pump is in the sump, to be used to finally drain the wet well after an event. The four submersible stormwater pumps are located across the length of the wet well. The discharge piping comes up out of the wet well to close to the underside of the roof slab and turns to the west to pass through the wall into the discharge chamber.

Adjacent and to the west of the discharge chamber is the pumping station control room. Access to the wet well is through an access hatch, set in the northern walkway of Second Street. Access to the discharge chamber is through another access hatch, also in this walkway. This grating can

provide ventilation to the discharge chamber. Access to the control room is also from the walkway but through a watertight hatch.

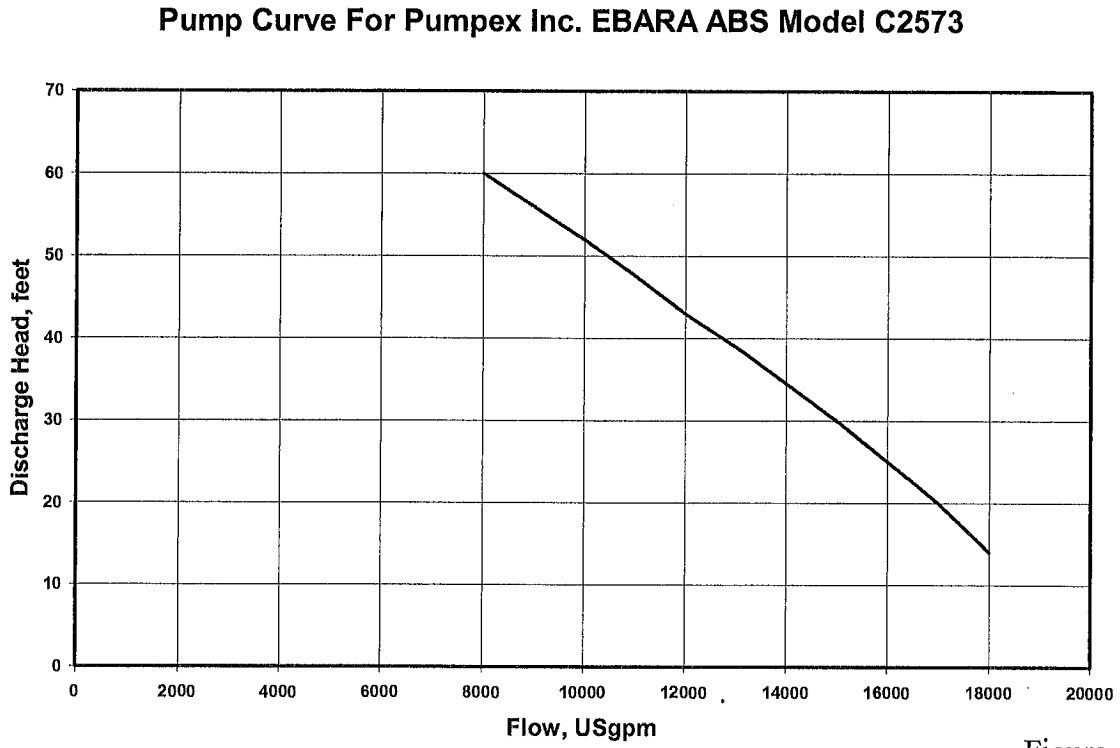


Figure A-4

The stormwater flows into the station from Fort Washington Way and Second Street and leaves the station from the discharge chamber through two 900 mm (36") diameter pipes which connect to the existing 1350 mm (54") Vine Street pipe, which is now a storm pipe with the Vine Street CSO captured by the Third Street conduit.

Pumping Station Operation

The pumping station has been designed to accommodate the storm flows from at least the 50-year storm from the new Fort Washington Way as well as the storm flows from the new Second Street. The water enters the station from the Interstate by a 1.200 mm (48") pipe, located in the northeast corner of the building, and a 600 mm (24") pipe located also in the northeast corner, adjaeent to the larger pipe. This water flows into the low-flow channel that transports it through the station wet well into the discharge chamber where it continues to the river. The upper elevation of the low flow channel is EL.146.800 (481.63) and the lower elevation is EL. 146.297 (479.98). This is also the elevation of the floor slab of the discharge chamber. The two 900 mm (36") pipes leave the discharge chamber at the slab elevation.

Using the estimated pump curve and estimated head losses in the discharge piping, the pumping station has a capacity of 38,000 gpm or 85 cfs if the river elevation ever reaches 512.6 (156.240), the maximum flood elevation considered for the Ohio River at the time of the original pumping

station design and construction. The pump curves at river elevation 512.6 (156.240) are presented in Figure A-5.

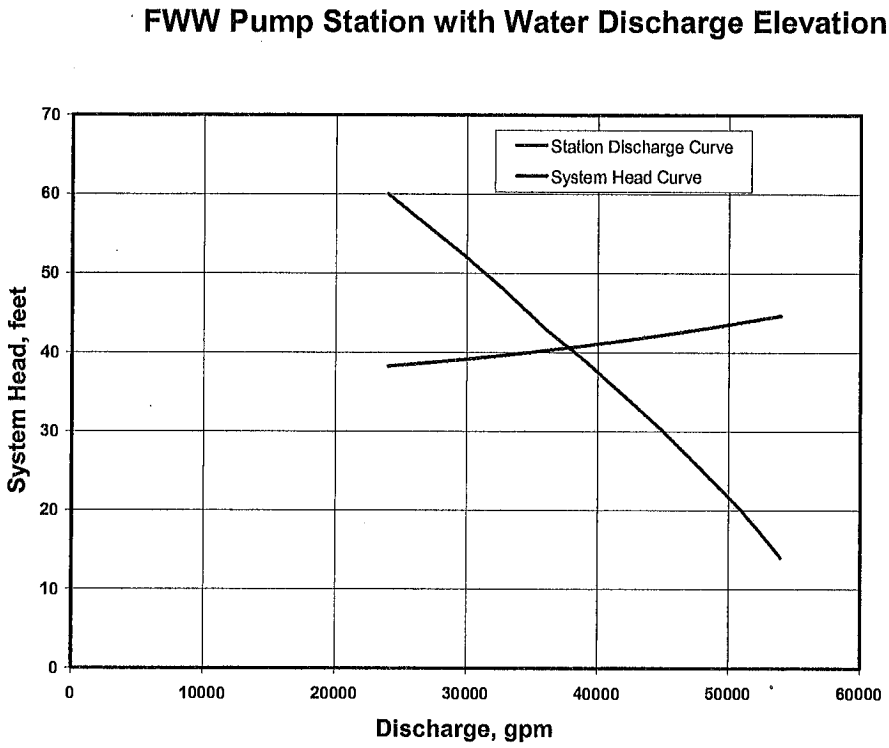


Figure A-5

A sluice gate has been installed inside the wet well on the wall connecting to the discharge chamber. The gate is designed for 7.62 m (25 feet) of seating or unseating head. This upper level is, then, 153.917 (504.98). If the river flood level should rise to Second Street level, this gate will still prevent the river water from entering the wet well but it will leak. The pumps will be able to pump out the wet well at a rate greater than the expected leakage through the gate. This gate is normally open to allow the flow to pass along the low flow channel and out to the river. When the weather is such that the river rises in flood and starts to surcharge into the discharge chamber, then this gate closes. If stormwater now enters the station from the Interstate, it will overtop the low flow channel wall, set at EL.147.900 (485.24) and flow into the wet well.

The four storm pumps will activate at the levels indicated above and pump the flow through the connecting wall into the discharge chamber. The inflow and outflow hydrographs during the 50-year storm from the Fort Washington Way pumping station are presented on Figure A–6. The flows from Second Street exit through the discharge chamber, thus these are included as a discharge from the pumping station, however, only the Fort Washington Way inflow is pumped. The pumps will discharge a flow of slightly less than 100 cfs due to the slight dampening effect of the wet well. Significant changes in discharge rates are a result of pumps either being started or shut down. With all four pumps in operation, the maximum wet well water elevation is EL.

146.500 (480.64), which is below the top of the low flow channel wall. The variation in water level in the wet well during the 50-year storm is presented on Figure A–7. The top of the low flow channel wall is actually the elevation of the High Level Alarm.

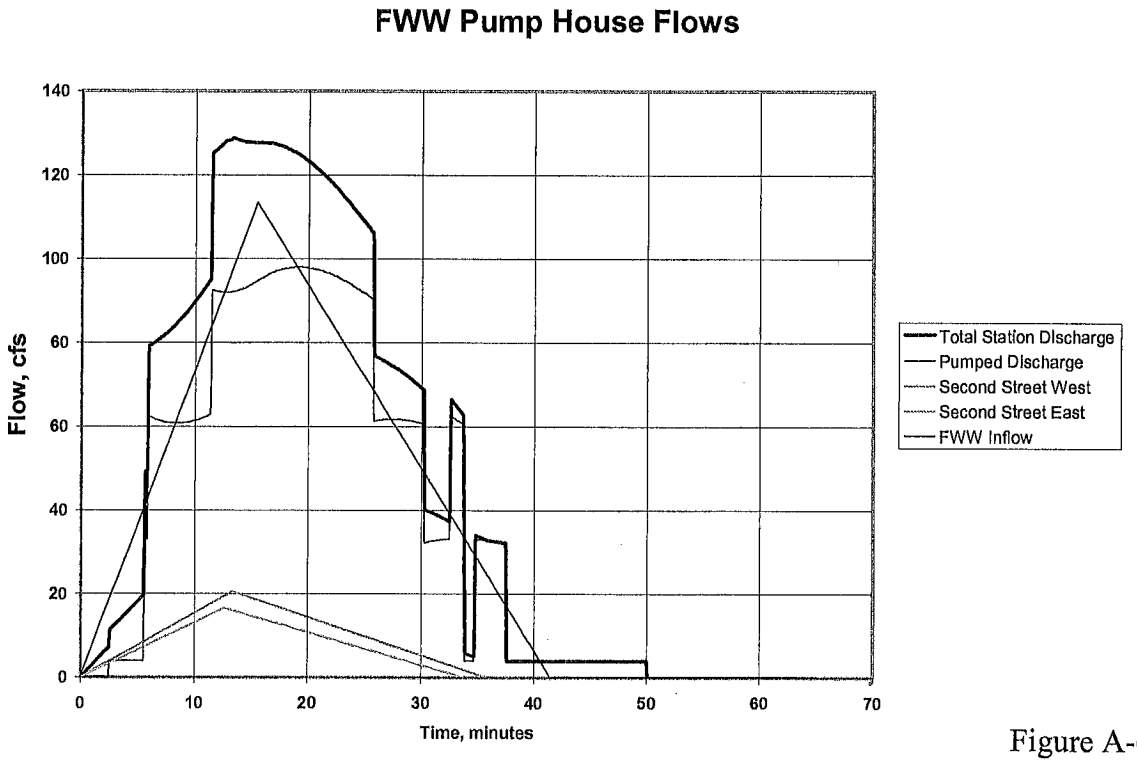


Figure A-6

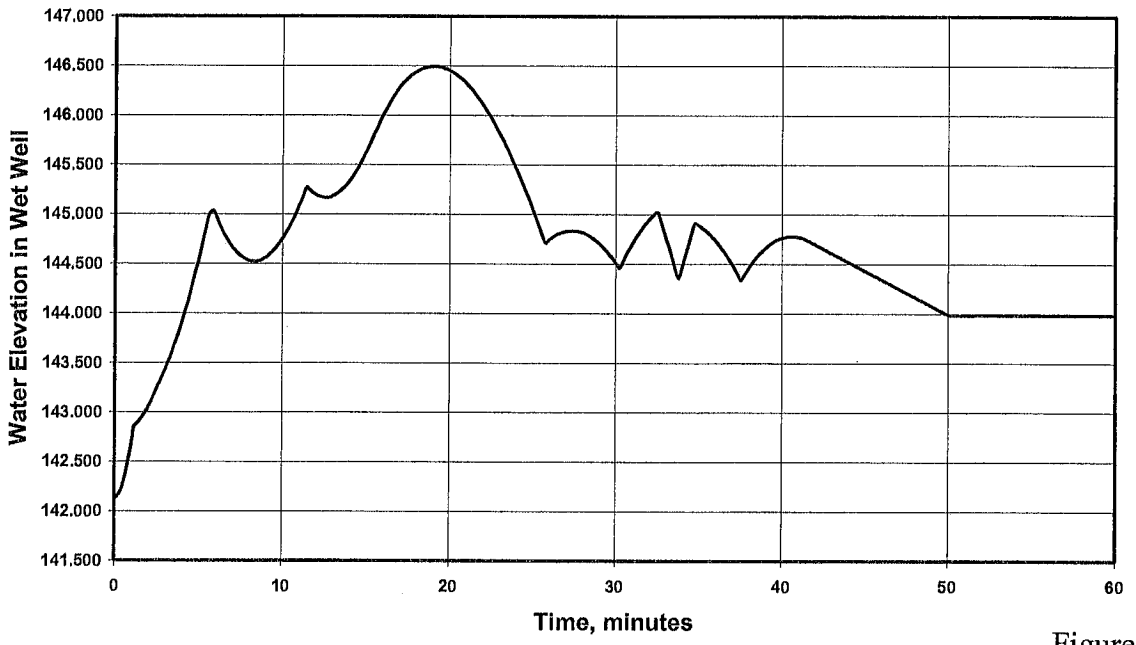


Figure A-7

Discharge Chamber and Piping

When the river elevation has risen and the sluice gate has closed, the discharge pipes from the station are surcharged. The headlosses through the outlet pipes are calculated to be 900mm (36"). There is presently an opening in the connecting wall between the discharge chamber and the wet well, at EL. 153.32 (503.01). The ground level in Second Street at the pumping station is approximately 156.253 (512.64). Considering the losses through the discharge piping, the station can handle a river elevation of 155.353 (509.69) before the river water can back up onto the Street. The pumps can maintain the maximum level in the wet well against these river elevations.

The opening in the connecting wall between the wet well and the discharge chamber should be sealed.

The Pumping Station Wet Well

Unless there is a power failure, the pumps will maintain the wet well level at 146.500 (480.64). But, there are two vent ducts that discharge from the wet well through into the Transit Center. These are at invert levels of EL. 153.266 (502.84) and EL. 153.692 (504.24). If the river flood level rises to EL. 155.353 (509.69) identified above, then the river water can penetrate the wet well through the vent ducts.

These two ducting systems are joined and alighted to discharge to the surface, at Second Street. Sealing of the ducts in the floodwall should be confirmed.

The electrical connections for the pumps are located on the northern wall of the wet well, above the access walkway. The average bottom elevation of these connecting boxes is approximately 151.790 (498.00). The bottom of the operating motor and gear for the sluice gate is at EL.151.486 (497). When the three openings into the wet well are sealed, and the pumps can be protected from power outage by the stand-by generator set, then the water level in the wet well will not rise to a level that threatens these electrical connections.

Stand-By Power

There is stand-by power for the pumping station in the form of a diesel generator and connected fuel tank. This equipment is located on the west elevated power platform, with a slab level of EL. 501.00 (152.705), between the south wall of Fort Washington Way and the line of the floodwall, the northern limit of the Transit Center. This platform is approximately 1175 feet (358.1m) to the west of the pumping station, between Plum and Elm Streets, at the western end of the floodwall. The fuel tank is located beneath the generator set. The normal and emergency power is one and the same, supplied through a sealed duct bank located between the floodwall and the retaining wall. The duct bank enters the control room at the very top of the room on the west end.

It should be checked that this opening is sealed.

If the river rises to EL. 503.00 (153.314), a level some 4.5 feet (1.37m) above the 100-year flood level, the switchgear will be flooded and will be inoperative. The fuel tanks can be filled from Second Street.

Access into the control room is from Second Street through two separate access hatches. One is not watertight. A check valve has been installed in the floor drain. The control room contains all pump controls. Water can enter the control room if the river rises to the level of Second Street, approximately EL.156.253 (512.64). Since some head would be required to force water through the hatch, then the floodwaters will be flowing over Second Street into Fort Washington Way, and the pumps are not designed for that amount of flow. Flooding of the control room will only occur from a storm of disastrous magnitude.

Maintenance of the stand-by power unit is important. Checking of the stability of the stored fuel will be necessary. If the fuel is in the tank for too long a time without use, then it may have to be replaced. Fuel deliveries will also require to be established. The stand-by motors should be operated regularly, as outlined in the operations manual, to ensure readiness.

It may be appropriate to have a portable stand-by unit that can be brought to the site quickly, in the event of a power failure to the pumps in addition to a problem with the stand-by unit.

Operations and Maintenance

The MSD of Greater Cincinnati operates the pumping station for the Ohio Department of Transportation. The necessary personnel have already been trained in operation of the station. This report is intended to be an update of the design of the station, and should be added to the O&M manual, for reference.

PART C – CONCLUSIONS

Comparison Matrix

Issue	Original Facility	New Facility
Outlet Conduit Losses	3 feet	3 feet
Maximum Level of Flood Protection to FWW	509.6 feet	509.6 feet
Required Flood Protection (FHWA)	495.27 feet (50 year)	495.27 feet (50 year)
Required Flood Protection (ODOT)	498.27 feet (50 year + 3 feet)	498.27 feet (50 year + 3 feet)
Number of Pumps	5 - 1 Low Flow Pump, 4 Storm Flow Pumps	4 - 1 Low Flow Pump, 3 Storm Flow Pumps
Pump Rated Capacity		
Low flow	1 pump - 700 gpm @ 37 feet	1 pump - 2,000 gpm @ 30 feet
Storm	4 pumps - 11,000 gpm @ 36 feet	3 pumps - 15,000 gpm @ 30 feet
Total	44,700 gpm or 99.6 cfs	47,000 gpm or 104.7 cfs
Maximum Wet Well Elevation	480.0	480.96
Back Flow Prevention	Pumps	Pumps
Stand-By Power	No	Yes
Sump Pump	Yes	Yes

Conclusion

The purpose of both the old and the new pumping stations was and remains to protect the Fort Washington Way trench from a 50-year storm irrespective of the Ohio River level. As detailed in this report, it is clear that the new pumping station is equivalent or better than the original pumping station.

Pumping Station Schematic Section

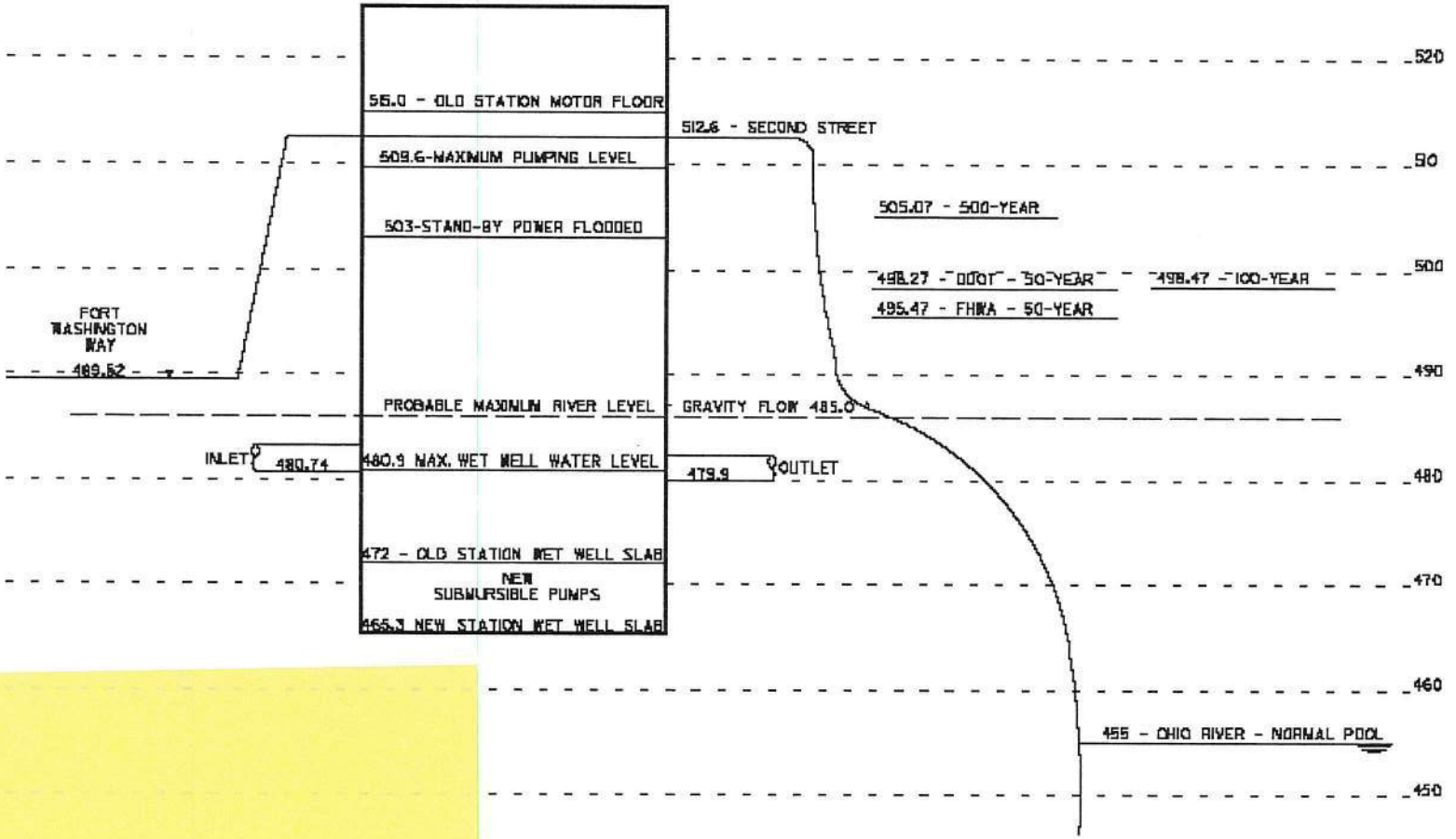


Figure A-8

APPENDIX A

Flood Protection Requirements

The Federal requirement for flood protection is contained in the *Federal-Aid Policy Guide*. As per, Title 23 Section 650.115 (a)(2), *"The design flood for encroachments by through lanes of Interstate highways shall not be less than the flood with a 2 percent chance of being exceeded in any given year."* In other words protection is required for a 50-year flood. The US Army Corps of Engineers provides river stage values at Ohio River mile 470.5, the Cincinnati gage station. At this location, the 50-year flood elevation is 495.27 feet (150.958 meters).

The State requirement is contained in the *ODOT Location and Design Manual, Volume 2 - Drainage Design Policies*. Section 1004.1 states, *"Where a new highway crosses or is located in a flood plain, the highway grade shall normally be set such that the low edge of the pavement will clear the design water surface profile for existing conditions by 3 feet [1 meter]"*. Section 1004.2 sets the design year frequency as 50 year for freeways. This increases the required protection level to 498.27 feet (151.873 meters). The state requirement exceeds the federal requirement.

APPENDIX B

MSD Punch List and Responses

Background: The Pumping station was constructed under Contract 12, Fort Washington Way. Parsons Brinckerhoff, and Wilson and Associates prepared plans under contract to the City of Cincinnati. Construction began with notice to proceed (NTP) on August 6, 1999 and was substantially completed on November 15, 2000.

1) Equipment -- Chambers and Structures
   a) Railing at east end of Pump chamber is flimsy. No cross member support to prevent platform C-section twisting from railing load moment. Handrails near the small pump and two of the large pumps need to be stiffened.
   C.J. Mahan has strengthened rail in several places.
   b) Railing at east end of Pump discharge chamber is flimsy. No cross member support to prevent platform C-section twisting from railing load moment.
   C.J. Mahan has strengthened rail in several places.
   c) There are no usable hand grabs at the top any of the ladders on any of the chambers. Provide handholds on side of each entrance to aid getting onto the vertical ladders. The current handhold is better, but you still need a second one getting onto the ladder.
   Hand grabs have been installed at each entrance.
   d) Gas detection system is inoperable; equipment control panel missing.
   This work has been completed and tested.
   e) Provide remote means to determine if it is safe to enter the control room, or any of the other chambers, since the gas detection system controls are in the control room itself, below grade.
   A switch for lighting and ventilation was installed at the entry, as per plan.
   f) Ventilation must come on automatically when the doors are opened in the control panel chamber.
   Switches for lights and ventilation are accessible immediately inside the entrance hatches, as per plan.
   g) Floor drain in the control room should have a check valve on it to keep flooding from backing into the room and to reduce a chance of a rodent from living in the drain piping, which will plug it up. If the drain discharges to a potential confined space or gas hazard area, it must be trapped to prevent passage of combustible or toxic gases into the control room area.
   A check valve was installed, as per plans.
   h) The entry into the generator shelter on the auxiliary equipment platform is approx 3' high, with no stair. If entry is made, exiting is hazardous.
   Stairs have been installed, as per plan.

2) Equipment -- Pumps and Electrical
   a) The top guide rail brackets on the ABS pumps appear to be carbon steel or cast iron. These should be a 300-series stainless steel. Even though these items are epoxy coated,

they will rust in the moist environment, and if they bridge against the 300-series stainless steel, then rapid corrosion will occur.
These items were installed as per pump manufacturer's plans and recommendations.

b) Please verify that the top guide rail bracket bushings on the larger Pumpex pump are adequately torqued and secured.
All bolts/bushings have been adequately torqued.

c) Retest pumps after repair of leaking pump discharge flanges. Retest witnessed by MSD staff. Coordinate with electrical testing requirements.
All leaks have been corrected and retested.

d) Document pump mechanical performance and electrical performance through actual test. Document all flow, delivery, discharge head, electrical phase draw, phase imbalance, supply phase voltage and drop, etc. for both across-the-line motor starters and soft starters. Coordinate with mechanical testing requirements.
Performance data was included with the O&M Manuals.

e) Pump floats must be labeled as to their function.
All pump floats have been labeled and inspected.

f) Only mechanical types pump level floats may be used. Mercury switches are not permitted. Correct.
Floats have been changed from mercury, as per plan, to mechanical, as requested.

g) Change any local (control cabinet room) and remote operated starters so that they cannot be operated remotely unless the local control is locked out. Please change wiring diagrams to reflect this.
This reflects standard procedures, in that the gate can be switched to hand operate for maintenance and testing and returned to remote once completed.

h) Secure bolting on electrical junction boxes. Most cover bolts were removed.
All bolts and covers have been secured.

i) Generator load test is required. Generator voltage drop test (the drop test shall be conducted will all the pumps and auxiliary items turned on during the transfer) must be performed on station using generator power. Provide reports to MSD.
The generator test data was provided by Holt/Caterpillar and included in O&M Manuals.

j) Provide labels on all the cabinets, panels, and boxes in the control cabinet room and pump chamber/wet well. These should be permanent types and be installed both outside and inside critical areas.
Labels have been installed on all cabinets, panels and boxes.

k) MSD Pump Station Specifications require generator to have an automatic transfer switch. Please provide.
Prior conversations had indicated that given the cost of this equipment, a manual switch should be installed. At MSD's request an automatic transfer switch will be added.

3) Documentation and Training Issues
MSD cannot accept the obligation of operating this station without the materials and documentation to assure safe and successful operation and maintenance of the station, now and in the future. To that end, after the documentation has been received and approved,

initial training on the station and all its equipment must be provided by the engineer, and equipment suppliers, supplemented by the as-built engineering plans and specifications, the approved shop drawing and equipment submittals, and reviewed and approved operation and maintenance manuals. Documentation must include 'scope and sequence' of all operations, preparation for operation, etc. MSD has received very few materials. Those materials that have been received are inadequate or incomplete.

MSD was supplied with detailed O&M Manuals on March 9, 2001, with updates issued on March 20 and December 6, 2001. PB has arranged MSD training for every system of the pumping station with contractors and manufacturers representatives.

a) Provide a complete set of drawings and manuals for this station. At least six copies must be provided for review and approval.
   i) Provide pump manuals which contain materials of construction of the pumps and electrical data of the motors.
   ii) Provide as-built electrical diagrams that includes the power and generator circuitry and interlocks. Provide additional copies suitable for posting in the control room.
   iii) Document and explain security features of the Pump Station Director-key pad in the electrical control room. How can unauthorized personnel be prevented from changing relay or control settings?
   iv) Document each and every final setting (and ranges) for relays, timers, controllers, etc. on drawings.

   MSD has been supplied with O&M manuals.

b) Plan, submit, and conduct training of operations and maintenance staff members on all electrical and mechanical electrical equipment, including all controls and computers, PLC, etc. in the control room.

   Testing and final inspection was performed at the pumping station on March 28, 2001. MSD and ODOT were invited to attend. At that time a Straffer Pump representative provided training for all MSD personnel in attendance. Straffer was also available on March 29, 2001 as needed. There was no interest from MSD personnel for additional training by Straffer so this was cancelled. Training for gas detector system and ventilation systems was held on Thursday March 29, 2001. No one from MSD attended.

4) Operational Issues and Questions on Design and Operation & Variances from MSD pump station specifications
   a) All gear in the pump chamber is explosion proof (only). As it is not waterproof, I hope it never floods or gets wet.

      All boxes are installed, as per plan, and are located above the level the pumping station is designed to protect to.

   b) If the station pumps fail to operate, that failure can cause the FWW roadway 'tunnel' to fill, back flooding the control room through drains, disabling control gear and thus ensuring the pumps can never operate. [150.39m = 493.4ft = 63.8 FS] Thus, you can never recover from a failure.

      A check valve has been installed (see comment 1g). All conduit penetrations will be checked to ensure that they are sealed. Floodwater can only enter the control room by way of the hatch at approximately elevation 512.6'.

c) If (multiple) pumps fail, you cannot pull pumps and remove for repair. You may have to swim underwater to disconnect the pump cables at junction box for removal, or possibly do so in full gear for confined space, if not flooded. Also, see, other items for other, related, details.
The new pumping station has three pumps. Each with a 24" discharge pipe and one pump with a 10" discharge pipe. As noted in this report, the pumps are operated from the Cinergy grid with stand-by power supplied by a generator. As further backup, portable stand-by power could be considered.

If one pump has been removed from service, it is expected a blank flange would be placed on the opening. Even if this is not done and the river rises, the maximum head to backflow into the wet well from the discharge chamber is 1' over the invert of the 24" discharge which is about 15 cfs. One pump with a 24" discharge can handle 15,000 gpm or 33.4 cfs.

Note: It is also considered that check valve installed on the discharge headers would reduce pumping capacity and, therefore, are not recommended.

d) Pump failures could cause flooding of pump chamber, and then flood out ventilation system installed fans, creating confined space.
See comment 4c. As noted, two pumps can handle up to 67 cfs or nearly 70% of the pumping station capacity.

e) Pump discharge chamber is connected to the pump chamber. I am unsure of the details regarding combustible gas monitoring, or the passage of gas between the two chambers.
This opening will be sealed as indicated in this report.

f) Inability to reach level transducer/float control junction box for service at west end pump chamber, behind and under ventilation fan, and suspended well over the railing into the wet well area.
Location of this structure was moved closer to the walkway than indicated on the plans.

g) There are no identification markings, labels, or placards on any equipment in the pump chamber.
All equipment has now been labeled.

h) Pump power cord routing from lower entry of junction box, around wall, up and over to the pump hangar.
All cabling was completed as per plan.

i) Control room, pump chamber, and discharge chamber light fixtures are apparently mercury vapor. There are no incandescent lamps, or other lamps to provide light during a power failure, or immediately upon power restoration. If you do switch to the backup generator, there is no light in control room for an extended period of time.
The lights in the wet well and discharge chamber are incandescent. Control room lights are mercury vapor lights as per plan.

j) There does not appear to be any means to read V, A, etc. for the pumps, either supply, or load, or indication of phase outages. Basically, the installed controls provided leave you blind, there are no tools of any kind to assist in troubleshooting.
Pump controls do provide information regarding V & A, etc. PLC provides this

information. The ability to connect remote monitoring (telemetry) was installed as per plan.

k) It is impossible, at this time, to know whether the station is ready or able to operate, or even has normal or emergency power available. There are no provisions for communications, or telemetry provided. Station underground location may prevent radio contact (MSD standard telemetry). Cellular phones are intermittent. There are no installed conduits "to somewhere else."
Provisions were made during construction to accommodate the Telemetry equipment. Adjacent traffic pole has extra conduit to allow for antenna installation.

l) There is a nearby signal duct that leads to the transportation center systems.
   i) A field order should be issued to correct this situation by adding conduit to that duct from the control room south hatch, and appropriate conduits, etc. at the remote end to meet MSD needs.
   ii) A field order should be issued to correct this situation by adding 1-1/2" Ø conduit from the control room and laid to the traffic signal pole at 2nd-Vine for future mounting of 800 MHz antenna on top of traffic signal pole.
These changes have been made.

m) There are no means of positively securing the control room, pump chamber, and discharge chamber. The hatch doors have recessed plugs for access for a square-key handle operator, but the control room hatch, presenting the greatest security risk, does not even have that. With doors at grade, they can be opened with hand tools. The control room has absolutely no latches or locking means.
The three hatch doors have security key locks on them. The large control room door has a security cap to prevent unauthorized entry.

n) Remote backup generator can only be started and operated from its own control panel which is located a long distance from the station. There is no transfer switch, etc.
An automatic transfer switch will be added. See comment 2k.

o) Remote generator / Cinergy normal electric feed does not have interlocking key switch. We were told that it was designed, but not yet completed.
This work has been completed.

p) There do not appear to be provisions to reach the auxiliary equipment platform for routine generator maintenance.
A ladder has been installed.

q) MSD Pump Station Specifications state the guide rails for each pump shall have an intermediate guide rail bracket every 10 -ft of rail height. Please revise installation.
The guide brackets were built to pump manufacturer specifications.

r) Fillets are required in the wet well to prevent debris deposition. Use 1 ft. dimension. Since the pumps are very close to the south (river side) wall, do not slope that area. Therefore, do only the other three remaining wet well sides.
These have been installed.

s) The generator does not have an automatic transfer switch, which is required by MSD Pump Station Specifications. Please add to system.
An automatic transfer switch will be added. See comment 2k.

t) What provisions have been made for generator access for load-bank testing and other required preventive maintenance?
A ladder has been installed.

5) Flood Protection Issues
   a) It appears that this entire station was designed based on the "100-year flood elevation," rather than the US Corps of Engineers historical construction, at the 1937 flood level plus 3 ft. freeboard. (equals 83 ft. FS)
   The recorded level of the 1937 flood was 80 feet. The base gage elevation is 429.1 feet, so that the flood elevation of the 1937 flood was 509.1'. As indicated in the report both the old and new pumping stations can pump to 509.69'. Also as noted, the requirement for protection of the highway is the 50-year flood elevation plus 3 feet, which is below this elevation.
   b) Some design decisions for this pump station are chilling. Equipment and structure arrangements appear to compromise the integrity of this particular project, and Cincinnati on the whole.
   As indicated in this report the capacity of this pumping station is equivalent or higher than the old station.
   c) Please note that if pump discharge elevations or equipment piping is modified, the existing pump performance (H v. Q curve) may not be suitable.
   We agree. If major modifications occur, performance will change. We anticipate any such changes would receive a full review.
   d) Pump discharge chamber is connected to the pump chamber through the pump's actual discharge piping. There are no check valves installed; this presents a clear and present danger to back flood the pump chamber from the discharge chamber which 'rides' on the river elevation through the discharge sewer. If a pump is removed for maintenance, there is absolutely no means to prevent this flooding. [152.31 m = 501.02 ft= 71.42f FS].
   See comment 4c.
   e) Pump discharge chamber is connected to the pump chamber through ventilation ductwork. This presents a means to back flood the pump chamber from the discharge chamber which 'rides' on the river elevation through the discharge sewer. [153.38 m = 503.07 ft = 73.47 FS].
   This report recommends that the ducts be sealed.

It appears that there is a sewer from 2nd St. (18"?) into pump discharge chamber which allows unmitigated flood damage and back flooding to occur in that area at estimated elev. 148. I further think this would likely flood the FWW itself? [148 m = 485.56 ft = 55.96 FS].
These drains are from Second Street, which is above the floodwall level and on the protected side.

APPENDIX C

Drawings

APPENDIX D

Meeting Minutes

Attendees: Sam George, Mike Heitz, Bill Gray, Stan Rauh, and Jeff Sinnard

There was a visit to the Fort Washington Way pumping station at 1.00 p.m. on Wednesday, June 19th 2002. The purpose of the visit was to review the various concerns of MSD discussed in the meeting of June 11th 2002.

Following are Parsons Brinckerhoff's estimates of cost and recommendations for the suggested modifications to the Fort Washington Way Pump Station as requested by MSD. Parsons Brinckerhoff has investigated:

1. A high water detector/level alarm in the discharge chamber
2. Strengthening the vent duct work
3. Sealing the opening between the Wet Well and the Discharge Chamber
4. Check Valves/Backflow preventers on the pipes from the pumps into the discharge chamber
5. A gate or valve assembly over the discharge pipes
6. Collars at the Access Hatches

1. A high water detector/level alarm in the discharge chamber.
MSD requested a detector be added in the discharge chamber that would alarm at elevation 485. This would allow the sluice gate be closed and protect from the river level rising above the low flow channel and flowing into the wet well. The estimated cost to install a level alarm for the discharge chamber is as follows:

Material and Labor	
Materials and labor to install one 5 ft. long Mulitrode Probe with 100 ft. cable with two relays	$4,250
Subtotal	$4,250
Contingency 15%	$638
Total Estimated Cost for New Detector	$4,888

2. Strengthening the vent duct work
There are two ducts that vent from the wet well through into the Transit Center where they join and continue discharge to the surface, at Second Street. These are at invert levels of EL. 153.266 (502.84) and EL. 153.692 (504.24). The estimated cost to add stiffening plates is as follows:

Material	11,200 lb. of stainless steel at $1.03/lb.	$11,536
Labor	11,200 lb. of stainless steel at $3.03/lb.	$33,936
	Removal and replacement of ceiling	$7,000
Subtotal		$52,472
Contingency 15%		$7,871
Total Estimated Cost to Stengthen Ductwork		$60,343

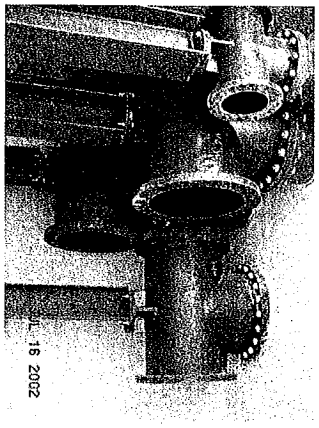
3. Sealing the opening between chambers

Currently the pump discharge chamber is connected to the pump chamber/wet well. To prevent flow between the two chambers this opening is proposed to be closed. The estimated cost for this is as follows:

Material	
Steel Plate or Masonry	$ 600
Labor	
Three laborers (one above, two inside) for two days. 3 X 2 X 8 hours X $65/hour	$ 3,120
Subtotal	$ 3,720
Contingency 15%	$ 558
Total Estimated Cost to Seal Chambers	$ 4,278

4. Check Valves on Discharge Lines

Within the discharge chamber there are four pump discharge lines protruding horizontally through the wall from the pump chamber. Three of the lines are 24-inch diameter and the other is 10-inch diameter. All have flanged tees attached with the axis of the tee placed vertically. This was intended to direct the flow downward. Each tee is braced to the opposite wall with a steel beam bolted to the tee and the wall. These braces were intended to counteract the force created by flow into the tee and being redirected downward.



Pump Discharge Lines in Discharge Chamber

If the tees are removed from the discharge lines there will be no significant force caused by the flow into the open chamber. Therefore, if the tees are removed, the braces may be removed also.

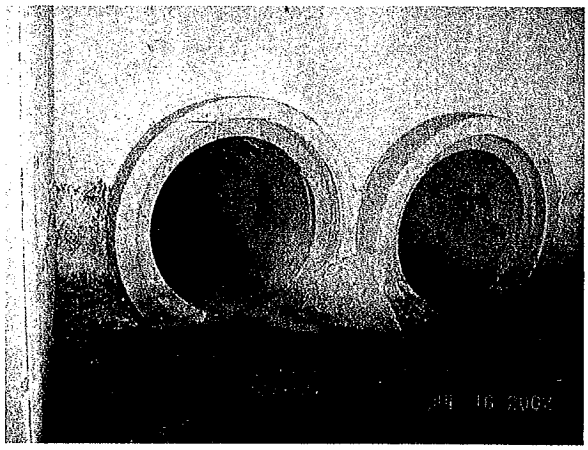
To prevent backflow into the pump discharge lines the addition of Red Valve flanged check valves has been discussed. The estimated cost for this is as follows:

Material	
3 – 24-inch Series 35 flanged check valves	$ 20,880
1 – 10-inch Series 35 flanged check valve	$ 1,574
	$ 22,454
Labor	
Three laborers (one above, two inside) for two days. Remove existing tees and braces. Install check valves. 3 X 2 X 8 hours X $65/hour	$ 3,120
Subtotal	$ 25,574
Contingency 15%	$ 3,836
Total Estimated Cost for Check Valves	$ 29,410

5. Gates on Outlet Pipes

It has been suggested that gates or stop logs be installed on the two 36-inch outlet pipes in the diseharge chamber. These could be closed to prevent backwater from a high river stage from entering the chamber and potentially flooding the station.

The two 36-inch lines protrude through the chamber wall at an angle, creating an uneven surface. Also, the horizontal midpoints of the pipes are touching, leaving no space between the pipes. These two conditions create a situation that prevents the attachment of separate gates to the end of the two 36-inch pipes.



36" Outlet Pipes from Discharge Chamber

Other options considered include:

- Installation of in-line check valves in the 36-inch openings. Though technically feasible, these valves would create an unacceptably high head loss (approximately 1.5 feet) in the system. For this reason this option was rejected.

- Installation of Red Valve type check valves on the downstream end of the 36-inch lines. It was determined that this option is not feasible because of the limited space available inside the chamber where the 36-inch lines transition to a single 54-inch line.

- Installation of stop logs across both 36-inch openings. This will require the construction of a wall extension to create a uniform surface around the openings. Also, because there could be as much as 30 feet of unseating head against the back of the stop logs, the anchors for the stop log channels will need to be embedded in the chamber wall rather than in the wall extension to be built. The estimated cost of this option is as follows:

Material	
Stop log channels, stop logs, concrete wall extension, anchors.	$ 6,000
Labor	
Three laborers (one above, two below) for five days. 3 X 5 X 8 hours X $65/hour	$ 7,800
Subtotal	$ 13,800
Contingency 25%	$ 3,450
Total Estimated Cost for Gates	$ 17,250

6. Collars at Access Hatches

The estimated cost to install 5 ft. high collars around the four access hatches is as follows:

Material and Labor	
Soil Removal	$600
Tree Removal	$2400
Collars to form, reinforce, and pour	$11,000
Subtotal	$14,000
Contingency 25%	$3,500
Total Estimated Cost to add Collars	$17,500

Cost Summary

The estimated cost of all options is summarized as follows:

1.	High Water Detector	$ 4,888
2.	Strengthen Ductwork	$ 60,343
3.	Sealing Chamber	$ 4,278
4.	Check Valves on Discharge	$ 29,410
5.	Gates on Outlet Pipes	$ 17,250
6.	Collars	$ 17,500
	Total	$ 133,669

Resolution

Subsequent to the release of this report, the City and MSD met to determine which items are to be addressed at this time. It was agreed that items 1, 3 and 4 would be constructed now. This work is to be constructed in the final Fort Washington Way contract.

APPENDIX E

Pump Station Operations and Maintenance

The Metropolitan Sewer District Greater Cincinnati (MSD) will operate the pumping station for the Ohio Department of Transportation. Access into the control room is from Second Street through two separate access hatches.

The pumping station has been designed to accommodate the storm flows from at least the 50-year storm from the new Fort Washington Way as well as the storm flows from the new Second Street. The water enters the station from the Interstate. This water flows into the low-flow channel that transports it through the station wet well into the discharge chamber where it continues to the river. During any rain events with a River stage of less than 485.0' the pump station operates by gravity flow.

A sluice gate has been installed inside the wet well on the wall connecting to the discharge chamber. This gate is normally open to allow the flow to pass along the low flow channel and out to the river. When the weather is such that the river rises in flood and starts to surcharge into the discharge chamber, then this gate closes. A high water alarm installed in the discharge chamber at elevation 485.00 activates the gate. If stormwater now enters the station from the Interstate, it will overtop the low flow channel wall and flow into the wet well.

The pumps operate to maintain the level of water in the wet well below the level of the top of the low flow channel at elevation 147.900 (485.24). The pumps will maintain the wet well level at 146.500 (480.64). This allows the water level to be sufficiently low to allow the 50-year flow to flow over the top of the low flow channel. In this way, Fort Washington Way is protected from flooding. The design start and stop elevations for the pumps are as follows:

Pump Number	Pump On Elevation (m) (ft.)	Pump Off Elevation (m) (ft.)
Sump Pump	142.430 (467.3)	142.130 (466.3)
1	143.200 (469.8)	142.930 (468.9)
2	144.800 (475.1)	144.400 (473.8)
3	145.000 (475.7)	144.500 (474.1)
4	145.200 (476.4)	144.800 (475.1)

The sump pump is in the sump, to be used to finally drain the wet well after an event.

Discharge Chamber and Piping

When the river elevation has risen and the sluice gate has closed, the discharge pipes from the station are surcharged. Considering the losses through the discharge piping, the station can handle a river elevation of 155.353 (509.69) before the river water can back up onto the Street. The pumps can maintain the maximum level in the wet well against these river elevations.

Stand-By Power

There is stand-by power for the pumping station in the form of a diesel generator and connected fuel tank. This equipment is located on the west elevated power platform, with a slab level of EL. 501.00 (152.705), between the south wall of Fort Washington Way and the line of the floodwall, the northern limit of the Transit Center. This platform is approximately 1175 feet (358.1m) to the west of the pumping station, between Plum and Elm Streets, at the western end of the floodwall. The fuel tank is located beneath the generator set. The normal and emergency power is one and the same, supplied through a sealed duct bank located between the floodwall and the retaining wall. The duct bank enters the control room at the very top of the room on the west end.

If the river rises to EL. 503.00 (153.314) the switchgear will be flooded and will be inoperative. The fuel tanks can be filled from Second Street.

Maintenance of the stand-by power unit is important. Checking of the stability of the stored fuel will be necessary. If the fuel is in the tank for too long a time without use, then it may have to be replaced. Fuel deliveries will also require to be established. The stand-by motors should be operated regularly, as outlined in the operations manual, to ensure readiness.

It may be appropriate to have a portable stand-by unit that can be brought to the site quickly, in the event of a power failure to the pumps in addition to a problem with the stand-by unit.

Flood Doors

If the river rises to EL. 493.00 (150.266) floodwaters will begin to inundate the Transit Center. Prior to floodwaters reaching this level flood doors need to be placed in the openings from the transit center through the floodwall. These flood doors are stored at the east end of the transit center. These doors are most easily installed using a rough terrain forklift. In order to allow time to mobilize equipment and install the doors, it is recommended installation begin when the river reaches elevation 491.0 and is rising.

Note: Because of ongoing construction activities on the riverfront it is possible the all anticipated flood protection may not be in place. It is therefore recommended that as the river approaches EL. 480.61 (River Stage 51.0) an onsite assessment be made.

Sequence of Operations

Elevation in Discharge Chamber	River Elevation / Gage	Elevation in Wet Well	Description
485.0	485.0 / 55.4	N/A	Sluice gate is lowered by high water alarm in discharge chamber.
	N/A	467.3	Sump Pump turns on.
	N/A	469.8	Pump Number 1 turns on.
	N/A	475.1	Pump Number 2 turns on.
	N/A	475.7	Pump Number 3 turns on.
	N/A	476.4	Pump Number 4 turns on.
	491.0 / 61.4 (and rising)		Install Transit Center flood doors.
	493.0 / 63.4		Transit Center begins to flood.
	509.6/ 80.0		Pumps can no longer pump against River head.
	512.6 / 83.0		Second Street and control room access over topped.
	N/A	475.1	Pump Number 4 turns off.
	N/A	474.1	Pump Number 3 turns off.
	N/A	473.8	Pump Number 2 turns off.
	N/A	468.9	Pump Number 1 turns off.
	N/A	466.3	Sump Pump turns off.

EG Controls
Jacksonville, Florida

11790 PHILIPS HIGHWAY / JACKSONVILLE, FL 32256-1642
(904) 292-0110 * FAX (904) 292-0119

FORT WASHINGTON WAY

FIELD REVISION DOCUMENTS

Manufacturer's Representative: Straeffer Pump And Supply, Inc.
6100 Oak Grove Road
P.O. Box 5248
Evansville, IN 47715
812-476-3075

Contact: Jeff Baehl

Manufacturer: EG Controls, Incorporated
11790 Philips Highway
Jacksonville, Florida 32256-1642
904-292-0110

Technical Contact: Luster Conner
Mike Hodges
Mark Walker
George Adams

EG Job Number: 256356

Please contact the Manufacturer's Representative for questions.

Information supplied on Field Revision Package:

10 Sets Drawings

10 Sets Technical Data

PANEL IS U/L 508 LABELED.

No.	REVISION	DATE	BY
1	SUBMITTAL	11-29-99	BWG
2	RE-SUBMITTAL	2-23-00	BWG
3	PRODUCIBLE	4-24-00	BWG
4	AS BUILT	6-12-00	BWG
5	FIELD REVISION	11-01-00	BWG

FORT WASHINGTON WAY PUMP CONTROL PANEL

A. System Description

This pump control panel is designed to control five submersible water pumps for pumping out water in a wet well. A 5 hp sump pump is provided for routine and very small amounts of water. The sump pump, in automatic mode, is turned "ON" and "OFF" by two mercury float switches. This sump pump is to take care of any water before the main control systems, (PLC and Back-up float switches), call for any of the remaining four pumps (Pumps no. 1, 2, 3, and 4). The sump pump in the automatic mode will not operate if any of the remaining four pumps are running or the back-up float system is engaged. The sump pump can be turned on at any time by placing its Hand-off-Auto (H-O-A) switch in the hand position.

The remaining four pumps make-up the main pumping system. Pump no. 1 is the smallest, 28 hp. Pumps no. 2, 3, and 4 are larger, 168 hp. A solid-state starter powers each pump normally. The pumps are also provided with contactors to start the pumps and by-pass the solid-state starters. The pumps are started with their by-pass contactor whenever the solid-state starter has failed and the pump is needed because of pumping demands. Example, if the PLC calls for pumps 1, 2, and 3, but the solid-state starter for pump no. 2 has failed, the PLC system will replace pump no. 2 by calling pump no. 4 to get the required number of pumps. If the wet well level requires four pumps, pump no. 2 will be called to run with its by-pass contactor.

B. System Operational Modes

Each of the main pumps can operate in either an automatic or manual mode by using its H-O-A selector switch. In the automatic mode two systems are used to control the pumps: (1) a PLC with submersible pressure transducer, and (2) a back-up float system using six mercury float switches. In the automatic mode with the main pumps controlled by either the PLC or the back-up float system, the smaller pump shall always be called first, followed by the three larger pumps. The three larger pumps will also alternate as lead pump under either PLC or back-up float control. In manual mode the pumps can be started and stopped in any order or sequence by using pushbuttons. For either automatic or manual mode of operations, there are four conditions that have to be met by each pump individually before it will start: (1) the incoming power monitored by the phase monitor has to be good, (2) the pump cannot be in an over temperature condition, (3) the pump motor insulation resistance has to be good, and (4) the pump starter over load relays has to be set.

1. Automatic Mode

During normal operations, and with all pumps in the automatic mode, the sump pump will take care of any water in the wet well, but if for any reason the sump pump is unable to handle the water the four main pumps will take over, controlled by the PLC system. The PLC receives the wet well level from a 4-20mA signal generated by a submersible pressure transducer in the wet well. The PLC can start each pump either with the solid-state starter or if needed with the by-pass contactor.

Pump no. 1 (28 hp) will start as the water level rises in the wet well above the "Sump Pump On" float switch, and reaches the programmed start level for pump no. 1. If pump no. 1 is able to lower the water level the larger pumps will not be called, and pump no. 1 will be

stopped as the water lowers to its stop pump programmed level. After pump no. 1 has stopped, the sump pump will come back on and continue to lower the water level to its "Sump Pump Off" float switch at which time the sump pump will stop. If however, the water level continues to rise, the first large pump, lead pump (168 hp), will be called to start. Should the wet well water level still continue to rise the remaining two large pumps (lag 1, and lag 2) will be called to start by the PLC as the water reaches their individual programmed start levels. As the water level falls each pump is stopped in the reverse order of start, last-on first-off. When the lead pump is stopped this will complete one pumping cycle for the three large pumps, and during the start of the next pumping cycle the larger pumps will alternate the lead pump position. Alternation is done by the PLC.

In the event that the wet well water level should continue to rise past the lag 2 pump starting level and should reach the high level mercury float switch, the float system shall be engaged and locked-in after a set period of time, and shall take control of the main pumps automatically, locking out the PLC start/stop contacts. The float system shall also assume control of the main pumps should any one of the following occur: (1) the PLC fails, (2) the submersible pressure transducer fails, or (3) manually by pressing the "Manual Float Enable" pushbutton. The float system will remain in control of the main pumps until the "Float System Reset" button is pushed and the above conditions are corrected.

In the float control system, each of the main pumps is started by its own float switch as the water level rises. One common "Stop Pump" float switch serves to stop the pumps at a set level as the water level falls. In the float control system, alternation of the three large pumps is controlled by an alternating relay. Opening of the "Stop Pump" float switch contact completes one pumping cycle for the float control system. After the first pumping cycle, the float system will remain in control until the system is reset manually, the main pumps will all be called to start when the wet well water level rises to the "High Level" float switch, and stopped when the wet well water level falls to the "Stop Pump" float switch. In the float control system their individual by-pass contactor can only start the pumps. Timers are used to ensure that the pumps do not all start at the same time.

2. Manual Mode

In manual mode, each pump is controlled by its own set of start and stop pushbuttons, and cannot be controlled by the PLC or the floats. A two position selector switch is used for each pump to select either solid-state or by-pass contactor starting.

Straeffer Pump & Supply, Inc.
6100 OAK GROVE RD. • P.O. BOX 5248 • EVANSVILLE, INDIANA 47716
TELEPHONE (812) 476-3075 FAX (812) 476-5164
Engineered Sales

"If you can pour it We can pump it"

Settings for Allen Bradley, SMC 150 Plus Reduced Voltage Soft Starts (RVSS)

A. Pump #1, 28HP/3/480V, Pumpex , 8"Pump, (1SSS)

Dip Switch #: 7, 9 (ON)
Current Limit: Set @ 6
Soft Stop Time: Set @ 2
Kickstart Time: Set @ 5

B. Pump#2, 168HP/3/480V, ABS, 24"Pump, (2SSS)

Dip Switch #: 7, 9 (ON)
Current Limit: Set @ 6
Soft Stop Time: Set @ 2
Kickstart Time: Set @ 5

C. Pump#3, 168HP/3/480V, ABS, 24"Pump, (3SSS)

Dip Switch #: 7, 9 (ON)
Current Limit: Set @ 6
Soft Stop Time: Set @ 2
Kickstart Time: Set @ 5

D. Pump#4, 168HP/3/480V, ABS, 24"Pump, (4SSS)

Dip Switch #: 7, 9 (ON)
Current Limit: Set @ 6
Soft Stop Time: Set @ 2
Kickstart Time: Set @ 5

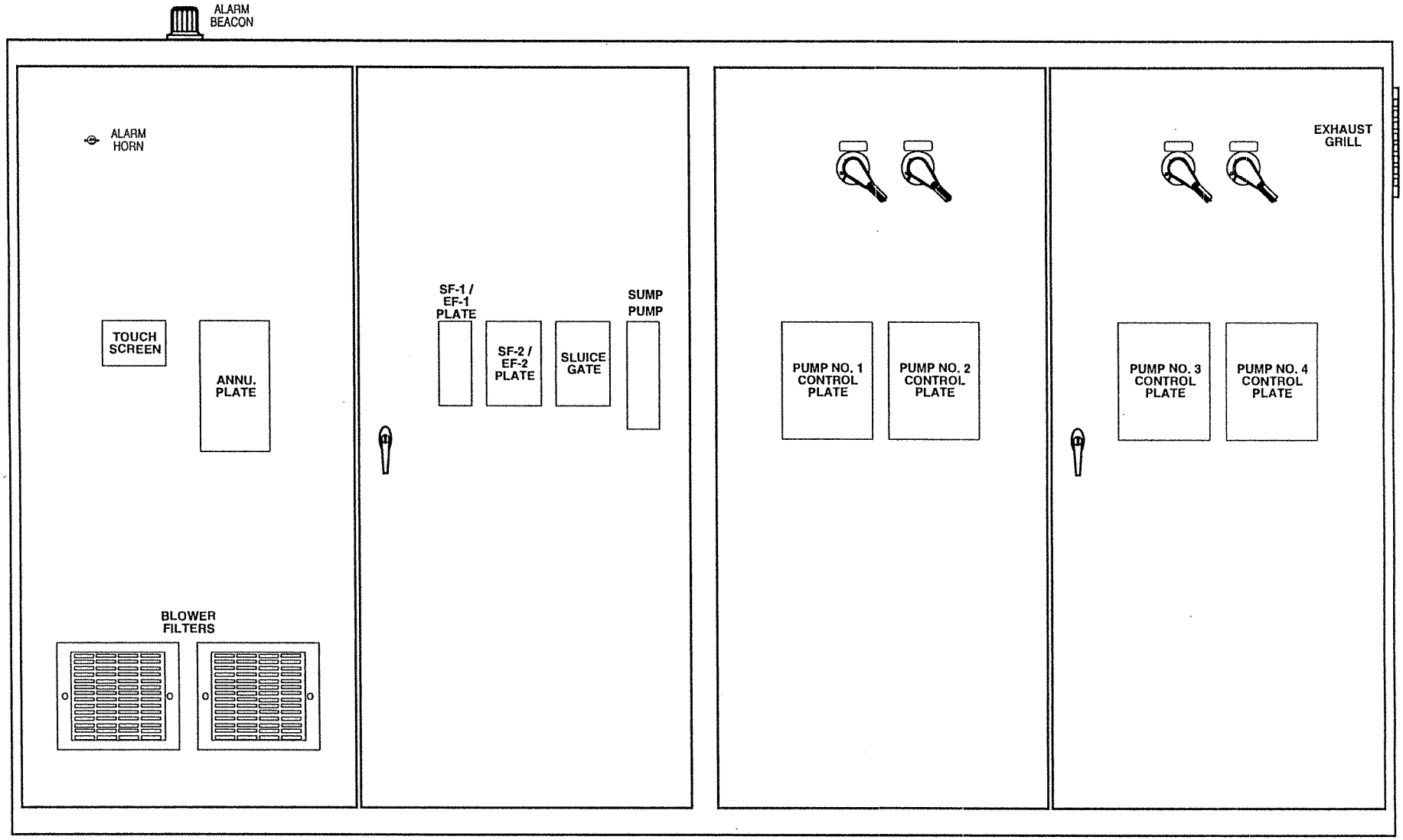
1/17/2001
J.L.B.

EG Controls, Inc., Jacksonville, FL

DATE 11-19-99

JOB # 256356

ENCLOSURE



ENCLOSURE - DOOR FRONT VIEW

SCALE: 1/16" = 1"

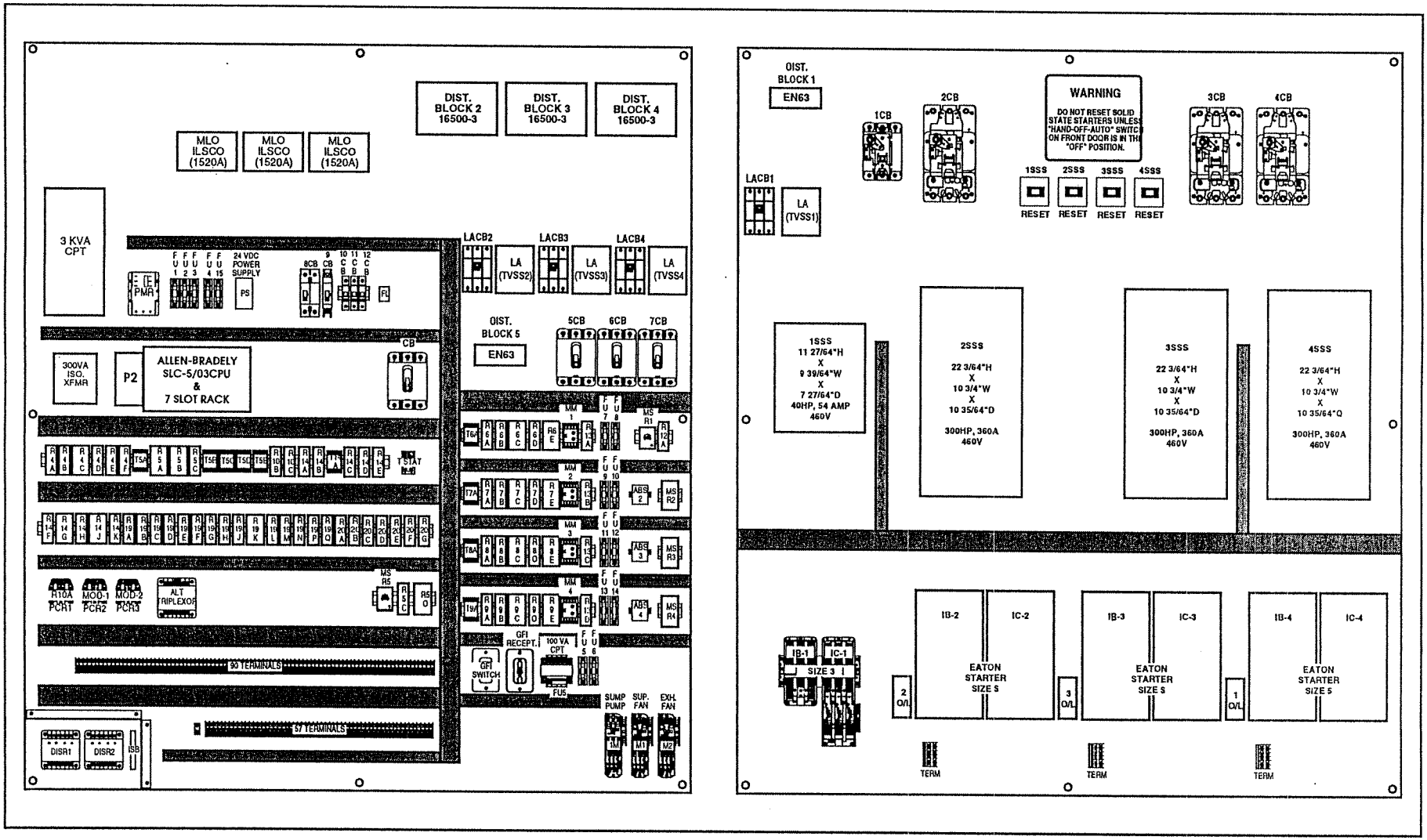
MULTI-DOOR ENCLOSURE: NEMA 12, A-86M4E (86.12" H x 149.19" W x 14.12"D) FREE STANDING.
FAB FROM #10 GA COLD ROLLED STEEL, FINISH IS ANSI 61 GRAY OUTSIDE, BAKED ON WHITE ENAMEL INSIDE.
EACH DOOR SHALL BE PROVIDED WITH TWO (2) 90 DEGREE DOOR STOPS.

EG Controls, Inc., Jacksonville, FL

DATE 11-19-99

JOB # 256356

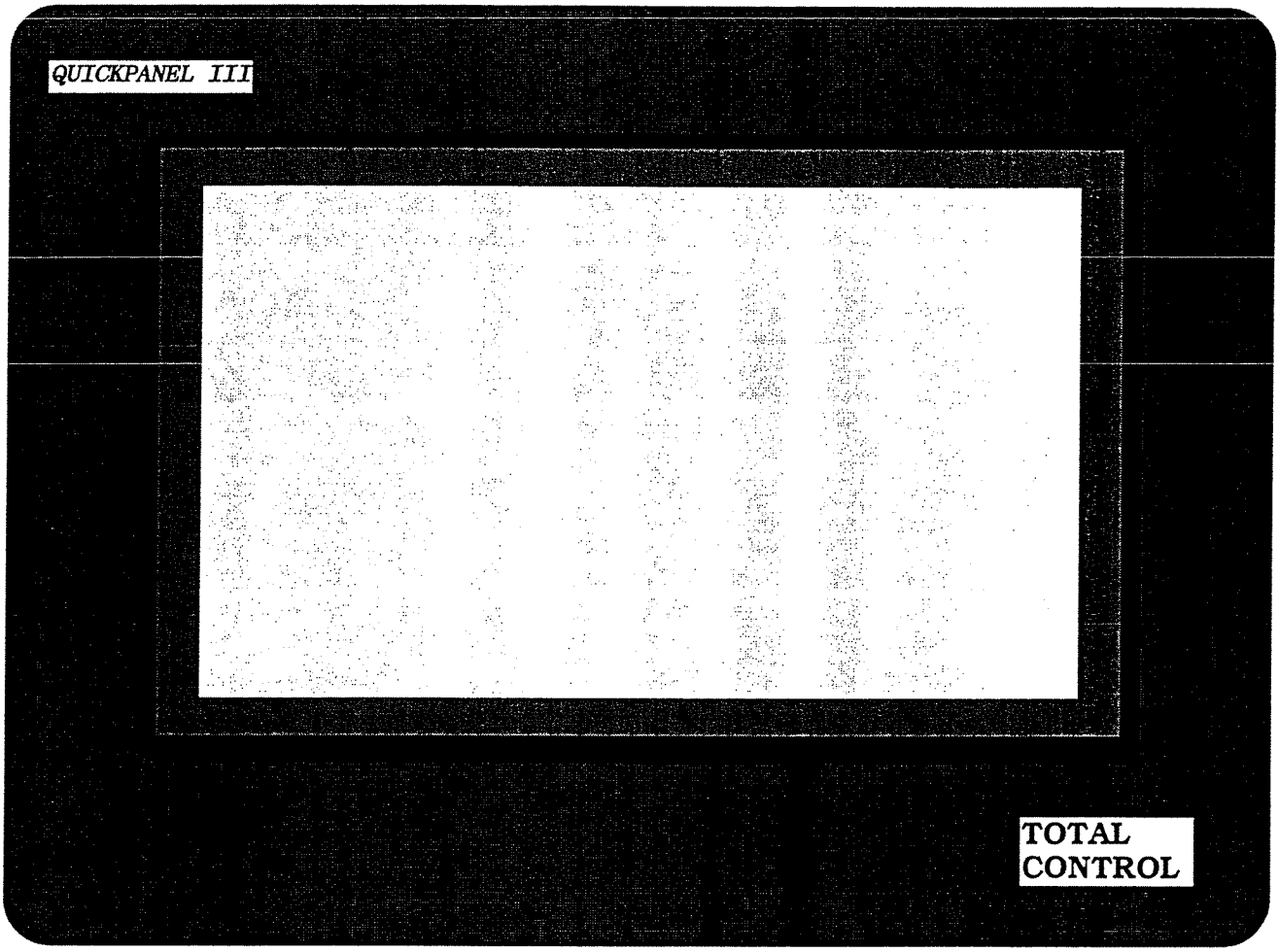
BACKPANEL



BACKPANEL LAYOUT

SCALE: 1/16" = 1"

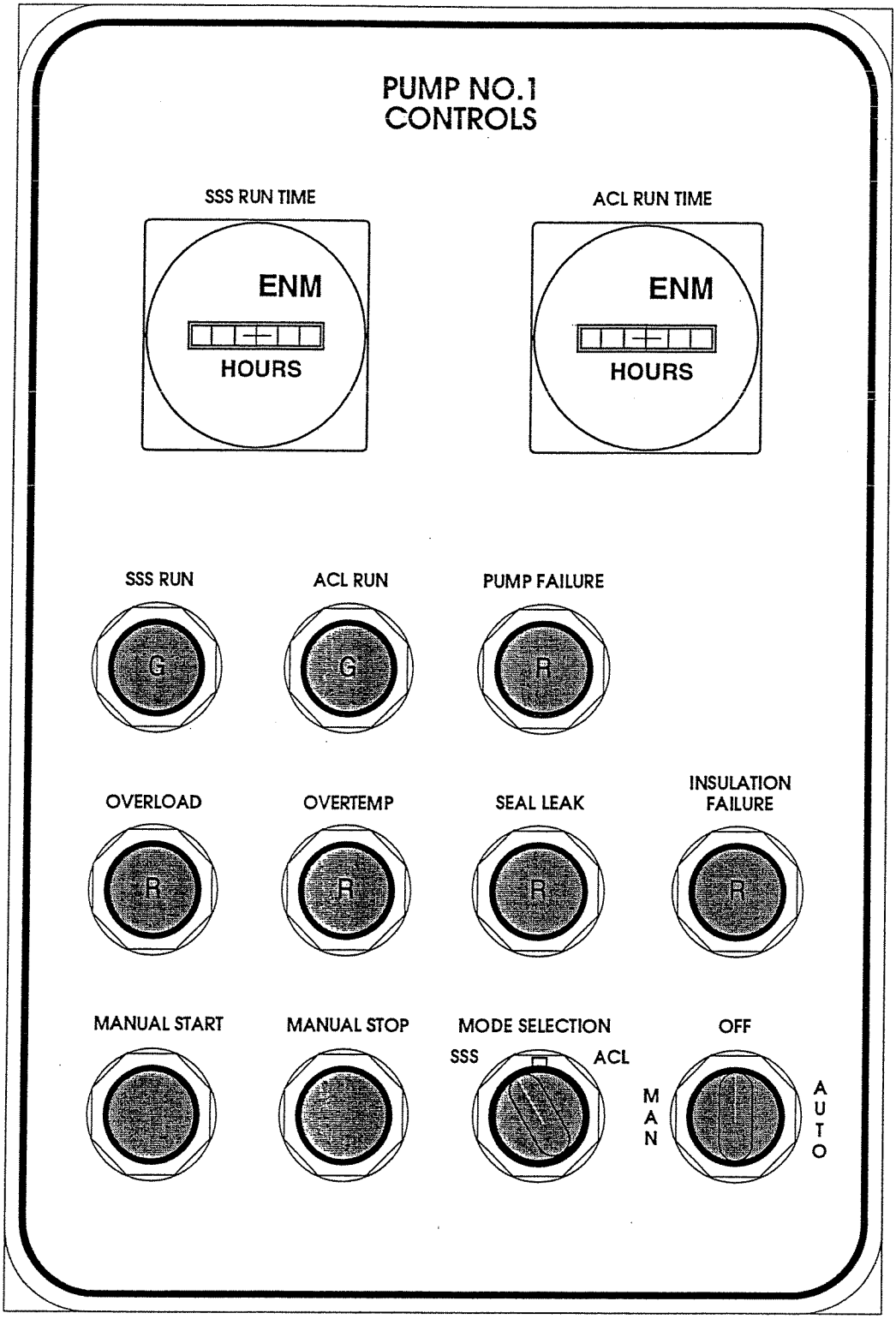
BACKPANEL: TWO (78" X 70") FAB FROM #10 GA. COLD ROLLED STEEL FINISHED WITH WHITE ENAMEL.



PUMP CONTROL STATION

5" TOUCH SCREEN

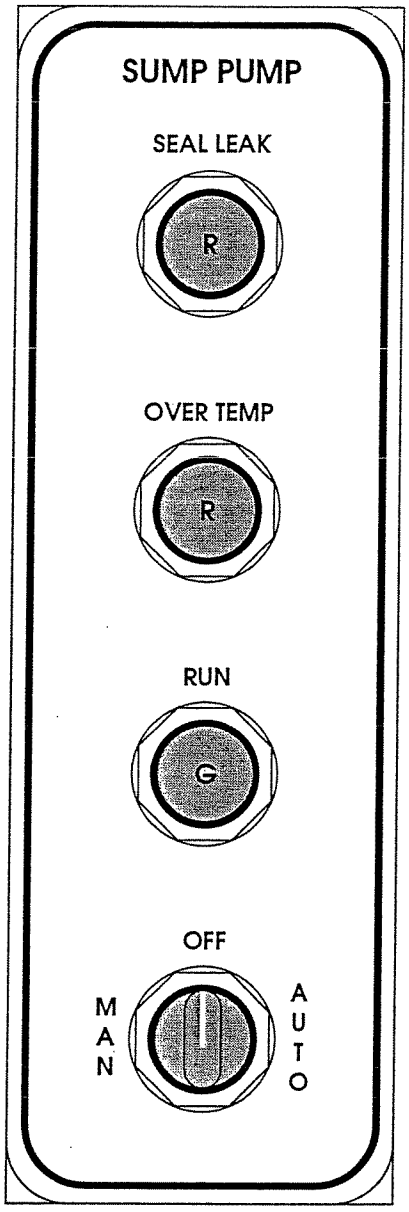
EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	DETAIL



CONTROL PLATE

TYPICAL FOR PUMPS No.2, No.3, AND No.4

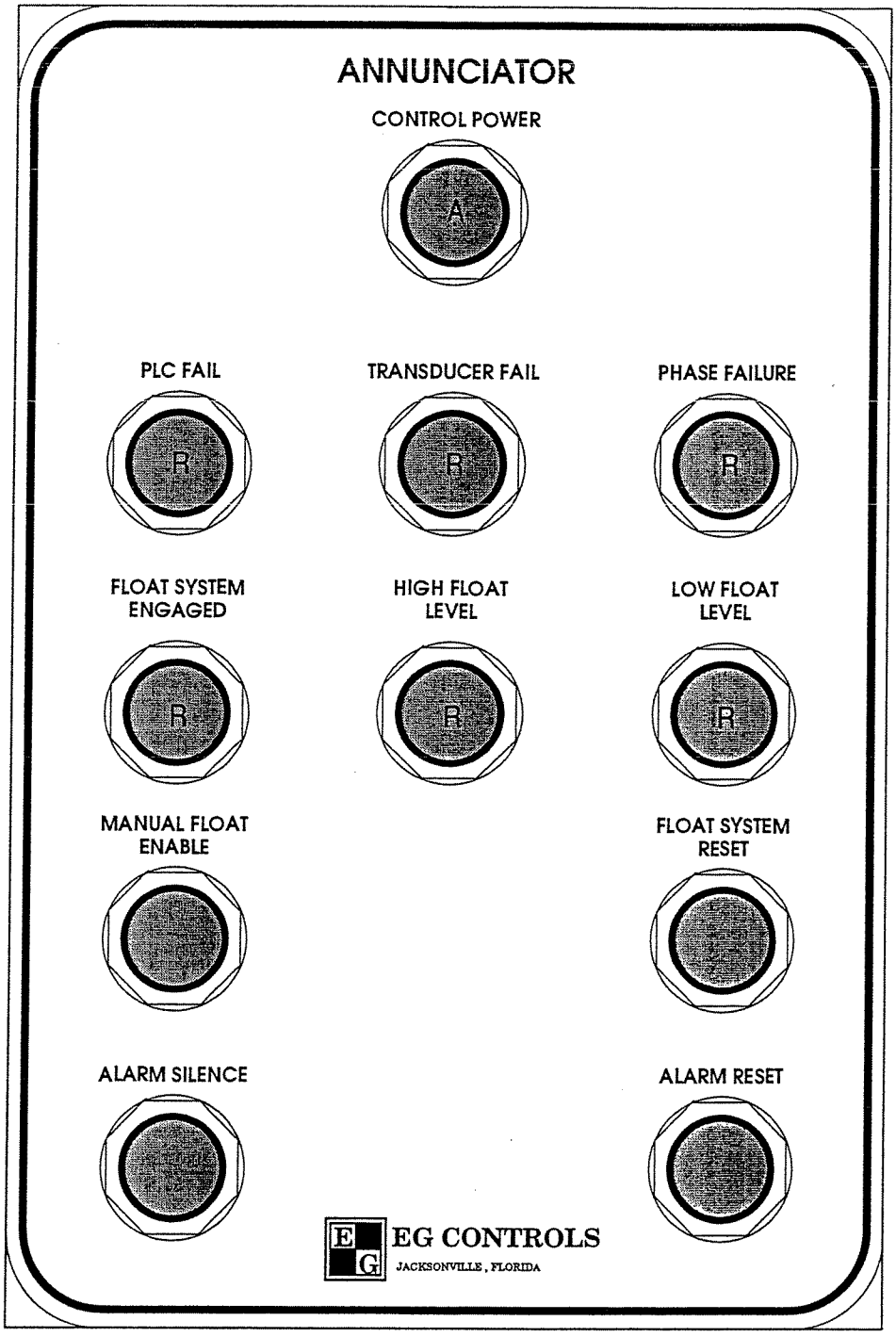
EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	DETAIL



SUMP PUMP CONTROL PLATE

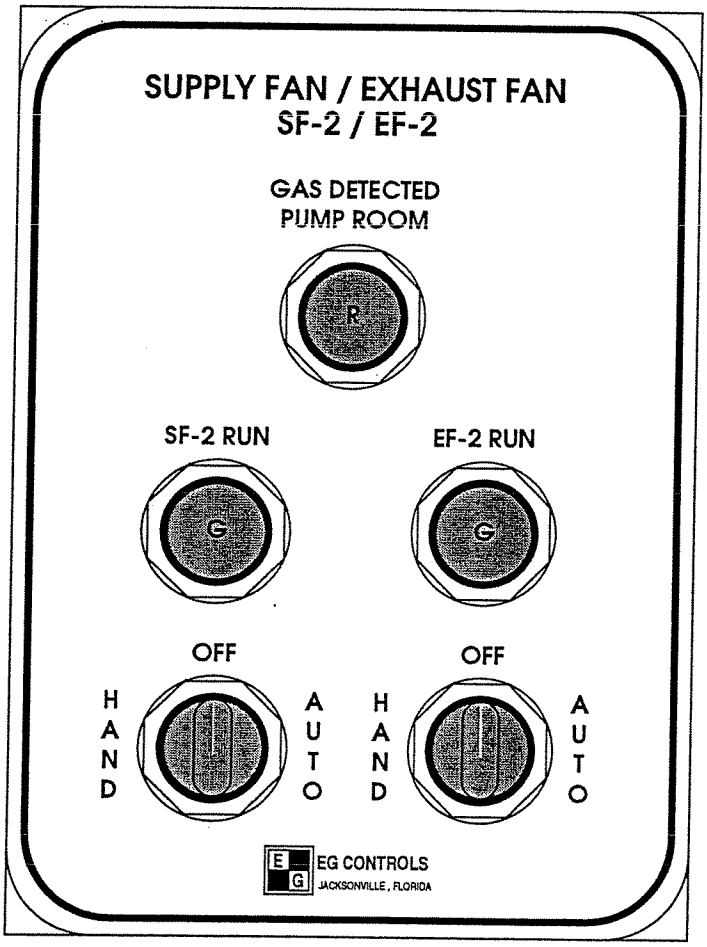
LASER-SCREENED LAMINATED MYLAR CONTROL PLATE
BLACK LETTERING ON GOLD BACKGROUND
MOUNTED ON OUTER DOOR

EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	DETAIL



MAIN ANNUNCIATOR PLATE

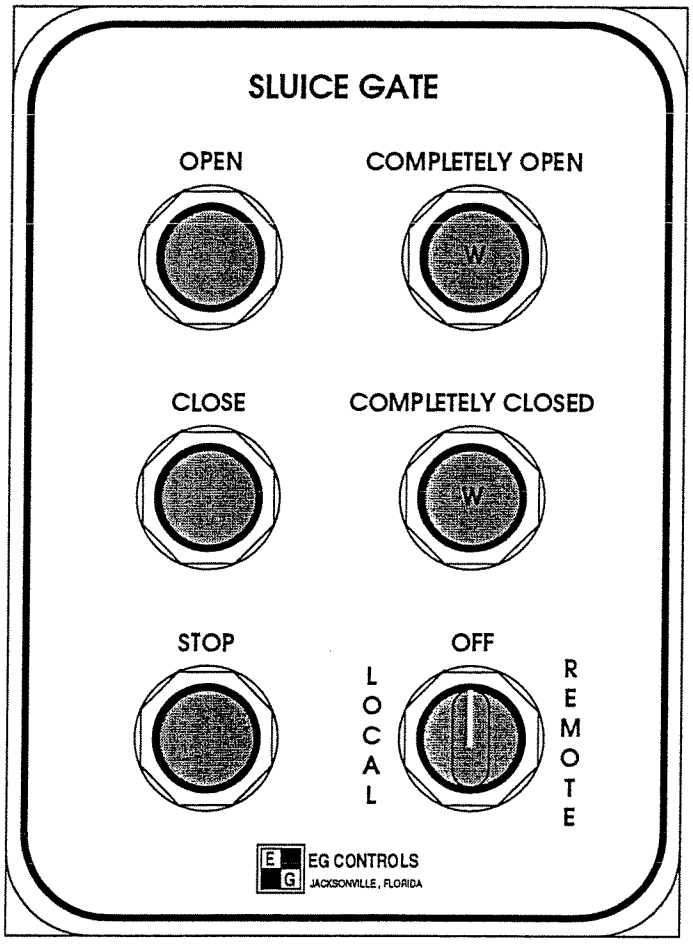
EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	DETAIL



CONTROL PLATE

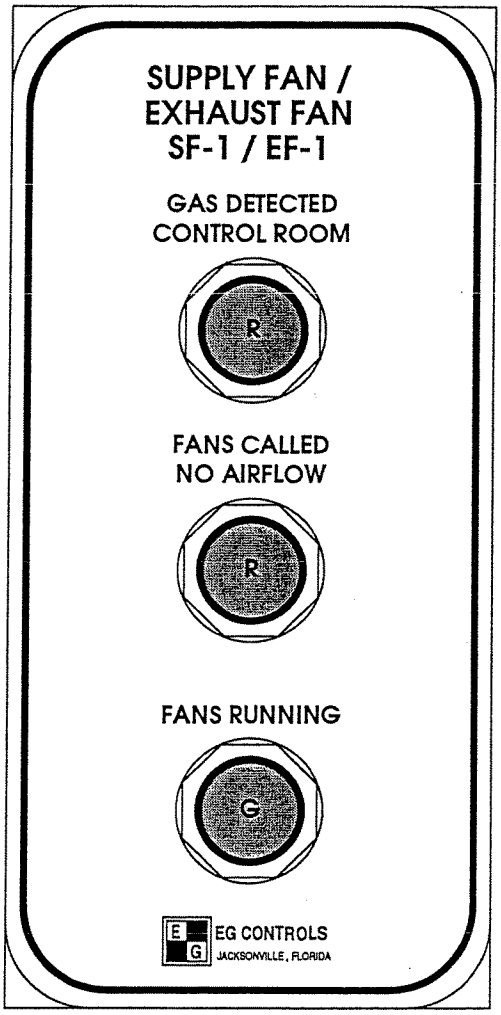
LASER-SCREENED LAMINATED MYLAR CONTROL PLATE
BLACK LETTERING ON GOLD BACKGROUND
MOUNTED ON OUTER DOOR

EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	DETAIL



CONTROL PLATE

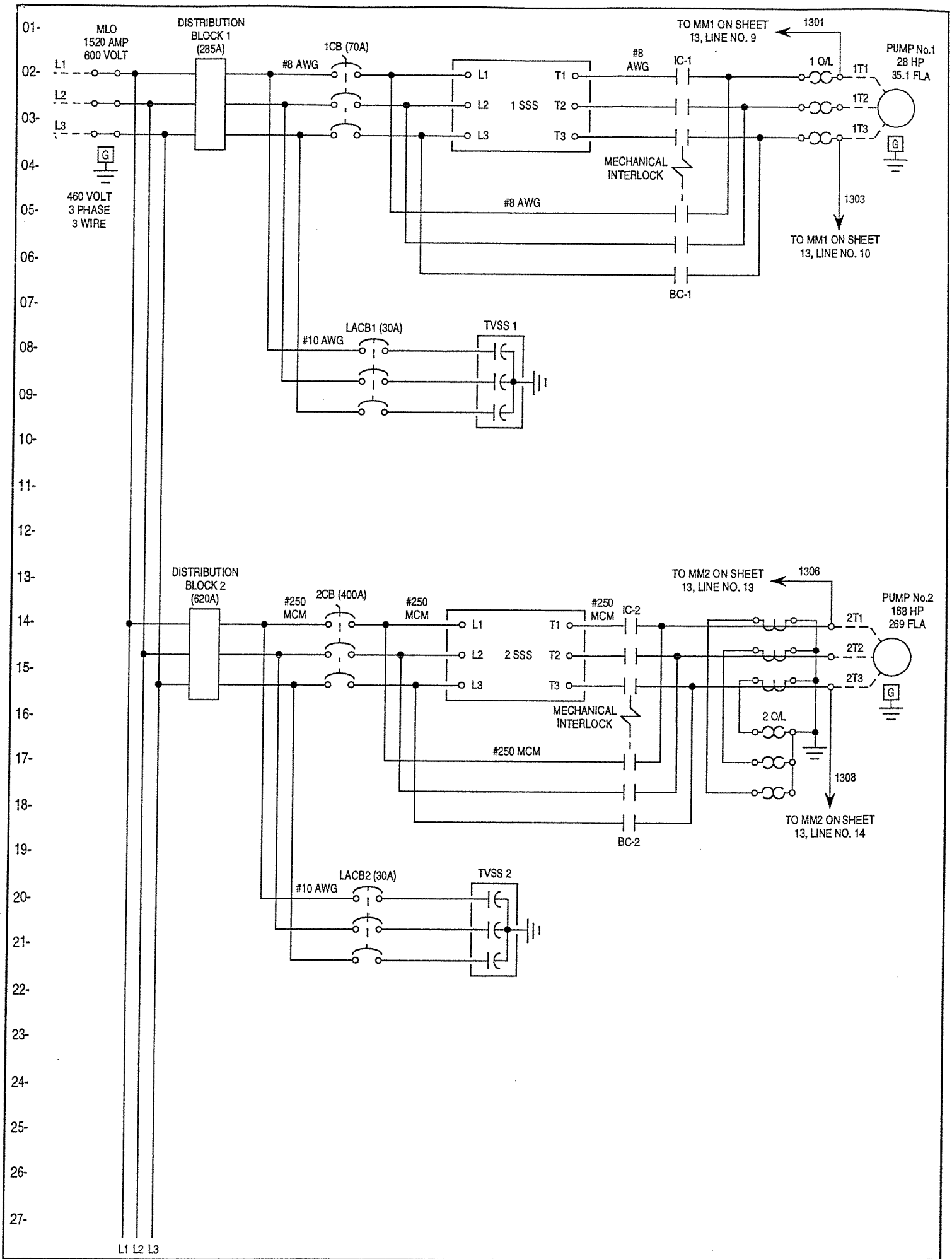
LASER-SCREENED LAMINATED MYLAR CONTROL PLATE
BLACK LETTERING ON GOLD BACKGROUND
MOUNTED ON OUTER DOOR



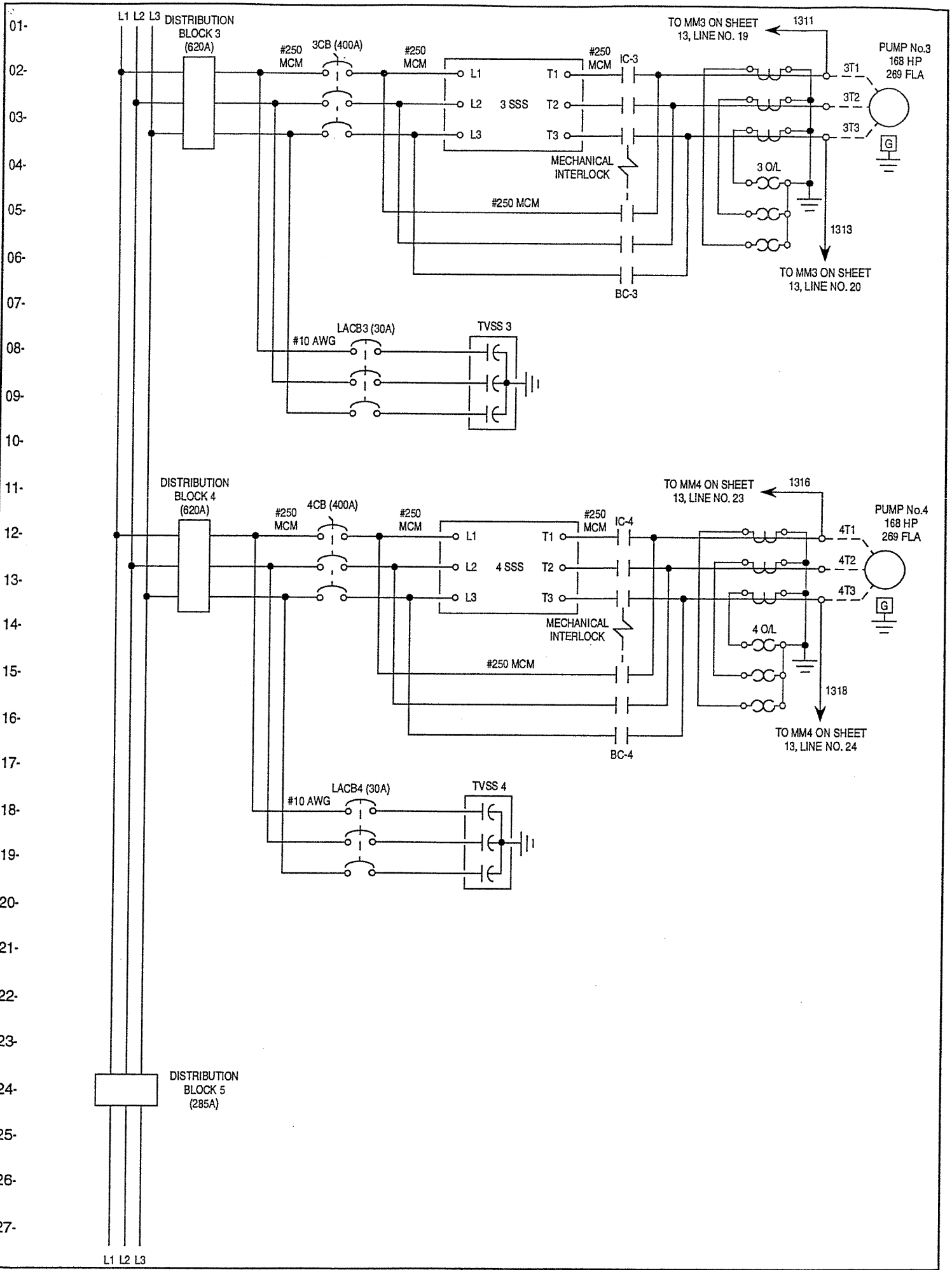
ANNUNCIATOR PLATE

LASER-SCREENED LAMINATED MYLAR CONTROL PLATE
BLACK LETTERING ON GOLD BACKGROUND
MOUNTED ON OUTER DOOR

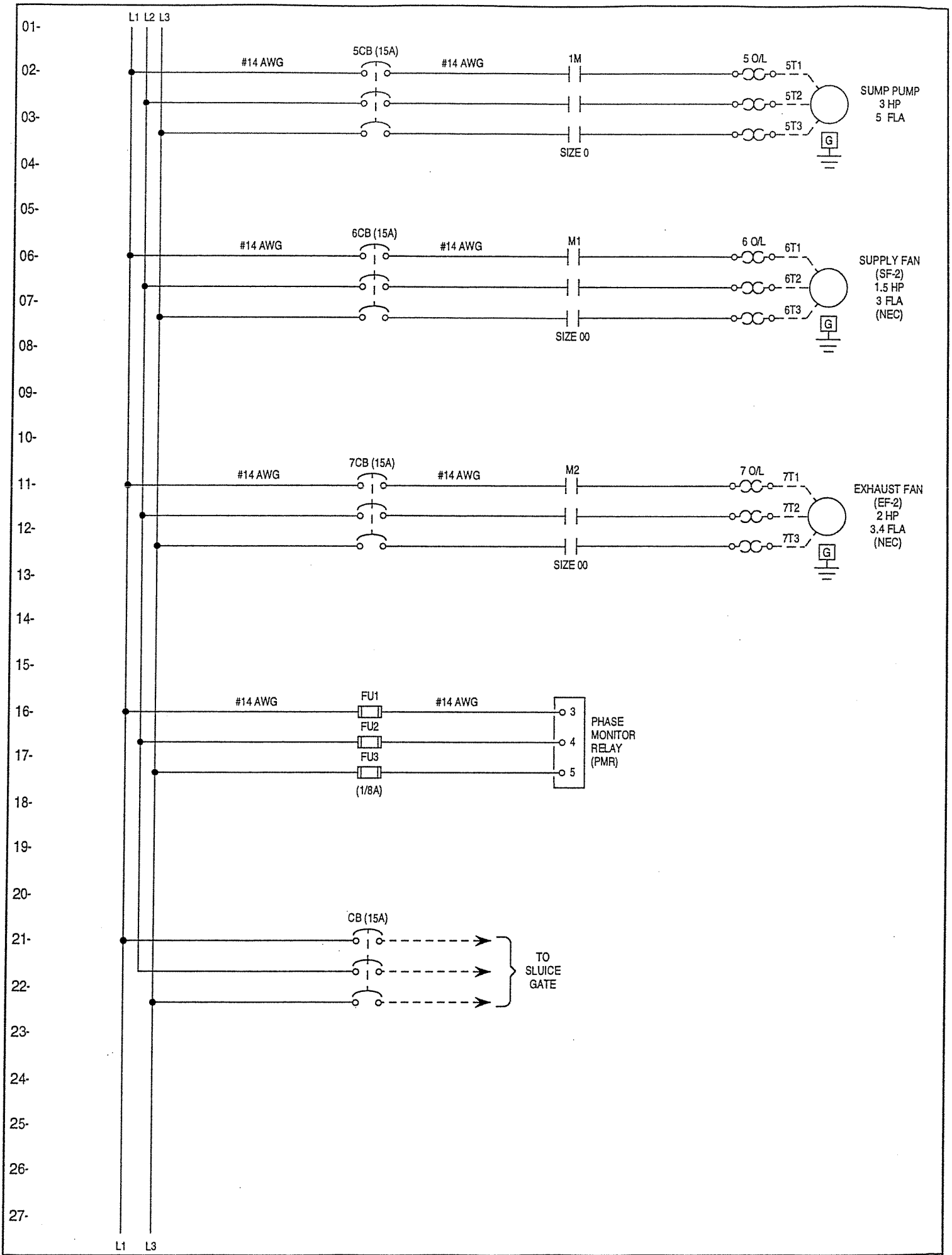
EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	DETAIL



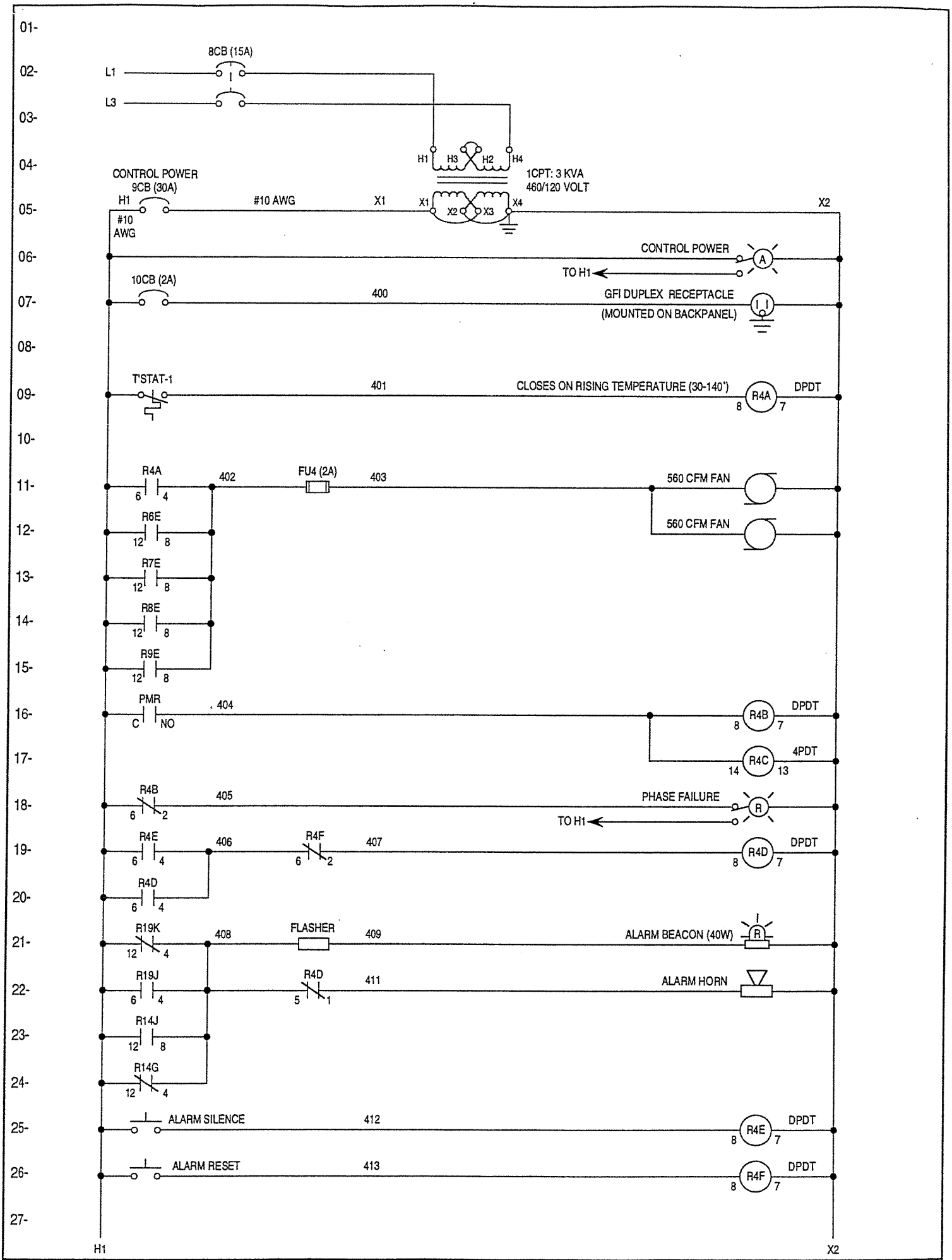
EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	SHEET 1



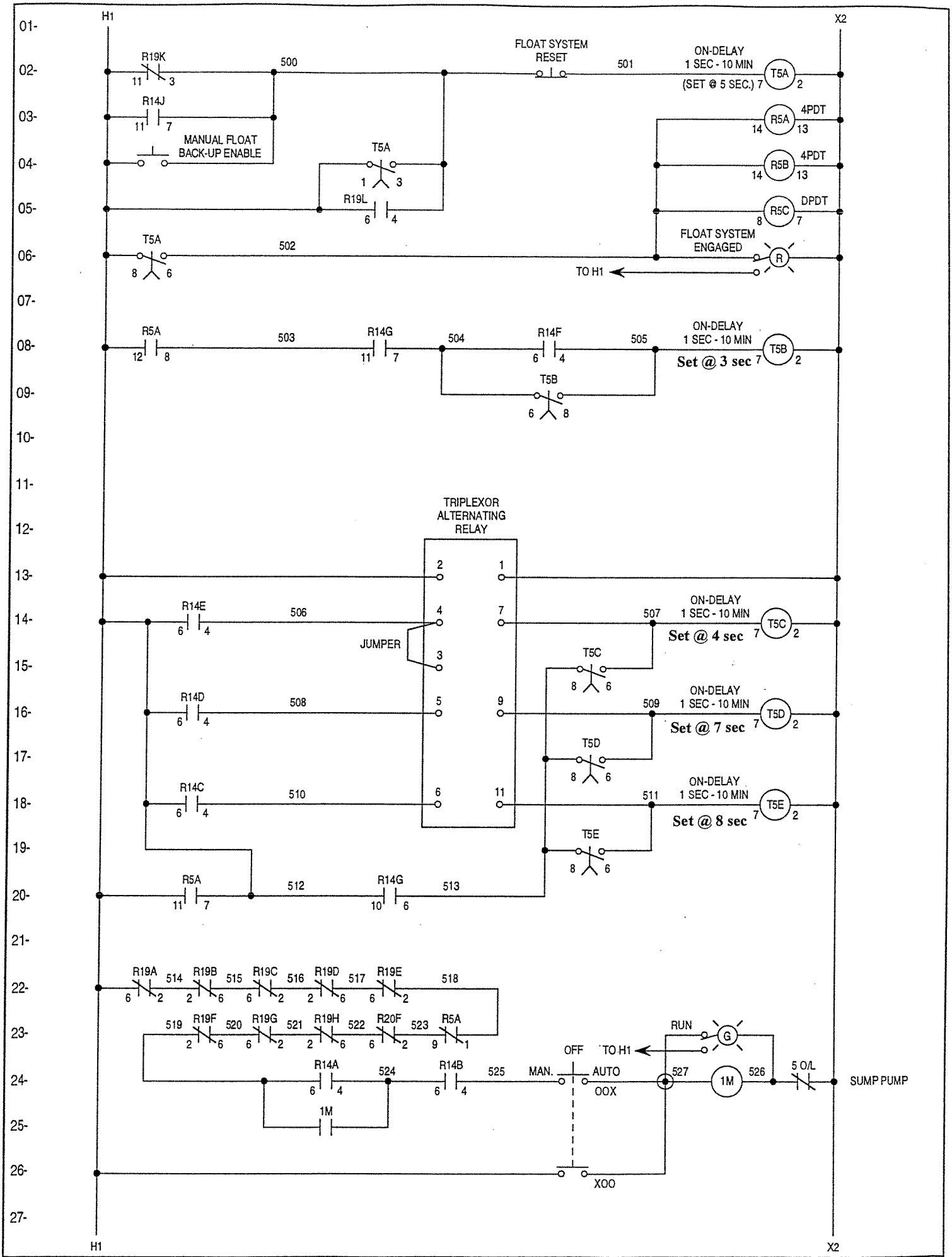
EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	SHEET 2



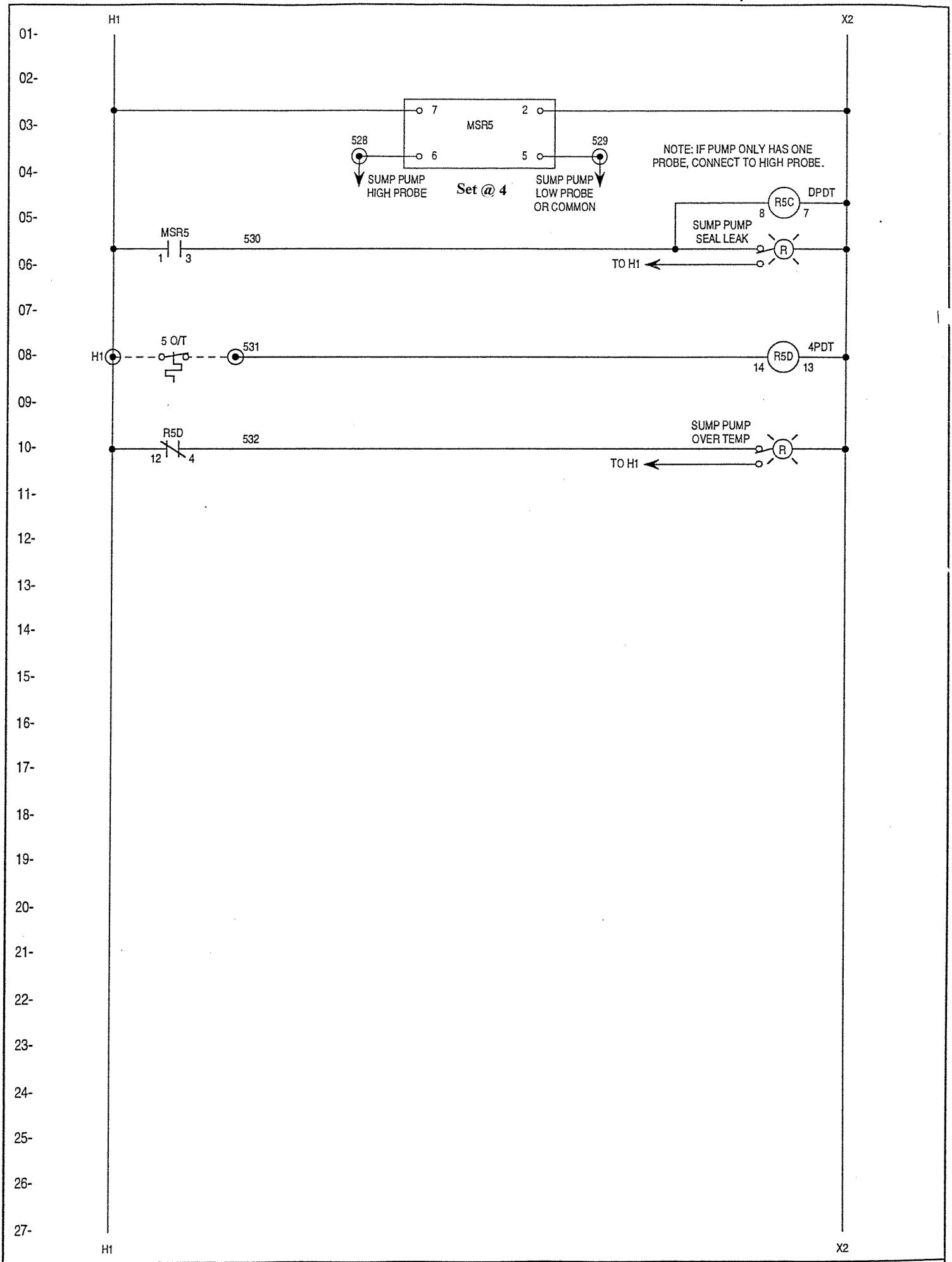
EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	SHEET 3



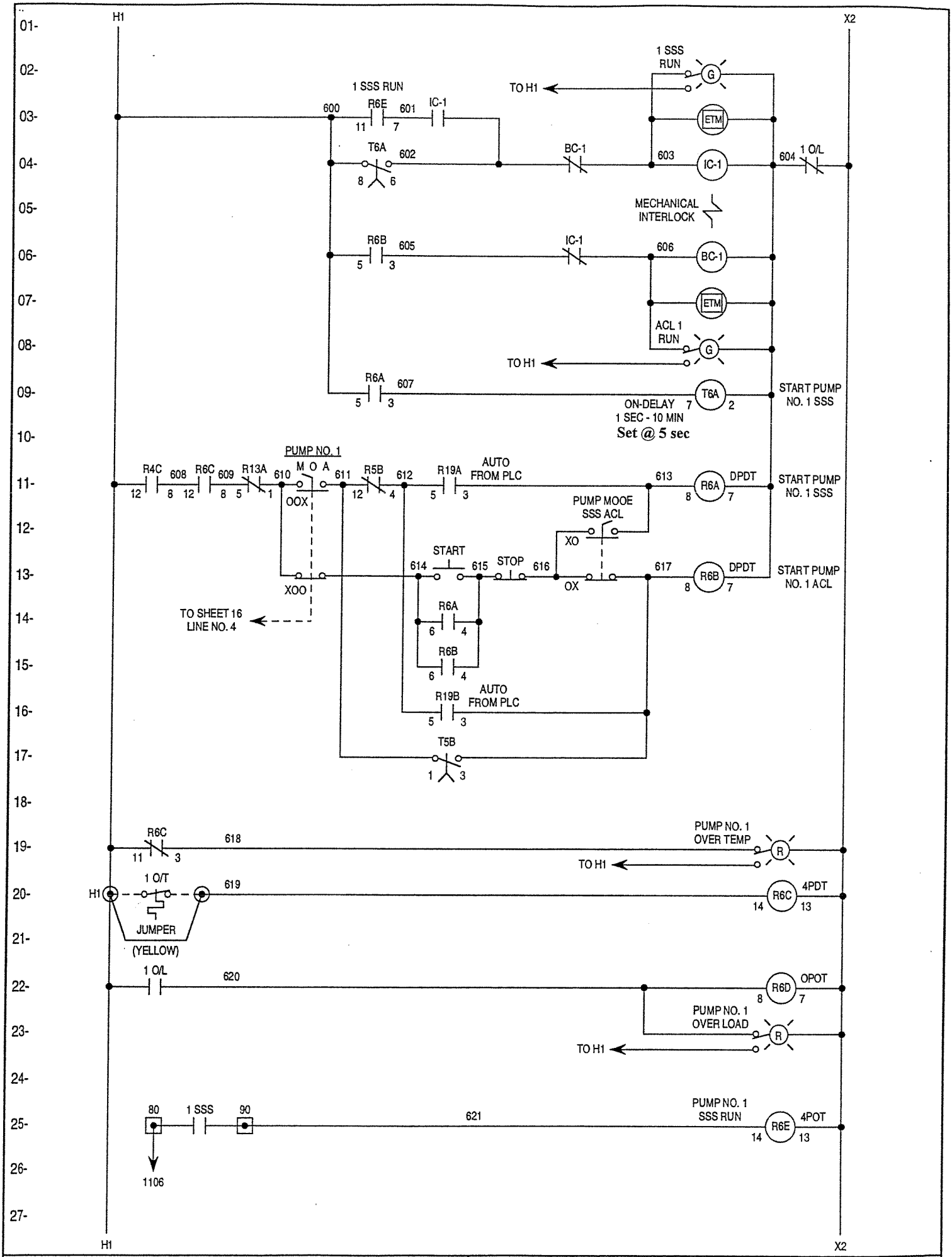
EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	SHEET 4



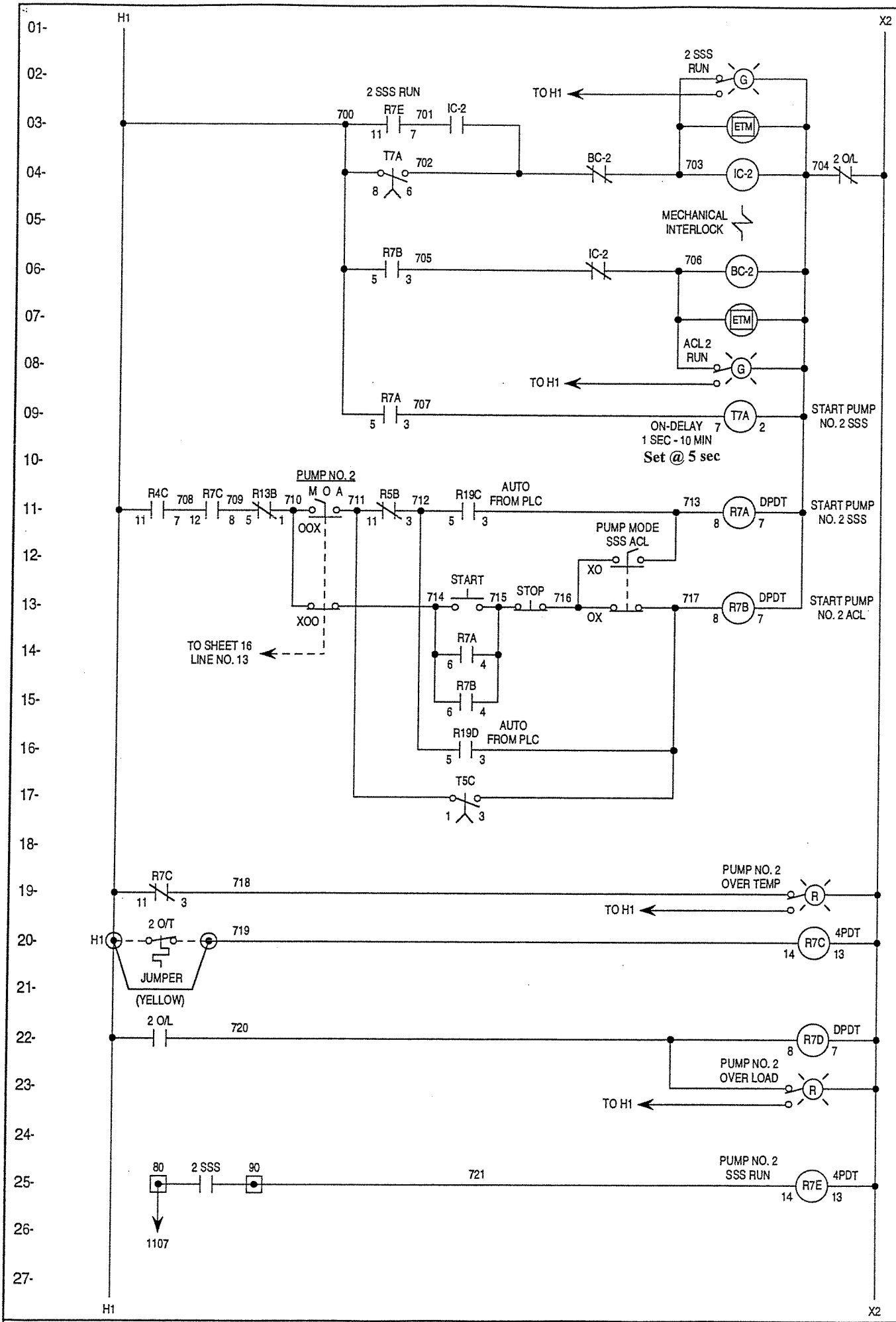
EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	SHEET 5



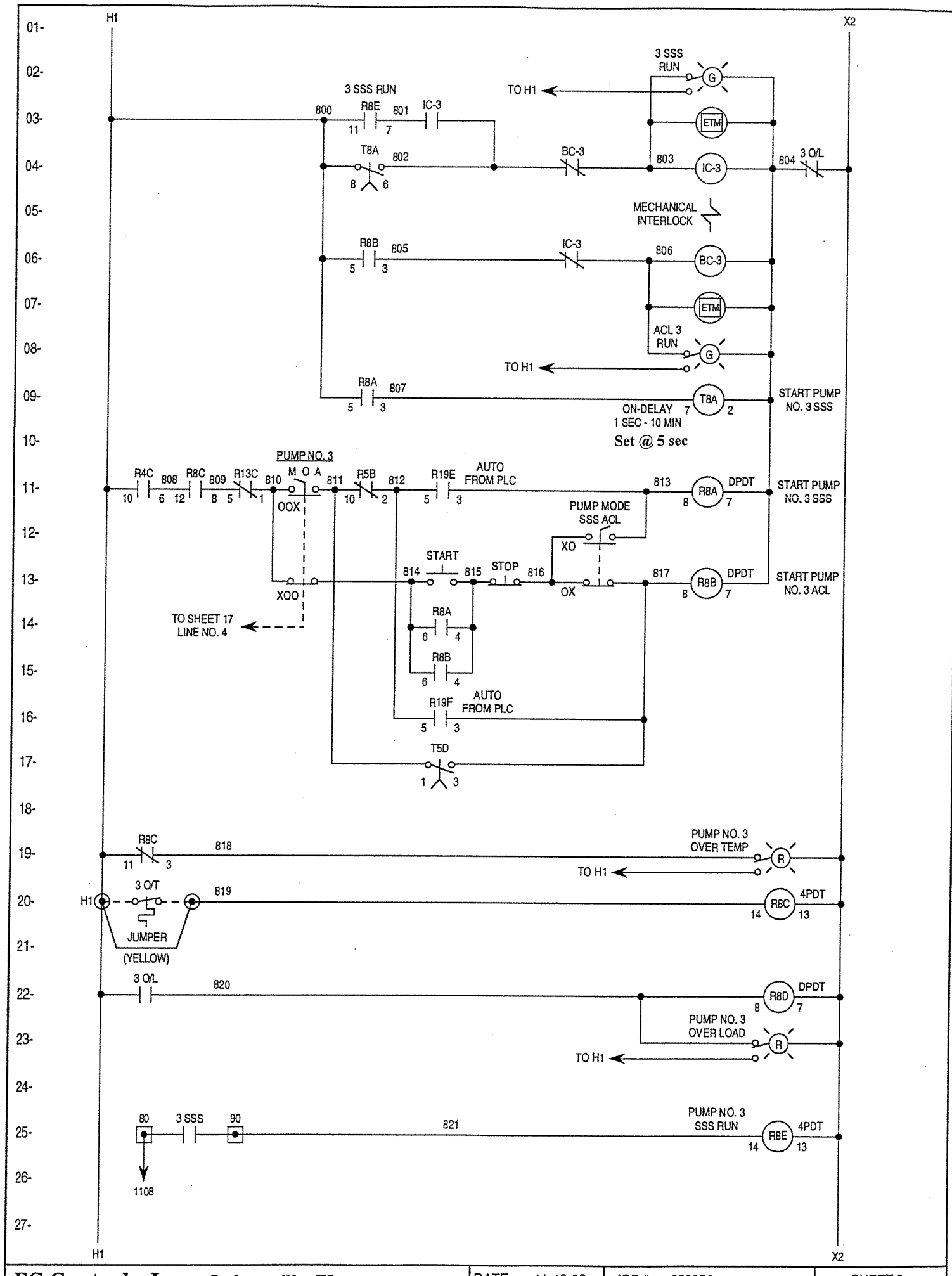
EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	SHEET 5A



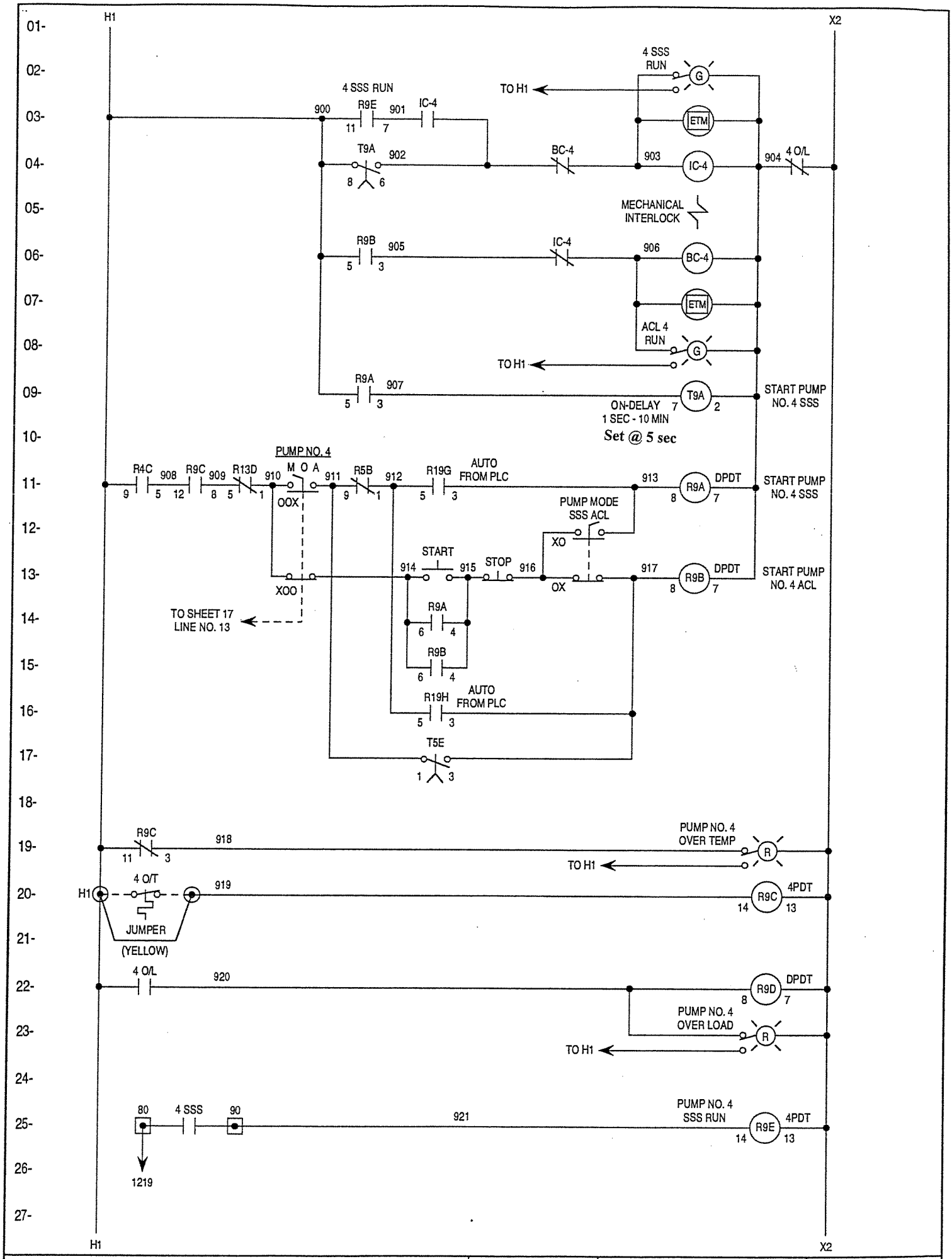
EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	SHEET 6



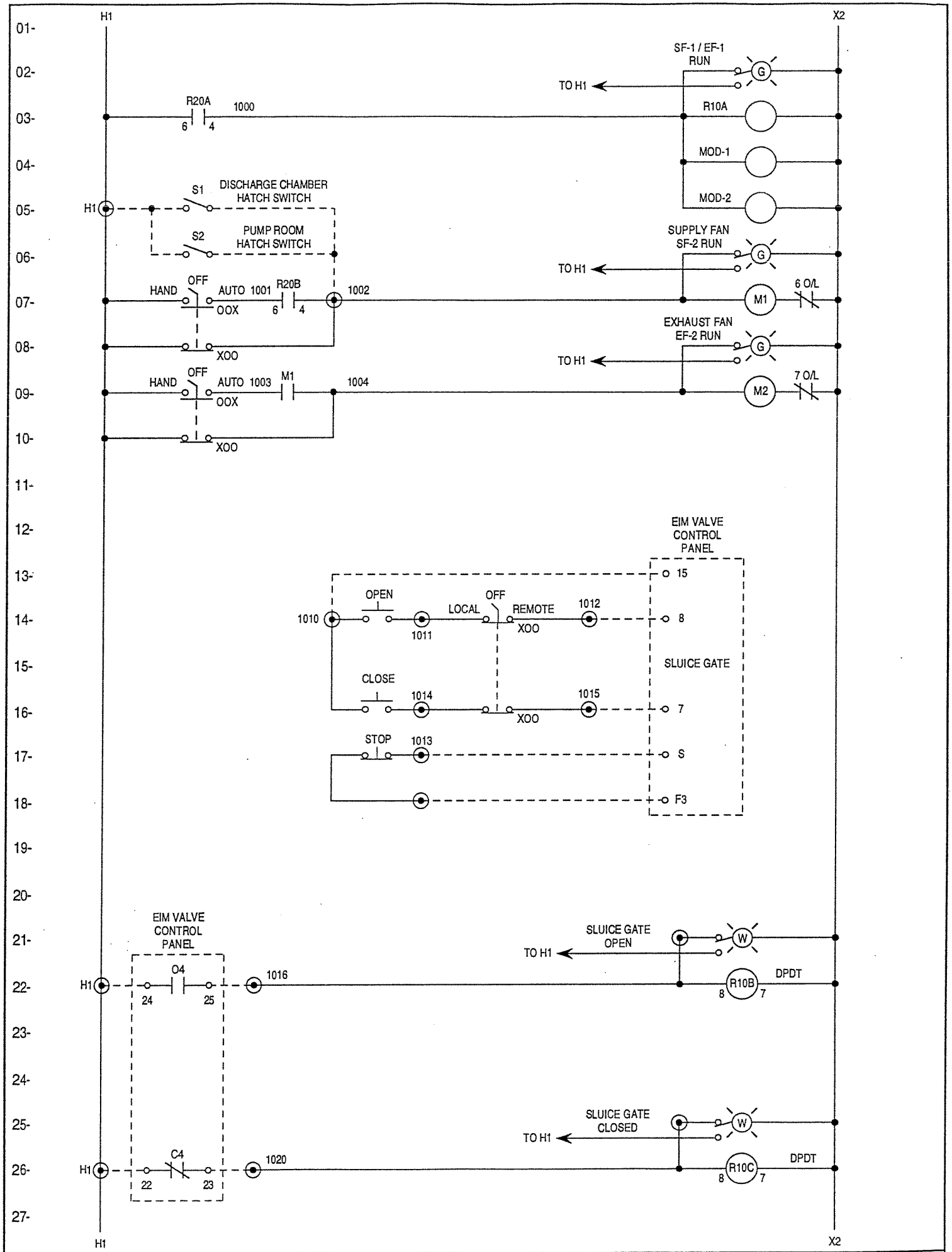
EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	SHEET 7



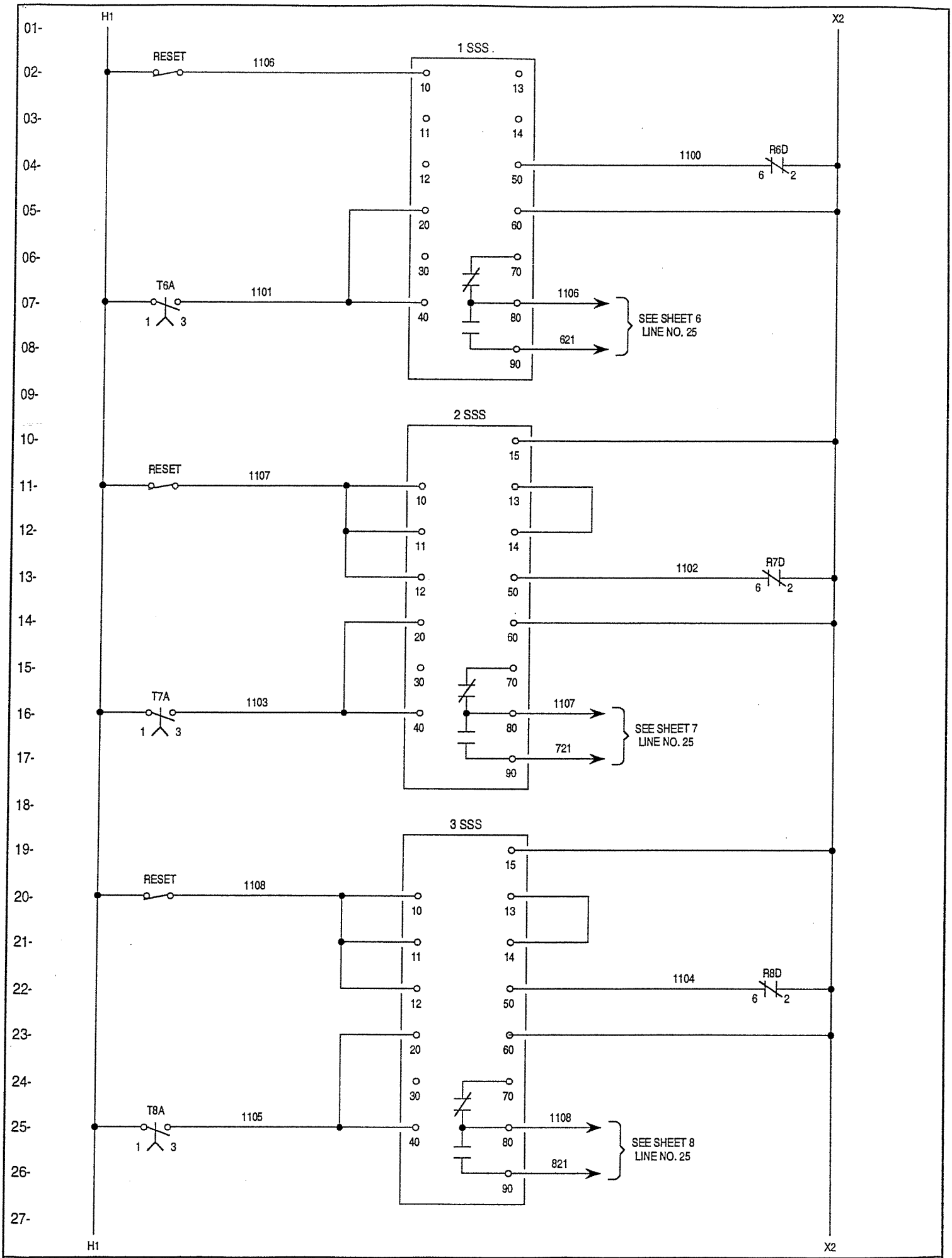
EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	SHEET 8



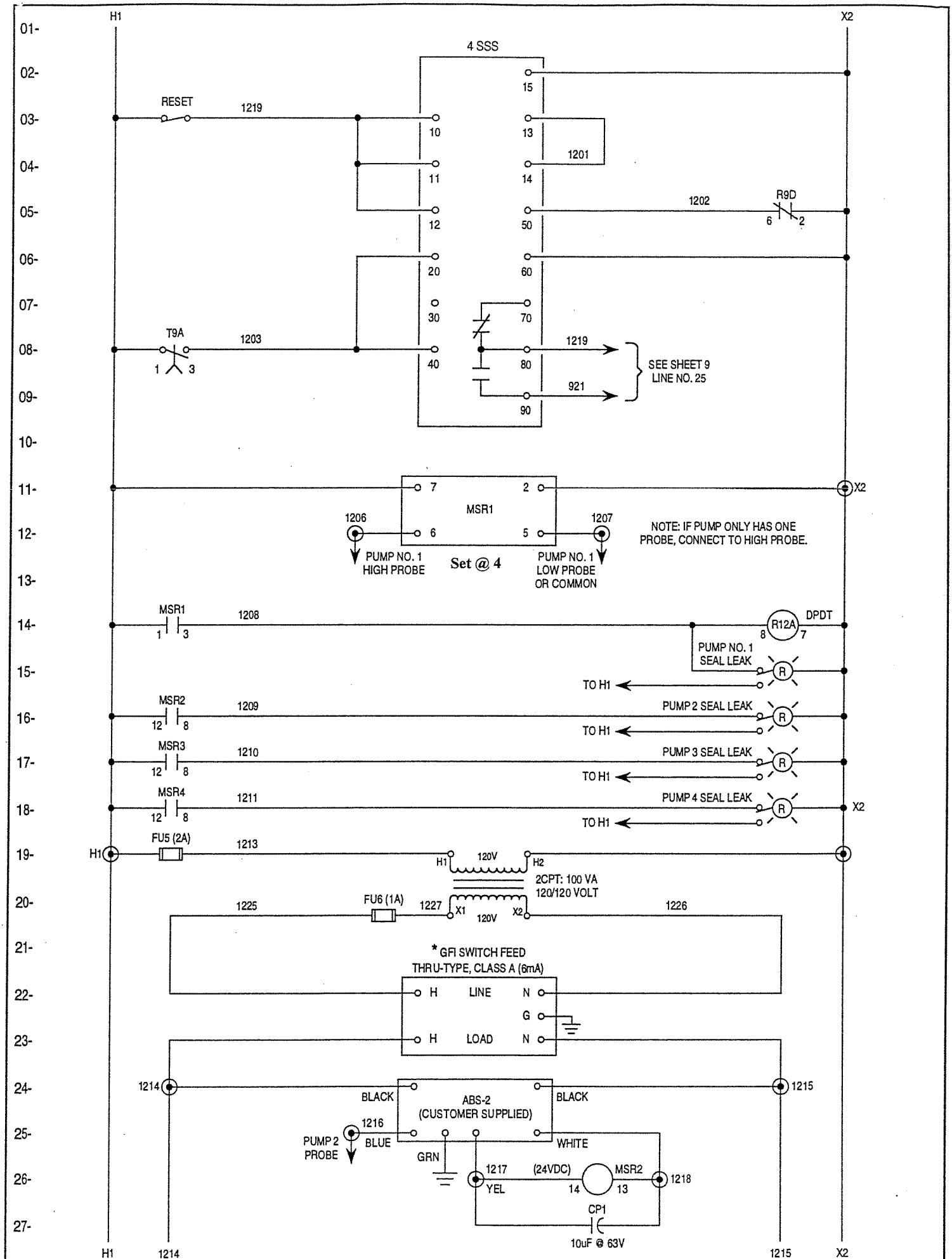
EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	SHEET 9



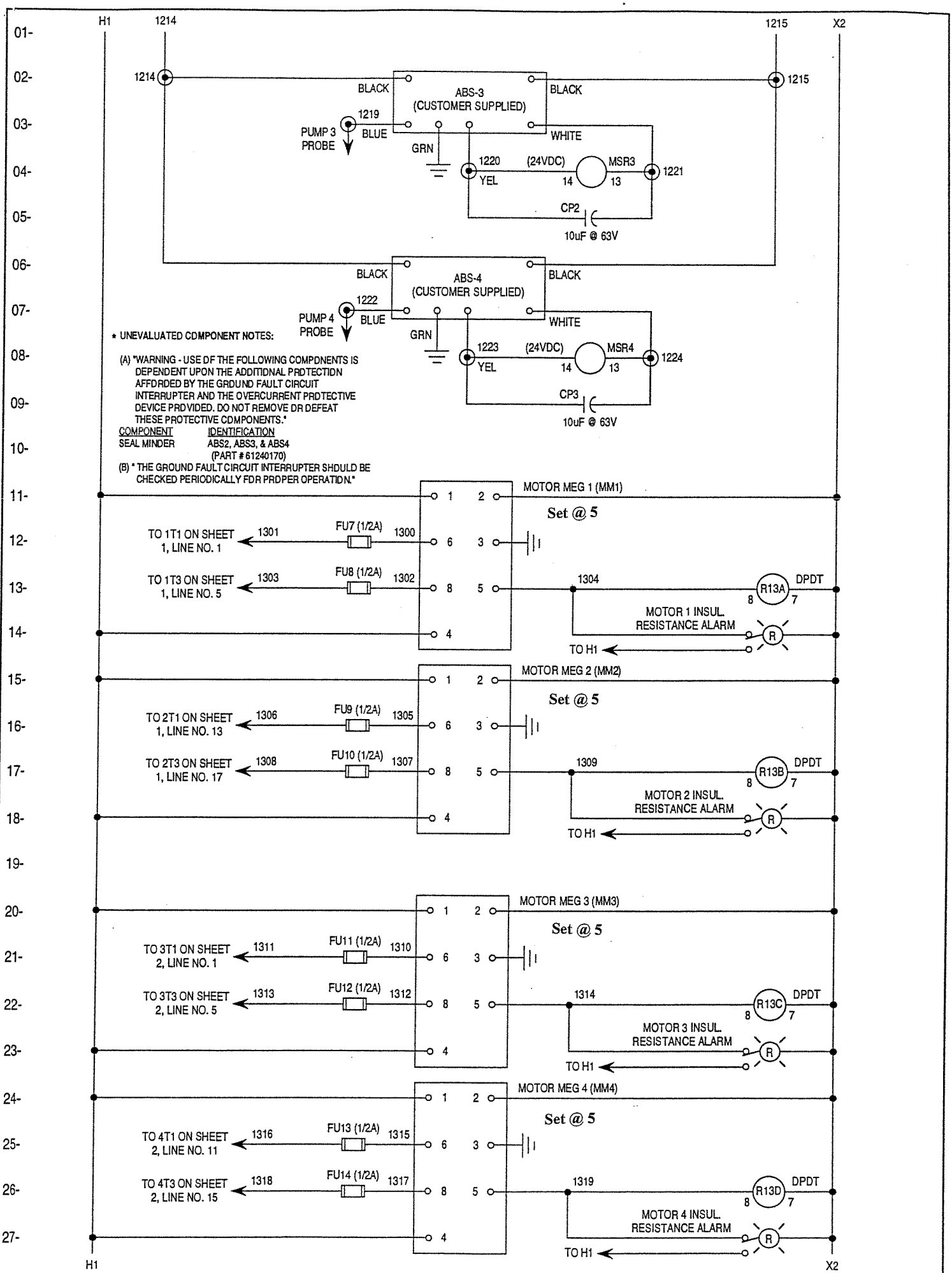
EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	SHEET 10



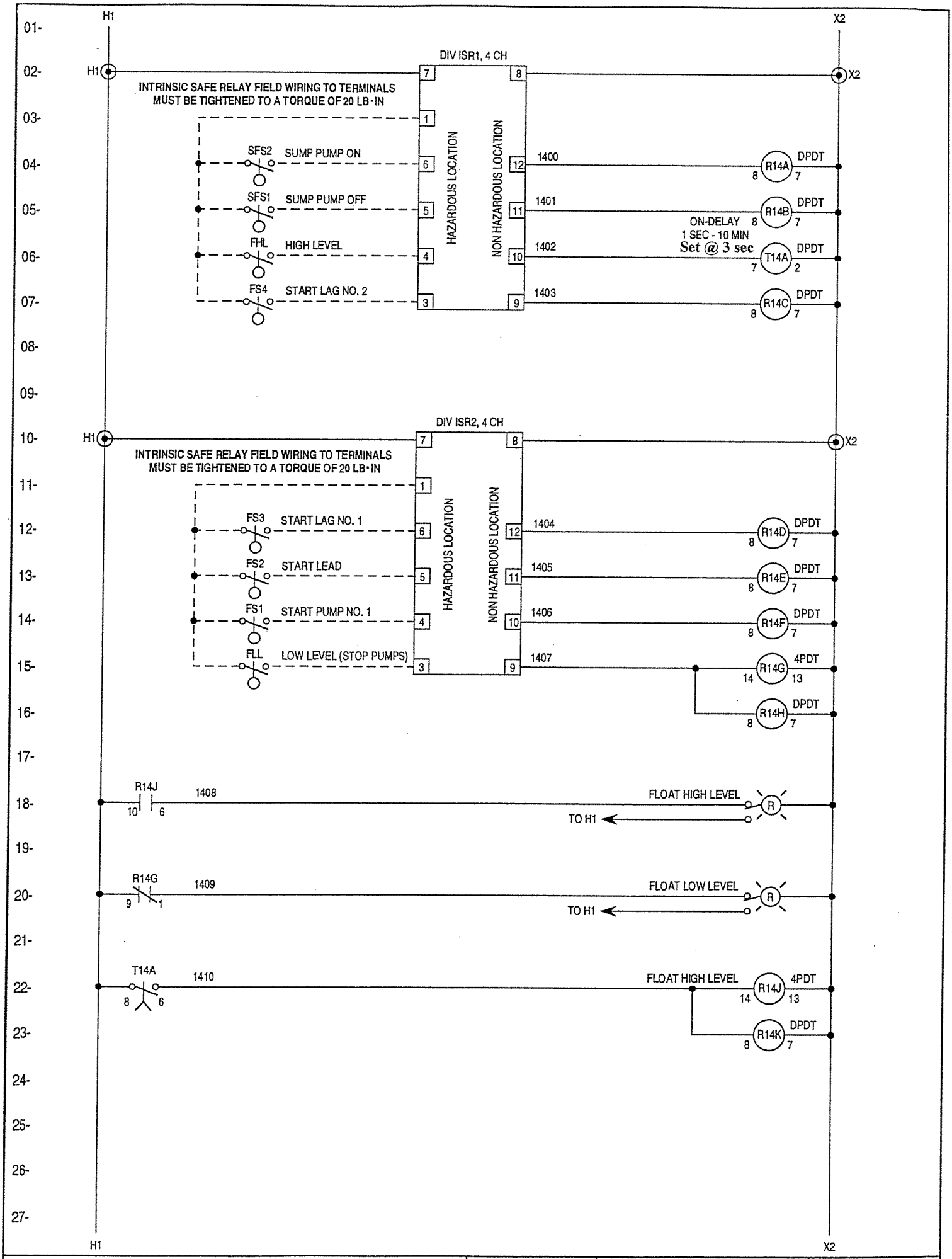
EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	SHEET 11



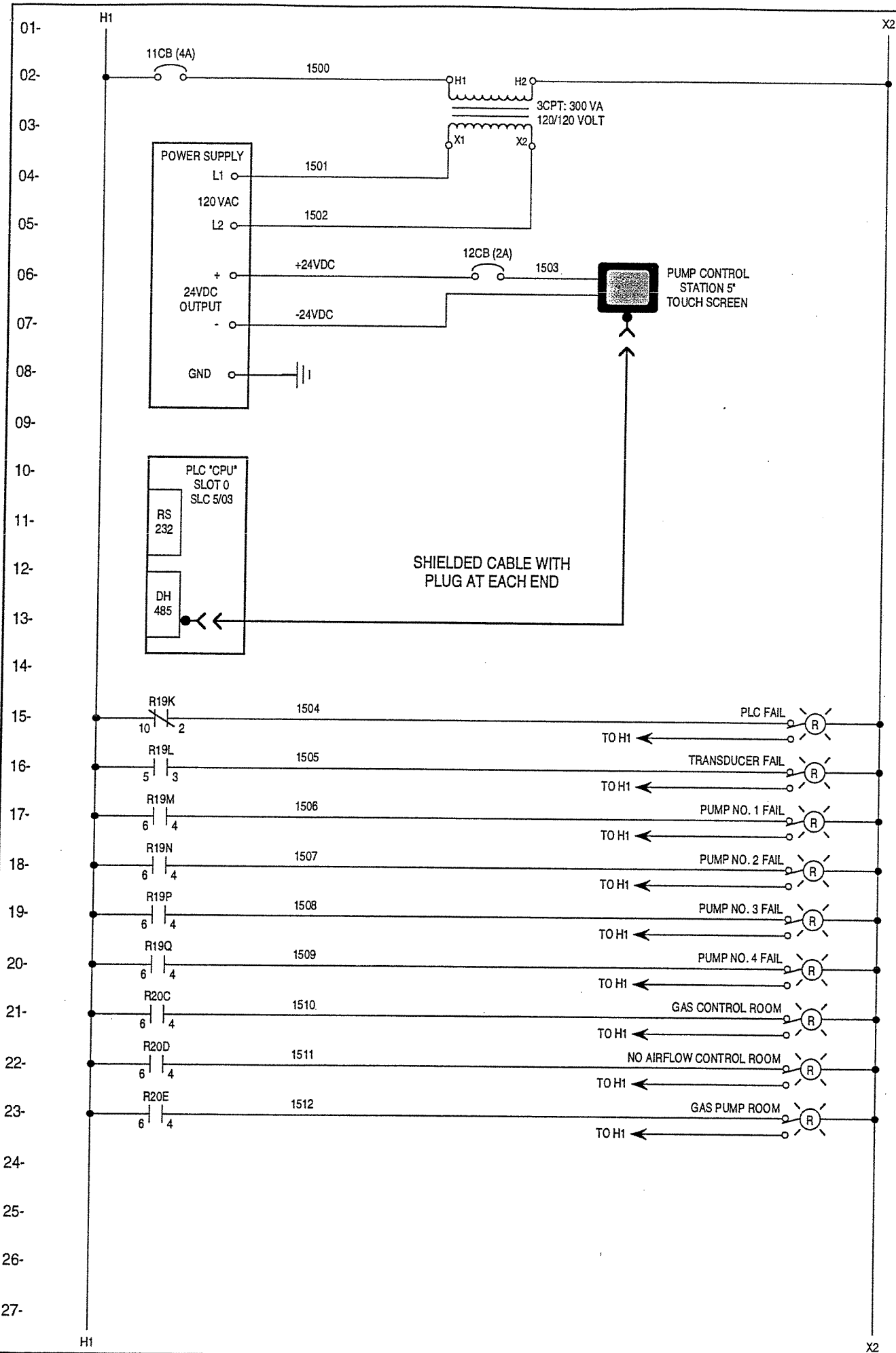
EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	SHEET 12



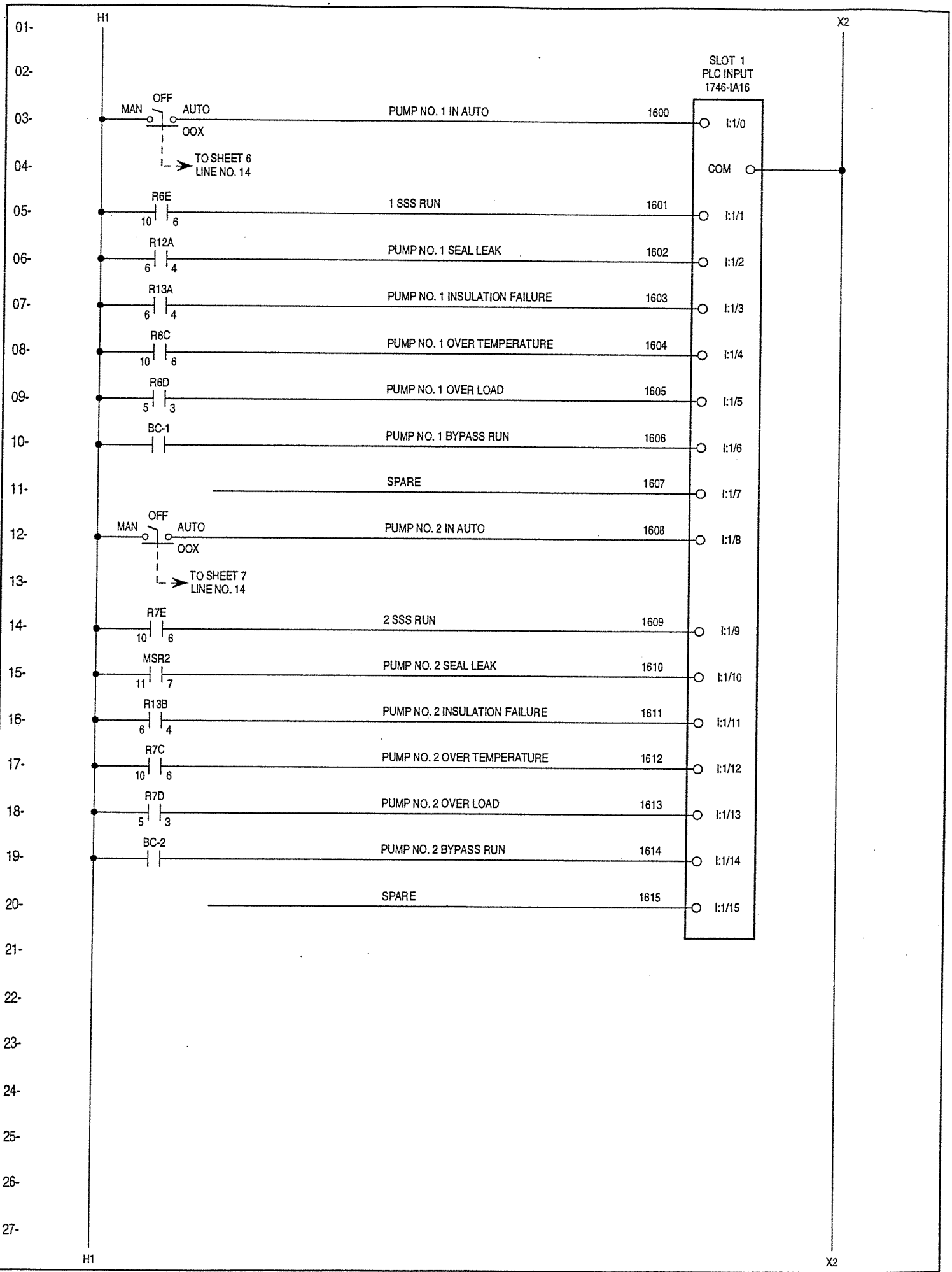
EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	SHEET 13



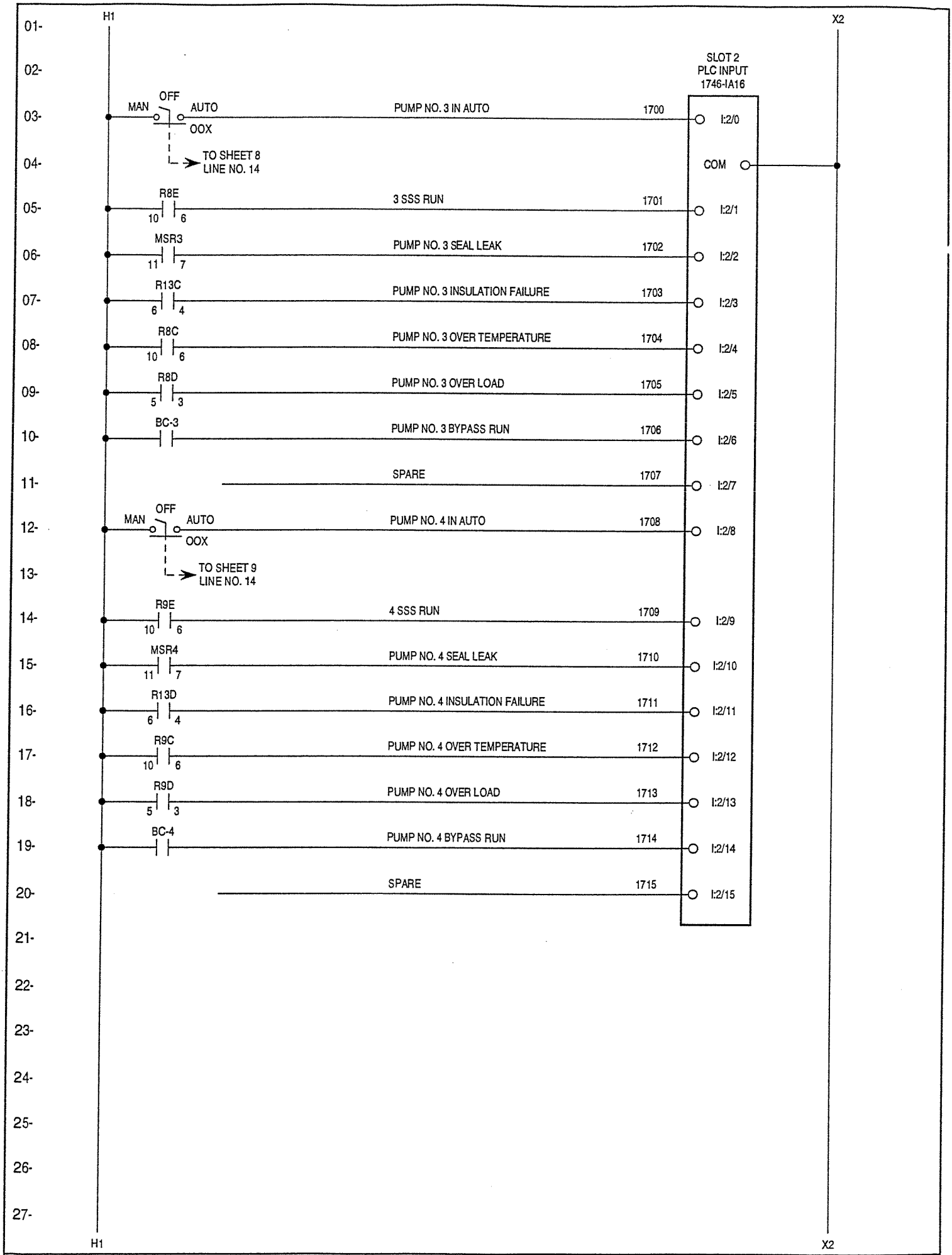
EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	SHEET 14

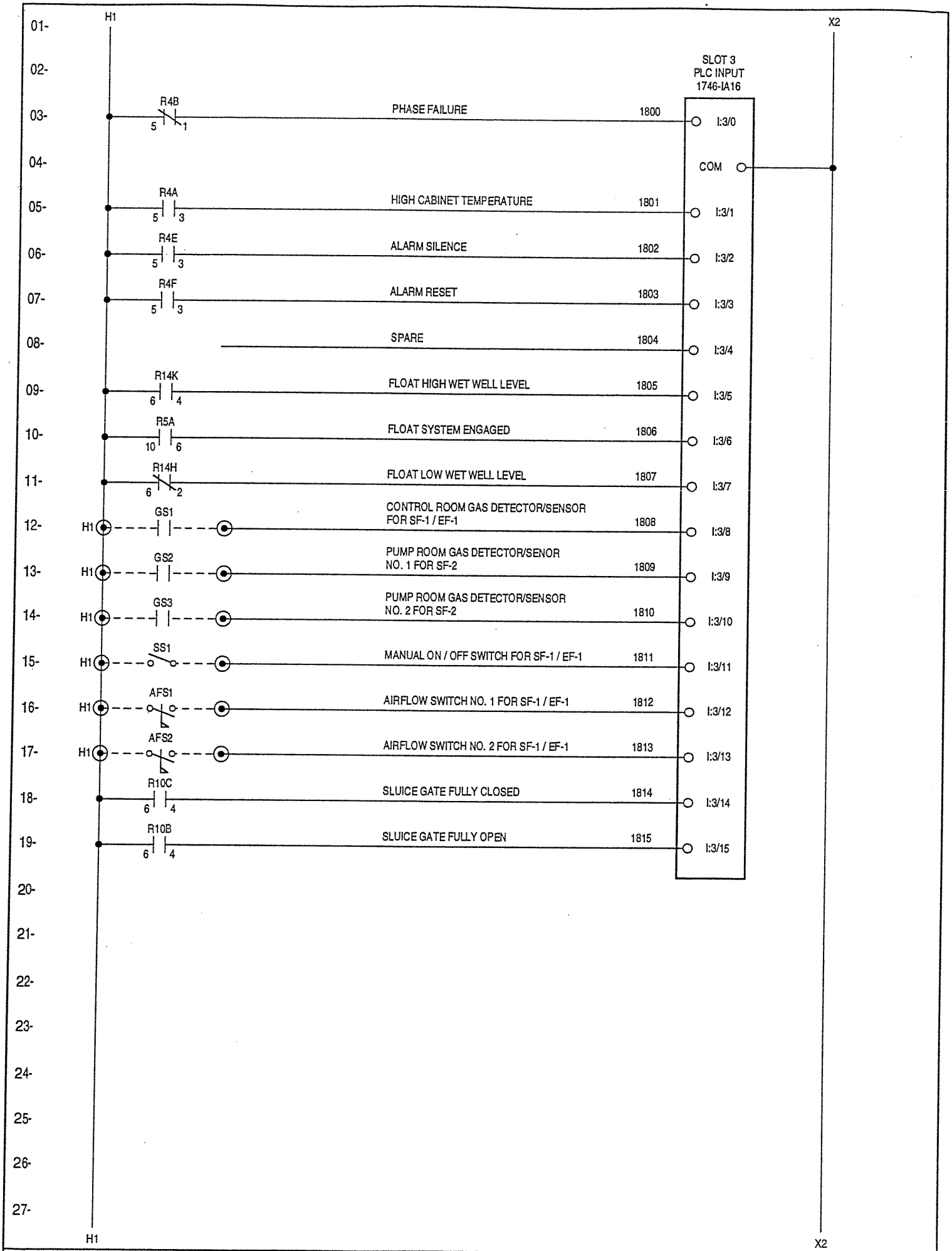


EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	SHEET 15

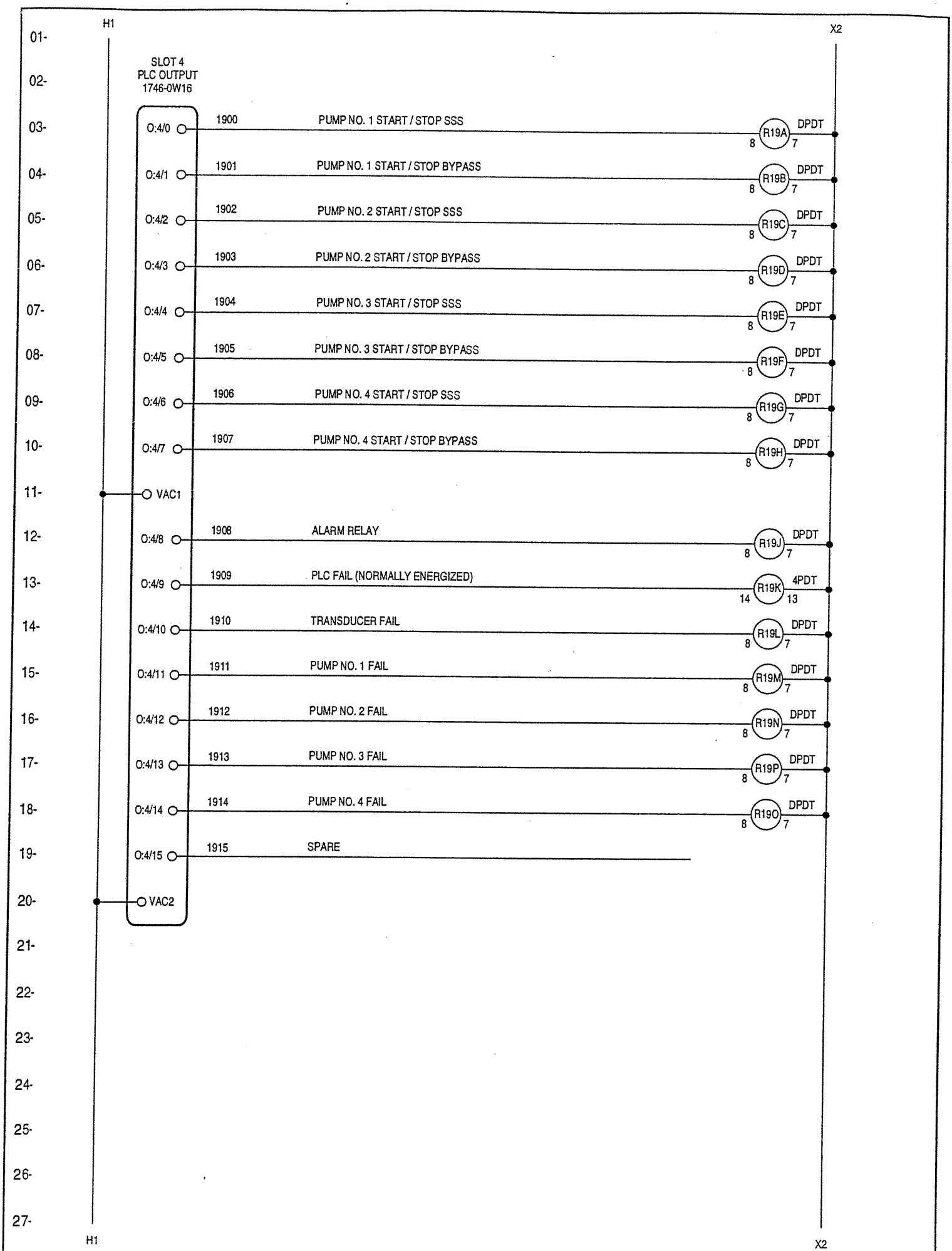


EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	SHEET 16

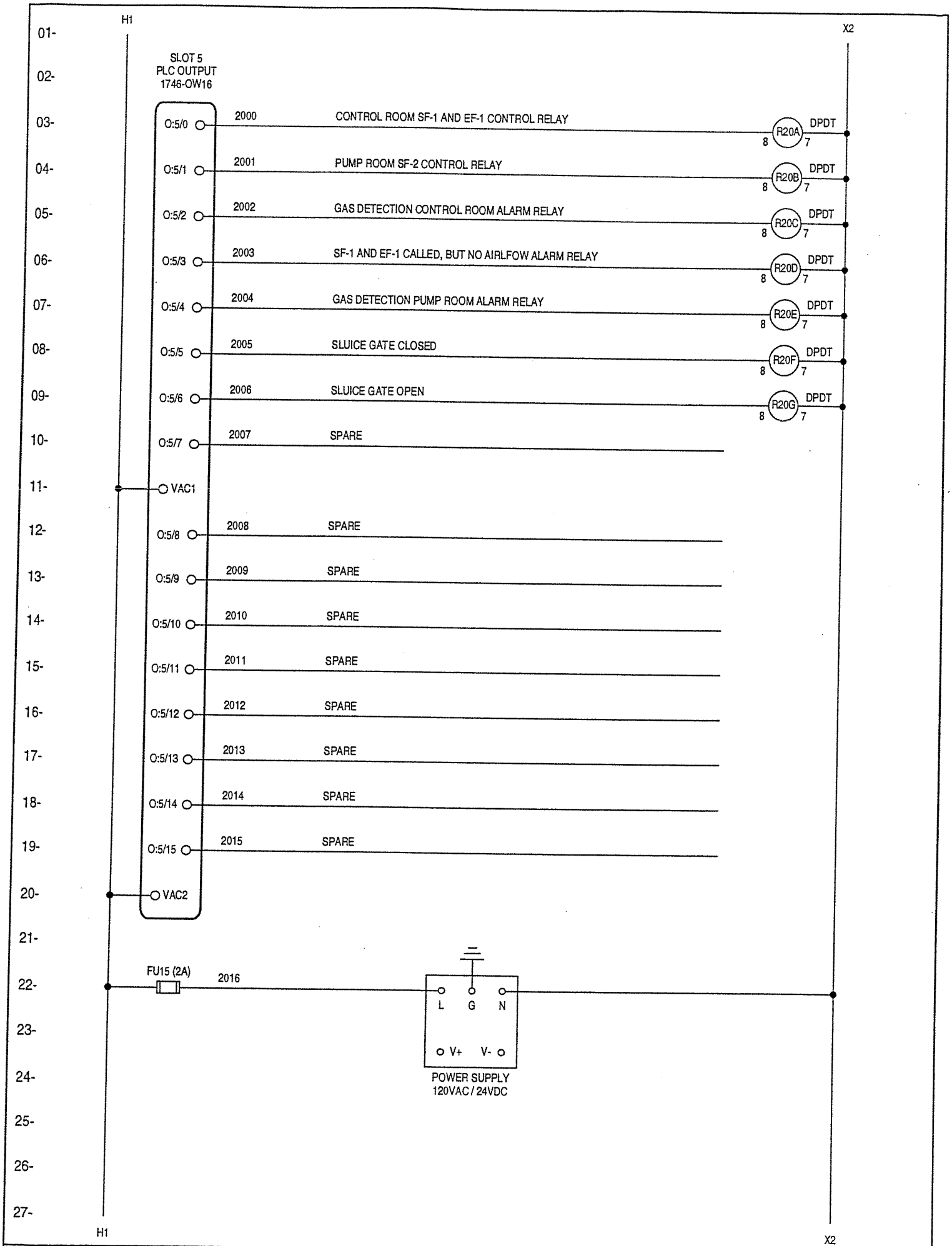

H1
X2
SLOT 2
PLC INPUT
1746-IA16
01-
02-
03-
04-
05-
06-
07-
08-
09-
10-
11-
12-
13-
14-
15-
16-
17-
18-
19-
20-
21-
22-
23-
24-
25-
26-
27-
MAN
OFF
AUTO
OOX
PUMP NO. 3 IN AUTO
1700
I:2/0
TO SHEET 8
LINE NO. 14
COM
R8E
10
6
3 SSS RUN
1701
I:2/1
MSR3
11
7
PUMP NO. 3 SEAL LEAK
1702
I:2/2
R13C
6
4
PUMP NO. 3 INSULATION FAILURE
1703
I:2/3
R8C
PUMP NO. 3 OVER TEMPERATURE
1704
I:2/4
R8D
5
3
PUMP NO. 3 OVER LOAD
1705
I:2/5
BC-3
PUMP NO. 3 BYPASS RUN
1706
I:2/6
SPARE
1707
I:2/7
PUMP NO. 4 IN AUTO
1708
I:2/8
TO SHEET 9
LINE NO. 14
R9E
4 SSS RUN
1709
I:2/9
MSR4
PUMP NO. 4 SEAL LEAK
1710
I:2/10
R13D
PUMP NO. 4 INSULATION FAILURE
1711
I:2/11
R9C
PUMP NO. 4 OVER TEMPERATURE
1712
I:2/12
R9D
PUMP NO. 4 OVER LOAD
1713
I:2/13
BC-4
PUMP NO. 4 BYPASS RUN
1714
I:2/14
SPARE
1715
I:2/15



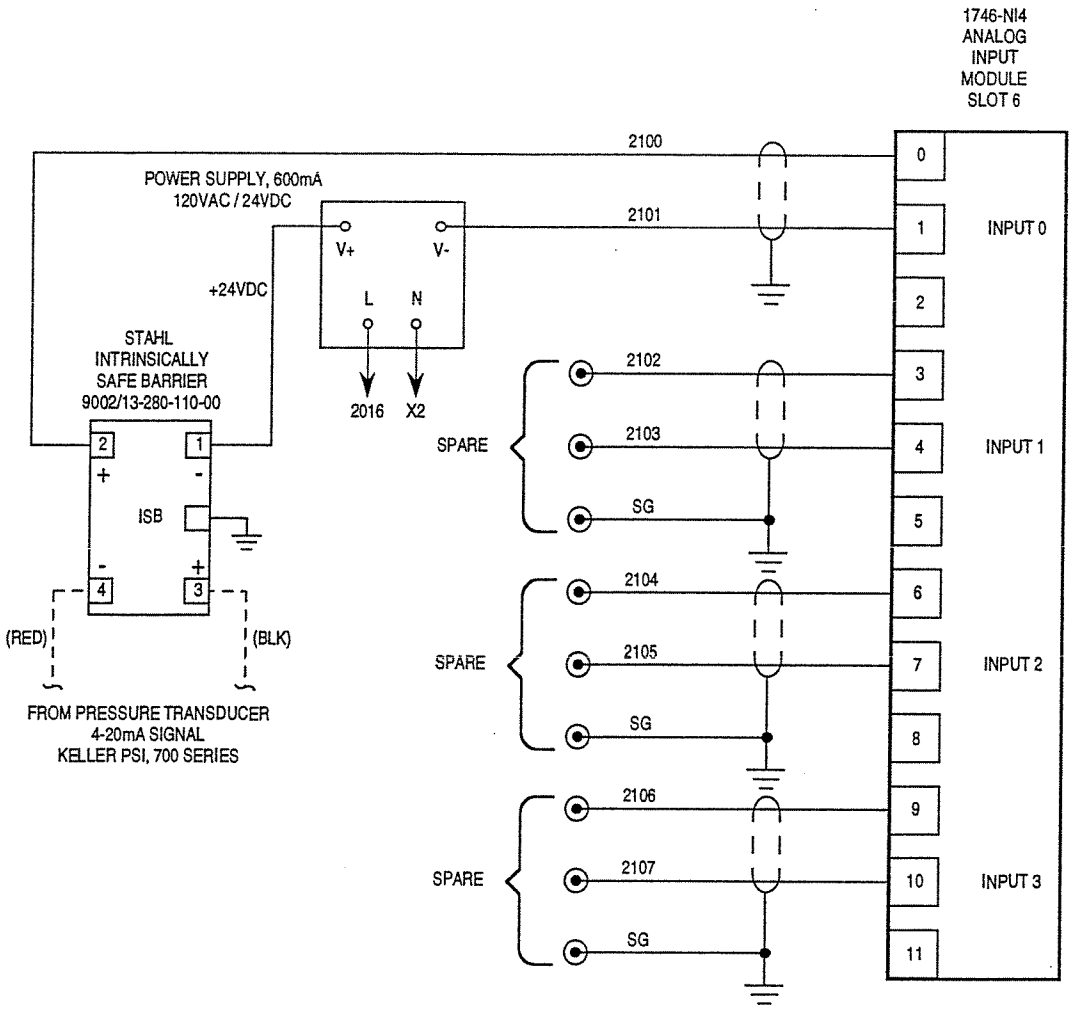
EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	SHEET 18

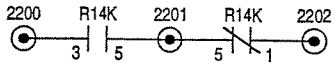


EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	SHEET 19

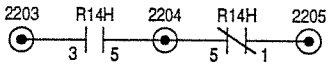


EG Controls, Inc., Jacksonville, FL	DATE 11-19-99	JOB # 256356	SHEET 20

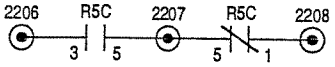

1746-NI4
ANALOG
INPUT
MODULE
SLOT 6
POWER SUPPLY, 600mA
120VAC / 24VDC
V+
V-
L
N
2016
X2
+24VDC
STAHL
INTRINSICALLY
SAFE BARRIER
9002/13-280-110-00
2
1
+
-
ISB
-
+
4
3
(RED)
(BLK)
FROM PRESSURE TRANSDUCER
4-20mA SIGNAL
KELLER PSI, 700 SERIES
2100
2101
2102
2103
SG
2104
2105
SG
2106
2107
SG
SPARE
SPARE
SPARE
0
1
2
3
4
5
6
7
8
9
10
11
INPUT 0
INPUT 1
INPUT 2
INPUT 3



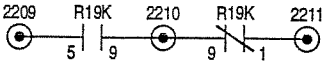
FLOAT HIGH LEVEL



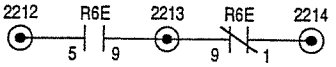
FLOAT LOW LEVEL



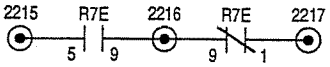
FLOAT SYSTEM ENGAGED



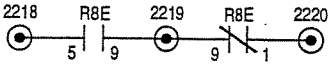
PLC FAIL



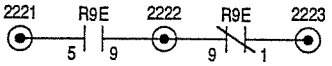
PUMP NO. 1 SSS RUN



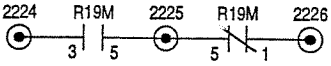
PUMP NO. 2 SSS RUN



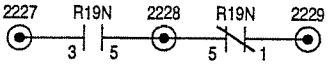
PUMP NO. 3 SSS RUN



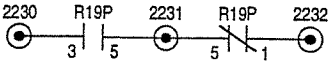
PUMP NO. 4 SSS RUN



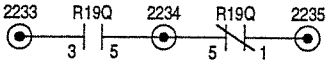
PUMP NO. 1 FAIL



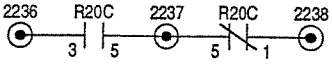
PUMP NO. 2 FAIL



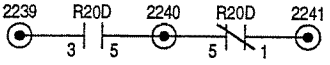
PUMP NO. 3 FAIL



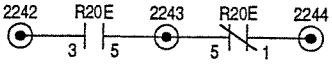
PUMP NO. 4 FAIL



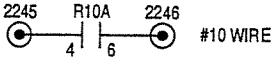
GAS ALARM - CONTROL ROOM



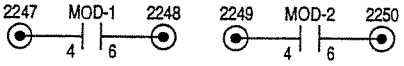
SF-1 AND EF-1 - NO AIRFLOW



GAS ALARM - PUMP ROOM



SF-1 AND EF-1 START
(REQUIRES 30A RATED CONTACT)



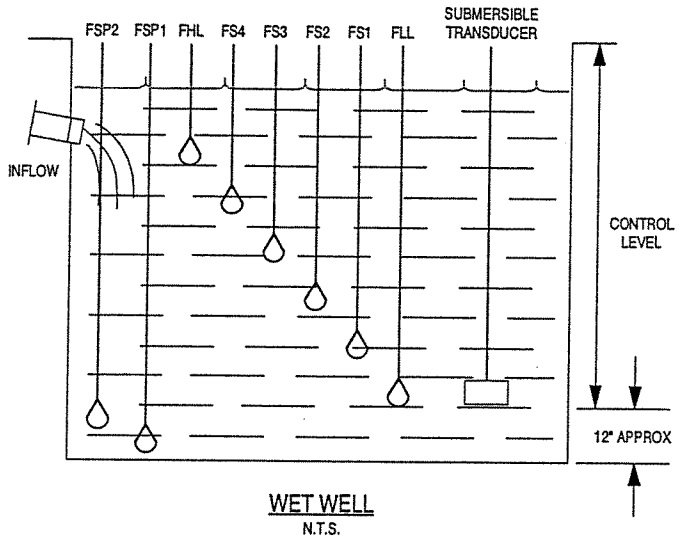
#10 WIRE #10 WIRE

NFT SERIES
FIELD WIRING TQ TERMINALS MUST
BE TIGHTENED TO THE FOLLOWING TORQUES:

WIRE SIZE	TORQUE
UP TO # 8	20LB-INCH
UP TO #4	35LB-INCH
UP TO #2/0	50LB-INCH

FIELD WIRING TQ GROUND LUG MUST
BE TIGHTENED TO THE FOLLOWING TORQUES:

WIRE SIZE	TORQUE
#14-10	35LB-INCH
#8	40LB-INCH
#6-4	45LB-INCH
#3-2	50LB-INCH



WET WELL
N.T.S.

IMPORTANT

SEAL ALL CONDUITS BETWEEN THE WET WELL AND THE CONTROL PANEL TO PREVENT GAS IN THE WET WELL FROM ENTERING THIS PANEL. SERIOUS CORROSION WILL OCCUR IN THE CONTROL PANEL IF THIS IS NOT DONE.

NOTES

O/L OVER LOAD

O/T OVER TEMPERATURE, REMOVE JUMPER FOR O/T SHUT DOWN

⊙ TERMINALS ON TERMINAL STRIP

▣ TERMINALS ON SOLID STATE STARTERS (SSS)

- - - - FIELD WIRING (DEVICES EXTERNAL TO PANEL)

——— PANEL WIRING

LAST PAGE OF SCHEMATIC 23.

BILL OF MATERIALS

ITEM	DESCRIPTION	MANUFACTURER	CATALOG NUMBER	QTY
1	ENCLOSURE, NEMA 12, (86.12"H X 149.19"W X 14.12"D)	HOFFMAN	A-86M4E	1
2	CIRCUIT BREAKER, 3 POLE, PUMP NO. 1, 70 AMP	EATON-WESTINGHOUSE	HFD3070L	1
3	CIRCUIT BREAKER, 3 POLE, PUMPS 2, 3, AND 4, 400 AMP	EATON-WESTINGHOUSE	HKD3400	3
4	CIRCUIT BREAKER, 3 POLE, ZAP TRAP, 30 AMP	EATON-WESTINGHOUSE	GHC3030	4
5	CIRCUIT BREAKER, 3 POLE, SUMP PUMP / FANS, 15 AMP	EATON-WESTINGHOUSE	HFD3015L	4
6	STARTER, NEMA SIZE 3	EATON-WESTINGHOUSE	AN16KNOA	1
7	CONTACTOR, NEMA SIZE 3 / SIZE 5	EATON-WESTINGHOUSE	CN15KN3A / CN15TN3A	1 / 6
8	OVER LOAD HEATER PACK	EATON-WESTINGHOUSE	H2020-3 / H2006B-3	1 / 3
9	SOLID STATE STARTER, W/ SOFT STOP (SMC-PLUS)	ALLEN BRADLEY	150A54NBDA	1
10	SOLID STATE STARTER, W/ SOFT STOP (SMC-PLUS)	ALLEN BRADLEY	150A360NBDA	3
11	FUSE, 600V, 1/2 AMP / 500V, 1/8 AMP / 250V, 2 AMP, 1 AMP	LITTLEFUSE	KLKD-1/2 / FLQ-1/8 / FLM-2 / FLM-1	8 / 3 / 3 / 1
12	TRANSFORMER, 460/120 VOLT, 3 KVA	SIEMENS	1D1N003ST	1
13	TRANSFORMER, ISOLATION, 120/120 VOLT, 300 VA	MICRON	B300L15XK	1
14	POWER SUPPLY, 120VAC / 24VDC	IDEC	PS5R-B24	1
15	LIGHTNING ARRESTER	INNOVATIVE TECHNOLOGY	XT40-3Y201	4
16	PHASE MONITOR RELAY, ADJUSTABLE	SSAC	RLM 911	1
17	FLASHER, 2 AMP, 120 VOLT	SSAC	FS 127	1
18	ELAPSED TIME METER, 120 VOLT	EMN	T50E224	8
19	ALARM BEACON	INGRAM PRODUCTS	LRX-40	1
20	ALARM HORN	FLOYD BELL	MW-V09-201-S	1
21	CPU, SLC-5/03	ALLEN BRADLEY	1747-L532	1
22	TOUCH SCREEN, 5" (QUICK PANEL Jr.)	TCP	QPJ2D100-L2P / SERIES A	1
23	INPUT MODULE, 16 PTS / OUTPUT MODULE 16 PTS	ALLEN BRADLEY	1746-IA16 / 1746-OW16	3 / 2
24	ANALOG INPUT MODULE, 4 CHANNEL	ALLEN BRADLEY	1746-NI4	1
25	POWER SUPPLY	ALLEN BRADLEY	1746-P2	1
26	I/O CHASSIS, 7 SLOT	ALLEN BRADLEY	1746-A7 / SERIES A	1
27	COOLING PACKAGE, 560 CFM	HOFFMAN	A-PA10AXFN	2
28	INTRINSICALLY SAFE RELAY	STAHL	9002/13-280-110-00	1
29	RELAY, PLUG IN, DPDT / 4PDT, 120 VOLT	OMRON	LY2N / LY4N-110/120VAC	55 / 15
30	TIMER, ON-DELAY, DPDT, 120 VOLT (1 SEC. - 10 MIN.)	IDEC	RTE-P11-120V	10
31	STARTER, NEMA SIZE 0 / SIZE 00	CULTER-HAMMER	AN16BNOAC / AN16ANOAC	1 / 2
32	OVERLOAD HEATER PACK	CULTER-HAMMER	H2007B-3 / H2008B-3 / H2009B-3	1 / 1 / 1

BILL OF MATERIALS CONTINUED

ITEM	DESCRIPTION	MANUFACTURER	CATALOG NUMBER	QTY
33	CIRCUIT BREAKER, 2 POLE, TRANSFER PRI, 15 AMP	CULTER-HAMMER	GHC2015	1
34	CIRCUIT BREAKER, 1 POLE, 30 AMP	CULTER-HAMMER	GC1030	1
35	CIRCUIT BREAKER, 1 POLE, 2 AMP / 4 AMP	ABB	S271-K2 / S271-K4	2 / 1
36	THERMOSTAT, N.O.	VYNCKIER	VESNO	1
37	GFI DUPLEX RECEPTACLE, 15 AMP	LEVITON	6599-I	1
38	RELAY, POWER, DPDT, 120 VOLT, 30 AMP	WW GRAINGER	5X847	3
39	RELAY, TRIPLEX ALTERNATING	DIVERSIFIED	ARA-120-AFE	1
40	MOISTURE SENSOR RELAY	SSAC	LLC54AAS	2
41	MOTOR MEGGER	MSE	M603IND-120	4
42	INTRINSICALLY SAFE RELAY, 4 CHANNEL, 120 VOLT	DIVERSIFIED	ISO-120-ACE	2
43	PRESSURE TRANSDUCER, SUBMERSIBLE	KELLER	700 SERIES	1
44	RELAY, LED, PLUG-IN, 4PDT, 24 VDC	OMRON	LY4N-24VDC	3
45	TRANSFORMER, ISLOATION, 120/120 VOLT, 100 VA	MICRON	B100L15XK	1
46	GFCI SWITCH, 20 AMP	PASS & SEYMOUR	2081-SI	1
47	ENCLOSURE, NEMA 12, PUSHBUTTON, 6-HOLES, 30.5mm	HOFFMAN	E-6PBY25	1
48	OVER LOAD RELAY, 3 POLE, 32 AMP	CULTER-HAMMER	C306DN3B	3
49	SEAL MINDER RELAY	ABS (CUSTOMER SUPPLIED)	61240170	3

Pump Station Director jr

Operational Screen Guide

Including step by step instructions for operating all of the PSD jr screens

EG Controls

11790 Phillips Highway, Jacksonville, Fl 32256-1642 • P.O. Box 16388, Jacksonville, FL. 32245-6388
Phone (904) 292-0110 Fax (904) 292-0119

Note: Not all PSD Jr. screens illustrated in this "Operational Screen Guide" are available. Individual PSD Jr. screens available, vary , depending upon your needs and applications per the written specifications.

There are no security features for the PSD Jr. controller.

Pump Station Director jr (PSD jr)

Operational Screen Guide

Table of Contents

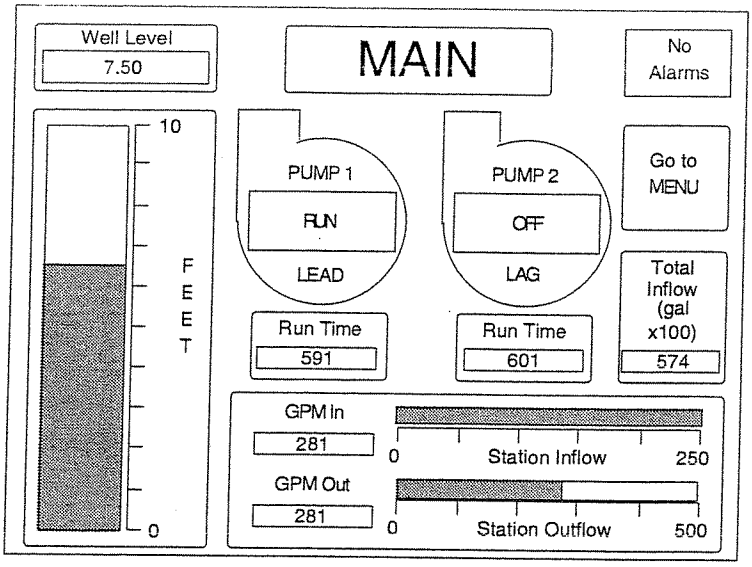
Introduction

The Pump Station Director jr (PSD jr) is a system interface controller specifically designed for use with constant speed pumping stations. There are 16 soft touch information and control screens in the PSD jr system.

The screens graphically and digitally display all of the operating information for a pump station. The PSD jr includes graphical trend screens that help you get "inside" your system, detailed pump information screens and a unique System Test screen that allows you to evaluate all operational functions quickly and easily.

The actual screens contain instructions and "walk the user through the system". Ninety percent of the features can be used without referring to this guide or attending any special training. This guide will help explain the application and functionality of each screen and is a ready reference tool for specific questions that may develop as you use the screens.

MAIN SCREEN



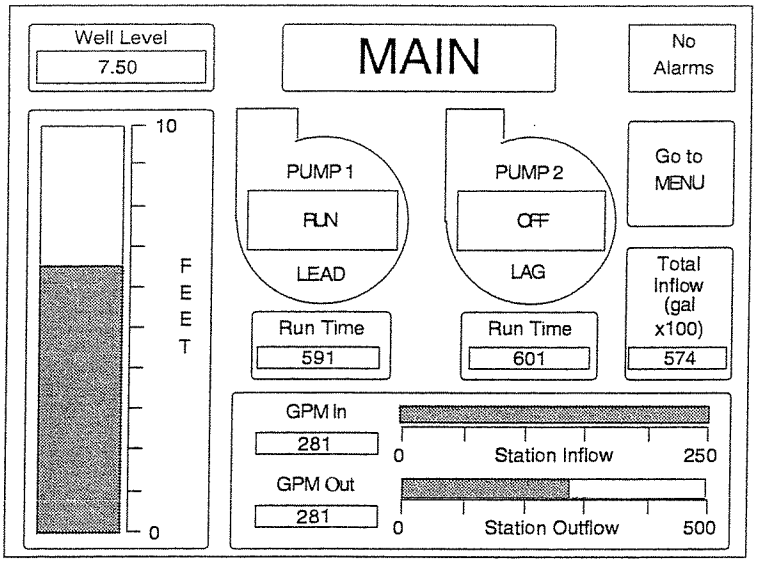
The **Main Screen** is an informational screen designed to give you an overview of your pump station operations. Changes in pump operating conditions cannot be made from this screen. It constantly displays and updates the following information:

1)	Wet Well Level (in hundredths of feet)	Displayed digital readout with vertical bargraph
2)	Pump Identification	Displayed at the top of the pump icons
3)	Pump Position (Lead or Lag)	Displayed at the bottom of the pump icons
4)	Pump Condition (Run, Off, Called, Problem, Lock-out)	Displayed in the center of the pump icons
5)	Pump Run Time (in hours)	Displayed digitally below the pump icons
6)	Total Inflow	Displayed digitally at lower right of pump icons
7)	Station Inflow (in GPM)	Displayed in a digital readout with bargraph
8)	Station Outflow (in GPM)	Displayed in a digital readout with bargraph
9)	Alarm Condition	Alarm button blinks for active alarms Alarm button steady once alarm is acknowledged Alarm button states "No Alarms" when appropriate

Pump Station Status

This screen can be used to monitor your station's wet well level, pump condition and flow status on a regular basis. The condition of each pump (Run, Off, Called, Problem, Lock-out) and the assigned pump position (LEAD or LAG) in the alternation scheme is displayed within the pump icons in the center of the Main Screen. The total run time for each pump is also displayed below the pump icons.

MAIN SCREEN



Alarm Condition

If an alarm condition currently exists, the Alarm button in the upper right hand corner will flash. If the alarm is still active but has been acknowledged, the light will go to a steady state. By touching the Alarm button, the system will automatically take you to the appropriate Pump Alarms or General Alarms Screen corresponding to the actual alarm condition.

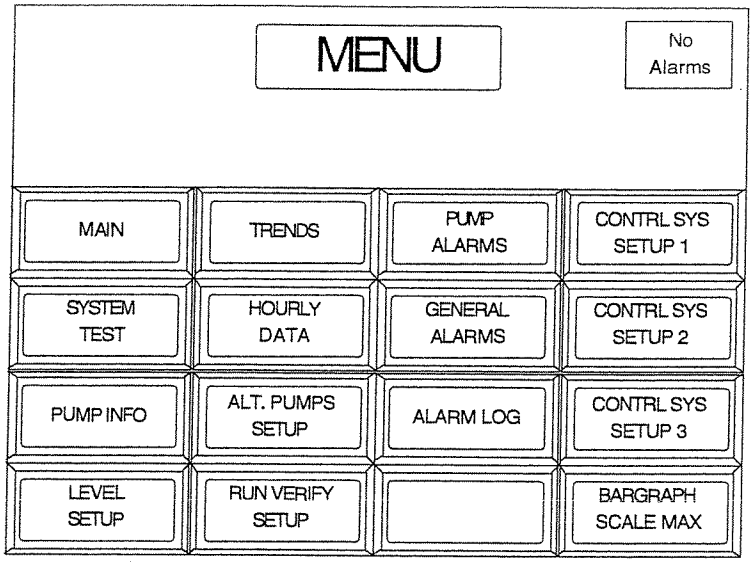
Any action to acknowledge or reset an alarm condition can be accomplished from the General Alarms or Pump Alarms Screens. Some alarm conditions, however, require an external or automatic reset prior to being able to be cleared from the screen. Examples of alarm conditions that cannot be immediately screen reset are Overload Tripped, Motor OverTemp, Power Monitor Alarm or High/Low Level. See pages 18 - 24 for more information on Alarms.

Note: This description of how the alarms function applies to all screen throughout the PSD jr system.

From the Main Screen:

Touch the interactive GO TO MENU button to go directly to the Menu Screen or touch the Pump icon to move to the Pump Information Screen for that particular pump. You may also touch the Level Bargraph to move to the Level Set up Screen or the Inflow/Outflow bargraphs to move to the Trends Screen.

MENU SCREEN



The **MENU Screen** is your road map to the various status conditions throughout your system. Touch the appropriate button to take you to any of the different PSD jr screens indicated. The menu choices cover two primary informational and control categories: System Operating Status and System Set up Screens. Through the MENU screen, you can reach any of the following screens:

1) **System Operating Status Information Screens**

A) Main Screen to show an overview of your pump station
B) System Test to test all system operating functions
C) Pump Information to provide detailed pump operating status
D) Trends Screens that compares your pumping operations over 24 hours including flow, pump starts, pump amps, as well as one auxiliary input for an external device to record factors, such as pH or temperature
E) Hourly Data Screen gives you information for any one hour from the last 24 hour time period, including flow, pump starts, pump amps and one auxiliary input (4 - 20mA DC) of your choice
F) Alarm Conditions Screens including:
A) Pump Alarms B) General Alarms C) Alarm Log

2) **Pump Set up Screens**

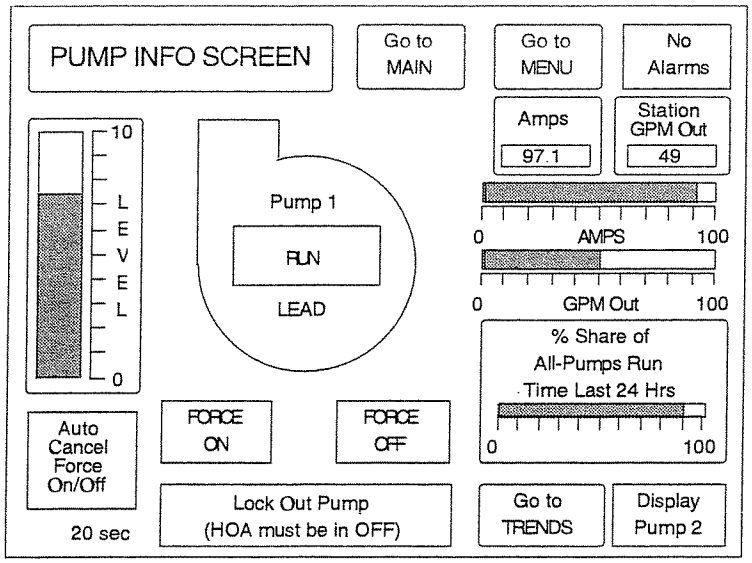
A) Level Set up
B) Positive Run Verification Set up
C) Control System Set up (consists of three separate screens)
D) Pump Alternation Set up
E) Bargraph Scale Set up

Alarm Conditions

The alarm indicator is also shown on this screen to provide continuous information regarding any critical alarm conditions. Touch the Alarm button to move to either the Pump Alarms or the General Alarms screens (see pages 18 - 24) where action may be taken to acknowledge or reset alarms.

Touch the interactive buttons on the MENU to view any screen listed on the menu.

PUMP INFORMATION SCREEN



The Pump Information Screen is designed to give you a complete and up-to date status for each pump in your system. Each Pump Information Screen uses pump icons, vertical and horizontal bargraphs , digital readouts and display buttons to provide and update the following information.

1)	Station Wet Well Level	Displayed by vertical bargraph
2)	Pump Identification (Pump #1 or #2)	Displayed within Pump icon
3)	Pump Position (Lead or Lag)	Displayed within Pump icon
4)	Pump Condition(Run, Off, Called, Problem, Lock-out)	Displayed within Pump icon
5)	Pump Amps	Displayed in amps by a bargraph and digital readout
6)	Station Outflow (GPM Out)	Displayed in Gallons per Minute by both a horizontal bargraph and digital readout
7)	Pump Run-Time Comparison	Displayed by % share of pumps run during last 24 hours
8)	Alarm Condition	Alarm button blinks for active alarms Alarm button steady once alarm is acknowledged Alarm button states "No Alarms" when appropriate

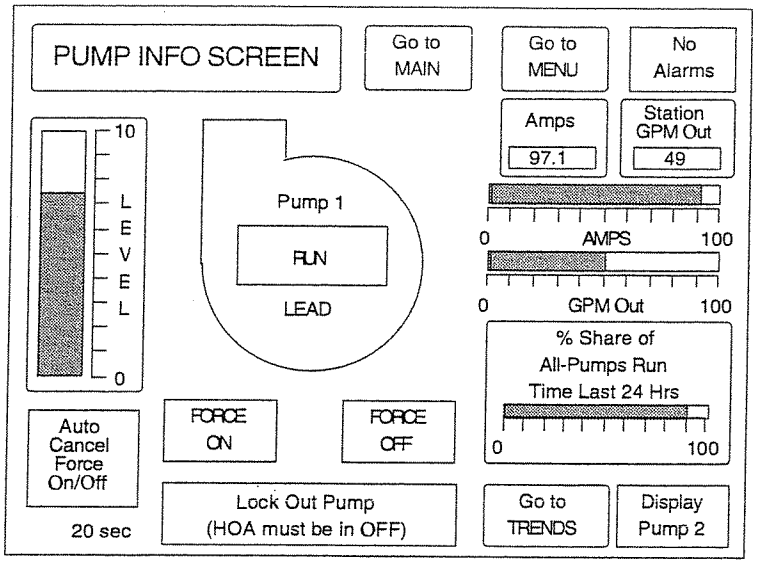
Pump Operation

Being able to see the percentage of time that each pump has run during the last 24 hours is an important predictive maintenance tool. Flow monitoring in conjunction with other factors, such as the current draw of the pump, can provide early warning of obstructions and pump wear. Pumps can also be forced ON or OFF from this screen by touching the buttons in the lower left hand side of the screen.

Auto Cancel

A user selectable Auto Cancel Force indicator showing remaining time before the Force action is canceled can be found in the lower left hand corner. This Auto Cancel time in seconds is selected by the operator through the Control System Set-up Screen 1 of 3 (see page 26 for more information). The RETURN TO AUTO button which is displayed once you Force ON or OFF any pump can be used to stop any Forced action at any time.

PUMP INFORMATION SCREEN (continued)



Pump Lock-out

A Pump Lock-out button is available on this screen. Touch this button to lock out a pump and note that PUMP LOCKED OUT is displayed on the Pump icon. The Lock-out feature tells the control system that the pump has been purposefully locked out and will not sound an alarm if the pump is called to run. If your system is operating in Automatic and the pump is turned OFF but not locked out -- the alarm will sound when the pump is called for.

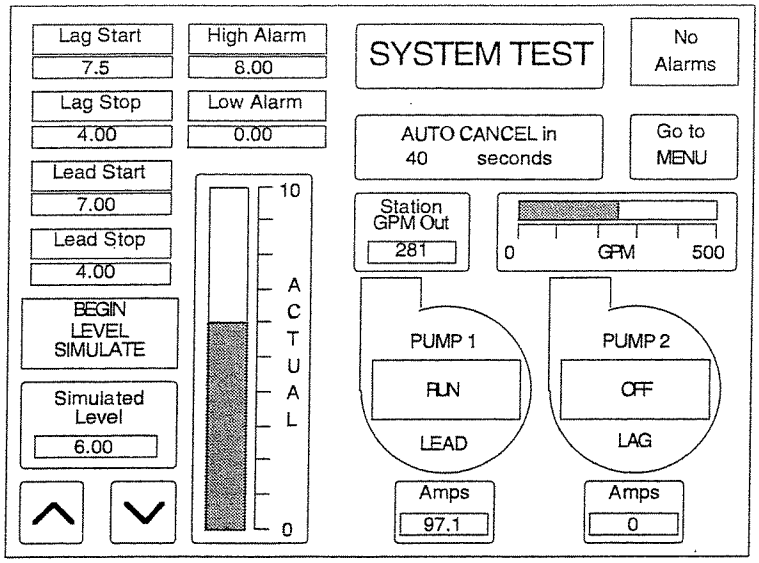
Note: The HOA switch must be in the OFF position to enable the Lock -out feature.

From the Pump Information Screen: Touch the interactive buttons found in both the upper and lower right corners of the screen:

Upper Right
Touch GO TO MAIN button to return to the Main Screen.
Touch GO TO MENU button to return to the Menu Screen.

Lower Right
Touch GO TO TRENDS button to go directly to the Trends Screen
Touch DISPLAY PUMP #
If viewing Pump 1 information, touch DISPLAY PUMP 2 button to display information for Pump 2.
If viewing Pump 2 information, touch DISPLAY PUMP 1 button to display information for Pump 1.
Both Pump 1 and 2 cannot be displayed at the same time.

SYSTEM TEST SCREEN



The **System Test Screen** simulates a complete pump cycle and tests level alarms in minutes. All of the data that you need for a complete operations test of your system is found on one screen.

The System Test Screen displays and updates the following information during your system test:

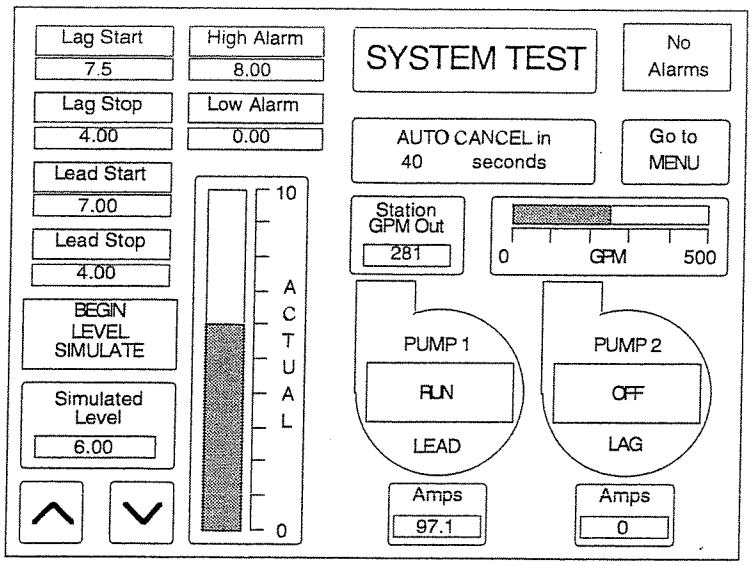
1)	Wet Well Level (Simulated)	Displayed in digital readout box
2)	Wet Well Level (Actual)	Displayed in vertical bargraph
3)	Pump Start and Stop Setpoints	Displayed for each pump digitally
4)	Alarm High and Low Level Setpoints	Displayed for each pump digitally
5)	Pump Identification (#1 or #2)	Displayed within Pump icon
6)	Pump Condition (Run, Off, Called, Problem or Lock-out)	Displayed within Pump icon
7)	Pump Position (Lead or Lag)	Displayed within Pump icon
8)	Station Outflow((in GPM)	Displayed in digital readout and in a bargraph
9)	Pump Amps	Displayed in digital readout below the pump icon
10)	Alarm Condition	Alarm button blinks for active alarms Alarm steady once alarm is acknowledged Alarm button states "No Alarms" when appropriate

Testing

1) Touch the BEGIN LEVEL SIMULATE button to activate your test cycle. The button indicator will now read CANCEL LEVEL SIMULATE. Touching this button again at any time will end the test cycle and return the system to the full Automatic mode.
2) Use the UP and DOWN arrow keys located in the lower left hand corner to raise or lower the simulated wet well level.
3) Your simulated level will be displayed digitally in the Simulated Level box located above the scroll arrows. Each level setpoint indicator will flash when it is activated so that you can verify which setpoint is active. The system testing will actually bring the pumps and alarms ON and OFF in response to your simulated changes in the wet well level.

Note: Simulation may not occur in the presence of actual high or low level alarm condition.

SYSTEM TEST SCREEN (continued)



Note: The vertical bargraph labeled "Actual" will continue to display the actual level of the wet well at all times throughout the test cycle. We recommend that you pay close attention to the actual level displayed on the vertical bargraph. Being able to see both levels enables you to maintain control over the actual level while testing your system at the same time.

AUTO CANCEL Feature

The System Test Screen also offers an AUTO CANCEL feature, sometimes referred to as "deadman control". The Auto Cancel time in seconds is displayed digitally just below the System Test screen identification located in the upper right hand side of the screen. The Auto Cancel time can be set by the user in the Control System Set-up Screen 1 of 3, under Level Simulation. See page 26 for more information.

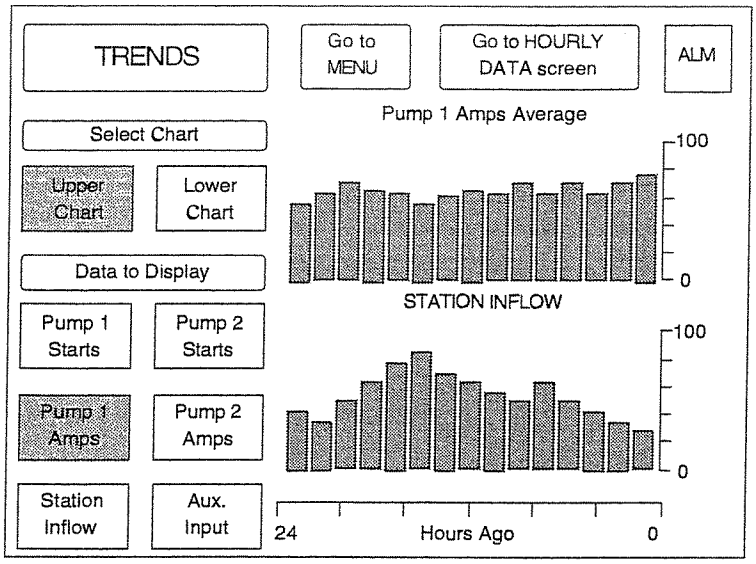
Once you have removed your finger from the scrolling arrows or have touched the BEGIN LEVEL SIMULATE button, the Auto Cancel time will begin to count down. After the user selectable time out period has elapsed, the control system will revert to the full Automatic mode. Touching either scroll button during the Auto Cancel time period will reset the Auto Cancel time and allow the simulation to continue.

Use of Testing Information

The amp draw shown below each pump icon can be compared to the station outflow in GPM (gallons per minute) and can give the viewer insight into the efficiency of the pumping station. This information can also be used to make key predictive maintenance decisions and to head off potential pump failure.

From the System Test Screen:
Touch the interactive GO TO MENU button to go directly to the Menu Screen.

TRENDS SCREEN



The **Trends Screen** is designed to help you compare and evaluate your station performance over the last 24 hour period. This screen compiles data on the following operational parameters:

1)	Pump 1 Starts	Number of starts per hour over last 24 hours
2)	Pump 2 Starts	Number of starts per hour over last 24 hours
3)	Pump 1 Amps	Pump 1 Average Amp Draw over last 24 hours
4)	Pump 2 Amps	Pump 2 Average Amp Draw over last 24 hours
5)	Station Inflow	Total hourly inflow over last 24 hours
6)	Auxiliary Input	Hourly average of 4 - 20mA DC input available for use by the operator

Reviewing this specific data will enable operators to identify unusual events that occurred in the last 24 hours. You may select any two data series choices for evaluation. Your choices are limited to two because they are displayed on only two charts: upper and lower.

The left side of the screen allows you to select either the upper or lower chart and determine which data should be displayed on that chart. The data choices shown Under DATA TO DISPLAY can be listed on either chart. You can compare any two data items by following these steps:

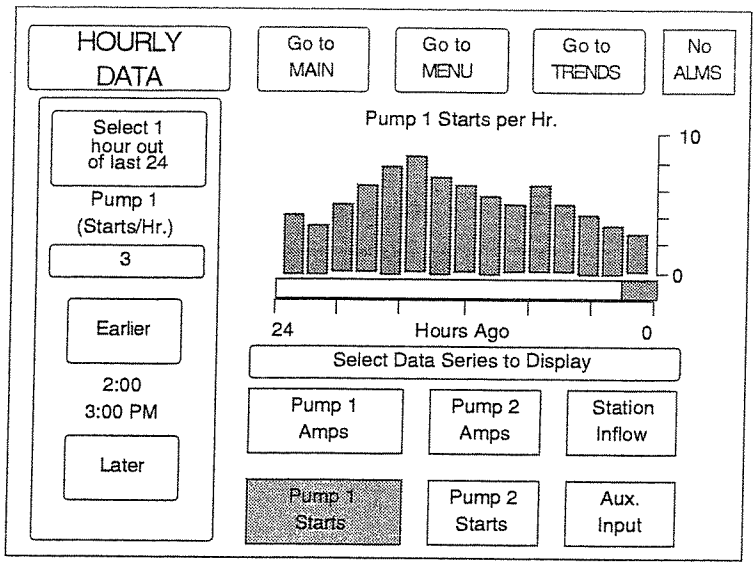
Example: To compare Pump 1 Average Amp Draw with Station Inflow:

1) Display Pump 1 Amps on the upper chart by touching UPPER under SELECT CHART and then, PUMP 1 AMPS under DATA TO DISPLAY.
2) Display Station Inflow on the lower chart by touching LOWER under SELECT CHART and then, STATION INFLOW under DATA TO DISPLAY.
3) Screen now gives you a comparative analysis of Pump 1 Average Amp Draw on the upper chart compared to Station Inflow on the lower chart for the last 24 hours.

These steps can be repeated with any data listed under DATA TO DISPLAY.

From the TRENDS Screen:
Touch the interactive buttons GO TO MENU button to return to the Menu Screen
GO TO HOURLY DATA SCREEN button to go directly to the Hourly Data Screen.

HOURLY DATA SCREEN



The **Hourly Data Screen** allows you to select one hour from the last twenty four displayed on the Trends Screen. You may want to choose a specific time period when a particular event or alarm condition may have occurred. Looking back at accurate data from that period helps to determine the source of the problem and find a solution.

Data from the station's performance for this one hour period is displayed both digitally and graphically for any of the following data series choices:

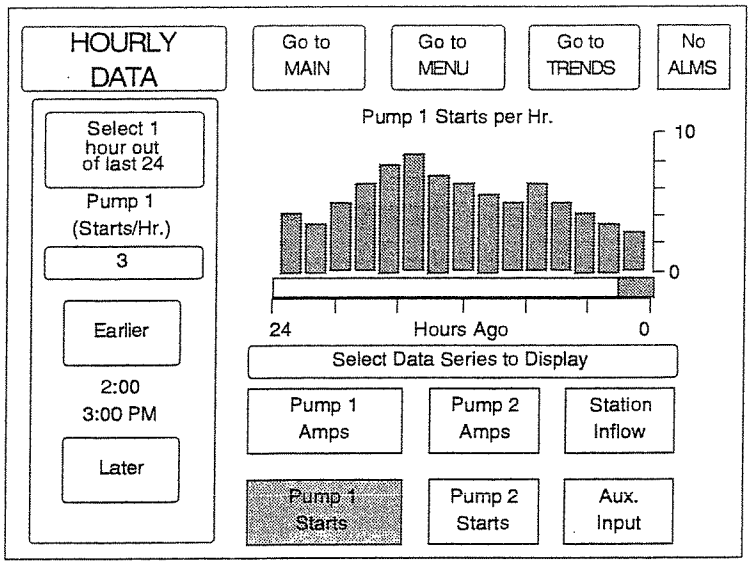
Note: You may only select one data series to be displayed at a time.

1)	Pump 1 Starts	The actual number of Pump 1 Starts for a one (1) hour period
2)	Pump 2 Starts	The actual number of Pump 2 Starts for a one (1) hour period
3)	Pump 1 Amps	Average Amp Draw for Pump 1 over a one (1) hour period
4)	Pump 2 Amps	Average Amp Draw for Pump 2 over a one (1) hour period
5)	Station Inflow	Total inflow for a one (1) hour period
6)	Auxiliary Input	This external analog input (4 - 20mA DC) may be connected to any user-installed 4 - 20mA DC transducer to log parameters, such as pressure, flow, temperature or pH.

The Hourly Data Screen is divided into two parts: SELECT HOUR TO DISPLAY and SELECT DATA SERIES TO DISPLAY.

The **SELECT 1 HOUR OUT OF LAST 24** section on the left allows you to determine which hour to review. Between the EARLIER and LATER buttons, a one hour time period is displayed. For example, the screen in the picture above reads 2:00 to 3:00 PM. Touch the EARLIER button to move to a time prior to 2:00 PM -- for example, 1:00 - 2:00 PM Touch the LATER button to move to a time period after 3:00 PM -- for example, 3:00 - 4:00 PM. The time period will move one hour earlier or later each time you touch the button. Continue to press the button until the desired time period is reached.

HOURLY DATA SCREEN (continued)



The PSD jr will also help you determine which one hour period to review. Watch the bargraph while pressing the EARLIER or LATER button. You will be able to see what time during the last 24 hours peaks occurred in your system. Watch the horizontal bargraph as you touch the EARLIER or LATER buttons. You can see when the peak times in your system occurred and get a digital read-out for this peak value. The digital read-out will be accurate even if the peak is off scale.

The **SELECT DATA** section on the lower right enables you to choose which data you wish to display. Any of the data series shown on this screen can be selected. The type of data and the actual value is displayed on the graph and in the box located below the SELECT ONE HOUR button.

Once the time and data choices have been made, they are displayed on the Data Series Graph. Time is located on the horizontal axis with the selected data on the vertical axis. These steps can be repeated for any time period and data value under DATA SERIES TO DISPLAY.

Example: To look at Pump Starts for Pump 1 for the time between 7 and 8 a.m.:

1) Under SELECT HOUR, touch EARLIER repeatedly until the display shows 2:00 to 3:00 p.m.
2) Under SELECT DATA, touch PUMP 1 STARTS. This button will remain lit to show the type of data being displayed.
3) The Data Series Graph will now read Pump 1 Starts at the top of the graph. A solid line will move into position at 2:00 p.m. in the 0 to 24 hour line on the horizontal axis of the chart. The number of Pump Starts per hour will be represented in the 0 to 10 vertical axis.

From the TRENDS Screen:
Touch the interactive GO TO MAIN button to return to the Main Screen
GO TO MENU button to return to the Menu Screen
GO TO TRENDS button to go directly to the Trends Screen.

PSD jr Set-up Screens

The Set up Screens are your access into the Programmable Logic Controller (PLC) -- your operating system. With these screens, you are able to make changes to the pump configuration and the control functionality throughout the system. There are five different set up screens, as follows:

1) Level Set up Screen for setting the start, stop, high and low level alarm setpoints.
2) Pump Alternation Set up Screen for selecting alternation type
3) Positive Run Verify Set up Screen for creating the minimum amp setpoints needed to verify that the pump is actually running
4) Control System Set up Screens (3 screens) for setting miscellaneous system times, delays or other parameters affecting the functionality of the system
5) Bargraph Scale Set up Screen for adjusting the scales for displaying bargraphs and trends on your PSD jr screens

How to create or change your settings:

Once at the specific set-up screen, you can make any changes by either answering a YES or NO question or entering a numeric value. The method of making these entries is the same for all screens.

For Question Type Entries:

The question will be displayed on the screen followed by a box for YES (Y) or NO (N). The box will light to indicate the answer currently entered in the system. If you wish to change this answer, touch the button with your desired response. The box you have chosen will light to indicate that the change has been accepted. No further action is required.

For Entering Numeric Values:

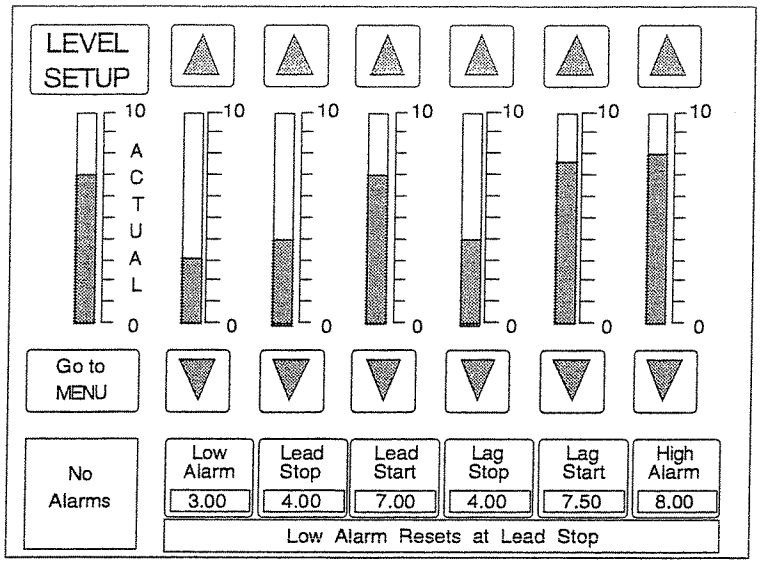
A statement will be displayed on the screen with a blank box for filling in a value. On each screen, you will find scrolling UP and DOWN arrow keys to select the proper value. In some cases, there is only one set of arrows for the entire screen and in other cases, a statement has a dedicated pair of UP and DOWN arrows.

If there is only one set of scrolling arrows for multiple statements on the screen, you must first touch the button you wish to change. The button will light to indicate that it is ready to accept the change. Use the scrolling arrows to set the desired value.

If the statement has a dedicated pair of scrolling arrows, the button will already be lit and it is not necessary to touch the button to be changed. Use the scrolling arrows to set the desired value and it will immediately be displayed.

Throughout the system, you may see that some of the set-up procedures span more than one screen or work in conjunction with another screen. In these cases, interactive buttons that move between these related screens are available to make it easier to move between the screens.

LEVEL SET UP SCREENS



The **Level Set up Screen** was designed to allow the operator to easily and quickly create the pump and alarm setpoint sequencing required to operate your pump station.

Level Setpoints to be created:

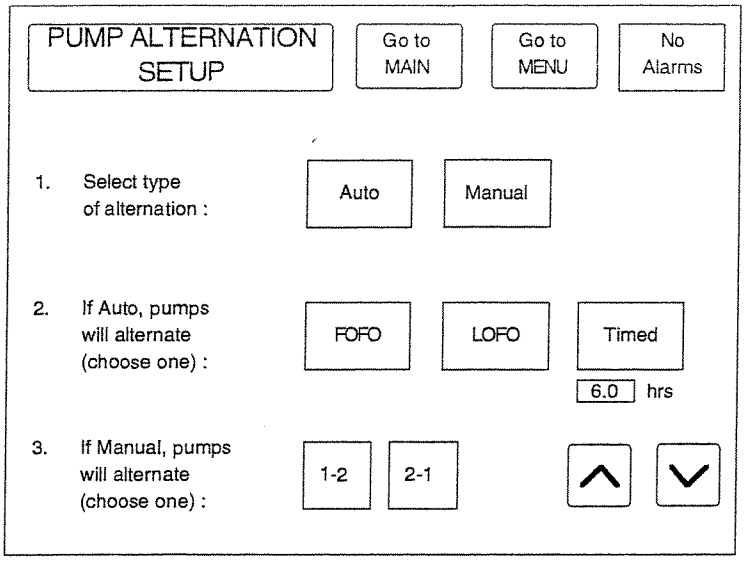
Setpoint	Definition
Low Alarm	Level in wet well that activates Low Alarm Entered as numeric value in the second bargraph from the left. *Note: This alarm will automatically reset once the wet well level has reached the Lead stop setpoint.*
Lead Stop	Level in wet well that stops Lead Pump Entered as a numeric value in the third bargraph from the left.
Lead Start	Level in wet well that starts Lead Pump Entered as a numeric value in the fourth bargraph from the left.
Lag Stop	Level in wet well that stops Lag Pump Entered as a numeric value in the fifth bargraph from the left.
Lag Start	Level in wet well that starts Lag Pump Entered as a numeric value in the sixth bargraph from the left.
High Alarm	Level in wet well that activates High Alarm Entered as a numeric value in the last bargraph.

To create these numeric values or setpoints, note that each vertical bargraph has UP and DOWN arrows at either end. Use these scrolling arrows to raise or lower values for the setpoint associated with that bargraph. The setpoint value will be shown on the bargraph by a solid line that will move in accordance with the UP and DOWN arrows and on the digital display located below the bargraph. The digital display located below the bargraph identifies the associated setpoint.

The actual level of the wet well is displayed by the bargraph on the far left of the screen. Knowing the actual level at all times allows the operator to stay in touch with monitoring the wet well while working with other settings.

From the Level Set up Screen:
Touch the interactive GO TO MENU button to return to the Menu Screen.

PUMP ALTERNATION SET UP SCREEN



The **Pump Alternation Set up Screen** was designed to allow you to select the desired type of alternation considered most suitable for your pump station.

Alternation Type (#1 on screen)

Two types of alternation are available: Automatic and Manual. Touch the button to specify your choice. You can only make changes in the mode that you have selected. If Automatic has been chosen, go to #2. If Manual has been chosen, go to #3.

Automatic Alternation Decisions (#2 on screen)

Three modes of Automatic Alternation are available:

FOFO	First pump on, First pump off	Touch FOFO button to activate.
LOFO	Last pump on, First pump off	Touch LOFO button to activate.
Timed	Pumps alternate every ___ hours	Touch the EVERY button to activate. Button will change to read TIMED and will display hours (HRS) immediately below the TIMED button. Use the scrolling arrows to select the number of hours between pump alternation.

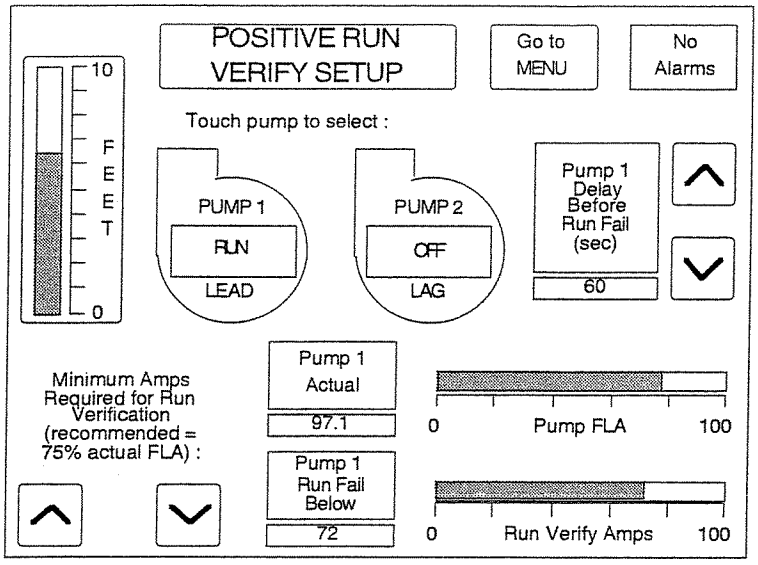
Manual Alternation Decisions (#3 on screen)

Two types of manual alternation are offered:

"1 - 2"	Pump 1 is always Lead Pump 2 is always Lag	Touch "1 - 2" button
"2 - 1"	Pump 2 is always Lead Pump 1 is always Lag	Touch "2 - 1" button

From the Pump Alternation Set up Screen:
Touch the interactive GO TO MAIN button to return to the Main Screen
GO TO MENU button to return to the Menu Screen

POSITIVE RUN VERIFICATION SET UP SCREEN



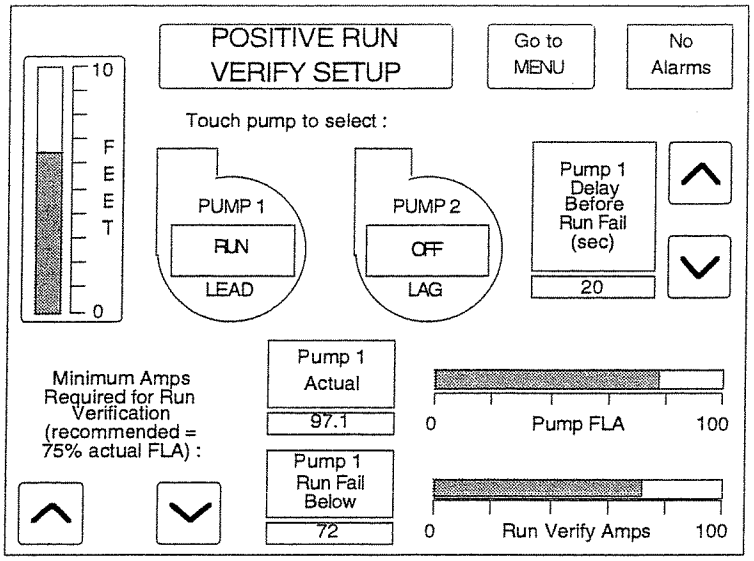
The **Positive Run Verification Set up Screen** was designed to establish a positive validation that a pump is pulling a minimum amount of full load amps or operating up to a certain standard. This minimum setting is user selectable so it can be established to be consistent with the capability of your equipment.

The screen displays and updates the following information:

1)	Pump Identification	Displayed at the top of the Pump icons
2)	Pump Position (Lead or Lag)	Displayed at the bottom of the Pump icons
3)	Pump Condition (Run, Off, Called, Problem or Lock-out)	Displayed at the center of the Pump icons
4)	Wet Well Level Bargraph	Displays wet well level in feet on the left side
5)	Pump Delay before Run Fail	Displays time allowed for pump to reach the minimum positive run verification setting before activating Failed Run Verify Alarm.
6)	Pump Actual Full Load Amp Draw	Displays real-time full load amp draw for selected pump via a digital display and horizontal bargraph
7)	Pump Run Fail Below	Displays minimum full load amp draw acceptable for each pump via a digital display and horizontal bargraph

Once the Positive Run Verification system is in place, each pump must be able to meet this minimum requirement or normal alternation will be overridden and the problem pump will be moved to the Lag position (but not disabled). For example: If Pump 1 is called to run and is incapable of meeting the minimum full load amps requirement, it will be moved from the Lead position and put in the Lag position. The Failed Run Verify Alarm will activate. Pump 2 will be put in the Lead position to handle the flow. Pump 1 will still remain on line and will be called to run if the Lag pump start point is reached.

POSITIVE RUN VERIFICATION SET UP SCREEN (continued)



Through this screen, you will be creating the following user-selectable settings needed to fully implement the positive run verification process:

1) PUMP 1 (OR 2) ACTUAL: The actual full load amp draw for the selected pump is shown in the box. Touch either pump icon to display the actual amp draw from the specified pump both digitally and with a horizontal bargraph (Pump FLA). This allows you to monitor your actual FLA while you are setting your minimum amp draw setpoint. Compare the two bargraphs to ensure that the Run Fail setpoint is below any normal FLA fluctuations.

2) PUMP RUN FAIL BELOW: Determine the Minimum full load amps draw acceptable for each pump in the Lead or Lag position. Use the UP and DOWN scrolling arrows to the left of the PUMP RUN FAIL button. The UP arrow will increase the numeric value and the DOWN arrow will decrease the same value. This value is displayed digitally and with a horizontal bargraph (Run Verify Amps). Setting this value to "0" will effectively disable this feature and prevent activation of the Run Verify alarms. Factory setting will be "0" until this setting is created. *Note: Typical pumps will not function normally with an amp draw less than 75% of the FLA stated on the nameplate. Check with your pump manufacturer for their recommendation.*

3) PUMP DELAY BEFORE FAIL: Determine the time that will be allowed for the pump to reach this minimum setting before it will activate the Failed Run Verify Alarm. Consider how long it takes for the amp reading on your pump to reach full speed cycle. For example, your pump may take 20 to 30 seconds to reach full speed. In this case, you would set your time delay for 40 to 60 seconds. Use the UP and DOWN arrows to the immediate right of the PUMP DELAY button. Touch the UP or DOWN arrow keys to increase or decrease the time desired in seconds. This value is displayed both digitally and with a horizontal bargraph. You may disable this feature by setting time to "0" but please note that disabling this time delay function will also disable the Demand Charge Avoidance function.

From the Pump Verification Set up Screen:
Touch the interactive GO TO MENU button to return to the Menu Screen.

PSD jr Alarms Screens

Both Alarm Screens in the PSD jr are designed to give the operator a complete overview of all critical alarms relating to the pumping station.

Please note that all of these alarms may not appear on your screens. The screens in your PSD jr system will show only those alarms appropriate for the configuration of your system.

The **Pump Alarms Screen** enables you to isolate a problem with the pump and the pump control system by leading the operator quickly to the source of the problem. The Pump Alarms shown on this screen include: Overload Trip Alarm, Pump Restarts Alarm, Seal Fail Alarm, Amp Sensor Fail Alarm, Overtemp Alarm, Megger Trip Alarm, Fail Run Verify Alarm and Ground(GND) Fault Alarm for each pump. See page 20 for more information.

The **General Alarms Screen** provides the same detailed information for alarm conditions not specifically related to pumps. The General Alarms shown on this screen are: High Level Alarm, PLC Low Battery Alarm, Low Level Occurred Alarm, Lag Pump Running Alarm, Power Monitor Alarm, Level Sensor Alarm and Standby Float (Stdby Flt) Alarm and Control Power Alarm. See page 22 for more information.

These alarms are displayed as individual alarm buttons on both the Pump Alarms and the General Alarms Screen. When an alarm condition first occurs, the Alarm button will flash and the text will change to indicate that the alarm condition is currently active. The alarm condition must now be acknowledged and then reset. Although all alarm conditions may be acknowledged from the screen, only some conditions can be immediately reset from the screen. Other alarms may require an external reset or automatic reset prior to being cleared from the screen.

Those alarm conditions that can be immediately reset from the screen are **Pump Restarts Alarm** and **Run Verification Alarm** on the Pump Alarms Screen and **Lag Pump Run Alarm** on the General Alarms Screen. For those alarm conditions, you would use the following sequence:

1) Alarm condition occurs - button lights and flashes
2) Operator touches alarm button once to acknowledge - button goes steady but stays on until reset
3) Operator touches alarm button quickly two times to reset - alarm light goes out

For all other alarm conditions that require external or automatic reset prior to being able to reset from the screen, you would use the following sequence:

1) Alarm condition occurs - button lights and flashes
2) Operator touches alarm button once to acknowledge - button goes steady but stays on until reset
3) The alarm condition must be externally or automatically reset.
4) Operator touches the alarm button quickly two times to reset - alarm light goes out

Note: The Alarm button in the upper right corner of all screens follows the appropriate sequence.

PSD jr Alarms Screens

In each alarm button, the PSD jr displays the status of the alarm condition in one of four possible stages:

1) **Alarm Condition OK** meaning that the alarm condition has not occurred.

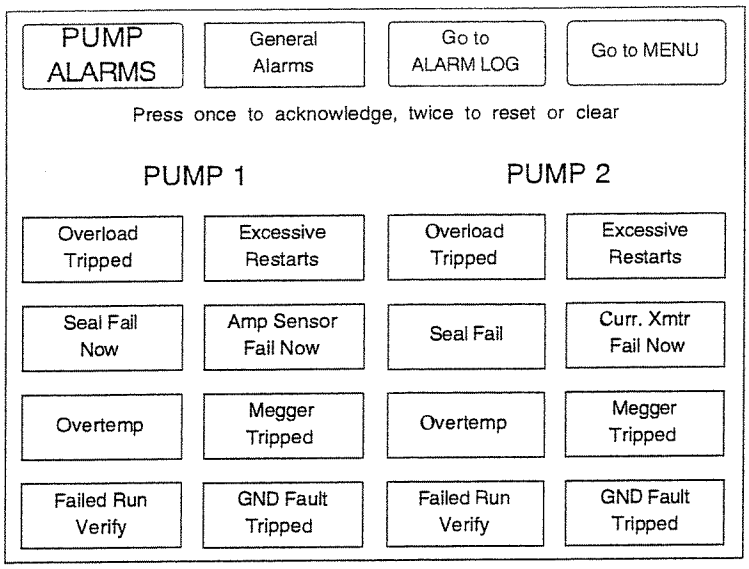
2) **Alarm Condition Now, Tripped or Failed** meaning that the alarm condition is now occurring.

3) **Alarm Condition Occurred** meaning that the alarm condition may no longer be present but did occur in the past. This is helpful when reviewing pump station activity over a 24 hour period. Although the alarm condition may have corrected itself, the PSD jr still provides a historical picture.

   Note: You may also get more information about the alarm condition by referring to the Alarm Log (see page 24) or looking at the Trends Screen (see page 10) for the time that the alarm occurred.

4) **Alarm Condition Acknowledged (Ack'd)** meaning that the alarm condition is still active but that the operator has been notified and responded.

PUMP ALARMS SCREEN



The **Pump Alarms Screen** was designed to give you a complete overview of all critical alarms relating to each pump. This screen offers eight different alarms for each pump and enables you to isolate a problem with the pump and the control system by leading you quickly to the source of the problem. Down time and damage to equipment is minimized.

When an alarm condition occurs, the specific Alarm button will light and the text will change to one of the statements in the boxes below. Although all alarms can be acknowledged from this screen by touching the specific alarm button once, only two alarms on the Pump Alarm Screen can be reset from the screen: **Restarts and Run Verification Alarm.** All other alarms displayed on this screen require an external reset prior to being cleared from the screen by touching the alarm button twice.

Overload Alarm	**Restarts Alarm**
O/L Trip Relay OK - No overload condition currently exists. **Overload Tripped** - Starter overload relays have tripped due to excessive current drawn by pump motor and alarm has not yet been acknowledged or reset. **Reset O/L Trip Relay** - Alarm has been acknowledged. Alarm condition will automatically reset once overload condition has cleared.	**Restarts OK** - Pump has not exceeded acceptable number of restarts. **Excessive Restarts** - Pump restarts have exceeded acceptable number of restarts. **Restarts Alm Occurred** - The restart alarm condition is no longer active but has not yet been acknowledged. **Restarts Alm Ack'd** - The operator has acknowledged alarm and may reset on this screen.
Seal Failure Alarm	**Amp Sensor Fail Alarm**
Seal OK - No seal failure has occurred **Seal Fail Now** - Moisture is currently sensed in the motor housing. **Seal Failed**- Moisture is no longer present but alarm has not yet been acknowledged. **Reset Seal Fail** - Seal failure alarm has been acknowledged and can be cleared after external reset has occurred.	**Amp Sensor OK** - No amp sensor failure has occurred **Amp Sensor Fail Now** - Amp sensor sensing the full load amps of the motor has failed out of the 4 - 20mA range. **Amp Sensor Failed** - Amp Sensor Fail condition may no longer exist but alarm has not yet been acknowledged. **Amp Sensor Fail Ack'd** - Alarm has been acknowledged and can be cleared after external reset has occurred.

Figure 4.4 - Miscellaneous situations (continued)

Symptom	Possible Causes	Remedy
Motor surges still occur with soft stop option	• Misapplication	• The soft stop is intended for loads that stop suddenly when voltage is removed from the motor • Refer to Publication 150-806 – Pump Control Option
Motor overheats ①	• Duty cycle	• Preset Slow Speed Option: Extended operation reduces motor cooling efficiency. Consult motor manufacturer for limits of operation • Smart Motor Brake Option: Check duty cycle ② • Accu-Stop Option: Extended operation at the preset slow speed level reduces motor cooling efficiency. Consult motor manufacturer for limits of operation. Verify maximum inertia limits ②

① When applying SMB, Accu-Stop, Preset Slow Speed and Slow Speed with Braking, it may be necessary in some applications to consult with motor manufacturer on motor heating due to the duty cycle, high load inertia or other application parameters.

② Depending on the application, the SMB Smart Motor Braking, Accu-Stop, and Slow Speed with Braking options may cause some vibration or noise during the stopping cycle and this may be minimized by lowering the braking current. If this is a concern in your application, consult the factory prior to applying these options.

Control Module Removal

The control module is not intended for field repair. The entire module must be replaced in the event of failure. The following procedure must be followed before unplugging the control module.

ATTENTION: To avoid shock hazard, disconnect main power before working on the controller, motor, or control devices such as Start/Stop pushbuttons.

ATTENTION: Make sure that wires are properly marked and DIP switch settings are recorded.

1. Disconnect all power from the controller.
2. Remove controller cover and control access door.
3. Remove all control wires.
4. Remove six screws as shown in Figure 4.5.
5. Unplug control module from power modules by pulling forward.

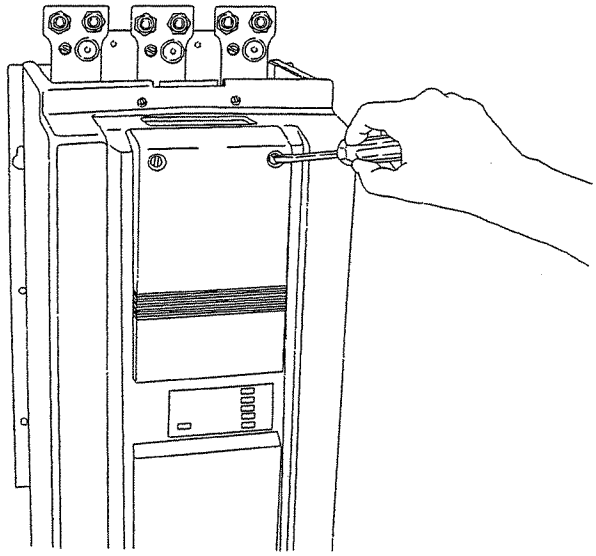
ATTENTION: When removing control module make sure power module pins do not bend. Make sure pins are not bent prior to installing control module.

The gold interconnection pins on the power poles are protected with a special contact lubricant. **Do not clean or wipe these pins.**

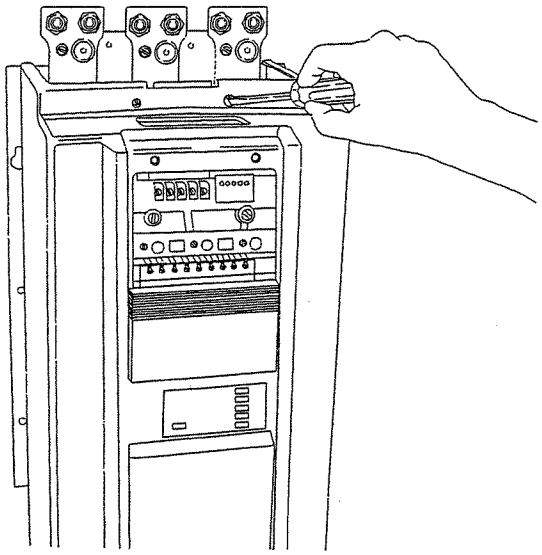
To install control module, follow the reverse order for removal.

Control Module Removal (continued)

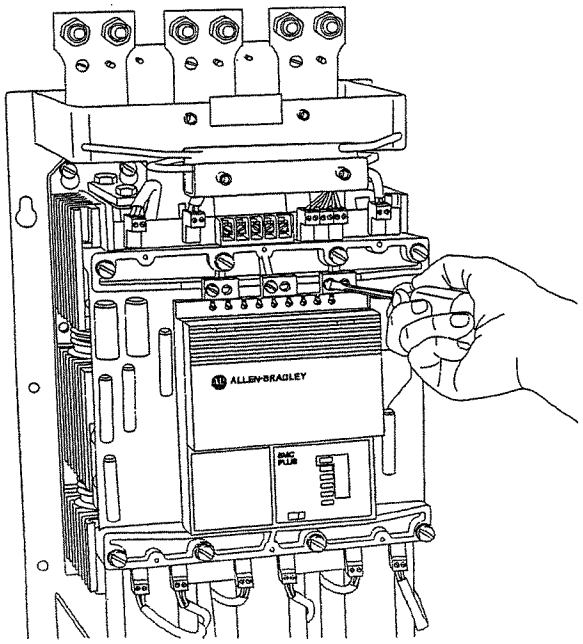
Figure 4.5 - Removal of Control Module



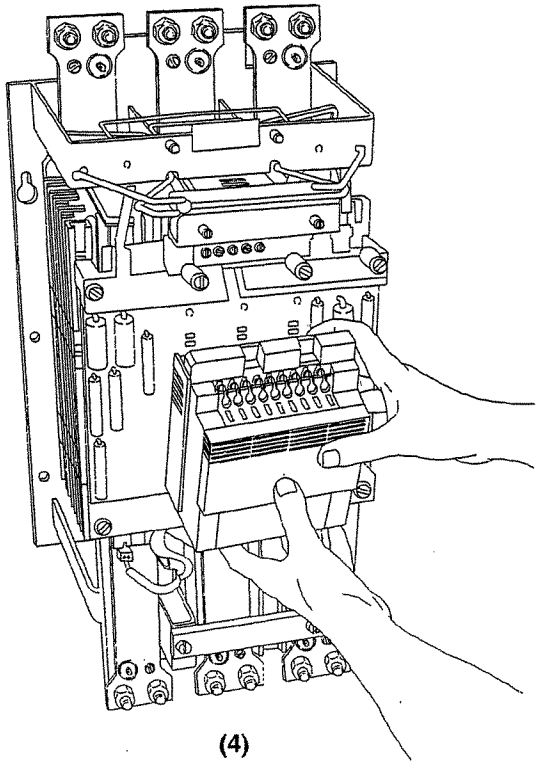
(1)



(2)



(3)



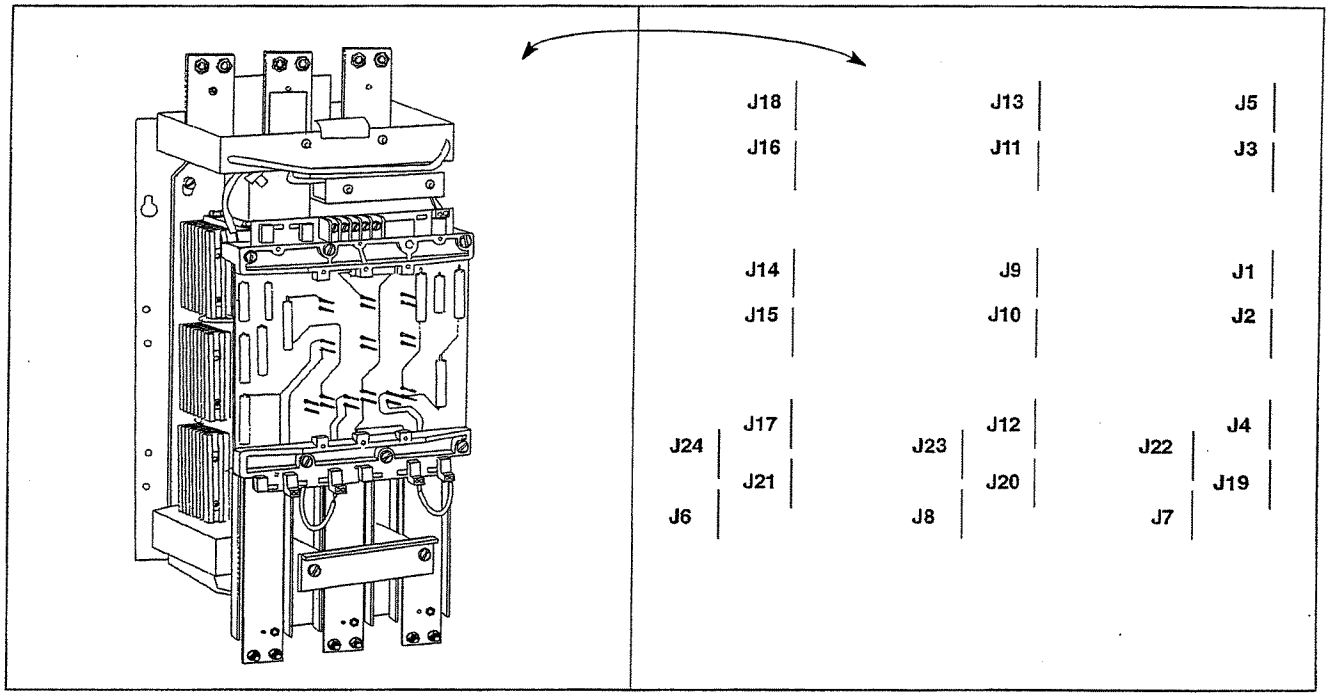
(4)

Power Pole and Interface Board Resistance Check

ATTENTION: To avoid shock hazard, disconnect main power before working on the controller, motor, or controller devices such as Start/Stop pushbuttons

ATTENTION: Make sure that wires are properly marked and DIP switch settings are recorded.

Figure 4.6 - Pin Locations for Power Pole Resistance Check



1. Disconnect ALL power from the controller.
2. Using an ohmmeter, measure the resistance between the line and load terminals of each phase on the controller (refer to Figure 2.4, Page 2-2). Resistance should be greater than 10,000 ohms.
3. Remove controller cover and control access door.
4. Remove all control wires.
5. Remove six screws as shown in Figure 4.5.

ATTENTION: When removing control module make sure interface board pins do not bend. Also, make sure pins are not bent prior to installing control module.

6. Unplug control module from power modules by pulling forward.

Power Pole and Interface Board Resistance Check (continued)

7. Measure resistance between:
   - pins J17 and J18 for phase L1/T1,
   - pins J12 and J13 for phase L2/T2,
   - pins J4 and J5 for phase L3/T3.

   The resistance should be 19KΩ.
8. Measure resistance between:
   - pins J14 and J21 for phase L1/T1,
   - pins J9 and J20 for phase L2/T2,
   - pins J1 and J19 for phase L3/T3.
   - The resistance should be 19KΩ.
9. Measure resistance between:
   - pins J16 and J18 for phase L1/T1,
   - pins J11 and J13 for phase L2/T2,
   - pins J3 and J5 for phase L3/T3.

   The resistance should be less than 100Ω.
10. Measure resistance between:
    - pins J14 and J15 for phase L1/T1,
    - pins J9 and J10 for phase L2/T2,
    - pins J1 and J2 for phase L3/T3.

    The resistance should be less than 100Ω.
11. Measure resistance between:
    - pins J6 and J24 for phase L1/T1,
    - pins J8 and J23 for phase L2/T2,
    - pins J7 and J22 for phase L3/T3.

    The resistance should be less than 500Ω.

The gold interconnection pins on the interface board are protected with a special contact lubricant. **Do not clean or wipe these pins.**

To install control module, follow the reverse order for removal.

Renewal Parts

Description	Controller Rating	Line Voltage Rating	Part Number
Control Module (Standard)	All	All	40888-899-01
Preset Slow Speed	All	All	40888-899-03
Soft Stop	All	All	40888-899-02
Pump Control	All	All	40888-899-14
SMB Smart Motor Braking	180A-360A	All	40888-899-11
Accu-Stop	180A-360A	All	40888-899-06
Slow Speed with Braking	180A-360A	All	40888-899-17
Power Modules	180A	200-480 200-600	40382-809-03 40382-809-04
	240A	200-480 200-600	40382-809-05 40382-809-06
	360A	200-480 200-600	40382-809-07 40382-809-08
Fan	180A-360A	All	40382-804-01
Interface Board	180A-360A	All	40382-805-01

Rockwell *Automation*

Allen-Bradley

Allen-Bradley, a Rockwell automation business, has been helping its customers improve productivity and quality for more than 90 years. We design, manufacture and support a broad range of automation products worldwide. They include logic processors, power and motion control devices, operator interfaces, sensors and a variety of software. Rockwell is one of the world's leading technology companies.

Worldwide representation.

Argentina • Australia • Austria • Bahrain • Belgium • Brazil • Bulgaria • Canada • Chile • China, PRC • Colombia • Costa Rica • Croatia • Cyprus • Czech Republic • Denmark Ecuador • Egypt • El Salvador • Finland • France • Germany • Greece • Guatemala • Honduras • Hong Kong • Hungary • Iceland • India • Indonesia • Ireland • Israel • Italy Jamaica • Japan • Jordan • Korea • Kuwait • Lebanon • Malaysia • Mexico • Netherlands • New Zealand • Norway • Pakistan • Peru • Philippines • Poland • Portugal Puerto Rico • Qatar • Romania • Russia–CIS • Saudi Arabia • Singapore • Slovakia • Slovenia • South Africa, Republic • Spain • Sweden • Switzerland • Taiwan • Thailand Turkey • United Arab Emirates • United Kingdom • United States • Uruguay • Venezuela • Yugoslavia

Allen-Bradley Headquarters, 1201 South Second Street, Milwaukee, WI 53204 USA, Tel: (1) 414 382-2000 Fax: (1) 414 382-4444

Publication 150-812 May 1996
Supersedes Publication 150-812 dated January 1996

40055-080-01(F)

**Item#9-Pump #1, Pumpex, 28HP, 1SSS
**Item#10-Pump #2, ABS, 168HP, 2SSS
**Item#10-Pump #3. ABS, 168HP, 3SSS
**Item#10-Pump #4, ABS, 168HP, 4SSS

Allen-Bradley

SMC PLUS™ Smart Motor Controller:

Soft Stop Option Manual

Wiring and Set-up Procedures
24-1000 Ampere
(Bulletin 150)

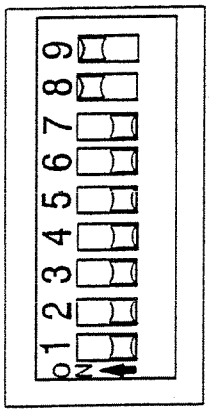
This is a supplementary guide for the Soft Stop Option, it is intended to be used with the Installation Manual. This guide contains the information pertaining to the wiring and customer adjustment set-up procedures for the Soft Stop Option. Other information specific to the operation and maintenance of the SMC PLUS is given in the following Installation Manuals:

150-811 (24, 35, 54, 97, 135 Amps)
150-812 (180, 240, 360 Amps)
150-813 (500, 650, 720, 850, 1000 Amps)

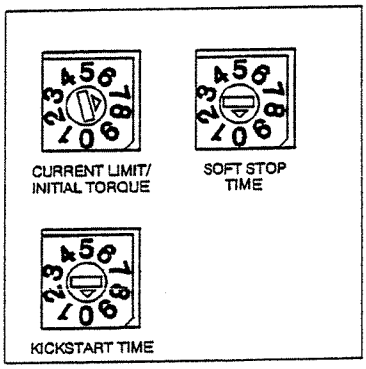
For Bulletin 150 SMC Smart Motor Controller technical support on start-up or existing installations, contact your Allen-Bradley representative. In the United States you can also call **1–800–765–SMCS** (765–7627) for assistance during the hours of 8:00 am to 12:00 noon and 1:00 pm to 4:30 pm (Central Time Zone) from Monday through Friday.

Soft Stop Option

Figure 1.1 - Soft Stop Option Factory Settings



Starting Time
Starting Time
Starting Time
Current Limit/Soft Start Select
Energy Saver Select (On/Off)
Auxiliary Contact Select (Up-to-Speed/Normal)
Stall Trip Select (On/Off)
Not Used
Not Used



Factory Settings

The conttroller has been factory-set for the following as shown in Figure 1.1 above:

- 10 second ramp
- Energy Saver "Off"
- Auxiliary Contacts "Off" (Normal)
- Stall feature "Off"
- Initial Torque 70%
- Kickstart "Off"
- Soft Stop "Off"

NOTE: Soft Stop feature is deactivated with factory settings.

Application Considerations

For multispeed, reversing and multimotor applications, consult your nearest Sales Offices or the Sales Department in Milwaukee

150-805

Soft Stop Option

With the soft stop option, pressing the soft stop pushbutton signals the controller to initiate a ramp down. The RUNNING LED turns off and the STOPPING LED turns on. When the logic completes the ramp down sequence, the latch circuit across terminals 30 and 40 is released, the form C auxiliary contacts reset (terminals 70, 80 and 90) and the STOPPING LED turns off. The controller logic resets. If "up-to-speed" auxiliaries are selected, the contacts reset when the motor begins to decelerate.

If the stop pushbutton is pressed, a normal (coast to rest) stop is initiated.

Figure 1.2 - Soft Stop Option

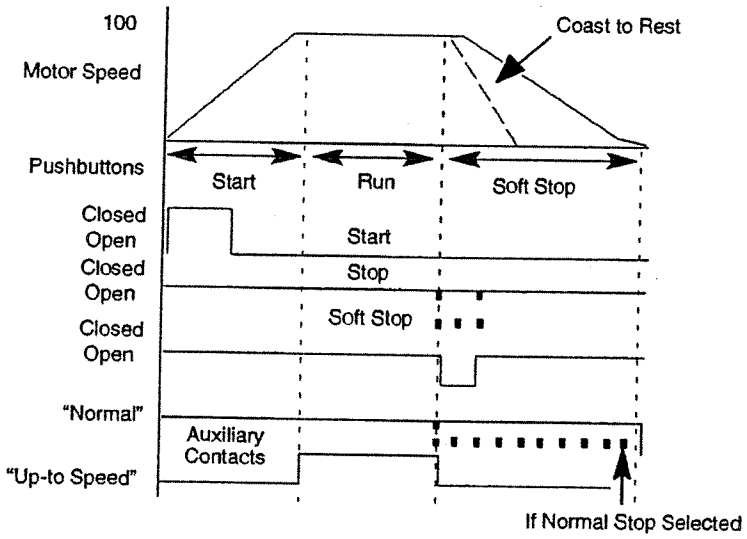
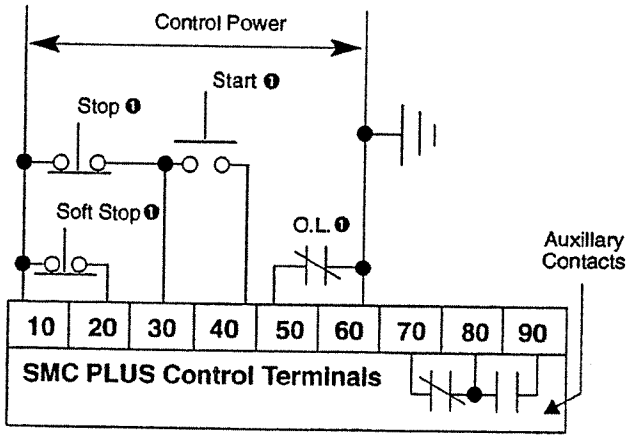


Figure 1.3 - Soft Stop Terminal Wiring

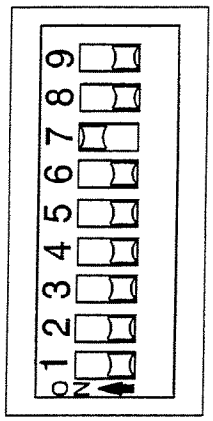


❶ Customer Supplied

ATTENTION: Soft Stop is not intended to be used as an emergency stop. Refer to the applicable standards for emergency stop requirements.

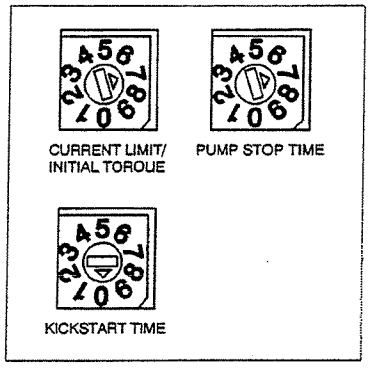
Soft Start Selection with Soft Stop Option

Figure 1.4 - Set Up Procedures - Soft Start Selection with Soft Stop Option



Starting Time
Starting Time
Starting Time
Current Limit/Soft Start Select
Energy Saver Select (On/Off)
Auxiliary Contact Select (Up-to-Speed/Normal)
Stall Trip Select (On/Off)
Not Used
Not Used

EXAMPLE: Above DIP switch is set for 20 second ramp



1. **Starting Time** -
   Set switches 7-9 according to the period desired. For example, if you want a ramp of 20 seconds, switch 7 would be **ON** and switches 8 and 9 would be **OFF**.
2. **Kickstart Time** -
   Set Kickstart Time rotary digital switch to the kickstart time desired.
3. **Initial Torque** -
   Set Initial Torque rotary digital switch to the value desired.
4. **Current Limit/Soft Start** -
   For soft start operation, switch 6 must be **OFF**.
5. **Energy Saver Select** -
   Set switch 5 **ON** if you want the energy saver feature (of **OFF** if you do not want this feature active).
6. **Auxiliary Contact Selection** -
   Set switch 4 **OFF** if you want "normal" auxiliary contacts, **ON** if you want "up-to-speed" auxiliary contacts.
7. **Stall Select** -
   Set switch 3 **ON** if you want the stall feature (or **OFF** if you do not want this feature active) **NOTE:** For resistive load operation, switch 3 must be **OFF**.
8. **Soft Stop Time** -
   Set Soft Stop Time rotary digital switch according to the time desired. **For example,** if you want a soft stop of 30 seconds, set the rotary digital switch to 6.

ATTENTION: The user has the ultimate responsibility to determine which stopping mode is best suited to the application and will meet applicable standards for operator safety on a particular machine.

Soft Start Selection with Soft Stop Option

Switch Number	TIME (seconds)					
	2	5	10	20	25	30
9	ON	Off	ON	Off	ON	Off
8	Off	ON	ON	Off	Off	ON
7	Off	Off	Off	ON	ON	ON
6	Off					
5	ENERGY SAVER SELECT					
4	AUXILIARY CONTACT SELECT					
3	STALL SELECT					
2	NOT USED					
1	NOT USED					

Kickstart Time

Position	0	1	2	3	4	5	6	7	8	9
Time (seconds)	Off	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0

Initial Torque

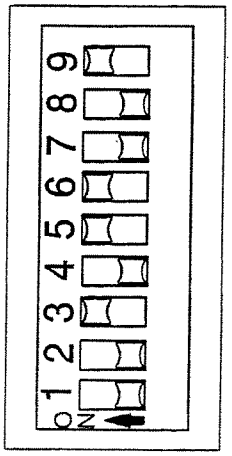
Position	0	1	2	3	4	5	6	7	8	9
% of Locked Rotor Torque	5	10	20	30	40	50	60	70	80	90

Soft Stop Time

Position	0	1	2	3	4	5	6	7	8	9
Time (seconds)	Off	2	5	10	20	25	30	40	50	60

Current Limit Selection with Soft Stop Option

Figure 1.5 - Set Up Procedures - Current Limit Selection with Soft Stop Option



Starting Time

Starting Time

Starting Time

Current Limit/Soft Start Select

Energy Saver Select (On/Off)

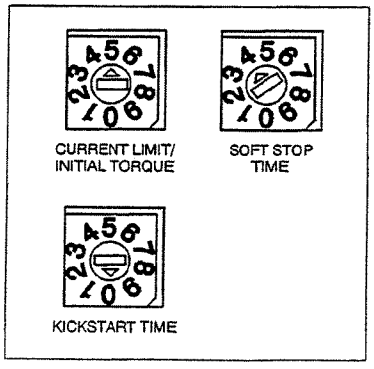
Auxiliary Contact Select (Up-to-Speed/Normal)

Stall Trip Select (On/Off)

Not Used

Not Used

EXAMPLE: Above DIP switch is set for 30 second ramp



Current Limit Selection with Soft Stop Option (continued)

1. **Starting Time -**
   Set switches 7-9 according to the time desired. **For example**, if you want current limit active for 30 seconds, switch 9 would be **ON** and switches 7 and 8 would be **OFF**.
2. **Kickstart Time -**
   Set Kickstart Time rotary digital switch to **OFF**.
3. **Current Limit/Soft Start -**
   Switch 6 must be **ON** in the current limit mode. Set Current Limit rotary digital switch accordingly. **For example**, if you want to restrict the starting current to 300% of full load amperes, set rotary switch to position 5.
4. **Energy Saver Select -**
   Set switch 5 **ON** if you want the energy saver feature (of **OFF** if you do not want this feature active).
6. **Auxiliary Contact Selection -**
   Set switch 4 **OFF** if you want "normal" auxiliary contacts, **ON** if you want "up-to-speed" auxiliary contacts.
7. **Stall Select -**
   Set switch 3 **ON** if you want the stall feature (or **OFF** if you do not want this feature active) **NOTE:** For resistive load operation, switch 3 must be **OFF**.
8. **Soft Stop Time -**
   Set Soft Stop Time rotary digital switch according to the time desired. **For example**, if you want a soft stop of 20 seconds, set rotary digital switch to 4.

Switch Number	TIME (seconds)			
		15	30	
9		Off	ON	
8	Off			
7	Off			
6	ON			
5	ENERGY SAVER SELECT			
4	AUXILIARY CONTACT SELECT			
3	STALL SELECT			
2	NOT USED			
1	NOT USED			

Kickstart Time

Position	0	1	2	3	4	5	6	7	8	9
Time (seconds)	Off	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0

Current Limit

Position	0	1	2	3	4	5	6	7	8	9
% of Full Load Current	50	100	150	200	250	300	350	400	450	500

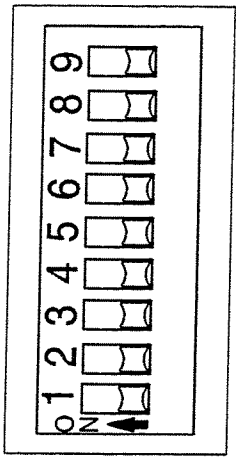
Soft Stop Time

Position	0	1	2	3	4	5	6	7	8	9
Time (seconds)	Off	2	5	10	20	25	30	40	50	60

150-805

Full Voltage Selection with Soft Stop Option

Figure 1.6 - Set Up Procedures - Full Voltage Selection with Soft Stop Option



Starting Time

Starting Time

Starting Time

Current Limit/Soft Start Select

Energy Saver Select (On/Off)

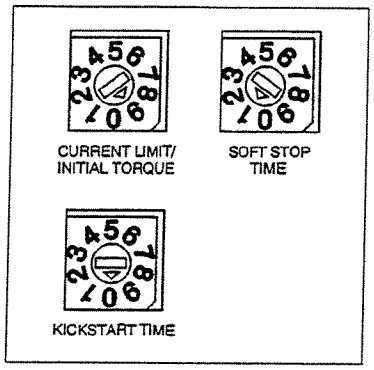
Auxiliary Contact Select (Up-to-Speed/Normal)

Stall Trip Select (On/Off)

Not Used

Not Used

EXAMPLE: Above DIP switch is set for full voltage start



1. **Starting Time** -
   Set dip switches 7-9 **OFF** and switch 6 **OFF**.
2. **Kickstart Time** -
   Set to 0.
3. **Initial Torque** -
   Set to 9.
4. **Current Limit** -
   For fully voltage operation, switch 6 must be **OFF**.
5. **Energy Saver Select** -
   Switch 5 must be **OFF**. Energy Saver not available with full voltage start.
6. **Auxiliary Contact Selection** -
   Set switch 4 **OFF** if you want "normal" auxiliary contacts, **ON** if you want "up-to-speed" auxiliary contacts.
7. **Stall Select** -
   Set switch 3 **ON** if you want the stall feature (or **OFF** if you do not want this feature active) **NOTE:** For resistive load operation, switch 3 must be **OFF**.
8. **Soft Stop Time** -
   Set Soft Stop Time rotary digital switch according to the time desired. **For example**, if you want a soft stop of 30 seconds, set rotary digital switch to 6.

ATTENTION: The user has the ultimate responsibility to determine which stopping mode is best suited to the application and will meet applicable standards for operator safety on a particular machine.

Full Voltage Selection with Soft Stop Option

(continued)

Switch Number	TIME (seconds)
	1/4
9	Off
8	Off
7	Off
6	Off
5	ENERGY SAVER SELECT
4	AUXILIARY CONTACT SELECT
3	STALL SELECT
2	NOT USED
1	NOT USED

Kickstart Time

Position	0	1	2	3	4	5	6	7	8	9
Time (seconds)	Off	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0

Initial Torque

Position	0	1	2	3	4	5	6	7	8	9
% of Locked Rotor Torque	5	10	20	30	40	50	60	70	80	90

Soft Stop Time

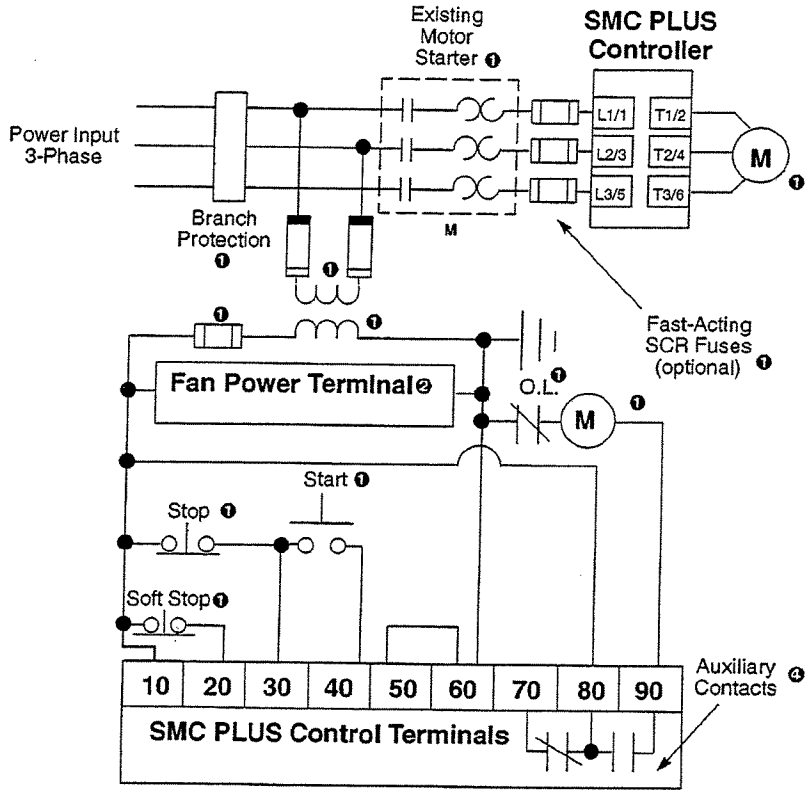
Position	0	1	2	3	4	5	6	7	8	9
Time (seconds)	Off	2	5	10	20	25	30	40	50	60

150-805

Typical Connection for Retrofit Application

Typical connection diagram for retrofit application: Figure 1.7 shows the typical diagram to use when retrofitting a SMC PLUS with Soft Stop into an existing control scheme. Starting and stopping of the motor is handled by the controller. Be sure the incoming side of the starter coil is routed through terminals 80 and 90 to insure the starter stays on long enough to allow soft stopping to occur and that the auxiliary is configured for normal operation.

Figure 1.7 - Typical Connection Diagram Retrofit Application



NOTE: For two wire control, remove stop/start pushbuttons and hardwire terminals 10 and 40.

❶ Customer Supplied.

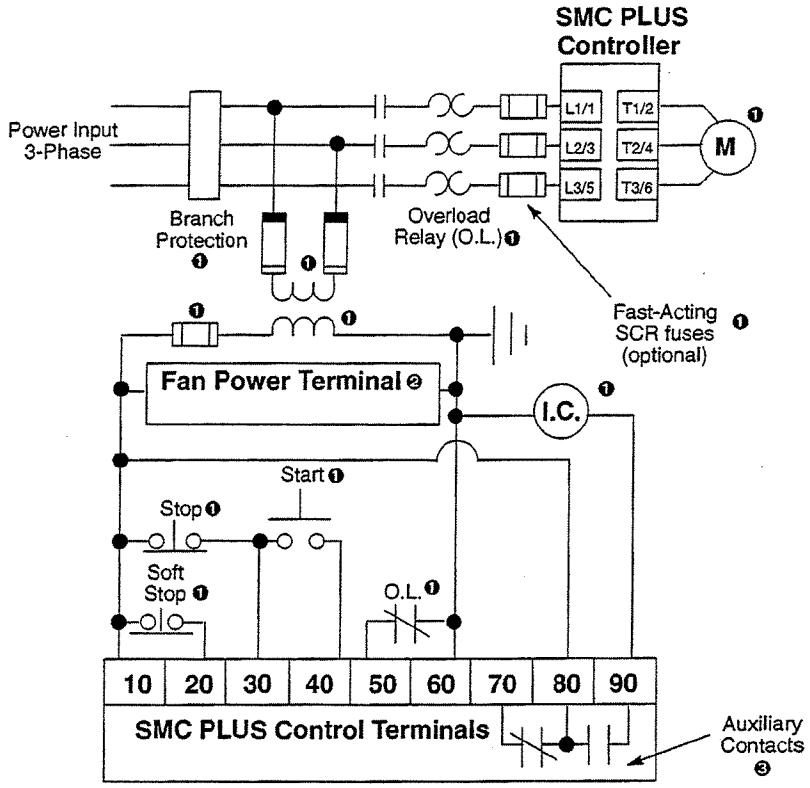
❷ Customer wires fan to control voltage supply. For 97A controllers and up, see installation manuals for jumper locations and wiring diagrams.

❸ Set auxiliary contacts for normal setting.

Typical Connection with Isolation Contactor

Typical connection diagram for Soft Stop with isolation contactor: Both starting and stopping of the motor is controlled by the controller. The controller also controls the electromechanical contactor. The contactor provides isolation between the motor and power lines when controller is OFF.

Figure 1.8 - Typical Connection Diagram with Isolation Contactor



NOTE:

❶ Customer Supplied.

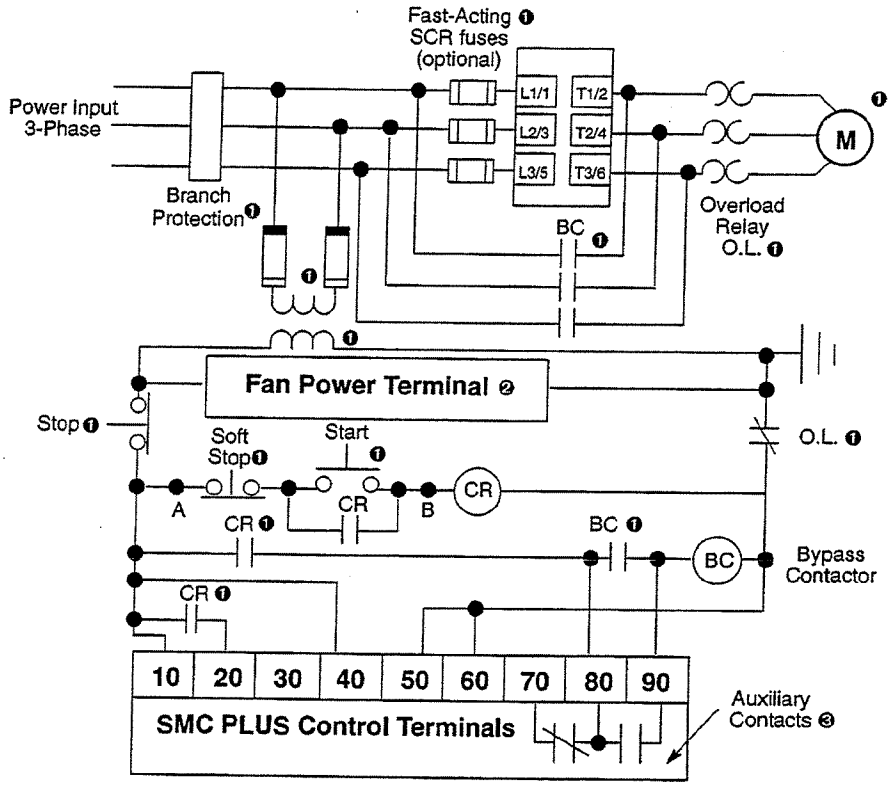
❷ Customer wires fan to control voltage supply. For 97A controllers and up, see installation manuals for jumper locations and wiring diagrams.

❸ Set auxiliary contacts for normal setting.

By-pass Mode

Typical connection diagram of a by-pass contactor: By using the following circuit a start and soft stop can be realized with the controller bringing the bypass contactor on for normal full speed operation.
NOTE: Because the controller is bypassed during this mode, controller features are not available when contactor is energized.

Figure 1.9 - Typical Application Diagram of a By-pass Contactor



NOTE: For two wire control, remove stop/start pushbuttons and connect two wire device between A and B.

❶ Customer Supplied.

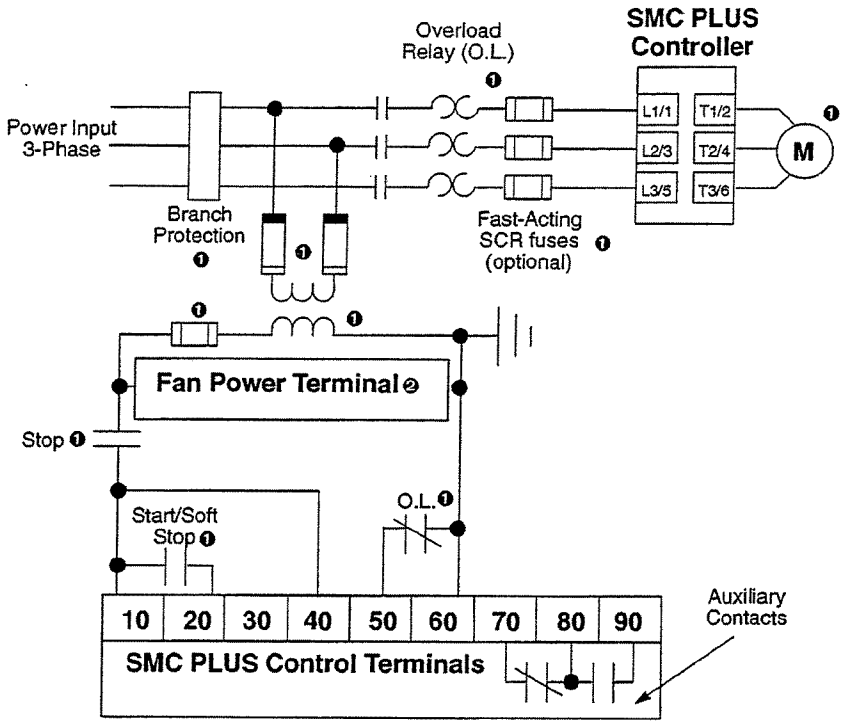
❷ Customer wires fan to control voltage supply. For 97A controllers and up, see installation manuals for jumper locations and wiring diagrams.

❸ Set auxiliary contacts for up-to-speed setting.

Programmable Controller and Sensor Interface

When using solid-state devices to operate the SMC PLUS controller the voltage and frequency range will be 100-240V, 50/60 Hz. The OFF state leakage current from the solid-state device must be less than 6 mA. The nominal input current is 25 mA at 120 VAC and 50 mA a 240 VAC.

Figure 1.10 - Typical Connection with PLC or other Logic Devices



NOTE:

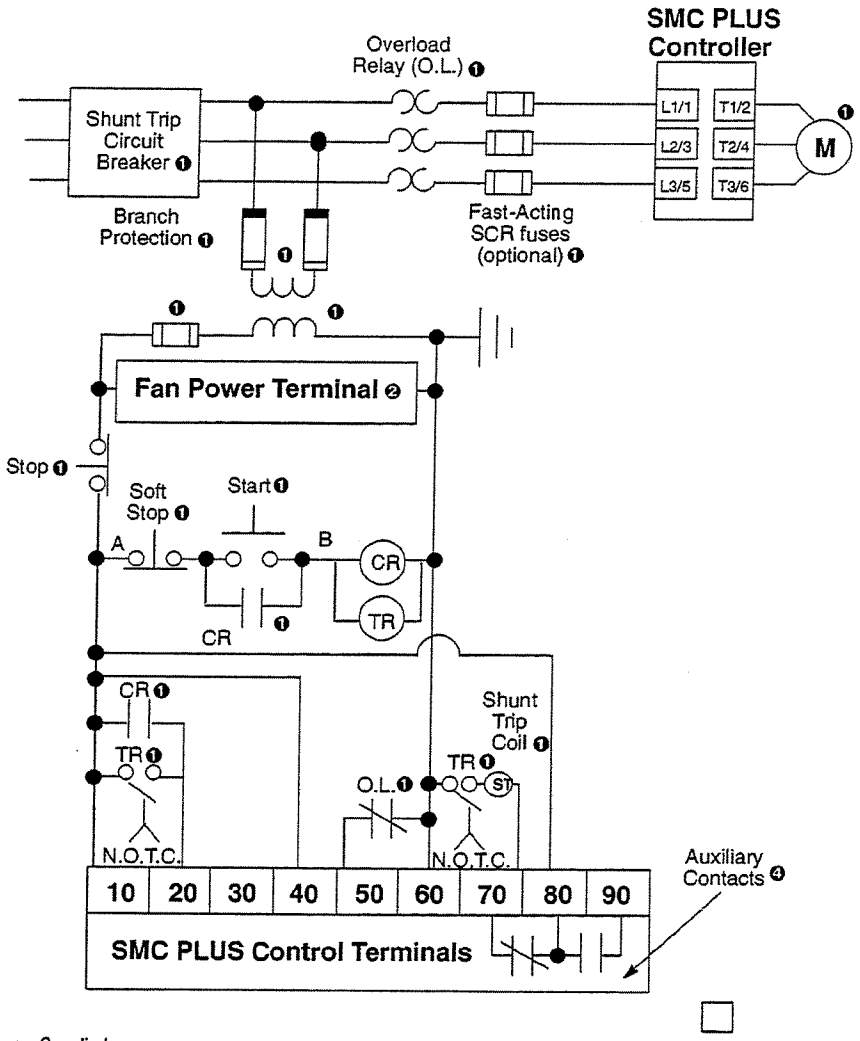
❶ Customer Supplied.

❷ Customer wires fan to control voltage supply. For 97A controllers and up, see installation manuals for jumper locations and wiring diagrams.

Typical Connection with Shunt Trip Circuit Breake

Typical connection diagram with shunt trip breaker. To use the Soft Stop Option with a shunt trip breaker, a control relay and a timing relay are required. The timing relay used to prevent tripping before the motor has had a chance to start and to prevent nuisance tripping of breaker for stopping.

Figure 1.11 - Typical Connection Diagram with Shunt Trip Circuit Breaker



❶ Customer Supplied.

❷ Customer wires fan to control voltage supply. For 97A controllers and up, see installation manuals for jumper locations and wiring diagrams.

❸ For two wire control, remove stop/start pushbuttons and connect two wire device between points A and B.

❹ Set auxiliary contacts for normal setting.

Rockwell *Automation*

Allen-Bradley

Allen-Bradley, a Rockwell automation business, has been helping its customers improve productivity and quality for more than 90 years. We design, manufacture and support a broad range of automation products worldwide. They include logic processors, power and motion control devices, operator interfaces, sensors and a variety of software. Rockwell is one of the world's leading technology companies.

Worldwide representation.

Argentina • Australia • Austria • Bahrain • Belgium • Brazil • Bulgaria • Canada • Chile • China, PRC • Colombia • Costa Rica • Croatia • Cyprus • Czech Republic • Denmark Ecuador • Egypt • El Salvador • Finland • France • Germany • Greece • Guatemala • Honduras • Hong Kong • Hungary • Iceland • India • Indonesia • Ireland • Israel • Italy Jamaica • Japan • Jordan • Korea • Kuwait • Lebanon • Malaysia • Mexico • Netherlands • New Zealand • Norway • Pakistan • Peru • Philippines • Poland • Portugal Puerto Rico • Qatar • Romania • Russia–CIS • Saudi Arabia • Singapore • Slovakia • Slovenia • South Africa, Republic • Spain • Sweden • Switzerland • Taiwan • Thailand Turkey • United Arab Emirates • United Kingdom • United States • Uruguay • Venezuela • Yugoslavia

Allen-Bradley Headquarters, 1201 South Second Street, Milwaukee, WI 53204 USA, Tel: (1) 414 382-2000 Fax: (1) 414 382-4444

Publication 150-805 May, 1995
Supersedes Publication 150-805 October, 1992

40052-082-01(C)

**Item#15-Lightning Arrestor, Innovative Technology, XT40-3Y201

IS-004

TRANSIENT VOLTAGE SURGE SUPPRESSORS
MANUFACTURED BY

15470 Flight Path Drive, Brooksville, Florida 34609 USA
A DELTA COMPANY
SURGE SUPPRESSION LEADER ...BY DESIGN

INNOVATIVE TECHNOLOGY, INC.

INSTALLATION INSTRUCTIONS FOR:
3 PHASE WYE (STAR) (-3Y) MODELS

- See "Product Identification and Installation Requirements Table" on page 3 of this document for specific model family details.
- Optional features operation and installation instructions are located on attached page(s).
- If specific model contains SD (SMART Diagnostics), Review SD Installation and Operation instructions now.

WARNING: HAZARDOUS VOLTAGES PRESENT
Improper installation or misapplication of these devices may result in serious injury to installer and/or damage to electrical system or related equipment. Read and understand all instructions before beginning installation. Protective eyewear should be worn whenever working around hazardous voltages.

NOTICE: All instructions and measurements must be completed by a licensed/qualified electrician in accordance with the U.S. National Electrical Code, state and local codes or other applicable country codes. The U.S. National Electrical Code and state and local requirements (or other applicable country codes) supersede this instruction.

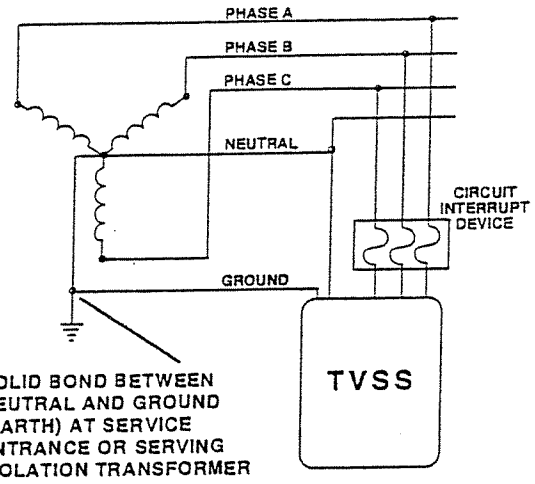
BEFORE INSTALLATION:

Fully complete the following:

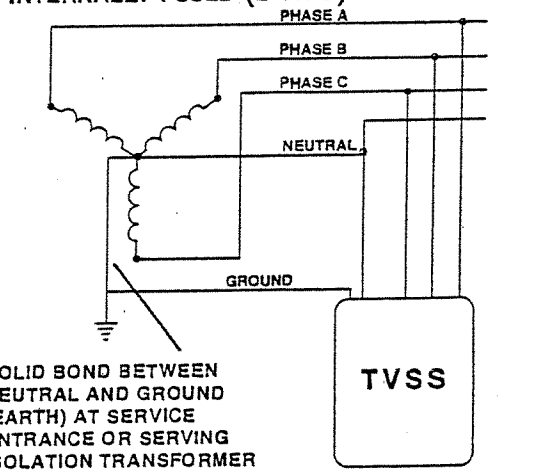
1. Verify system is wired in a **Three Phase Wye (Star)** configuration and that the voltage rating of the system matches the voltage rating of the suppressor as shown on label. Verify Neutral is solidly bonded to Ground at service entrance or at serving isolation transformer as required by the NEC or other applicable country code.
2. Identify applicable wiring connection diagram at right.

WIRING CONNECTION DIAGRAMS FOR NORTH AMERICAN POWER SYSTEMS

MODELS USING EXTERNAL CIRCUIT INTERRUPT DEVICES



INTERNALLY FUSED (L OR D) MODELS



3. **REMOVE POWER FROM ELECTRICAL SYSTEM BEFORE INSTALLING SUPPRESSOR.**
4. Do not install suppressor if Neutral to Ground (Earth) bond is not present as suppressor may be damaged.
5. If Neutral to Ground (Earth) voltage is greater than 5 vac, then a problem may exist in the electrical system. Suppressor may be installed; however, a qualified person should be consulted to correct the problem.
6. For models with enhanced Neutral to Ground (Earth) (N-G) protection: disable N-G protection if product is to be installed in medical applications where direct patient contact is present or if GFCI interaction is possible (**see page 3**).
7. Suppressor contains no position-oriented components and can be mounted upside down or sideways. The cover may be rotated only 180 degrees to improve readability of the label (not applicable to Fused (L or D) models). Take care to support the cover to prevent damage to the indicator light circuit board and wiring when removing and manipulating lid.
8. Isolated Ground (Earth): suppressor Ground (Earth) wire is bonded to suppressor housing internally. If system utilizes isolated Ground (Earth), then suppressor housing must be isolated from Ground (Earth) via insulated conduit fitting and Ground (Earth) wire must be connected to isolated Ground bus (Earth bar).
9. Assure weatherproof (corrosion resistant) conduit and fittings are used to maintain NEMA 4 (IP66) or 4X rating as applicable. Additionally, check lid to ensure screws are sufficiently tight as loosening may occur in the shipping process.

FUSED (L or D) MODEL NOTES:

- All Fused (L or D) models are equipped with Gould type VSP40-2 fuses except PTE640 and PTX640 (D) models which are equipped with Class RK5 fuses.
- Punch or drill hole through suppressor enclosure for minimum connecting wire length. Assure that no internal components are disturbed or damaged. Caution should be taken to capture and remove all metal shavings during drilling process to avoid a possible short circuit condition.

CIRCUIT INTERRUPT DEVICES:

Suppressor must be connected to electrical system via the circuit interrupt devices as specified in the **Product Identification and Installation Requirements Table** (this does not apply to integrally Fused (L or D) models).

- One (1) triple pole/single throw circuit breaker sized according to **Product Identification and Installation Requirements Table**.
  NOTE 1: pre-existing breaker(s) of rated load size may be utilized if provisions for multi-conductor connections are made according to U.S. NEC 110-14a (or other applicable country codes).
  NOTE 2: avoid utilizing a pre-existing breaker which when operated will cause a critical system shut down.
- Three (3) single pole/single throw circuit breaker(s) sized according to the **Product Identification and Installation Requirements Table.**
- Three (3) Class RK5 fuse(s) sized according to the **Product Identification and Installation Requirements Table.**

INSTALLATION CONNECTION AND WIRING INSTRUCTIONS:

IMPORTANT: Suppressor should be located so that the shortest possible conductor length may be used. Conductors should be bound or twisted together to reduce impedance factor. Excessive wire length and sharp bends degrade suppressor performance; therefore, avoid excessive wire length and sharp bends.

STEP 1: REMOVE POWER FROM ELECTRICAL SYSTEM BEFORE INSTALLING SUPPRESSOR

STEP 2: Mechanically mount suppressor

- Mount through panel knockout using conduit fitting as well as suppressor mounting brackets, feet, holes, or other mounting means provided.
- Assure weatherproof conduit and fittings are used to maintain NEMA 4 (IP66) or 4X rating when required
- Mount suppressor to ensure shortest and straightest possible conductor length is used from suppressor to circuit interrupt device to the system bus bar. Twist or bind conductors as much as possible.

NOTE: If installing suppressor on system other than electrical panel, mount the suppressor in close proximity to the system being protected using necessary means for mounting. **A circuit interrupt device is still required when installing on a system other than an electrical panel** (not applicable to Fused (L or D) models).

STEP 3: Wire suppressor into electrical system

- Measure and cut conductors (wires) to ensure length is adequate while keeping conductors as short as possible for optimum suppressor performance.

NOTE: If Suppressor does not have wires provided by the factory, obtain wires as specified in the **Product Identification and Installation Requirements Table.**

- Connect Green Ground (Earth) wire to the system Ground (Earth) bus bar. (For systems utilizing isolated grounds, please see "Isolated Ground" bullet in the Before Installation section of these instructions).
- Connect White Neutral wire to the system Neutral bus bar.
- Connect Phase wire(s) to system Phase(s), one phase wire per each phase, via the circuit interrupt device.

STEP 4: Verification and power up

- Verify installation is complete as per these instructions and applicable codes and regulations.
- Once verified and lid is closed securely, apply power to device. LEDs should be glowing and alarm contacts should move to normal state. If light(s) do(es) not glow, remove power and contact supplier.
- Suppressor is equipped with two sets of contacts. One set (labeled N/O) is normally open and the other (labeled N/C) is normally closed with power applied. Contacts are rated at 60W or 100VA maximum voltage is 150VDC or 220VAC and 2Amps maximum. Connections may be used for remote alarm hook up.

TRANSIENT VOLTAGE SURGE SUPPRESSORS
MANUFACTURED BY
INNOVATIVE TECHNOLOGY, INC.
15470 Flight Path Drive, Brooksville, Florida 34609 USA
A DELTA COMPANY
SURGE SUPPRESSION LEADER ...BY DESIGN

PRODUCT IDENTIFICATION AND INSTALLATION REQUIREMENTS TABLE

MODEL FAMILY	CIRCUIT INTERRUPT DEVICE	CONDUCTOR/WIRE SIZES **NOTE 1: Wires should be sized in accordance with U.S. National Electrical Code Paragraph 240-21 (b), Exception 5 or d; or, other applicable country code. THHN, THWN-TEW or better is acceptable.**
EQX	20 amp – Class RK5 fuse(s); or 20 amp circuit breakers	PROVIDED WITH PRODUCT
XT40; PTE048; PTX048; PTE080; PTX080; PTE160; PTX160	30 amp – Class RK5 fuse(s); or 30 amp circuit breakers	PROVIDED WITH PRODUCT
Fused (L or D) PTE048; PTX048; PTE080; PTX080; PTE160; PTX160	VSP-40 fuse(s) – PROVIDED WITH PRODUCT	#6AWG rated minimum 90 degrees centigrade. Ground and Neutral terminal studs use #10 ring lug.
PTE320; PTX320	60 amp –Class RK5 fuse(s); or 60 amp circuit breakers	#6AWG rated minimum 90 degrees centigrade. Ground and Neutral terminal studs use #10 ring lug.
Fused (D) PTE320; PTX320	VSP-40 fuse(s) – PROVIDED WITH PRODUCT	#6AWG rated minimum 90 degrees centigrade. Ground and Neutral terminal studs use #10 ring lug.
PTE640; PTX640	100 amp – Class RK5 fuse(s); or 100 amp circuit breakers	Neutral and Ground Terminal lugs take #6AWG to #1/0AWG wire sizes. Disconnect switch Terminal lugs take #6AWG to #1AWG wire sizes.
Fused (D) PTE640; PTX640	60 amp – Class RK5 fuse(s) – PROVIDED WITH PRODUCT	Neutral and Ground Terminal lugs take #6AWG to #1/0AWG wire sizes. Disconnect switch Terminal lugs take #6AWG to #1AWG wire sizes.

TO DISABLE NEUTRAL-GROUND ATN ENHANCEMENT IF NECESSARY...

ENSURE THAT NO AC POWER IS BEING APPLIED TO THE MODEL

REMOVE AC POWER

All PTE Models come from the factory with an ATN filter circuit between N-G (Neutral - Ground/Earth). This filter circuit should be disabled if the model is connected to a panel feeding medical patient care equipment or containing a ground fault circuit interrupting (GFCI) main breaker.

PTE048, 080, 160 - Carefully open front cover. Look down into the model and locate the loop of wire coming in and out of the encapsulation. Use diagonal wire cutter and carefully cut the wire in the center of the loop. Cap off both wire ends with UL listed wire nuts. Reinstall cover and install product.

PTE320 & 640 - Carefully open front cover and locate the exposed green circuit board. Find the letter "G" on the circuit board. Find the black component next to the marking "R7". Use diagonal wire cutter and cut out the black component by cutting the 2 wires emanating from the black component. Discard the black component. Reinstall cover and install product.

These procedures will only disable the enhanced N-G circuit. Other protection circuits will not be affected by this procedure.

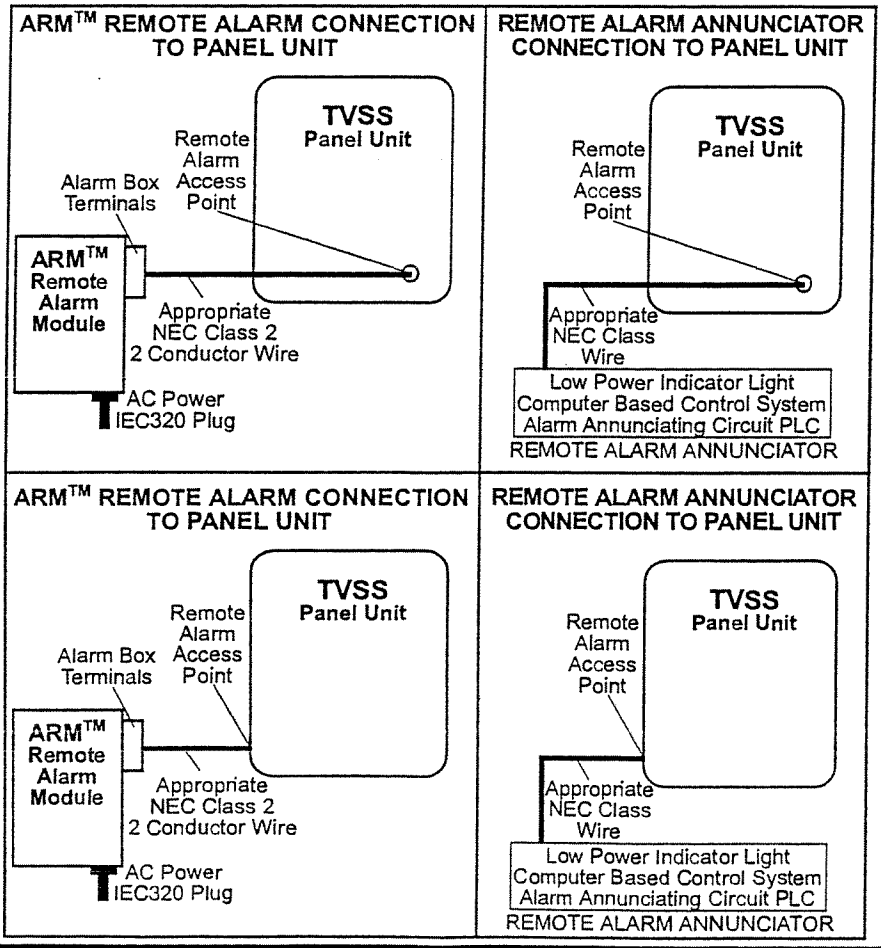
TRANSIENT VOLTAGE SURGE SUPPRESSORS
MANUFACTURED BY
INNOVATIVE TECHNOLOGY, INC.
15470 Flight Path Drive, Brooksville, Florida 34609 USA
A DELTA COMPANY
SURGE SUPPRESSION LEADER ...BY DESIGN

TO UTILIZE SUPPRESSOR "FORM C" (VOLT FREE) CONTACTS FOR REMOTE ALARM

1. Assure power is removed.
2. Open or remove suppressor lid. Take care to support the cover to prevent damage to the indicator light circuit board and wiring when removing and manipulating lid.
3. Punch clearance hole through overlay access point and install provided watertight strain relief such as Altech #225-A00 (Part No. SR011). If side, top or bottom location is required, punch or drill 0.5" (12.7mm) diameter hole, centered at 1.125" (28.5mm) from the lip of the box (lid open/removed) in a place not interfering with the lid clamps, and install the strain relief.Caution should be taken to capture and remove all metal shavings during drilling process to avoid a possible short circuit condition.

NOTE: Suppressor is equipped with two sets of contacts. One set (labeled N/O) is normally open and other (labeled N/C) is normally closed with power applied. Contacts are rated at 60 W or 100 VA, max. voltage = 150VDC or 220VAC and 2A max. Connections may be used for alarm hook up. The terminal labeled "COM" is common to both N/O and N/C contacts.

4. Connect suppressor alarm circuit(s) to Normally Open (N/O) or Normally Closed (N/C) terminals as required.
5. Alarm contacts take AWG #26 (0.13mm^2) to #16 (1.3mm^2) wire. Assure appropriate U.S. NEC (or other applicable country code) class wire is used to coordinate with power supply wire. Follow rules of wiring class used when determining routing of alarm leads. To maintain NEMA 4 (IP66) rating use appropriate cable and watertight strain relief.
6. Reconnect indicator pigtails, color to color. Close or replace and tighten lid.
7. Connect suppressor alarm contact wire(s) to Alarm Remote Module or annunciator device. Follow applicable U.S. NEC Articles (or other applicable country code) for cable type selection.
8. Apply power to system. Indicator light(s) on suppressor should glow and alarm contacts should move to normal state, If light(s) do(es) not glow, remove power and contact supplier.
9. To install **Optional** Alarm Remote Module (ARM-3) Part No. ZARM-003, see installation instructions shipped with ARM-3.



**Item#16-Phase Monitor, Adjustable, SSAC, RLM-911

SSAC INSTALLATION INSTRUCTIONS

RLM Series — 3-Phase Line Monitor

PROTECTS MOTORS FROM:

- **Phase Reversal (Incorrect Phase Sequence)**
- **Single Phasing (Loss of One Phase)**
- **Low Voltage**
- **Voltage Unbalance**

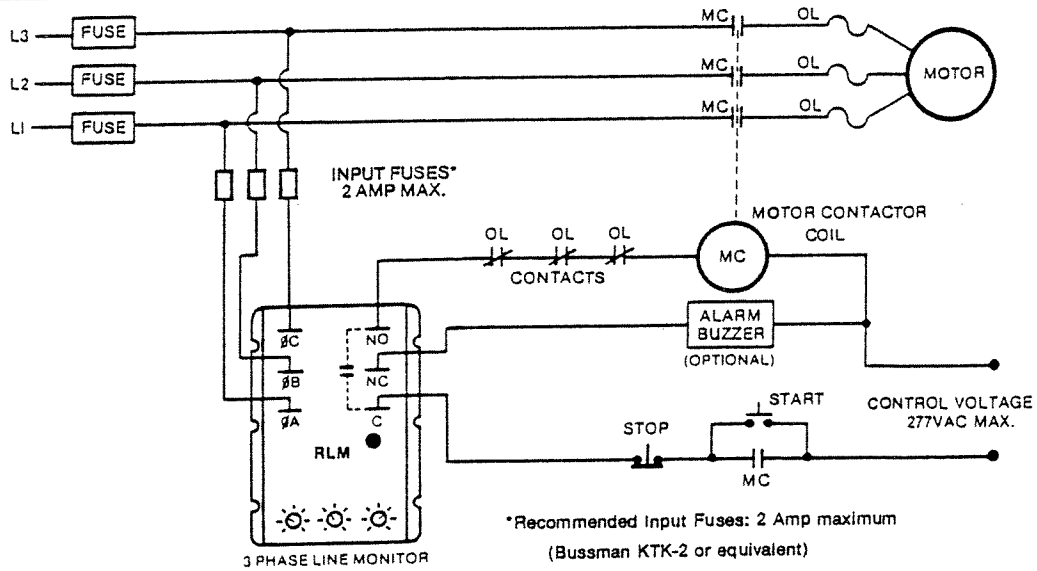
OPERATION: The output relay is energized and the LED glows when all voltage parameters are acceptable and the phase sequence is correct. The relay and the LED de-energize immediately when phase reversal or single phasing is sensed. If low voltage or voltage unbalance is sensed for a full trip delay, the relay and LED will be de-energized. The relay and LED are re-energized automatically upon correction of the fault condition.

CAUTION: Disconnect all voltages before making connections.

MEASURE LINE VOLTAGE TO ENSURE IT IS CORRECT FOR THE EQUIPMENT TO BE OPERATED.

1. Securely mount the RLM Monitor in the equipment control enclosure. #16 gauge, 600 volt wire is suggested for all connections.
2. Set the line voltage knob at the measured line voltage. This adjustment automatically sets the low voltage trip point.
3. Set the voltage unbalance knob at 6%. If the knob is not present, the RLM has been factory fixed. (See Part Numbering Information).
4. Set the trip delay knob at 11 seconds. If the knob is not present, the RLM has been factory fixed. (See Part Numbering Information).
5. Connect the RLM terminals ØA, ØB, ØC to L1, L2, L3 respectively. A typical connection point is between the fuse and the motor contactor contacts. (See Typical Connection Diagram).
6. Apply line voltage. The LED indicator should light and remain ON. If the LED fails to light, a fault condition(s) exists and must be corrected. Switch any two connections on the RLM terminals ØA, ØB, or ØC to correct for phase reversal. A slight counter-clockwise adjustment of the line voltage knob will lower the low voltage trip point. Measuring the line-to-line voltages at the RLM terminals ØA, ØB, and ØC will identify single phasing or voltage unbalance faults. Consult a qualified electrician to correct voltage unbalance conditions in the 3-phase supply.
7. After the unit has been properly connected and the line voltage adjusted, the voltage unbalance and trip delays can be adjusted to agree with the equipment manufacturer's requirements. The trip delay must be longer than the motor start time.
8. Connect the output relay contacts to the equipment's control circuitry. Connecting the relay contacts to control voltages greater than 277VAC is not recommended. The contacts are rated 8 amps resistive at 240VAC.

TYPICAL CONNECTION DIAGRAM DELTA OR WYE SYSTEMS (No Neutral Connection)



PART NUMBERING SYSTEM

Example: **RLM 6 1 1**

Series	Operating Voltage	Voltage Unbalance	Trip Delay
RLM	6 — 200-240VAC	1 — Adjustable 2 to 6%	1 — Adjustable 2 to 20 Seconds
	†8—360-430VAC 9—400-480VAC	(†Adjustable 2 to 8%) Fixed: 4, 5, 6, 7, or 8%	Fixed 2 to 20 Seconds

SSAC INC
PO Box 1000, Baldwinsville, NY 13027 Application Assistance 800-377-SSAC (7722)
Internet Address http://www.ssac.com Phone (315) 638-1300 Fax (315) 638-0333

**Item#28-Intrinsically Safe Relay(Transducer), Stahl, 9002/13-280-110-00

INTRINSPAK

Installation Instructions
Series 9000 Intrinspak® Intrinsic Safety Barriers

General Description
The Series 9000 Intrinspak® Intrinsic Safety Barriers are designed to provide intrinsically safe connections to process sensors located in potentially hazardous locations. These sensors may be either approved Intrinsically Safe Apparatus such as solenoid valves and transmitters, or Simple Apparatus such as RTDs, thermocouples, and LED indicators. Reference should be made to the process sensor manufacturer's documentation and the R. Stahl Certification Drawing indicated below.

Electrical Characteristics

Rated Voltage	Refer to RST49 Product Catalog
Rated Current	Refer to RST49 Product Catalog
Internal Resistance	Refer to RST49 Product Catalog
Replaceable Fuse Rating	160mA (one per channel on Type 9002)
Pole Reversal Protection	Protected by replaceable fuse
Current Limitation	
Type 9001	Resistive
Type 9002	Resistive
Type 9004	Electronic

Transmission Characteristics

Leakage Current	≤ 1µA unless stated otherwise
Temperature Effect	≤ 0.25%per 10K
Short Circuit Proof	Yes, unless stated otherwise
Frequency	
Type 9001	≤ 100kHz @ I_{sc} > 50mA
	≤ 50kHz @ I_{sc} ≤ 50mA
Type 9002	≤ 100kHz @ I_{sc} > 50mA
	≤ 50kHz @ I_{sc} ≤ 50mA
Type 9004	≤ 10kHz

Vibration Resistance

Vibration Frequency	55Hz
Vibration Amplitude	± 0.006in. (± 1.5mm)
Shock Resistance	20g

Ambient Conditions

Operating Temp. Range	-4° to +140°F (-20° to +60°C)
Storage Temp. Range	-40° to +167°F (-40° to +75°C)
Relative Humidity Range	to 95%, no condensation

Grounding Method
Electrical connection is made between barrier and mounting platform (NS35/15 DIN rail). This mounting platform must be connected to designated ground electrode. Two additional terminals are provided for grounding each barrier and for termination of shielded cable.

Mounting Method	NS35/15 DIN Rail
	A1-0006 Universal Busbar
	A1-0004 Busbar
	Surface Mount

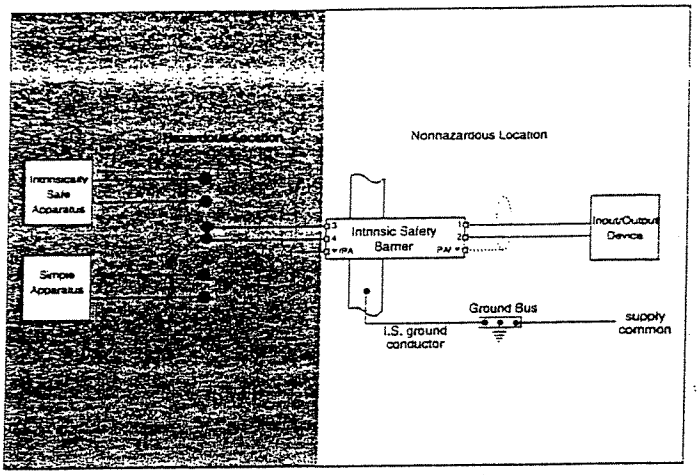


Figure 1. Application of Series 9000 Intrinspak® Intrinsic Safety Barriers

Mounting Location
Nonhazardous or Class I, Div. 2 location.

Mechanical Specifications

Housing Material	Polyamide
Degree of Protection	IP40 to IEC 529
Flame Resistance	
Self extinquishing to IEC924, UL94, ASTM D635-77	
Weight	0.22 lbs. (100 grams)
Screw Terminal Size	
Four #12 AWG (1.5mm²) captured, self-opening	
Two #10 AWG (4.0 mm²) for ground and shield	
Screw Terminal Material	
#12 AWG Terminals	Copper-Zinc alloy
#10 AWG Terminals	Copper-Tin alloy

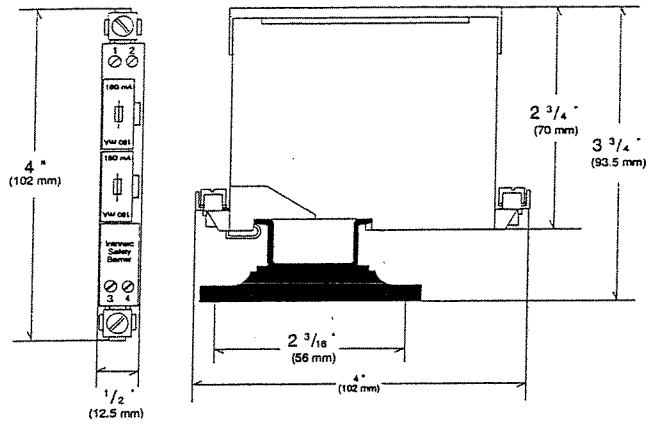
Certification Drawing

Type 9001	90 016 01 31 0 (specify agency)
Type 9002	90 026 01 31 0 (specify agency)
Type 9004	90 046 01 31 0 (specify agency)

Test Certificates

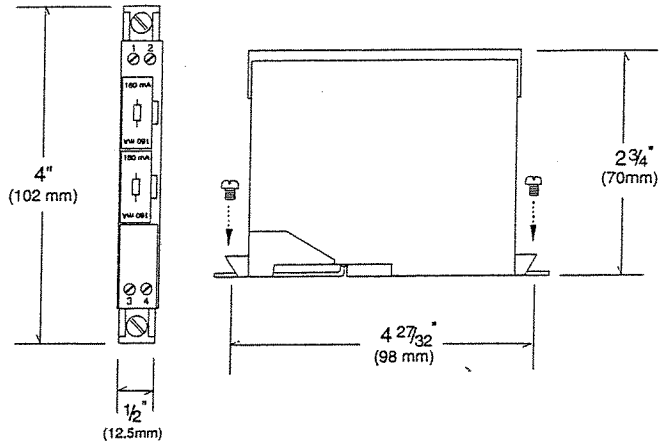
FM	
Type 9001	FM 3610 (J.I. 3T9A1.AX)
Type 9002	FM 3610 (J.I. 3T9A2.AX)
Type 9004	FM 3610 (J.I. 3T9A3.AX)
PTB	
Type 9001	EN 50014/ 50 020(Ex-91.C.2046X)
Type 9002	EN 50 014/50 020(Ex-91.C.2045X)
Type 9004	EN 50 014/50 020(Ex-92.C.2013X)
UL	
Type 9001, 9002, 9004	UL913 (E 81680)
CSA	
Type 9001, 9002, 9004	CSA 22.2 No. 157 (LR43394)
SA	
Type 9001	AS 2380 (Ex-1464X)
Type 9002	AS 2380 (Ex-1473X)
Type 9004	AS 2380 (Ex-1480X)
MSHA	
Type 9001, 9002, 9004	(Consult R. Stahl)
JIS	
Type 9001, 9002, 9004	(applied for)

Figure 2. Mounting and Dimensional Information



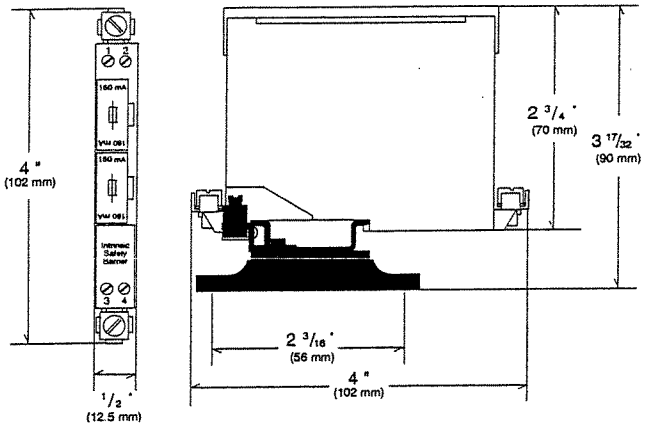
NS35/15 DIN Rail Assembly

The Series 9000 is designed to mount directly to an NS35/15 DIN Rail Assembly available from R. Stahl. This assembly consist of a user specified length of DIN rail, SSO-002 insulated standoffs- at 12" intervals, and two USLKG-4Ex ground terminals. Each barrier requires 1/2" of rail space. Once mounted, this rail becomes the ground bus for all barriers mounted on that rail. A 12 AWG or larger ground wire should be taken from the USLKG-4Ex to the designated ground point.



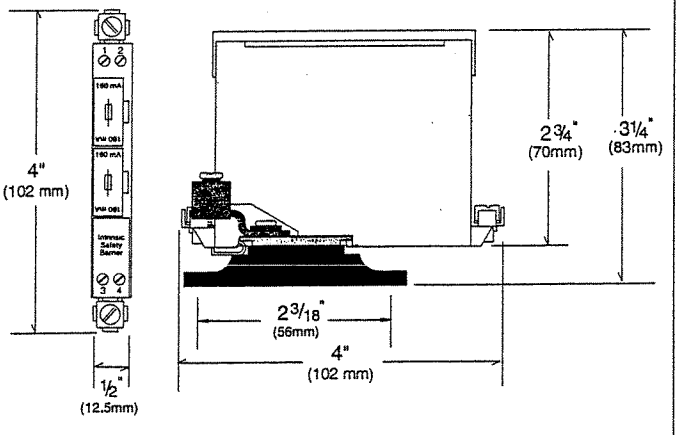
Surface Mount

The Series 9000 may be mounted directly to a PCB or other flat surface with the use of the factory installed MBA-001 adapter.



A1-0004 Busbar Assembly

For installations that use the A1-0004 Busbar Assembly, an adapter is required for mounting the Series 9000. It consists of a user specified length of A1-0002 busbar, SSO-002 insulated standoffs- at 12" intervals, and two SLU-35 ground terminals. This busbar becomes the intrinsic safety ground bus and should be grounded at the designated grounding point.



A1-0006 Universal Busbar

For installations that use the A1-0006 Busbar Assembly, no adapter is required for mounting the Series 9000. This busbar is specially machined to allow direct mounting of the Series 9000 as well as all previous series of R. Stahl barriers. It consists of a user specified length of A1-0005 busbar, SSO-002 insulated standoffs- at 12" intervals, and two SLU-35 ground terminals. This busbar becomes the intrinsic safety ground bus and should be grounded at the designated grounding point.

Fuse Assembly Replacement

All Series 9000 Intrinspak® Intrinsic Safety Barriers are equipped with standard replaceable 160mA fuses. They are located on the top face of the barrier for easy access. With a small instrument screwdriver, simply pry off the protective cover where indicated and remove the assembly. This may be done even while the circuit is energized. To install the replacement assembly, simply snap it back into place.

Spare Parts and Accessories

NS35/15	DIN Rail *specify length in inches*
011239	Fuse assembly(160mA)
SFH-001	Spare Fuse Holder *includes 5 fuses*
029959	Loop I.D. Tag Holder
022297	Loop I.D. Tag Paper
022231	Adapter
871646	Adapter, Metal
881109	Adapter, Plastic
821470	Ground Terminal, 12 AWG
821488	Ground Terminal, 10 AWG
SSO-002	Standoff, Insulator
ISL-001	Label, 5" DIA, "I.S. System"
ISL-002	Label, 3.5" DIA, "I.S. System"
ISL-003	Label, Cable Tray, "I.S. Wiring"
ISL-004	Label, Conduit, "I.S. Wiring"
ISL-005	Label, Ground, "I.S. Wiring"

Wiring Instructions

All Series 9000 Intrinspak® Intrinsic Safety Barriers have six terminals. Terminals (3) and (4) are the intrinsically safe connections. Devices in the hazardous location are connected to these terminals. Terminals (1) and (2) are the nonintrinsically safe connections for devices within the nonhazardous location. The maximum source voltage which could be applied to these terminals under a fault condition must not exceed 250V rms.

Along with the four terminals mentioned above, two additional screw terminals are provided, one on each side of the barrier. They are directly attached to the barrier mounting/grounding system and can be used to establish a redundant ground system or for terminating shields. On single channel barriers (Type 9001) they are also internally connected to terminals 2 and 4.

Since a common housing is shared between single, dual, and application dedicated barriers, refer to the schematic printed on the side of each barrier to determine the designation of the floating and grounded terminals.

Special attention must be given to the grounding system. Without a proper earth ground system, intrinsic safety barriers will not provide voltage protection. They must therefore be grounded to a designated grounding electrode which references the original power source and instrumentation within the nonhazardous location. The ground conductor shall be no smaller than a #12 AWG size wire and the ground path resistance from the farthest barrier to this ground point shall not exceed 1Ω.

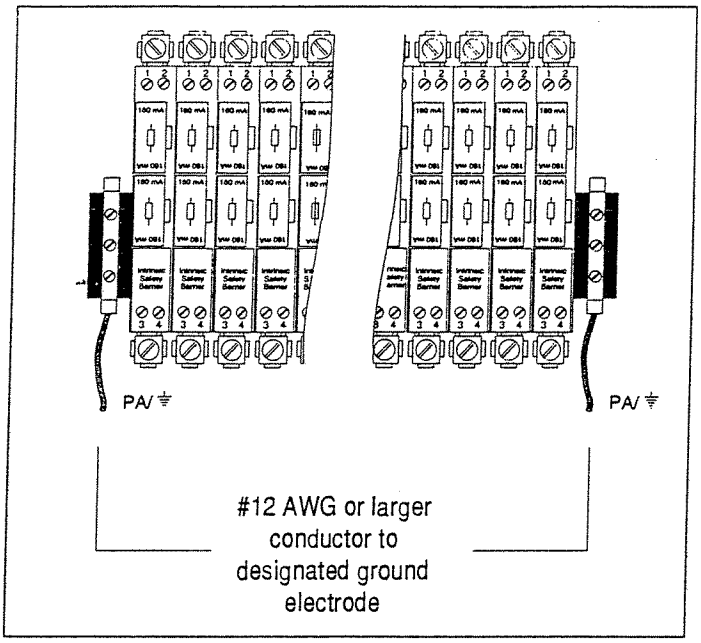


Figure 3. Typical grounding arrangement of Series 9000 Intrinspak® Intrinsic Safety Barriers

Installation of Intrinsically Safe Systems

It is important that the installer of an intrinsically safe system reference the requirements of the "authority having jurisdiction" at the installation site. In the United States reference should be made to Article 504 of the National Electrical Code, the ISA RP 12.6 and the manufacturer's certification drawing.

Where possible, associated apparatus should be mounted and grounded in a safe area as near to the hazardous area as possible. This will minimize the length of intrinsically safe conductors within the nonhazardous location, thereby lessening the possibility of inadvertent connection of nonintrinsically safe energy to the protected circuit. R. Stahl recommends that associated apparatus be mounted and installed within dust and moisture free enclosures. While this requirement is not part of any referenced standard it should be remembered that dust and moisture are conductive and can lessen the required distance (≥ 2" or 50 mm) between intrinsically safe and nonintrinsically safe conductors. In addition, the panel layout of these enclosures should be constructed so that the separation of intrinsically safe and nonintrinsically safe conductors is maximized.

In cases where it is necessary or desired to mount associated apparatus within a Division 1 hazardous location they must be placed within an enclosure suited for that environment, i.e., explosionproof or purged. In such instances, the requirements relative to those systems and installations must be adhered to. For installation within a Division 2 hazardous location reference should be made to the approval report of the respective testing agency.

It should always be remembered that whether it is in the nonhazardous location or within the hazardous location, intrinsically safe wiring must be installed, maintained and repaired with consideration to the following:

- Nonintrinsically safe wiring must never be connected to the intrinsically safe terminations of any associated apparatus, usually identified with blue.
- Intrinsically safe wiring should enter or leave the nonhazardous location by the shortest and most direct route.
- A clearance distance of at least 2 inches (50 mm) must be reliably maintained between any nonintrinsically safe conductors and any intrinsically safe wiring or terminations.
- Raceways should be used to keep intrinsically safe wire and nonintrinsically safe wire separated. Wire lacing or ties are acceptable as well.
- Intrinsically safe conductors must be identified, either by color coding with light blue jacketed cable, or by tagging at regular intervals, which the NEC identifies as every 25 feet.

Maintenance

The condition of associated apparatus should be checked periodically. During these inspections any accumulated dust, moisture or corrosion should be removed to ensure good conductor to terminal conductivity. The 2 inch minimum distance between intrinsically safe and nonintrinsically safe conductors should be verified. Terminal connections which may have loosened due to vibration should be checked, especially in the ground bus. As cited previously, the ground bus should be regularly maintained, and in all probability, more frequently than the intrinsic safety barriers themselves.

Pre-startup of Intrinsically Safe Systems

Verify the following:

- The selected associated apparatus connections are suited for the hazardous location to which the intrinsically safe wiring has been connected.
- The ground connection is less than 1 Ω in installations using intrinsic safety barriers.
- No electrical equipment with a primary source voltage in excess of 250 V is connected within the intrinsically safe control system. This includes energy which is being switched through relays within the intrinsically safe circuit (s).
- The voltage source to each associated apparatus does not exceed its maximum voltage rating.
- The 2 inch minimum distance between intrinsically safe and nonintrinsically safe wiring is maintained.
- All intrinsically safe wiring has been appropriately color coded or tagged.
- All intrinsically safe apparatus (field devices) which require approvals and/or certifications have been evaluated by appropriate agencies to the requirements of the authority having jurisdiction over the installation.

Troubleshooting Resistive Intrinsic Safety Barriers

In the event that an intrinsically safe circuit, after installation or after operation for a period of time ceases to function, a number of steps may be taken to identify and solve the problem. The following steps will assist the user in identifying problems should they appear:

- Make sure that the circuit is powered.
- Recalculate the circuit load and voltage drops to identify any overloading problems.
- Make sure that any electrical equipment which may have been added to the circuit has not created a loading problem.
- Remove the intrinsically safe lead(s) from the associated apparatus and perform a resistance test with an ohmmeter to insure the fuse has not open-circuited due to higher than maximum voltage or polarity reversal having been applied to it. In the case of a voltage spike or surge be certain it is transient in nature before replacing any fuse. Blown fuses are not covered under any warranty.
- If the circuit is still inoperative, remove the associated apparatus from service and reconstruct the circuit within a nonhazardous location. If the circuit operates, inspect all field wiring to insure no open-circuits, short-circuits or ground faults are present within the circuit. If the circuit does not operate within the reconstructed circuit remove the intrinsic safety barrier(s) from ground. This will prevent the zener diodes from conducting. Should the circuit then begin to operate, contact R. Stahl for further assistance.
- If the intrinsic safety barrier is not a resistive type, and a problem is suspected, please consult R. Stahl for testing parameters.

STAHL
R. Stahl, Inc.
45 Northwestern Drive • Salem, NH 03079-4809
800-782-4357 in the U.S. and Canada
Tel: 603-870-9500, Fax: 603-870-9290 • e-mail: sales@rstahl.com

INSTALLATION AND OPERATING INSTRUCTIONS
ARA SERIES
THREE AND FOUR LOAD ALTERNATING RELAYS

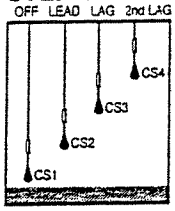
BE SURE POWER IS SHUT OFF PRIOR TO INSTALLING ALTERNATING RELAY!!

1. Follow all Local, State, and National Electrical Codes when installing this equipment.
2. Mount the unit in or near the control panel of the equipment to be sequenced.
3. Connect wire from the fused L1/L2 line voltage to terminals 1 and 2.
4. For additional wiring, refer to Figs. 1 for ARA-XXX-AFE (Triplexor). If you are installing model ARA-XXX-AGE (Quadraplexor), go to the reverse side of this sheet for wiring. Refer to Figs. 2 and continue with instructions 5A, 6A.
5. For Triplexor automatic alternations, a factory installed jumper is in place between terminals 3 and 4. The alternating action is accomplished when the control switch between terminals 2 and 4 opens. Terminal 4 must go to 0 V for proper sequencing to occur. Therefore, Solid State Switches are not recommended for control switch inputs because of their "off sate" leakage voltage potential.
6. For Triplexor external clocking alternations, remove the factory installed jumper and place an isolated normally open switch between terminals 2 and 3. The alternating action will occur each time this isolated switch is closed and then reopened.

***Item#39-Triplex Alternating Relay, Diversified, ARA-120-AFE*

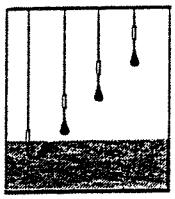
3 PUMP, 4 SWITCH OPERATION

STEP 1



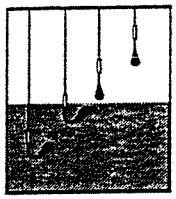
This example illustrates the normal operation of the Alternator in a pump down application with four normally-open-dry float switches. The switches are numbered CS1-CS4 and designate the off, lead, lag and 2nd lag. The example begins with switches open and all loads de-energized.

STEP 2



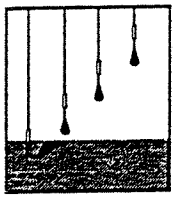
As the fluid level rises CS1 closes. No loads are energized.

STEP 3



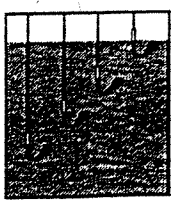
If the fluid level continues to rise CS2 closes and load M1 energizes closing the auxiliary M1 contact.

STEP 4

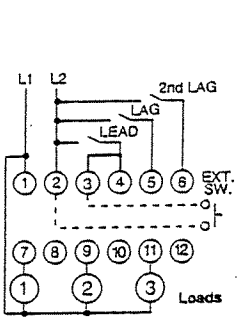


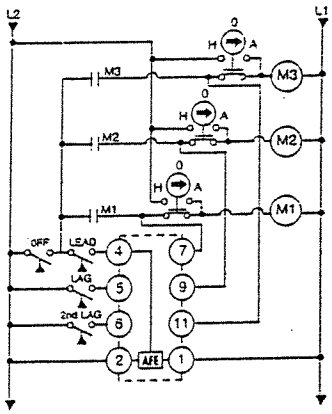
As the level falls CS2 opens, load M1 remains energized through the auxiliary contact M1.

STEP 5



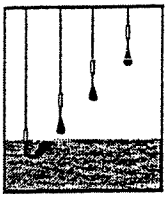
Assuming that the level did not fall but continued to rise, closure of CS3 will energize load M2 and closure of CS4 will energize load M3.





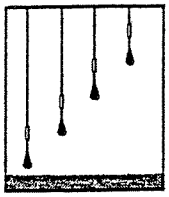
Figs. 1

STEP 6



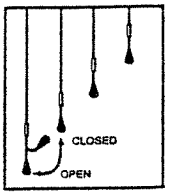
As the fluid level falls below each successive float, the loads M1-3 remain energized through their respective auxiliary contacts.

STEP 7



When CS1 opens all loads de-energize and the Alternating Relay toggles to Position #2 thus enabling M2 to become the lead load upon the next closure of CS2.

STEP 8



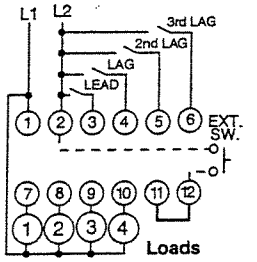
Each successive rise and fall in fluid level that allows the closing and opening of CS1, toggles the lead load position controlled by CS2 as follows: 1-2-3, 2-3-1, 3-1-2, 1-2-3, etc.

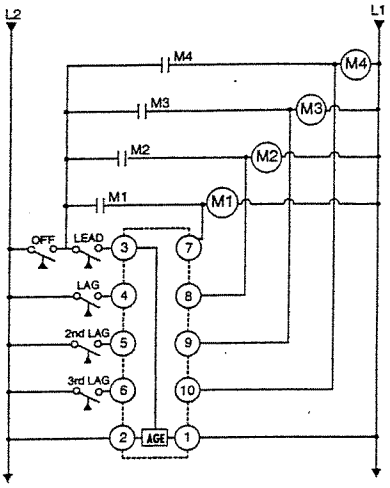
INSTALLATION AND OPERATING INSTRUCTIONS (CONT'D)

5a. For Quadraplexor automatic alternations, a factory installed jumper is in place between terminals 11 and 12. The alternating action is accomplished when the control switch between terminals 2 and 3 opens. Terminal 3 must go to 0 V for proper sequencing to occur. Therefore, Solid State Switches are not recommended for control switch inputs because of their "off state" leakage voltage potential.

6a. For Quadraplexor external clocking alternations, remove the factory installed jumper and place an isolated normally open switch between terminals 2 and 12. The alternating action will occur each time this isolated switch is closed and then reopened.

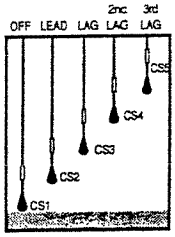
Figs. 2





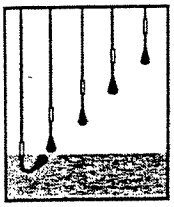
4 PUMP, 5 SWITCH OPERATION*

STEP 1



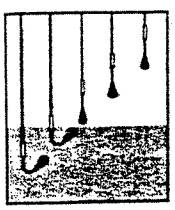
This example illustrates the normal operation of the Alternator in a pump down application with five normally-open-dry float switches. The switches are numbered CS1-CS5 and designate the off, lead, lag, 2nd lag, and 3rd lag. The example begins with switches open and all loads de-energized.

STEP 2



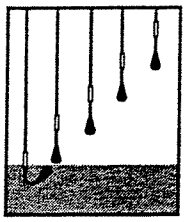
As the fluid level rises CS1 closes. No loads are energized.

STEP 3



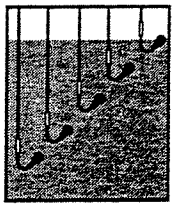
If the fluid level continues to rise CS2 closes and load M1 energizes closing the auxiliary M1 contact.

STEP 4



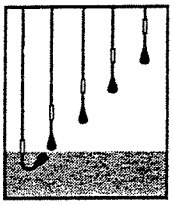
As the level falls CS2 opens, load M1 remains energized through the auxiliary contact M1.

STEP 5



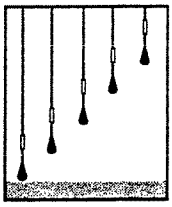
Assuming that the level did not fall but continued to rise, closure of CS3 will energize load M2. Closure of CS4 will energize load M3. Closure of CS5 will energize load M4.

STEP 6



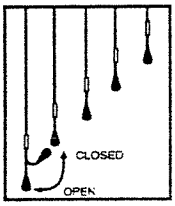
As the fluid level falls below each successive float, the loads M1-4 remain energized through their respective auxiliary contacts.

STEP 7



When CS1 opens all loads de-energize and the Alternating Relay toggles to Position #2 thus enabling M2 to become the lead load upon the next closure of CS2.

STEP 8



Each successive rise and fall in fluid level that allows the closing and opening of CS1 toggles the lead load position controlled by CS2 as follows: 1-2-3-4, 2-3-4-1, 3-4-1-2, 4-1-2-3, 1-2-3-4, etc.

* H-O-A switches may be wired as shown in Figs. 1.

DIVERSIFIED ELECTRONICS
1511 EAST MAIN STREET Toll Free (800) 874-0619
LEESBURG, FL 34748-5336 Fax (352) 787-8798

ENGLISH

MOTOSAFE™ MONITOR TYPE M-603-IND: INSTALLATION

IMPORTANT: READ THE FOLLOWING INSTRUCTIONS BEFORE INSTALLING THE MONITORI

The MOTOSAFE device continuously monitors the insulation resistance of idle machines to provide early warning of insulation deterioration. It withstands test voltages up to 1000V.

INSTALLATION

Disconnect power from the starter unit.

Install the mounting bracket close to the starter enclosure hinges using the screws supplied. Clip the monitor unit securely to the mounting bracket. If required, and where regulations permit, install the long life flashing alarm lamp (supplied) on the starter enclosure front panel close to the hinges and affix the self-adhesive warning label around the lamp.

Connect terminals 1 & 2 to the specified supply (control) voltage. Connect terminals 6 & 8 to any two phases on the load terminals of the main contactor (or the final running state contacter for other than direct-on-line starters). Connect terminal 3 to ground.

Terminals 9 & 10 are normally closed (may be used for start prevention). Terminals 4 & 5 are normally open (may be used for the supplied local alarm light).

INITIAL TEST PROCEDURE

Connect any of the motor phases to ground momentarily via the supplied test resistor. The red L.E.D. should light and the external alarm circuit become activated after a delay of 5-10 seconds. Reset the monitor by pressing the Reset button.

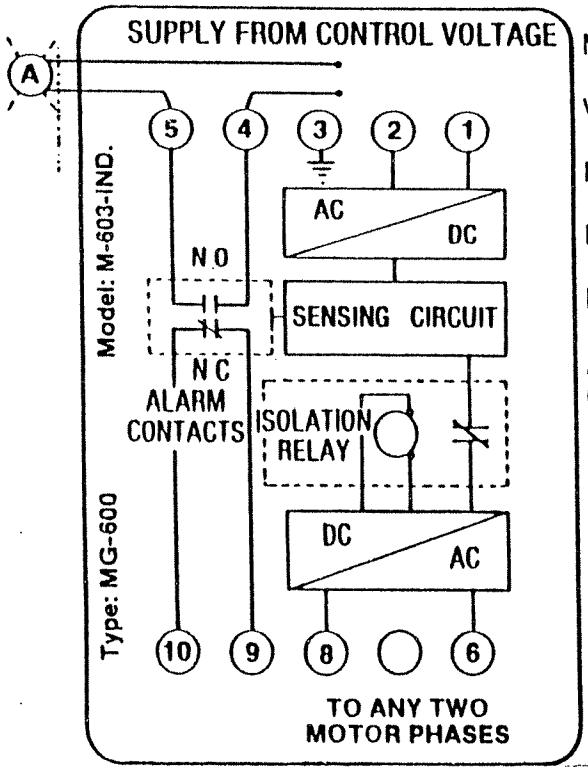
Repeat with the two other phases.

Start the motor. If the red L.E.D. lights while the motor is running, check connections of terminals 6 & 8 to motor phases, as instructed above.

Motor monitoring is now automatic. Correct operation may be checked by holding the TEST button down and establishing that the alarm operates within 10 seconds.

Alarm Setting Switch. Three settings available. Recommended position 5 MEG. However, if still in alarm at 1 MEG - call for service!

GENERAL SPECIFICATION



Max Power: 5 VA

Voltage: 115/220VAC. ±20% (*)

Frequency: 50/60 Hz. ±10%

Measuring Voltage: 12 VDC

Max. Measuring Current: 30μA

Alarm Contact Rating: 5 A (250 VAC, Resistive Load)

Dimensions in inches & millimetres:

4.4" L x 1.77"W x 2.67"H

112mm L x 45mm W x 68mm H

*D.C. control power available. Consult factory

NOTE: DISCONNECT POWER FROM THE STARTER ENCLOSURE IF HIGH VOLTAGE INSULATION TEST IS REQUIRED.

***Item#41-Motor Megger, MSE, M603IND-120*

**Item#42-Intrinsically Safe Relay(Floats), Diversified, ISO-120-ACE

INSTALLATION INSTRUCTIONS FOR MULTI-CHANNEL ISOLATED SWITCHES

Installation must comply with all local, state, and national codes!
WARNING: Improper installation of these units may result in serious injuries or damages!

These instructions are a guide to the proper installation and start-up of systems employing multi channel Isolated Switches. Please read them completely before starting.

The ISO-XXX-AAE/-ABE/-ACE and ISL-XXX-AAE/-ABE/-ACE are UL Listed Associated Apparatus (UL913, File E151578). An associated apparatus is a device which provides an electrical interface between a location made hazardous by the presence of a flammable or explosive substance and a non-hazardous location. The Isolated Switches themselves must be installed in a non-hazardous location. Only the wiring connected to terminals one through six is intrinsically safe.

Due to the potential explosion hazard, special wiring methods must be used to prevent intrinsically safe wiring from contacting non-intrinsically safe wiring. The special wiring methods can be found in *National Electrical Code ANSI/NFPA 70*, Article 504–Intrinsically Safe Systems. Check your local and state codes for additional requirements. Design and wiring of intrinsically safe systems should only be performed by persons familiar with local, state, and national codes including the articles of the NEC pertaining to hazardous locations (Articles 500 through 517).

REMOVE POWER FROM SYSTEM PRIOR TO INSTALLATION!

1. Mount the Isolated Switch in the control panel of the equipment to be controlled. The Isolated Switch must be installed in a non-hazardous location. Refer to the drawing on the back of this sheet for mounting dimensions.

2. Connect wiring to terminals seven through twelve as shown in DEI Control Drawing 193 on the back of this sheet.

3. Verify operation of the loads. The loads will energize one at a time for this test. Ensure that operation of the loads will not damage any equipment or cause any personal injury.
   A. Apply power to the Isolated Switch.
   B. Temporarily connect a test wire to terminal one.
   C. Momentarily touch the other end of the wire to terminal three. Output one will energize momentarily.
   D. Repeat step C on terminals four through six as necessary to test the remaining outputs.
   E. Remove the test wire from the unit.

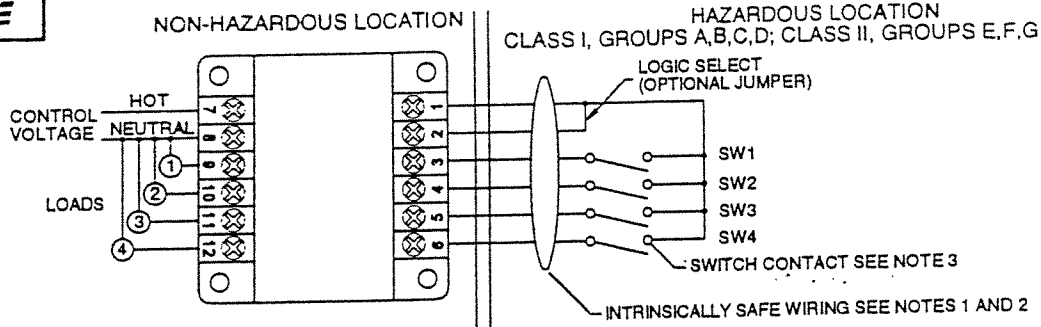
4. Remove power from system.

5. If using normally closed switches, install a jumper from terminal one to terminal two.

6. Connect remaining wiring to terminals one through six.
   - All wiring connected to terminals one through six must comply with local and state code requirements, the requirements of NEC, Article 504–Intrinsically Safe Systems, and DEI Control Drawing 193.
   - Voltage and current for the switch contacts are supplied by the Isolated Switch. Do not connect any external power supplies to terminals one through six.

7. Apply power to start normal operation of the Isolated Switch.

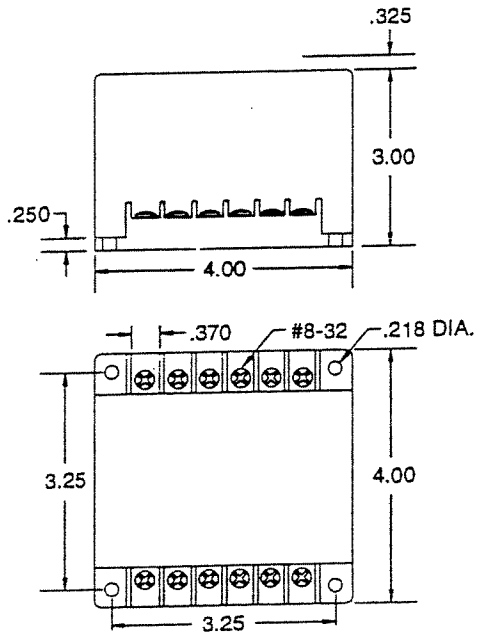
CONTROL DRAWING 193



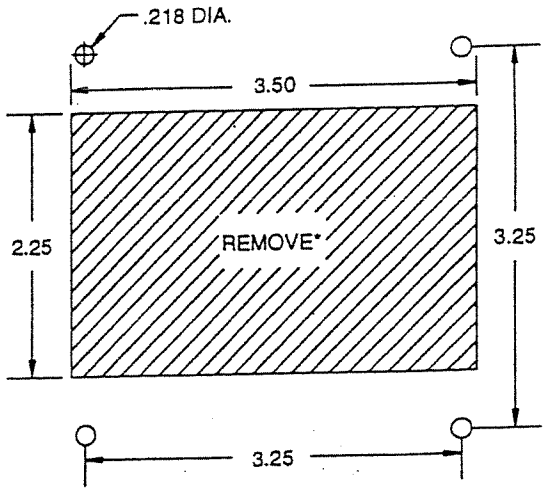
NOTES:

1. Maximum distance between unit and switch is 1000 feet.
2. All intrinsically safe wiring shall be separated from non-intrinsically safe wiring. Refer to article 504 of the National Electrical Code ANSI/NFPA 70 for installation of intrinsically safe wiring.
3. Switch contact shall be any non-energy storing or generating mechanical switch type device containing no capacitance or inductance.
4. Wiring to terminals 5, 6, 11, and 12 is omitted for models with the suffix AAE, AAEP, and -2XXX.
5. Wiring to terminals 6 and 12 is omitted for models with the suffix ABE, ABEP, and -3XXX.

DIMENSIONS



PANEL MOUNT CUTOUT



*GREENLEE PUNCH #60071 OR EQUIVALENT

DIVERSIFIED ELECTRONICS
1511 EAST MAIN STREET
LEESBURG, FL 34748-5336
Toll Free (800) 874-061
Fax (352) 787-879

**Item#43-Pressure Transducer, Keller (KPSI), 700 Series

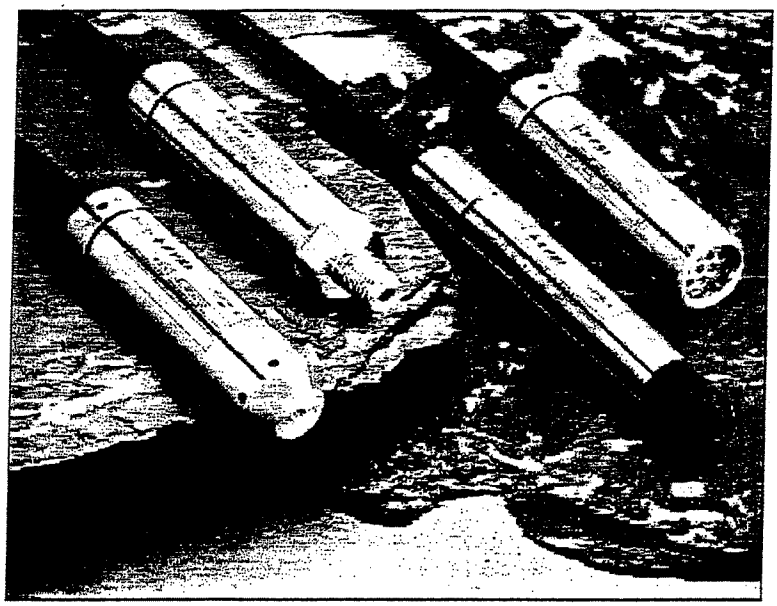
PRESSURE SYSTEMS

KPSI™ Level & Pressure Transducers

User's Manual

5th Edition

March 1, 2000



Pressure Systems, Inc.
34 Research Drive
Hampton, Virginia 23666
(757) 865-1243
FAX: (757) 865-8744
E-Mail: sales@psih.com
Internet: www.pressure-systems.com
A Roxboro Group Company

1.0 Order Administration

Order Entry

We accept orders by fax, phone, mail and e-mail. To ensure accuracy, all orders are reviewed by two technical specialists before being submitted for production. Orders are scheduled into production within 4 hours of order receipt.

Payment

Net 30 terms are available upon approved credit. We accept Visa/MasterCard, corporate checks, money orders and cash. Many orders are shipped C.O.D.

Method of Delivery

All orders are shipped freight on board (FOB) from our factory in Hampton, Virginia USA. We typically ship UPS but will use any shipper you specify.

Delivery Times

Shipment for standard products is typically 10 working days but we do offer two Expedited Shipment Options for selected products.

Option 1: 5 working days from receipt of order is $60.00 per unit.
Option 2: 2 working days from receipt of order is $100.00 per unit.

Warranty Protection

Any transducer/transmitter that is less than 2 years old (see DOM) which does not meet the product's specifications and exhibits **no obvious physical damage to the housing, sensor, or cable (cuts),** will be replaced under warranty.

Units 2-3 years old: Units that fall within this age group and exhibit no obvious physical damage to the housing, sensor, or cable (cuts), are replaced at a discounted list price.

Units greater than 3 years old: Units that fall within this age group are not repaired or replaced. The customer will need to contact our Sales Department at **1-800-328-3665** for replacement.

Example DOM: (The DOM is located on each transducer/transmitter housing)
DOM: 9914 99 is the last two digits of the year of manufacture (1999)
14 is the week of manufacture (14th week of 52 week year)

- When returning units to the Repair Department, please include the vent filter or aneroid bellows.
- **Vent filters should be changed when they are 75% spent (pink).** Do not remove the old vent filter until a new one is available. The number one failure mode is moisture and corrosion damage due to lack of maintenance of the vent filter.
- There is a 90 day warranty on all repairs.

Intrinsic Safety

Most of our products are available with FM, UL and CSA certification for intrinsic safety as well as CE approval for EMC.

2.0 Product Description and Use

General Characteristics

Our submersible pressure transducers use isolated diaphragm sensors that are specifically designed for use with hostile fluids and gases. These sensors utilize a silicon pressure cell that has been fitted into a stainless steel package with an integral, compliant stainless steel barrier diaphragm. This sensor assembly is housed in a rugged 316 stainless steel case which provides for a variety of pressure inputs from 0-1 through 0-300 PSI. Our devices feature internal signal conditioning. Standard outputs are 4 to 20 mA , 0 to 100 mV and 0 to 5 VDC. Other outputs are available upon request.

All units have surge and reverse polarity protection. For ease of use in the field, our transducers are permanently etched with our logo and name, wiring information, part number (P/N), serial number (S/N), date of manufacture (DOM), range, excitation and output. Pressure transducers are offered in diameters of 1.0 and .74 inches.

Care and Handling

Our submersible transducers are designed for rugged use. But they need protection from overpressure and sharp impact. When lowering them into a liquid, penetrate the surface slowly and only to the depth necessary. Avoid dropping the unit from above the surface. Clean transducers by rinsing them in a mild detergent. Direct probing of the diaphragm or attempts to remove protective screens will damage the sensor, voiding the warranty.

Calibration

All pressure transducers are shipped with calibration information unique to each transducer. Make sure you keep each calibration report. However, should you misplace your calibration sheet, you can contact the factory to have a duplicate faxed or mailed to you.

3.0 Product Accessories and Options

Nose Caps

There are several different user-installable nose caps for the Series 700, 710, 720, 730 submersible pressure transducers. The closed-faced ported cap (316 SS or Delrin) with #8-32UNC-2B threaded hole is best used where weights are required and for those installations where users may encounter sharp, protruding objects. The open-faced cap which allows maximum contact with the liquid media is ideal for wastewater and "greasy" applications where clogging of the sensor is a concern. The 1/4" male NPT pressure cap is not only useful for calibration purposes but also allows the device to be used as a submersible or above ground pressure transducer. The piezometer cap allows the unit to be buried in saturated soil without damage to the sensor diaphragm.

Series 810 Vent Filter or Series 815 Bellows

We supply with each submersible pressure transducer, a protective barrier against moisture collecting in the cable vent tube. This ensures reliable operation and long life as it protects sensitive electronic components from mildew, corrosion, rust and prevents the formation of a liquid column in the vent tube. Any such column directly affects calibration.

Series 820 Sacrificial Anode

The Series 820 Sacrificial Anode provides cathodic protection against galvanic corrosion for our submersible pressure transducers. Galvanic corrosion occurs when dissimilar metals are placed in contact with an electrolyte. This condition causes a potential difference to exist between the two metals, causing electron flow between them. Corrosion of the less corrosion-resistant metal is increased and attack of the more resistant metal is decreased. The Series 820 Sacrificial Anode is clamped to the exterior of the transducer. We also offer a 1" diameter version that attaches to the nose cap of the transducer.

Our sacrificial anodes are made from a special zinc alloy formulated to guarantee continued effectiveness over long periods. Because the anodes are 95% galvanic, they will not corrode unless there is an electrolytic demand. The anode maintains a high driving potential throughout its 12 month life, is self-sluffing and always exposes new zinc for the best possible protection. For those applications where cable buoyancy is a problem, the nominal 21 ounce sacrificial anode can be substituted for hanging weights.

Polyurethane & Tefzel® Jacketed Cable

Most installations of our submersible pressure transducers connect our polyurethane or Tefzel® cable to a junction box. From this junction box, users run their own cable to the required instrumentation. Polyurethane is used for most applications while Tefzel® is recommended for highly corrosive environments.

Specifications for our standard polyurethane and Tefzel® jacketed cable are as follows:

Specifications	Standard Submersible Cable
Weight	0.05 lbs/ft
Min. OD	0.28"
Max OD	0.31"
Conductors	4 - 22 AWG
Insulation **Conductors** **Outerjacket**	 PVC Polyurethane or Tefzel®
Shield	36 gauge spiral tinned copper wire
Vent Tube	polyethylene, .060" ID

Chemical Resistance of Polyurethane: Potable Water, Waste Water, Borax, Butane, Animal Fat, Carbonic Acid, Citric Acid, Cod Liver Oil, Corn Oil, Glycerin, Glycol, Mineral Oils, Potassium Nitrate, Potassium Sulfate, Silicone Oils, Stoddard Solvent, Tannic Acid (10), Tartaric Acid, Turbine Oil.

Chemical Resistance of Tefzel®: Acetic Acid (Glacial), Acetic Anhydride, Acetone, Aluminum Chloride, Anti-Freeze, Bromine, Calcium Chloride, Calcium Hydroxide, Chlorine, Copper Chloride, Ferrous Chloride, Hydrochloric Acid, Ketones, Lacquer Thinners, Sulfuric Acid.

The vented cable termination end is specially prepared at the factory to eliminate future moisture migration down its length. It can be noticed where the lead wires emerge from under the jacket that a potting material plus shrink tube "boot" have been added. Every effort should be made to leave this feature intact. Should the cable be longer than is needed for the particular installation, it is recommended that the excess length be accommodated in a service loop and that the potted end of the cable NOT be shortened.

The cable attached to this instrument is specifically engineered for submersible applications. The polyurethane outer jacket provides long term reliability under most conditions. The cable should be handled carefully, however, as the jacket may be subject to cutting should it be "raked" over extremely sharp edges. To guard against water incursion should an inadvertent cut occur, we have incorporated an exclusive "water block" feature immediately beneath the jacket. This feature makes the cable "self-sealing" in all but the most extreme cases. The cable is fully shielded, with the shield connected to the metal housing at the transducer end and terminated in a blue-insulated wire at the termination end. The shield should always be terminated to a good earth ground, unless the transducer is installed in an area where electrolytic corrosion is known to be a serious problem.

Lightning Protection

We can provide optional lightning and surge protection for the 0-5 VDC and 4-20 mA output of our 1 inch diameter units. This is achieved through the use of 2 protectors. One is housed in a 4 inch long, 1 inch OD 316 SS tubing attached directly to the non-pressure sensing end of the transducer while the other is the located at the surface and grounded to a DIN-3.

Featuring quick response and low clamping voltages, these devices protect against fast rising voltage transients as well as severe current surges associated with lightning discharges in excess of 10,000 amperes. Following a surge, the protector automatically restores the line to normal operation and awaits the next surge without having to reset a breaker or replace a fuse.

½" Male NPT Conduit Fitting

Submersible pressure transducers can be attached to a rigid conduit and the cable run through the conduit. To achieve this, all of our submersible transducers can be fitted with an optional ½" NPT male conduit fitting where the cable exits the transducer. This fitting can then be mated to a standard rigid conduit.

Variety of Electrical Outputs

Most applications call for a 0-5 VDC, 4-20 mA or a 0-100 mV output. But where necessary, our transducers offer a broad choice of possibilities including, among others, 0-10 VDC, 0-2.5 VDC, or ratiometric mV/V.

Temperature Output

A 4-20 mA output for temperature (OPTION-023) is also available for most transducers having a 4-20 mA pressure output. The temperature sensor requires an excitation of 9-30 VDC and is calibrated for a temperature range of 0-50°C. Wiring information: White = + Excitation, Green = Signal out. Please see Appendix B.

Cable Hanger

We can supply an optional cable hanger to help end users secure the cable. The cable hanger can be positioned anywhere on the cable by pushing the ends together. Once positioned, the cable hanger expands and provides a snug grip on the cable.

When mounting the transducer in a well casing, the cable hanger can be secured to a hook on the well plate or an eyebolt may be attached to the side of the well casing. The cable hanger loop is then secured to the eyebolt by using any number of types of fasteners. A similar technique can be used when working in still wells for surface water level measurement. In this case, the loop-end of the cable hanger can be attached directly to a screw or bolt bored into the still well shelf.

Cable Splicing Kit

Our field-installable cable splice allows you to splice our polyurethane and Tefzel® cable. It is most commonly used for well applications where the more expensive Tefzel® cable is required for suspension in corrosive media where the liquid level is fairly shallow but the well is hundreds of feet in depth. It also is used in those emergency situations where cable must be spliced together to get an application up and running.

4.0 Installation & Maintenance Tips

General Installation Procedures - Submersible Units

Most installations either suspend our submersible transducer in a perforated 1 ½" or 2" PVC instrumentation stilling well or attach the transducer (using our optional conduit fitting) to a rigid conduit. It is not advisable to tie the transducer to the pump or piping, as a problem with the transducer would then require that the pump be pulled (very expensive).

A minority of applications use our optional bracket to clamp the transducer to a fixed object (i.e., wall, ladder, step) or require the unit to be suspended without any protective still well or attachment device. In all installations, care should be taken to ensure no damage occurs to the cable as cable damage represents one of the most frequent causes of transducer failure.

Cable Lengths

The maximum length of cable to be used with our submersible pressure transducers is largely dependent upon the type of electrical output of the pressure transducer. For a 0-5 VDC output, a maximum cable length of 100 feet is recommended as a voltage output is more susceptible to electrical interference than a 4-20 mA signal.

A 4-20 mA signal can be transmitted much longer distances depending upon such factors as temperature, wire size, length of wire, power supply and voltage requirements of any devices to be powered. At 25°C the 22 AWG conducting copper wire used in our polyurethane jacketed cable has a resistance of 16.45 ohms per 1000 feet.

Using Ohms Law (E=IR) where E=voltage, I=current and R =resistance, one finds that a 20 mA signal requires .329 volts to drive it along 1000 feet of 22 AWG copper wire (E=16.45 x .020).

To find out how much voltage is required to drive our Series 700 submersible pressure transducer's 4-20 mA signal 10,000 feet, just add the minimum power requirement of the 700 (9 VDC) to the resistance offered by 10,000 feet of our polyurethane jacketed cable (10,000÷1000 x .329=3.29). The resulting power requirement is 12.29 VDC (9 + 3.29).

Reverse Signal

For some applications, it is important to know how far the water is from the top of the tank or the surface of the ground. If specified by the customer, our factory can set the transducer so that zero pressure reads full scale electrical output and maximum pressure reads zero output.

Drying Transducers

If you happen to get water in the vent tube and in the submersible pressure transducer, coil the cable and transducer in a pan and place the pan in an oven at 50°C for 2 hours. This on-site remedy may do the trick. Be careful that the oven temperature does not exceed 50°C. Otherwise, you may damage the transducer and cable.

4-20 mA Wiring

To connect a 2 wire 4-20 mA transducer to a typical power supply and mA meter, connect the + (red) lead of the transducer to the + terminal of the power supply. Connect the - (black) lead of the transducer to the + input terminal of the meter. Connect the - input terminal of the meter to the - terminal of the power supply with a length of 22-24 AWG wire.

VDC Wiring

To connect a 3 wire VDC output transducer to a typical power supply and the voltmeter, connect the - terminal of the power supply to the - input terminal of the meter with a length of 22-24 AWG wire. Connect the - excitation (black) lead of the transducer to the - input terminal of the meter. Connect the + input terminal of the meter to the signal lead (white) of the transducer. Connect the + terminal of the power supply to the + lead (red) of the transducer.

Cable Protection

An inexpensive way to protect the cable from damage is to order the submersible pressure transducer with a ½" conduit attachment. Connect an inexpensive flexible 5/8" garden hose to the ½" conduit fitting with an equally inexpensive female PVC ½" NPT x 3/4" NHT swivel fitting, available at your local hardware store.

Bending of Cable

Our polyurethane and Tefzel® jacketed cables are quite flexible. Care needs to be taken to ensure that when bending the cable to suit your installation you do not crimp the vent tube inside the cable. Consequently, do not bend the cable more than a radius of 1 inch.

Cable Compression

Many users require a compression fitting to secure our Tefzel® and polyurethane jacketed cable as it enters a junction box. Care needs to be taken that you do not overtighten the fitting so as to damage the cable.

Appendix A

Frequently Asked Questions

1. I need proof pressure much greater than 1.5 X. How can you help me?

   We can provide 5 X over pressure protection on most ranges if you can accept a thermal error of 0.1% full scale output per degree Centigrade.

2. What installation ideas do you have to help me get rid of electrical noise interfering with the signal?

   An ounce of prevention goes a long way. Either try to eliminate the source of noise or move the transducer as far away from it as possible. We strongly encourage you to secure our cable shield to a good earth ground and that you use a 4-20 mA signal output. Armed with these precautions and the fact that many of our transducers are CE approved for electromagnetic interference, you should have few problems.

3. My cable on the submersible always seems to get cut and damaged. What am I doing wrong?

   This is the most common problem that our users encounter. Make sure that all of your colleagues and staff understand the importance of handling the cable with care. The cable should not be bent around rough or sharp edges. Always use a cable reel during transport. Where possible, suspend the unit in a perforated 2" PVC pipe and thread the cable through protective conduit to the nearest junction box. This is a problem that KPSI directly addresses with the water block feature in our cable.

4. I have an application where the transducer is frequently damaged by voltage spikes. What can be done to prevent this?

   At a minimum, make sure the cable shield is connected to an earth ground as near as possible to the transducer. We can provide a surge protection kit for both our below and above ground transducers and transmitters. These kits will handle typical spikes that might come in through the power lines as well as surges that travel through the ground due to nearby lightning strikes.

5. How much impact shock can your submersible transducers withstand?

   The lower pressure ranges can be damaged if dropped from several feet onto an unforgiving surface like concrete, so we recommend that the protective shipping foam remain in place until the unit is installed.

6. What is the response time of your transducer?

   From initial power up, the transducer output will stabilize within a fraction of a second. The frequency response is rather low, probably less than 1 kHz, but it really depends on the application, the media, plumbing, etc. Call our factory for application assistance if frequency response is critical in your application.

7. How do I attach your vent filter or aneroid bellows to my cable vent tube?

   The vent filter can be mounted anywhere convenient, preferably out of the weather. It can be mounted in any position and connects to the cable vent tube via the extension tube with metal connector tube provided. The aneroid bellows must be mounted in a way that its movement is not encumbered. It is provided with a mounting base that will install to a standard DIN3 mounting rail common to most control panels. Also provided with the bellow is a 3 inch length of DIN3 rail, just in case one is not already available.

8. What is the best way to mark my cable?

   Use white vinyl marking tape available from your local hardware or electronic stores. These same stores may also sell cable marking kits.

9. Any ideas for preventing marine growth on your submersible transducers?

   You might want to try waterproof grease. Remove the threaded nose cap to facilitate applying the grease. Take care when applying the grease not to trap air bubbles against the sensing diaphragm and not to damage the diaphragm.

10. How many pressure measurements can you make before the diaphragm on the pressure sensor fails?

    In normal operation - millions of cycles. We find that transducer failure is rarely due to diaphragm fatigue.

11. What is the mean time between failure for your submersible pressure transducer?

    Most failures are due to misuse by the end user. However, properly installed units last tens of thousands of hours.

12. What can be repaired on your pressure transducers?

Cost of repairs varies depending on the problem. As a rule of thumb, very badly damaged units can be repaired for about 50% of list price.

13. What is the turnaround time on repairs?

Once we receive a unit into our facility it takes approximately 5 working days.

14. What is the longest length of cable you have attached to a submersible transducer?

Two thousand feet.

15. Why do you use 316 SS housings and sensors for your standard transducers?

It offers a good combination of corrosion resistance and reasonable cost. As an option, we do offer other metals such as Titanium and Hastelloy for very corrosive environments.

16. What wire gauge should I limit myself to when connecting to your 22 AWG wire?

Use 22 AWG or greater.

17. Does it make any difference if I mount the transducer in a vertical or horizontal position?

No. Our units have a minimum amount of position sensitivity. You should mount it in the same position, however, throughout the measurement cycle.

18. What is the longest length of time one of your products has run continuously?

Since 1986, the year we first started manufacturing all-media pressure transducers.

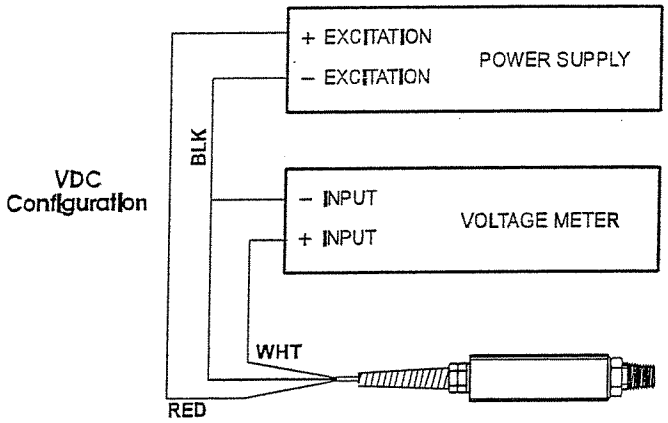
19. What happens when you freeze your transducer in a column of water?

We have frozen our submersibles in a container of water in a home freezer, with no resulting damage. However, depending on the pressure range of the unit, over pressure of the unit is possible. In harsh environments where debris is common and ice shifts, you might expect damage to both the transducer and cable.

20. What are the most common reasons customers keep buying your products?

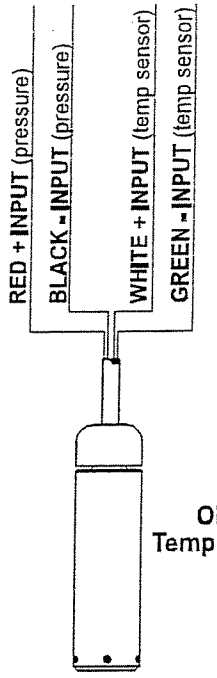
No hassle service.
Reliable, long lasting products.
We offer guaranteed lightning protection.
Use 800 numbers for order entry and support.
Excellent pre and post sales application support.
Quick response to problems.
Rapid delivery.

Appendix B

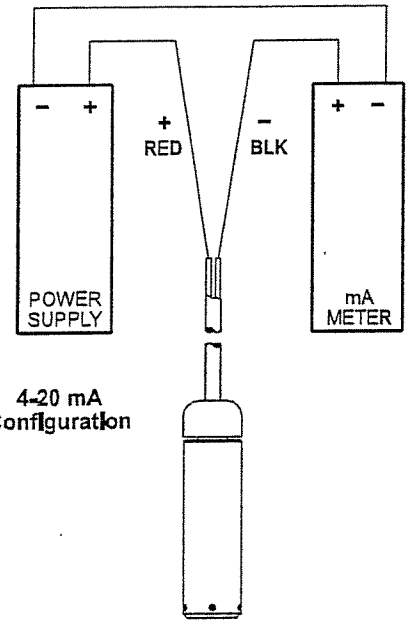


VDC Configuration

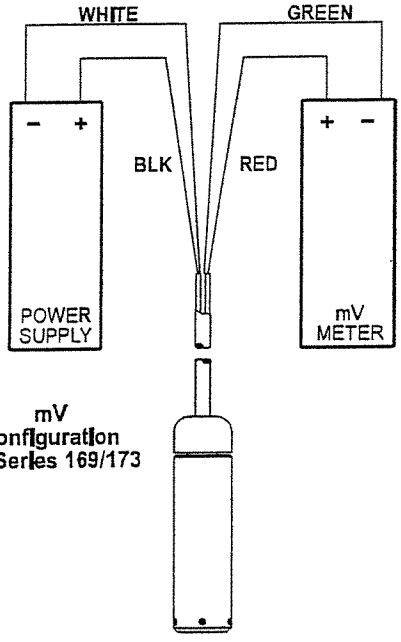
Note: These diagrams depict typical installations. Refer to your power supply and instrumentation manufacturer for the specifics of your application.



OPTION-023 Temperature output

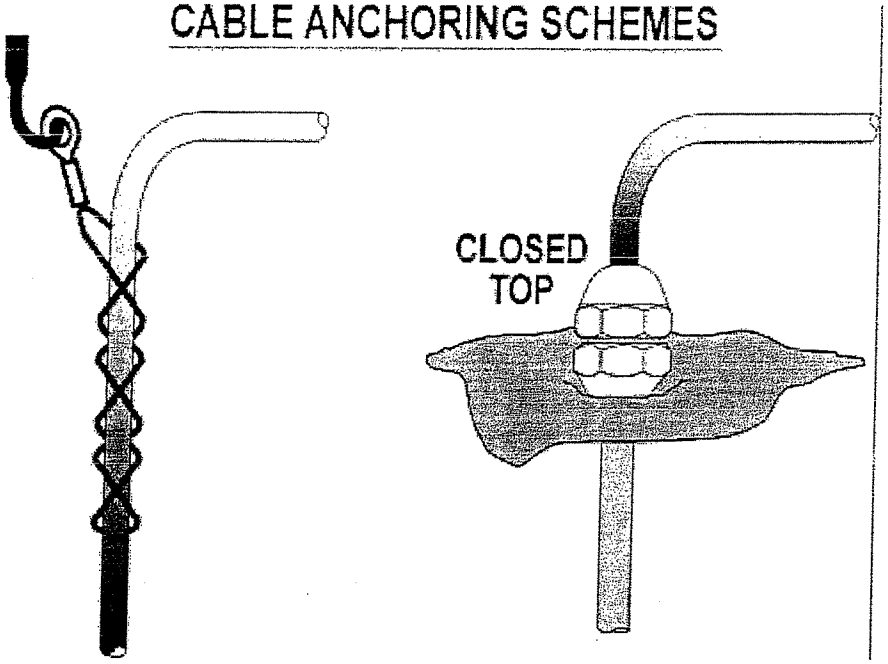


4-20 mA Configuration

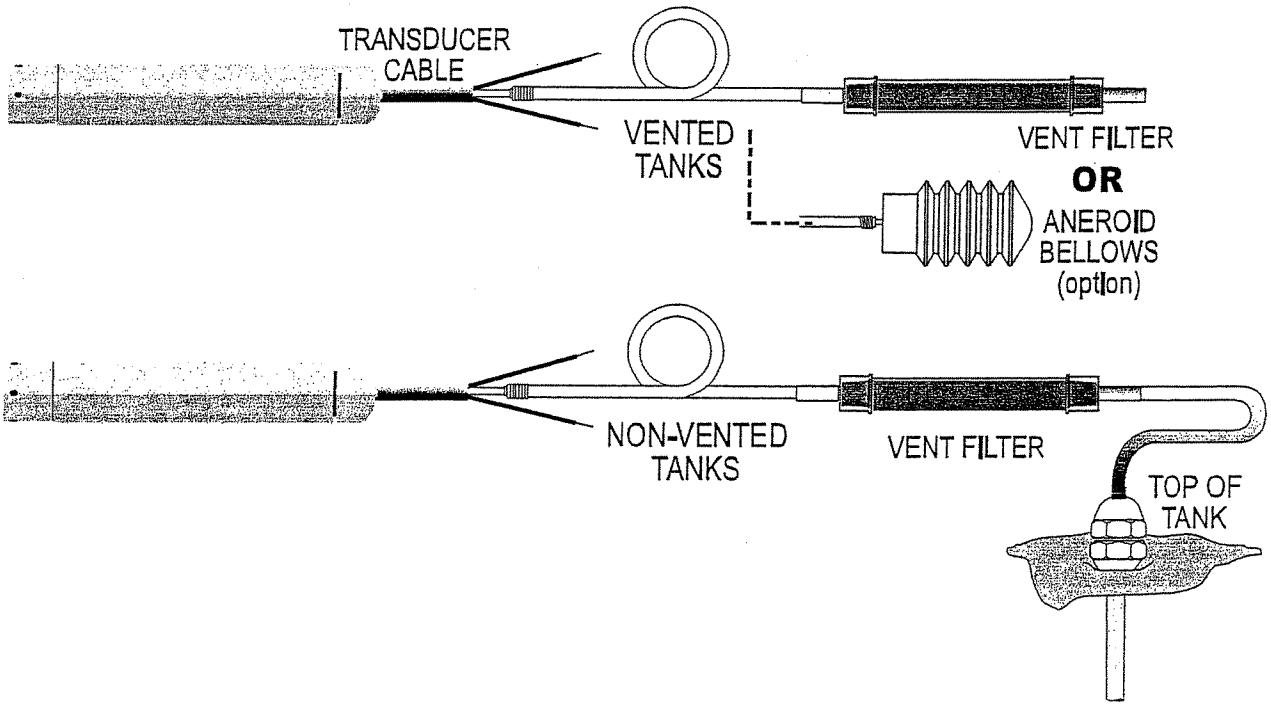


mV Configuration for Series 169/173

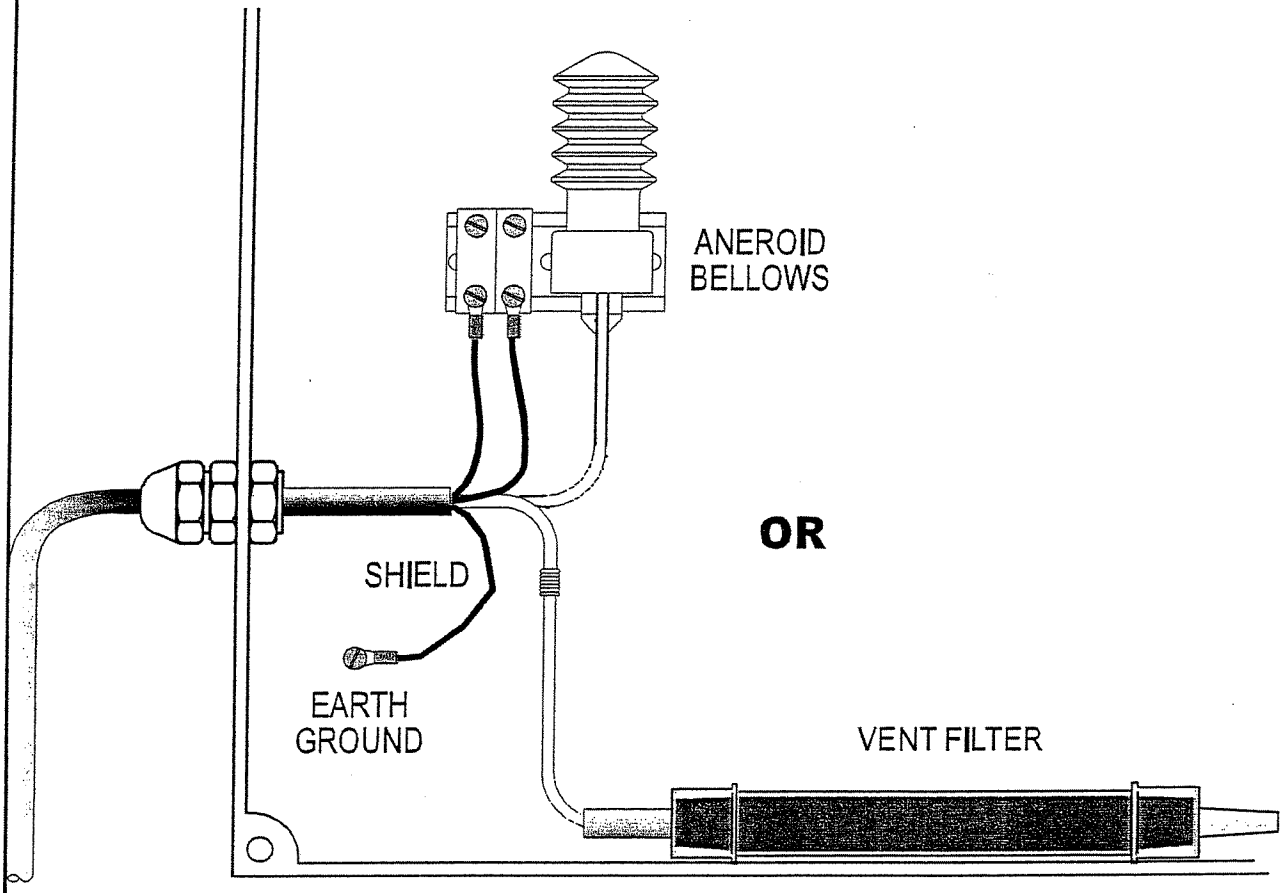
CABLE ANCHORING SCHEMES



REFERENCE CONNECTION SCHEMES



Submersible Cable Termination



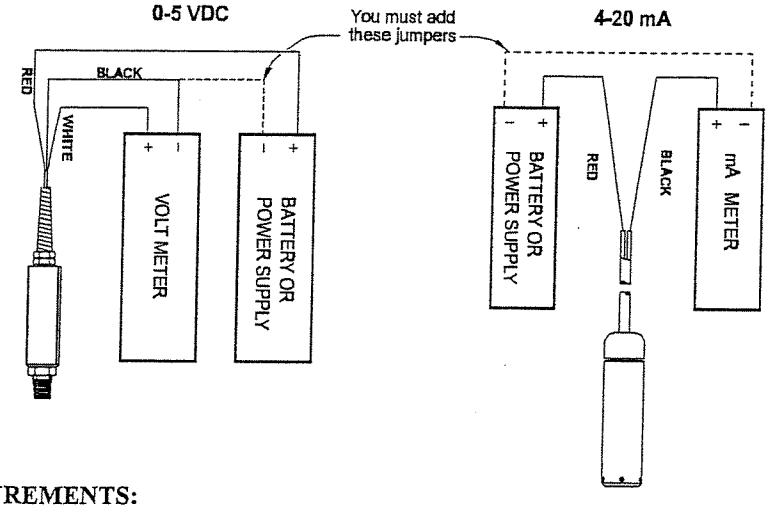
Quick Check Procedure for KPSI Transducers/Transmitters

Should a problem be encountered with a KPSI transducer or transmitter, it is sometimes helpful to test the transducer independently from the rest of the system, thereby establishing where to concentrate the troubleshooting effort.

Shown below are simple hookup diagrams for the two most common types of electrical output, a 0-5 VDC transducer and a 4-20 mA transmitter. In either case, the "power supply" can be a common 12 volt lantern battery, or even a 9 volt transistor radio battery, although the lifetime of a 9 volt battery will be limited. The meter should be a digital type capable of reading at least 2 digits to the right of the decimal point. Use 20-24 gage hookup wire or clip leads for jumpers. If your unit has other than a 0-5 VDC or 4-20 mA output, please call **(800) 328-3665** for assistance.

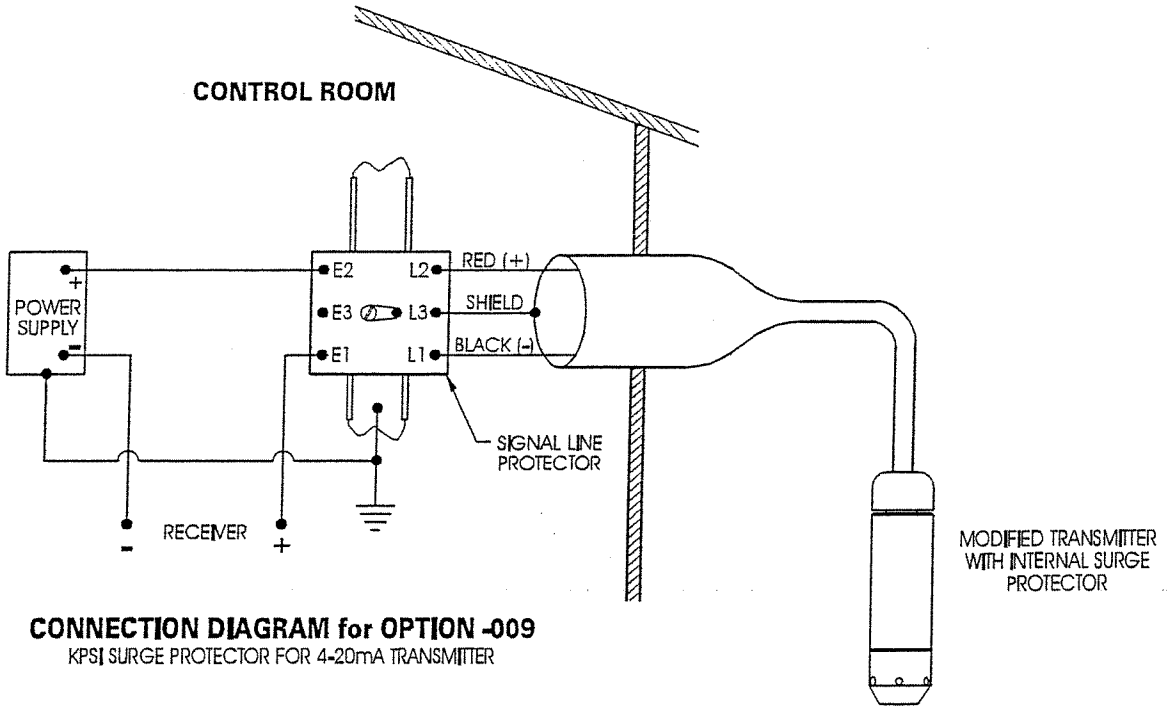
Once your transducer is correctly configured per one of the diagrams below, orient the transducer in a vertical position and then read the zero output on your meter. For a 0-5 VDC output, the zero should be between 0 and 0.060 volts, and for a 4-20 mA output, between 3.88 and 4.12 mA. If the output is outside of these limits, you may, at your option, choose to troubleshoot the transducer per the suggested measurements shown below. Otherwise, contact our Repair Department at **(800) 328-3665** for a Return Material Authorization number (RMA).

If the zero output is within these limits, the problem will more than likely be found elsewhere in your system.

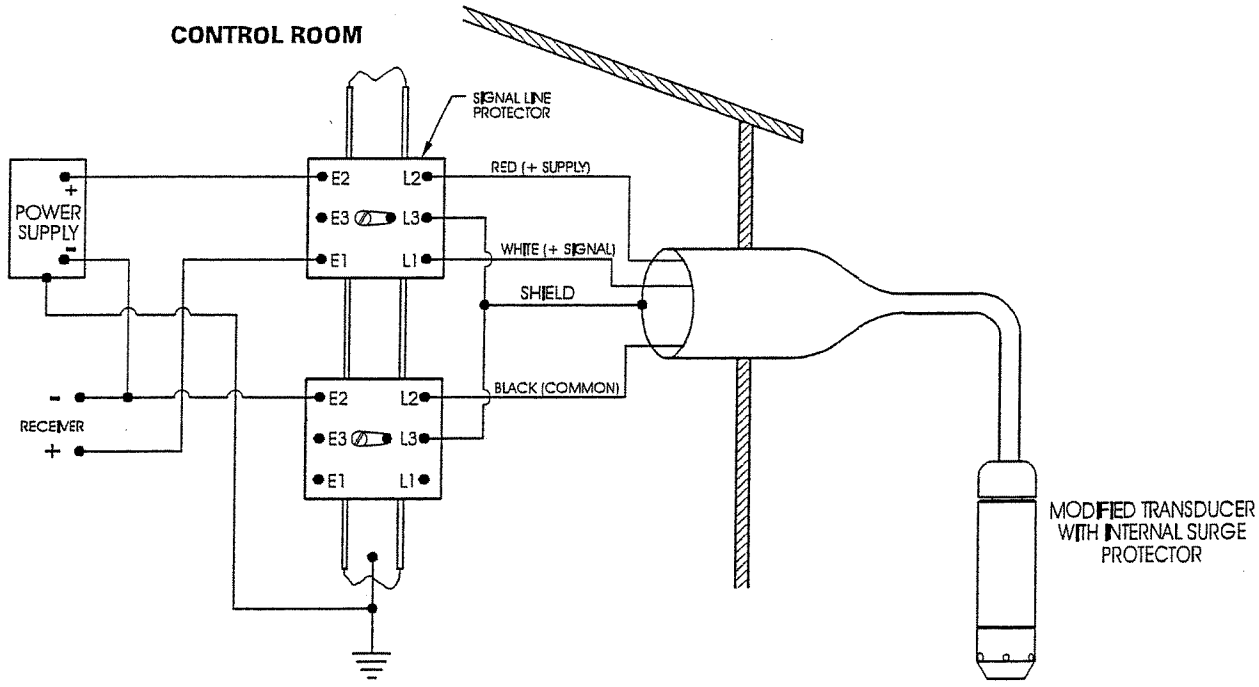


FURTHER MEASUREMENTS:

0-5 VDC	Should read:	4-20 mA	Should read:
+Excitation to Shield	> 2.5 Mohms	+Excitation to Shield	> 2.5 Mohms
-Excitation to Shield	> 2.5 Mohms	-Excitation to Shield	> 2.5 Mohms
+Output to Shield	> 2.5 Mohms	Shield to Housing	< 2 ohms
Shield to Housing	< 2 ohms		



CONNECTION DIAGRAM for OPTION -009
KPSI SURGE PROTECTOR FOR 4-20mA TRANSMITTER



CONNECTION DIAGRAM for OPTION -012
KPSI SURGE PROTECTOR FOR 0-5VDC TRANSDUCER

This page intentionally left blank.