



CLEAN-IN-PLACE

User's Manual

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INTRODUCTION

The surface of a reverse osmosis (RO) membrane is subject to fouling by foreign materials that may be present in the feed water, such as hydrates of metal oxides, calcium precipitates, organics and biological matter. The term “fouling” includes the build-up of all kinds of layers on the membrane surface, including scale.

Pretreatment of the feed water prior to the RO process is designed to reduce contamination of the membrane surfaces as much as possible. This is accomplished by installing an adequate pretreatment system and selecting optimum operating conditions, such as permeate flow rate, pressure and permeate water recovery ratio.

Fouling of the membrane surfaces is caused by:

- Inadequate pretreatment system
- Pretreatment upset conditions
- Improper materials selection (pumps, piping, etc.)
- Failure of the chemical dosing systems
- Inadequate flushing following shutdown
- Improper operational control
- Slow build-up of precipitates over extended periods (barium, silica)
- Change in feed water composition
- Biological contamination of feed water

The fouling of membrane surfaces manifests itself in performance decline, lower permeate flow rate and/or higher solute passage. Increased pressure drop between the feed and concentrate side can be a side effect of fouling.

Cleaning can be accomplished very effectively because of the combination of pH stability and temperature resistance of the membrane and the element components. However, if cleaning is delayed too long, it could be difficult to remove the foulants completely from the element surface. Cleaning will be more effective the better it is tailored to the specific fouling problem. Sometimes the wrong choice of cleaning chemicals can make a situation worse. Therefore, the type of foulants on the membrane surface should be determined prior to cleaning. There are different ways to accomplish this:

- Analyze plant performance data.
- Analyze feed water. A potential fouling problem may already be visible there.
- Check results of previous cleanings.
- Analyze foulants collected with a membrane filter pad used for SDI value determination.
- Analyze the deposits on the cartridge filter.
- Inspect the inner surface of the feed line tubing and the feed end scroll of the membrane. If it is reddish-brown, fouling by iron materials may be present. Biological fouling or organic material is often slimy or gelatinous.

SAFETY PRECAUTIONS

1. When using any chemical indicated here or in subsequent sections, follow accepted safety practices. Consult the chemical manufacturer for detailed information about safety, handling and disposal.
2. When preparing cleaning solutions, ensure that all chemicals are dissolved and well mixed before circulating the solutions through the elements.
3. It is recommended that the elements be flushed with purified chlorine-free water (20°C minimum temperature) after cleaning. Permeate water is recommended. Pre filtered raw water or RO feed water can be used for flushing out the cleaning solution, however there is a risk that cleaning chemical and/or foulant precipitation may occur. Care should be taken to operate initially at reduced flow and pressure to flush the bulk of the cleaning solution from the elements before resuming normal operating pressures and flows. Despite this precaution, cleaning chemicals will be present on the permeate side following cleaning. Therefore, when starting up after cleaning, permeate water must be diverted to drain for at least 15 minutes or until the water is clear.



CLEANING REQUIREMENTS

In normal operation, the membrane in reverse osmosis elements can become fouled by mineral scale, biological matter, colloidal particles and insoluble organic constituents. Deposits build up on the membrane surfaces during operation until they cause loss in normalized permeate flow, loss of normalized salt rejection, or both.

Elements should be cleaned when one or more of the below mentioned parameters are applicable:

- The normalized permeate flow drops 10%
- The normalized salt passage increases 5-10%
- The normalized pressure drop (feed pressure minus concentrate pressure) increases 10-15%

If you wait too long, cleaning may not restore the membrane element performance successfully. In addition, the time between cleanings becomes shorter as the membrane elements will foul or scale more rapidly.

Differential Pressure (ΔP) should be measured and recorded across each stage of the array of pressure vessels. If the feed channels within the element become plugged, the ΔP will increase. It should be noted that the permeate flux will drop if feed water temperature decreases. This is normal and does not indicate membrane fouling.

A malfunction in the pretreatment, pressure control, or increase in recovery can result in reduced product water output or an increase in salt passage. If a problem is observed, these causes should be considered first.

STARTUP & GENERAL CLEANING PROCEDURES

1. Use the following guide for determining the amount of water and cleaner that will be needed to treat each membrane of the RO system:

ELEMENT DIAMETER	LOW FLOW (gpm)	HIGH FLOW (gpm)	GALLONS
4"	4	10	2.5
8"	25	35	6

2. Multiply the amount of water by the number of membranes on the RO system to calculate the number of gallons needed to fill the CIP tank.

Startup & General Cleaning Procedures (Cont.)

3. Mix AXEON C-10 or C-20 cleaner in the ratio of 1lb to 10 gallons of clean water (either permeate water or potable water) in the CIP tank. Add powder to water by casting small amounts across the surface as the water is looped. Dumping powder in very quickly will not allow the powder to be mixed properly. Run system in Mixing Loop mode as shown on the Mixing Loop Valve Diagram on page 10, until all powder is fully dissolved and pH is normalized.
4. For low pH (2 – 3 pH) cleanings, the water temperature should be no colder than 70°F or 20°C and no hotter than 115°F or 45°C. For high pH (11 – 12) cleaning where there is a good deal of organic material on the membrane, heating the solution to no more than 110°F or 42°C can be beneficial. Membrane should not be exposed to solutions hotter than 115°F or 45°C as this will have adverse effects on the membranes.
5. To connect the CIP skid to the RO system, follow the diagram on page 8. Connect the outlet of the CIP to the cleaning port inlet valve on the RO system and connect the cleaning port outlet from the RO system to the inlet of the CIP system.
6. Circulate cleaning solution from the CIP tank to the system and back to the CIP tank as shown on the Cleaning Mode Valve Diagram. Circulate a minimum of 4 gpm per pressure vessel for 4×40 elements, and a minimum of 25 gpm per pressure vessel for 8×40 elements. Use as low a pressure and as high a flow as possible. Keep differential pressures across membrane stages below 60 psi.
7. For low and high pH cleanings, monitor the pH of the cleaning solution pH. For C-10, add additional powder to keep pH from rising above 3. For C-20, add additional powder to keep the pH from dropping below 11. Keep circulating through each section of system until the pH has stabilized for 30 minutes. Membrane systems heavily fouled with organic material can benefit, by inserting an overnight soak into the cleaning schedule.
8. After each type of cleaning, dump the cleaner and fill the CIP tank with good quality water.
9. Circulate through system for 5-15 minutes and dump flush.

Each cleaning situation is different; therefore, specific cleaning recommendations are dependent on the type of foulant. Consult the general cleaning instructions for information that is common to all types of cleaning such as suggested equipment, pH and temperature limits and recommended flow rates; then apply the specific recommendation as needed. The foulant type should be categorized as inorganic or organic. The following section covers the cleaning needs of each foulant type.

CARBONATE SCALE

There are seven steps in cleaning elements with carbonate scale.

1. Make up the cleaning solution as listed on page 4.
2. Introduce the cleaning solution as shown on page 8.
3. **Recycle.** Recycle the cleaning solution for 10 minutes or until there is no visible color change. If at anytime during the circulation process there is a color change, dispose of the solution and prepare a new solution as described in step 2. Maintain the pH for effective cleaning. Add additional cleaning chemical as needed to maintain pH.
4. **Soak.** For lightly scaled systems, a soak time of 1–2 hours is sufficient. Severely scaled systems can also be recovered with extended soak times. Severely scaled elements should be soaked individually outside of the pressure vessel in a vertical position. Check pH and adjust as required, or replace cleaning solution.
5. High-flow pumping.
6. Flush out.
7. Restart.

Recommended Cleaning Chemical:

AXEON C-10 Low PH Cleaner

Additional Information

For maximum effectiveness, the temperature of the cleaning solutions must be above 25°C. Elevating the temperature of the cleaning solution will assist in organic removal from the membrane surface. Some organics such as oils are very difficult to remove. To remove them, experiment with different soak times for optimum effectiveness. If the organic fouling is the result of overfeeding of a coagulant used for feed water pretreatment, reversing the order of the cleaners can be more effective. To determine the proper order of the cleaning solutions (high pH followed by low pH or vice versa), try to gather a sample of the organic foulant from your system. With the sample, try treating it with C-20 solution and then C-10 solution and vice versa to determine qualitatively which order of cleaning solution treatment dissolves the foulant better. If both treatments appear to work equally, it is usually better to clean with the C-20 solution first.

ORGANIC FOULING

The following cleaning procedure is designed specifically for a system that has been fouled with organic matter.

There are eight steps in cleaning elements fouled with organics, but the six steps are conducted first with a high PH cleaning solution and then repeated with a low PH cleaning solution.

1. Make up the cleaning solution as listed in step one of the General Cleaning Procedures (pg. 4) based on the recommended chemical type listed below.
2. Introduce the cleaning solution as shown on the Normal Operation Valve Diagram on pg. 8.
3. Recycle the cleaning solution for 30 minutes. If a color change occurs, dispose of the cleaning solution and prepare a fresh solution.
4. Soak.
5. High-flow pumping.
6. Flush out.
7. Repeat steps 2 through 6 with cleaning solution of C-10 at pH 2.
8. Restart.

Recommended Cleaning Chemical:

AXEON C-20 High PH Cleaner & AXEON C-10 Low PH Cleaner

COMPONENT IDENTIFICATION



ITEM #	PART #	DESCRIPTION
1	200714	Cartridge, Filter, Bag, 32", 5 MIC, Axeon
1	200640	Cartridge, Sediment, Polypro, 4.5" x 20" 5 MIC
1	210398	Cartridge, Depth Filter, Polypro, 2.5" x 30", 5 MIC, AXEON

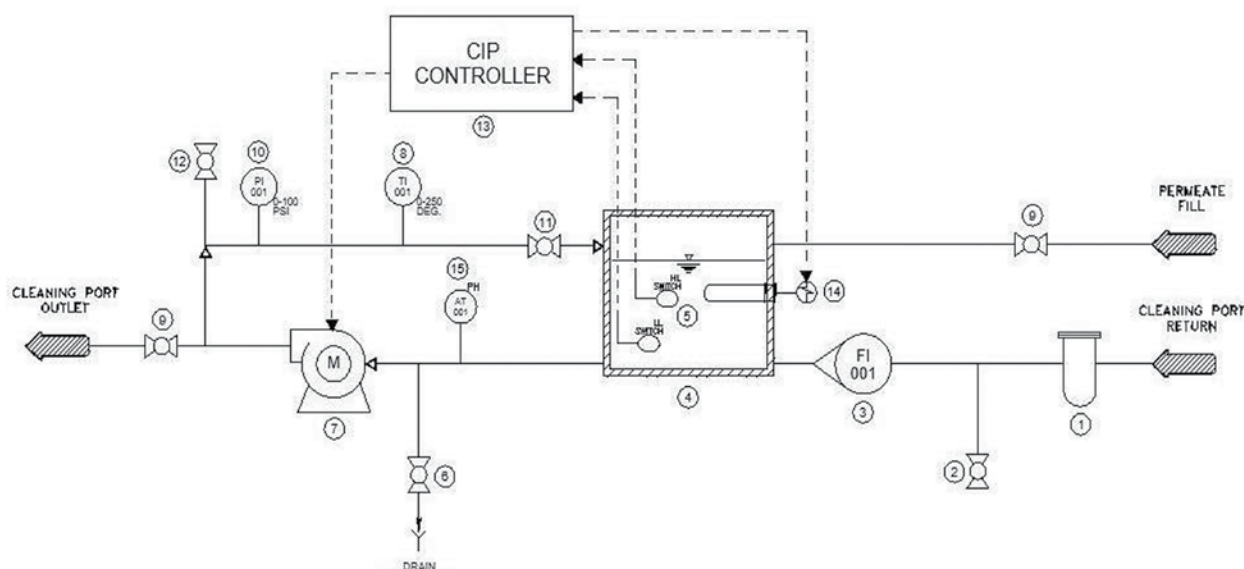
AXEON Membrane Chemical and Filter Replacement List

PART #	DESCRIPTION
206717	Chemical, Cleaner, Low pH, 25LB, C-10, Axeon
206718	Chemical, Cleaner, Low pH, 45LB, C-10, Axeon
206716	Chemical, Cleaner, Low pH, 4LB, C-10, Axeon
206720	Chemical, Cleaner, Low pH, 25LB, C-20, Axeon
206721	Chemical, Cleaner, Low pH, 45LB, C-20, Axeon
206719	Chemical, Cleaner, Low pH, 4LB, C-20, Axeon

AXEON Membrane Chemical MSDS sheets available online at axeonwater.com

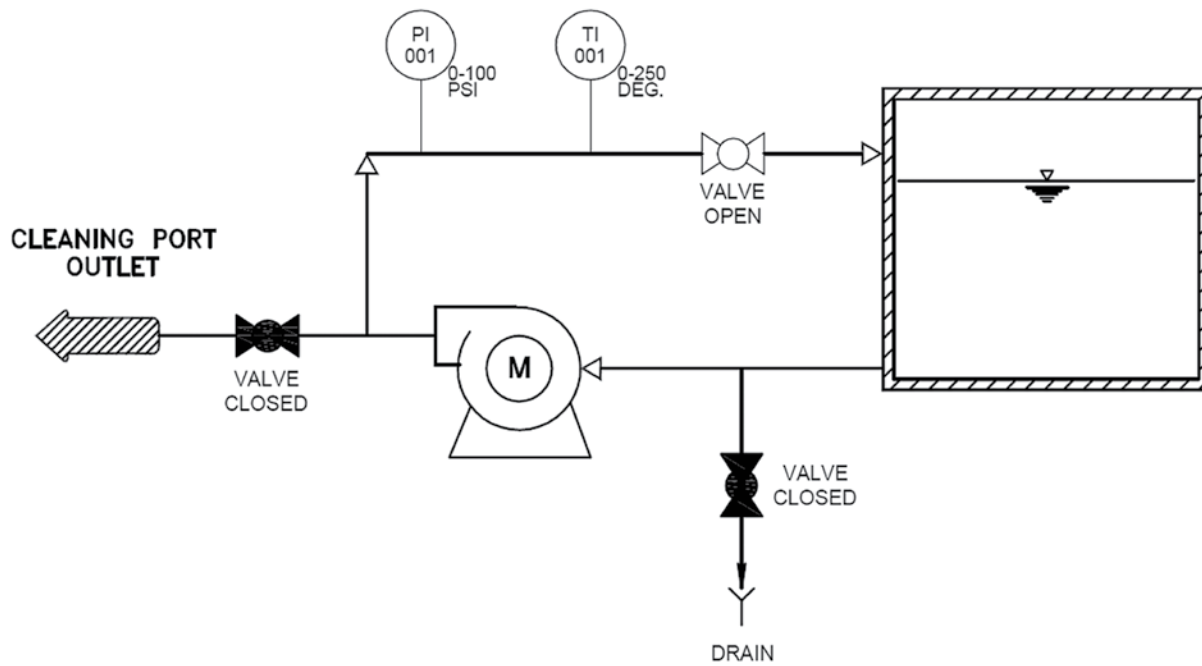
Component Identification (Cont.)

CLEAN-IN-PLACE SYSTEM DIAGRAM

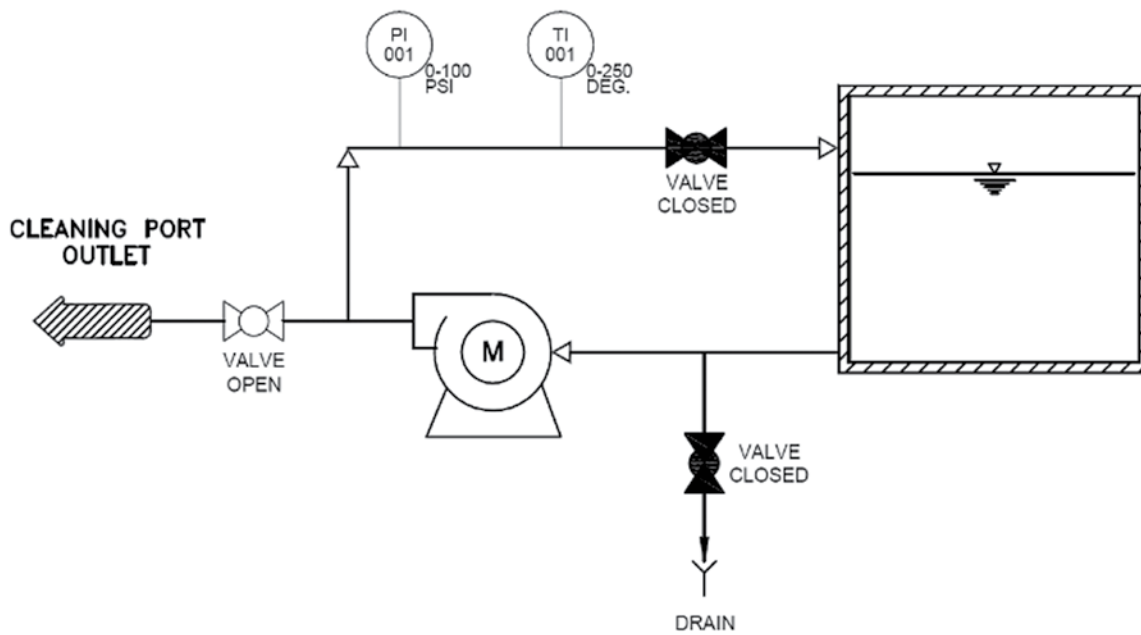


NUMBER	ITEM	DESCRIPTION
1	Filter Housing	Filters the water from the RO unit.
2	Ball Valve	Samples the quality of the return water from the RO unit.
3	Flow Meter	Measures the flow of the return water from the RO unit.
4	Tank	Holds the cleaning solution.
5	Low Level Switch	Safely shuts off the pump when the tank level is low.
6	Ball Valve	Drains cleaning solution from the tank.
7	Pump	Drains cleaning solution to the elements.
8	Temperature Gauge	Measures the temperature of the cleaning solution.
9	Ball Valve	Shuts off the cleaning port output
10	Pressure Gauge	Measures the pressure of the pump.
11	Ball Valve	Shuts off the mixing loop to the tank.
12	Ball Valve	Samples the quality of the mixing solution.
13	Controller	Controls the CIP unit.
14	Heater (Optional)	Increases the tank water temperature.
15	PH Monitor (Optional)	Provides a panel mounted display of the PH mixed solution.

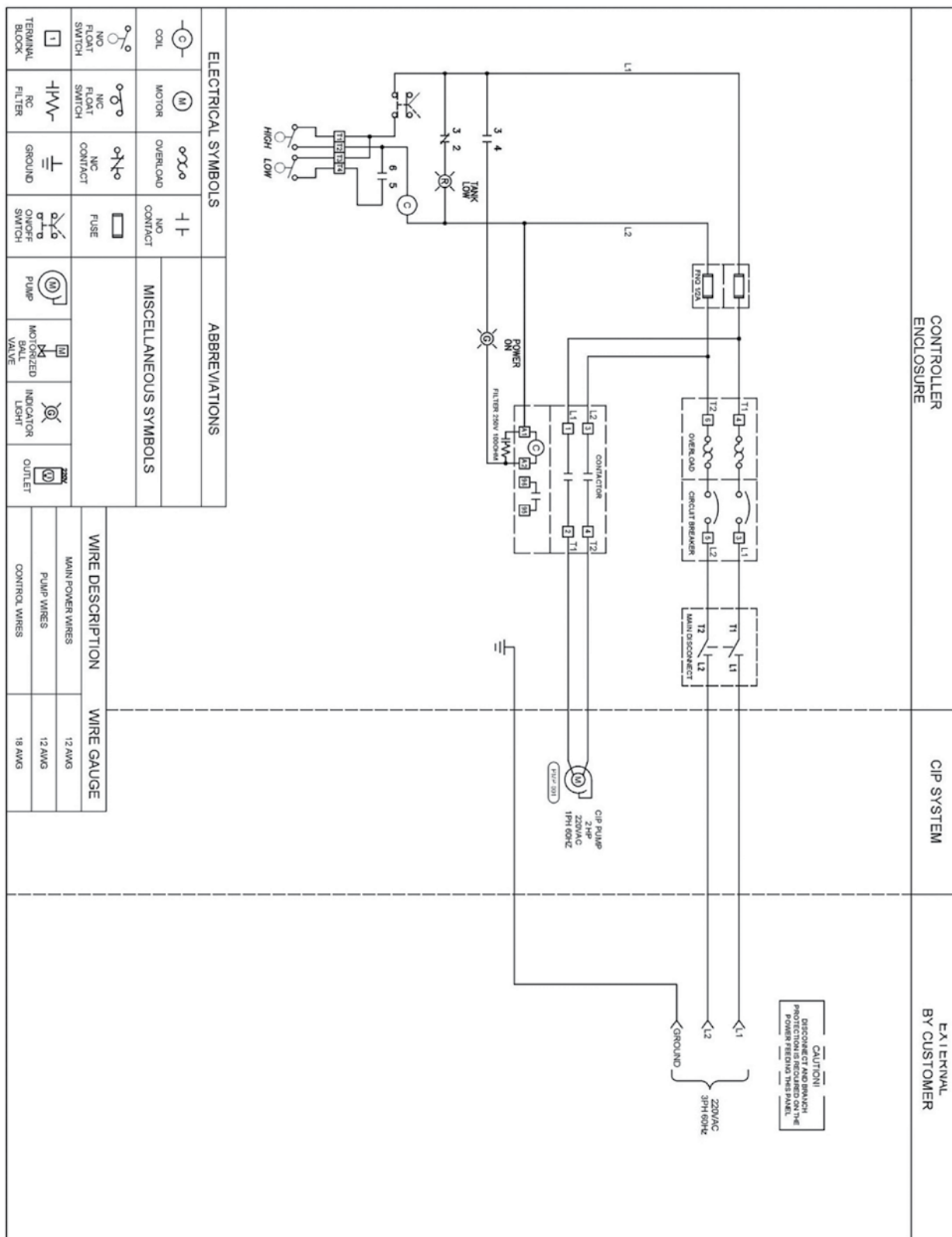
MIXING LOOP VALVE DIAGRAM



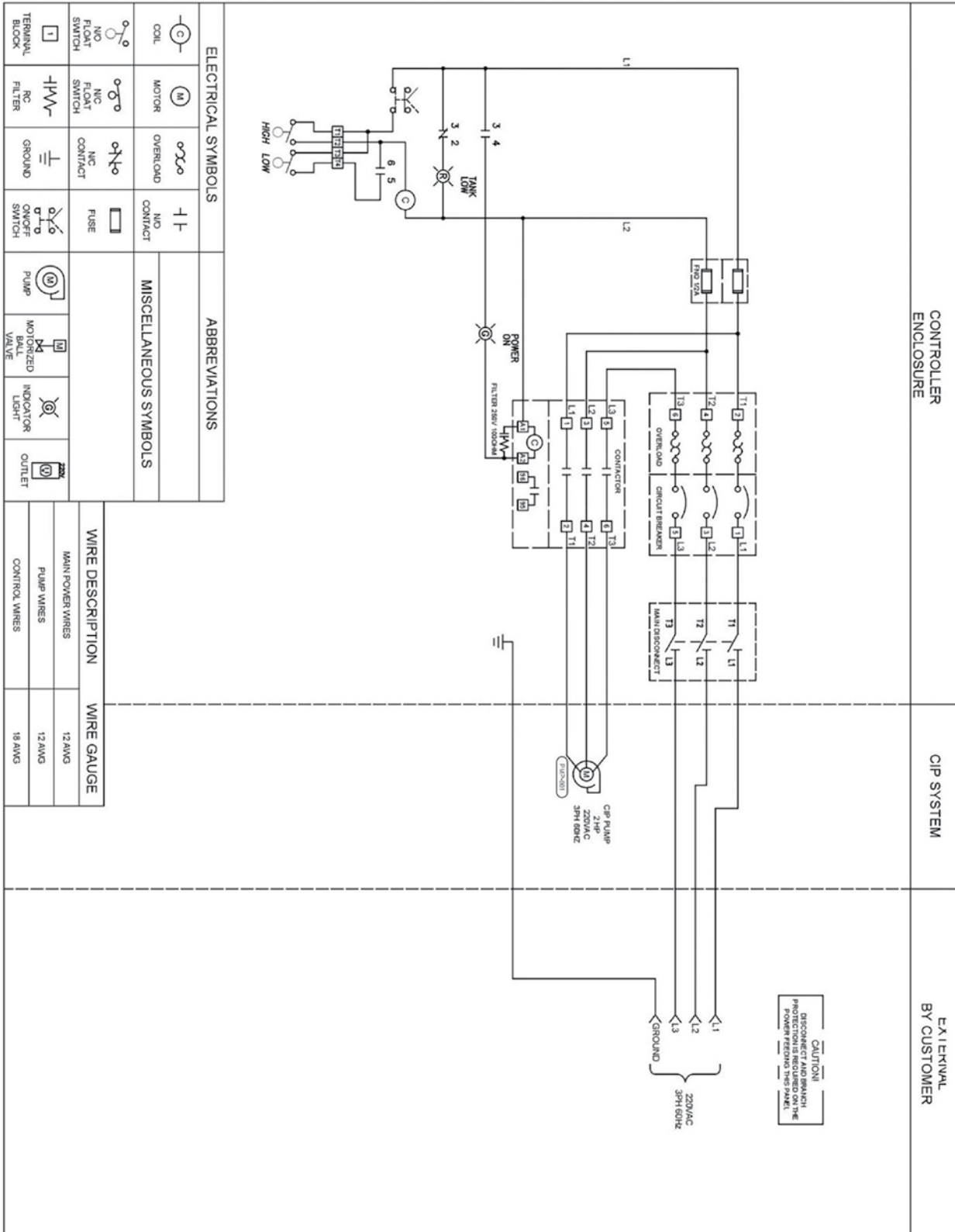
CLEANING MODE VALVE DIAGRAM



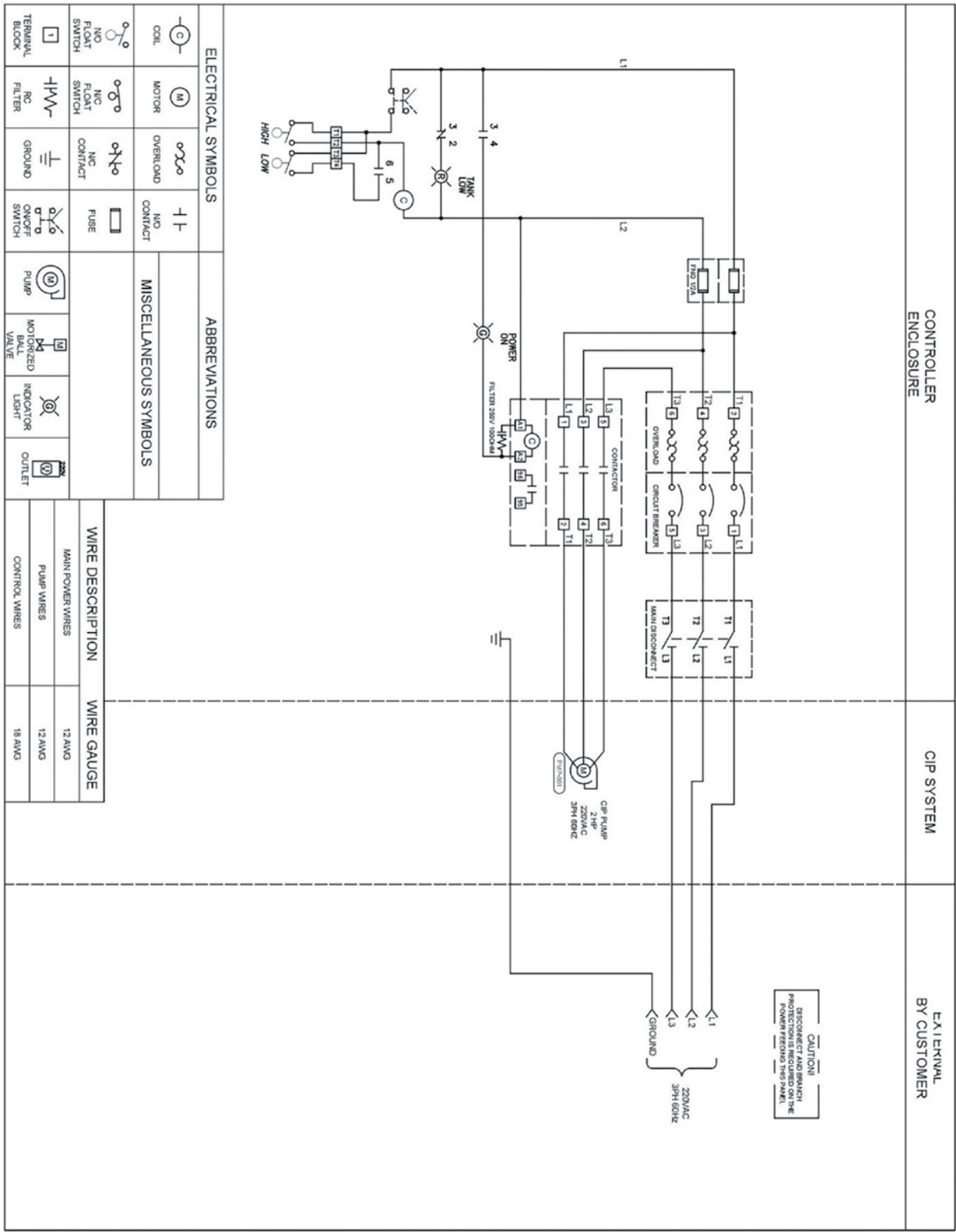
CIP-20 & CIP-40 (220V, 1PH, 60HZ) ELECTRICAL SCHEMATIC



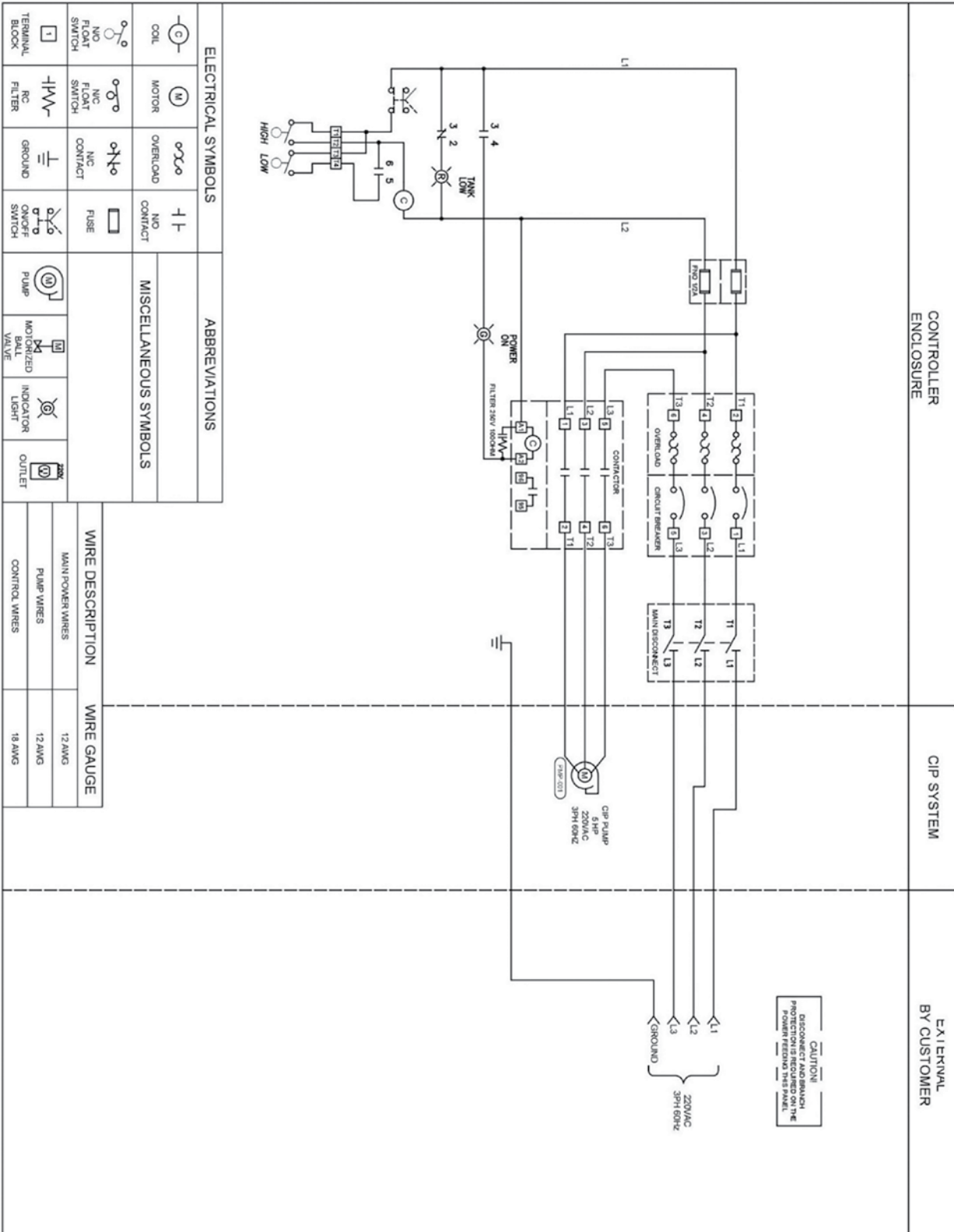
CIP-20 & CIP-40 (220V, 3PH, 60HZ) ELECTRICAL SCHEMATIC



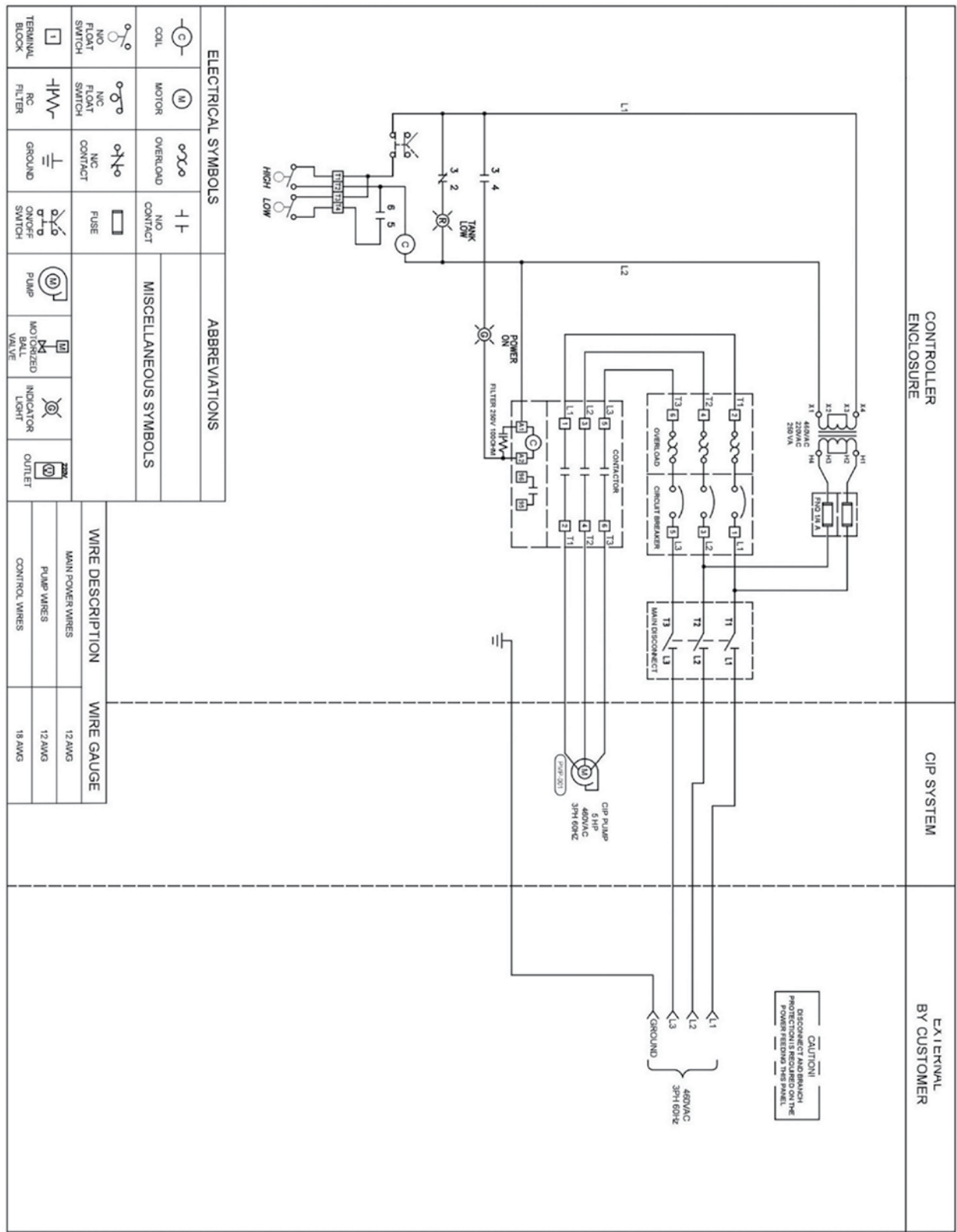
CIP-20 & CIP-40 (460V, 3PH, 60HZ) ELECTRICAL SCHEMATIC



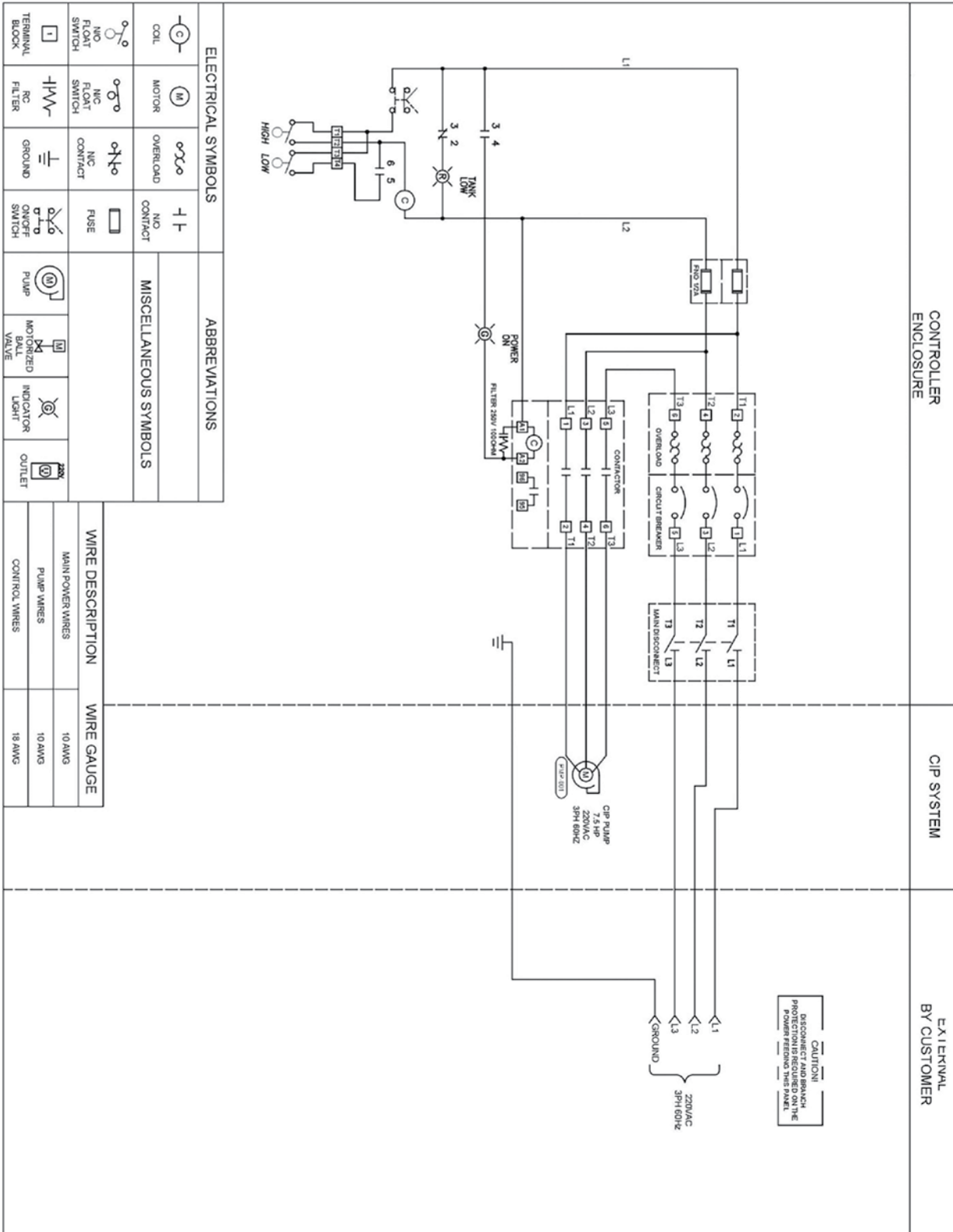
CIP-60 (220V, 3PH, 60HZ) ELECTRICAL SCHEMATIC



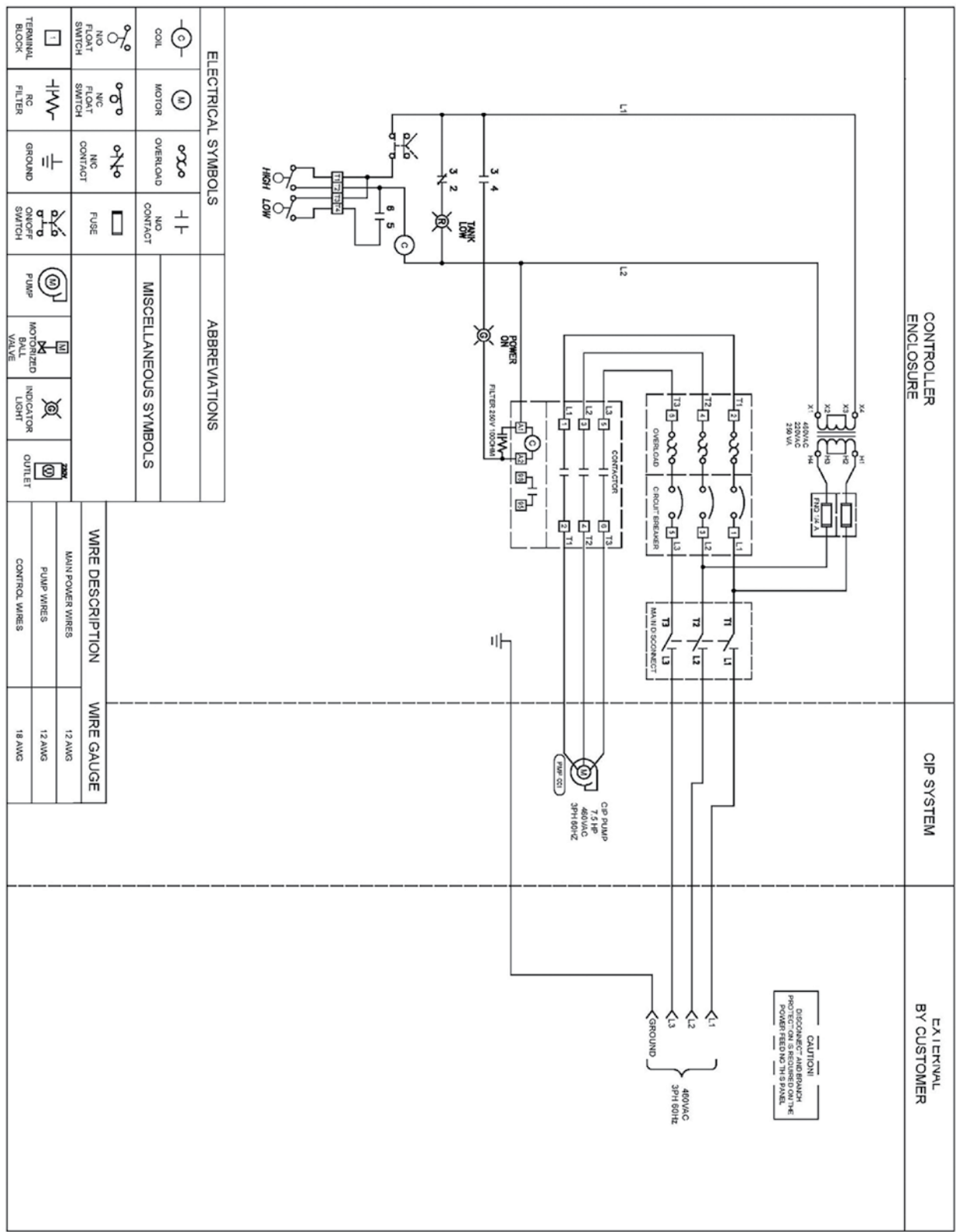
CIP-60 (460V, 3PH, 60HZ) ELECTRICAL SCHEMATIC



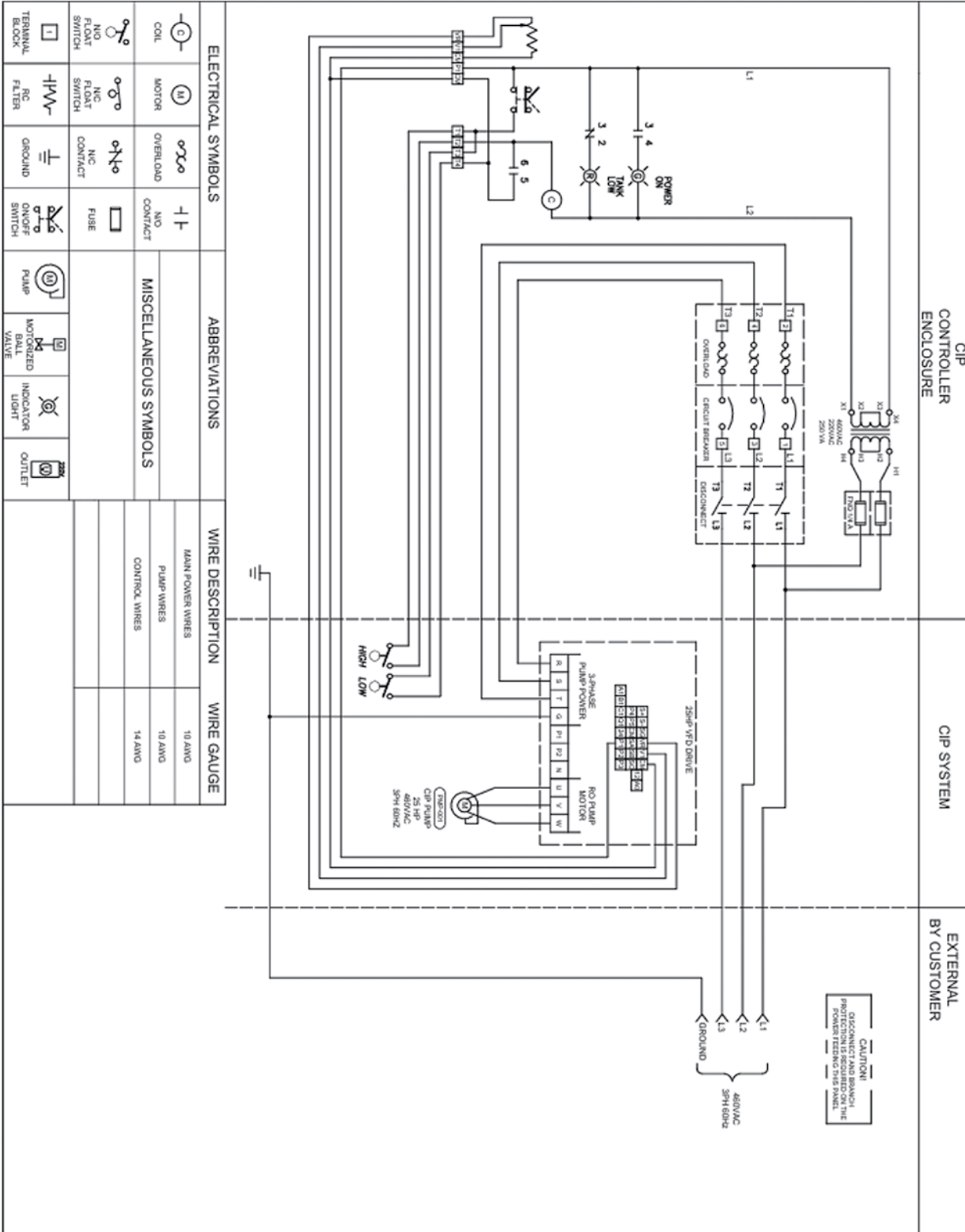
CIP-100 (220V, 3PH, 60HZ) ELECTRICAL SCHEMATIC



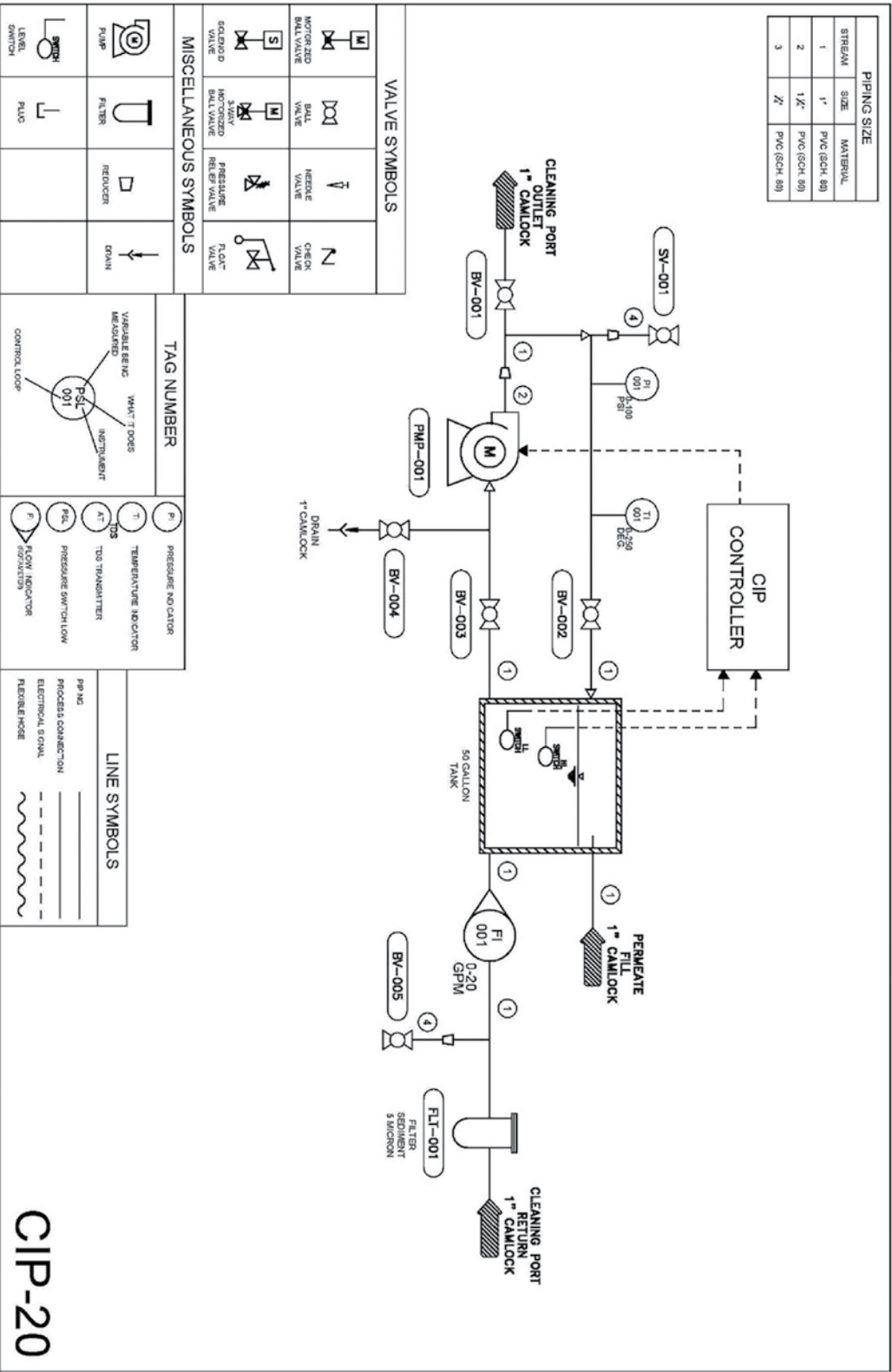
CIP-100 (460V, 3PH, 60HZ) ELECTRICAL SCHEMATIC



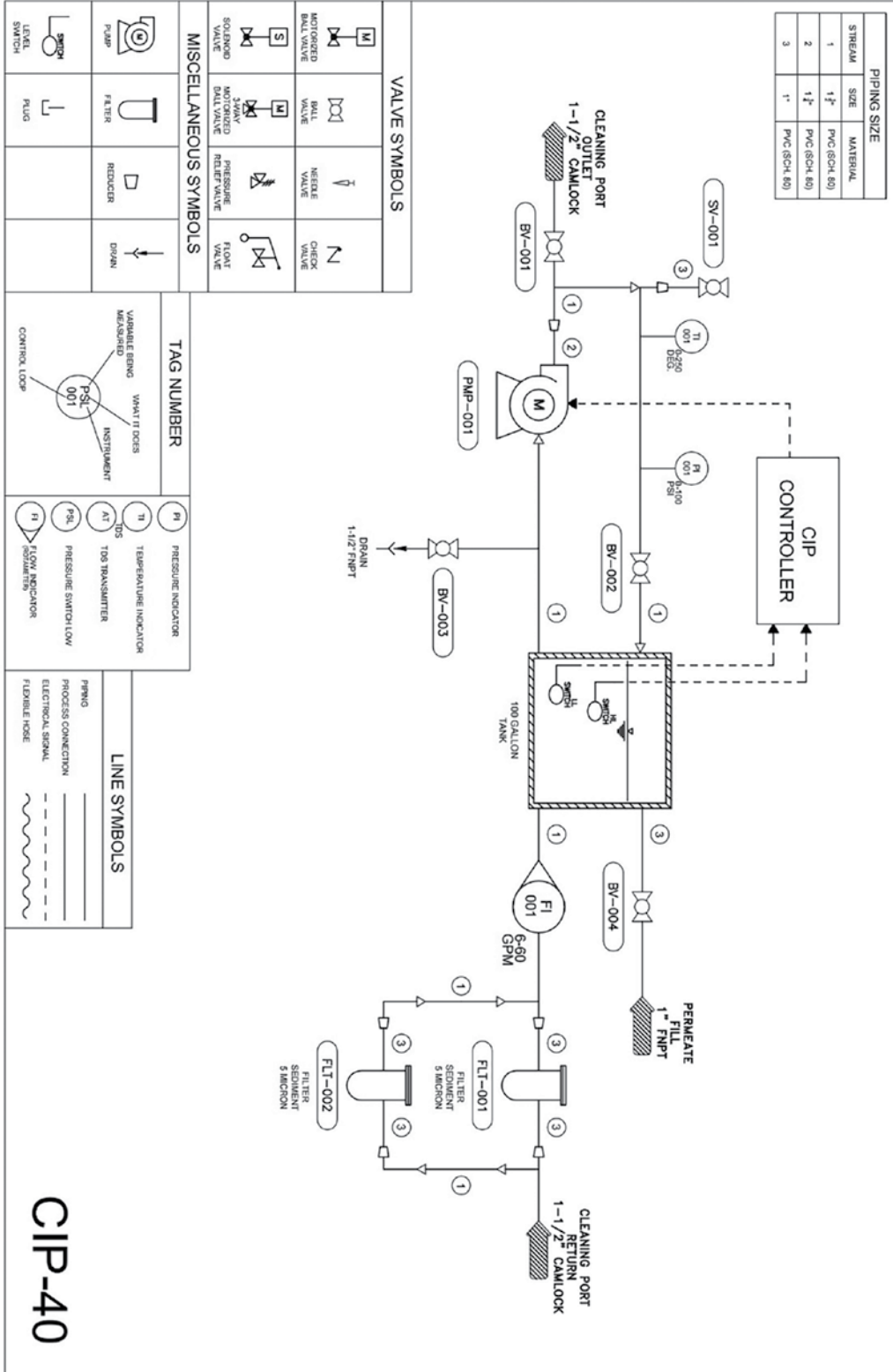
CIP-600 (460V, 3PH, 60HZ) ELECTRICAL SCHEMATIC



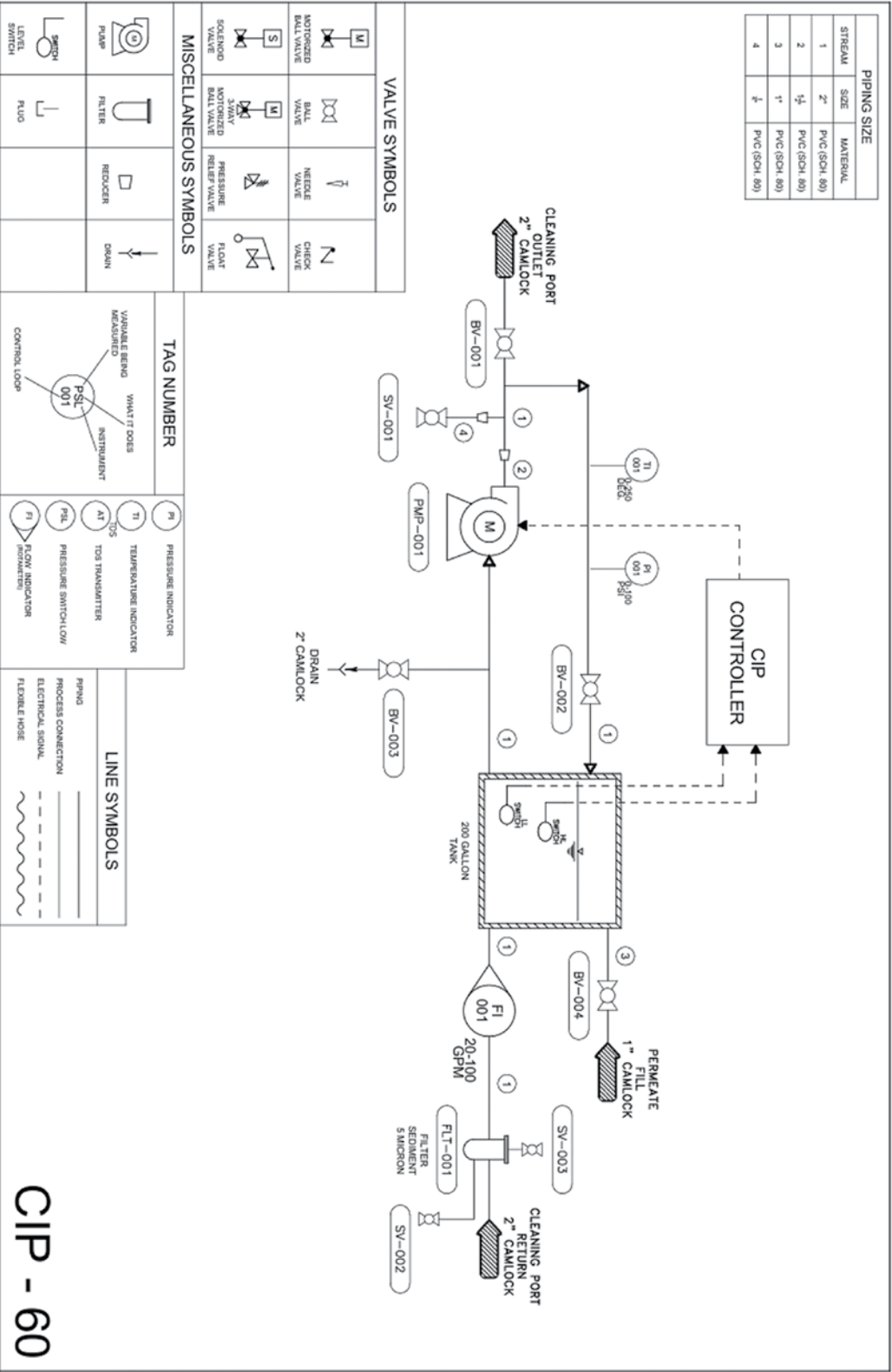
CIP-20 FLOW DIAGRAM



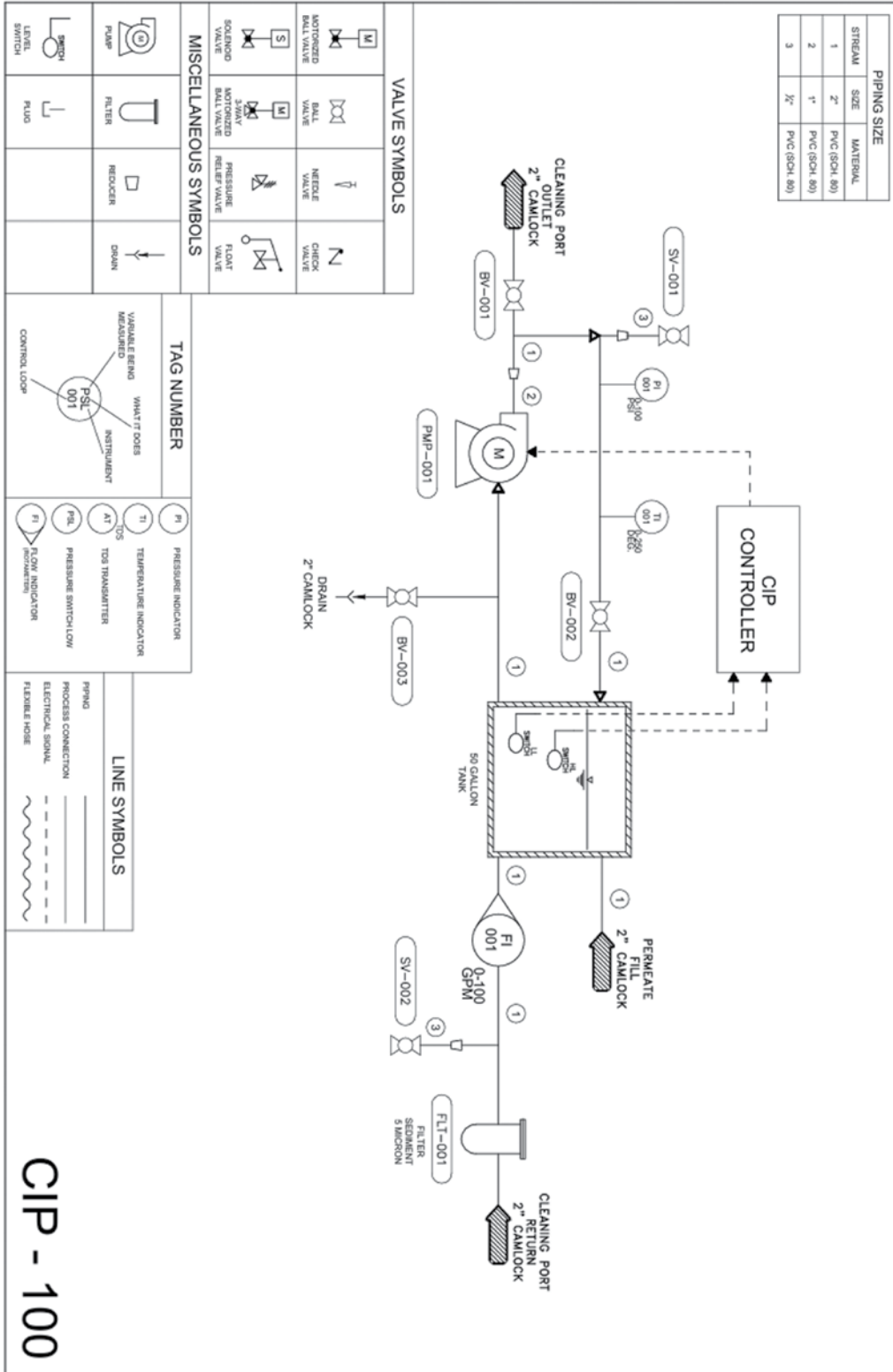
CIP-40 FLOW DIAGRAM



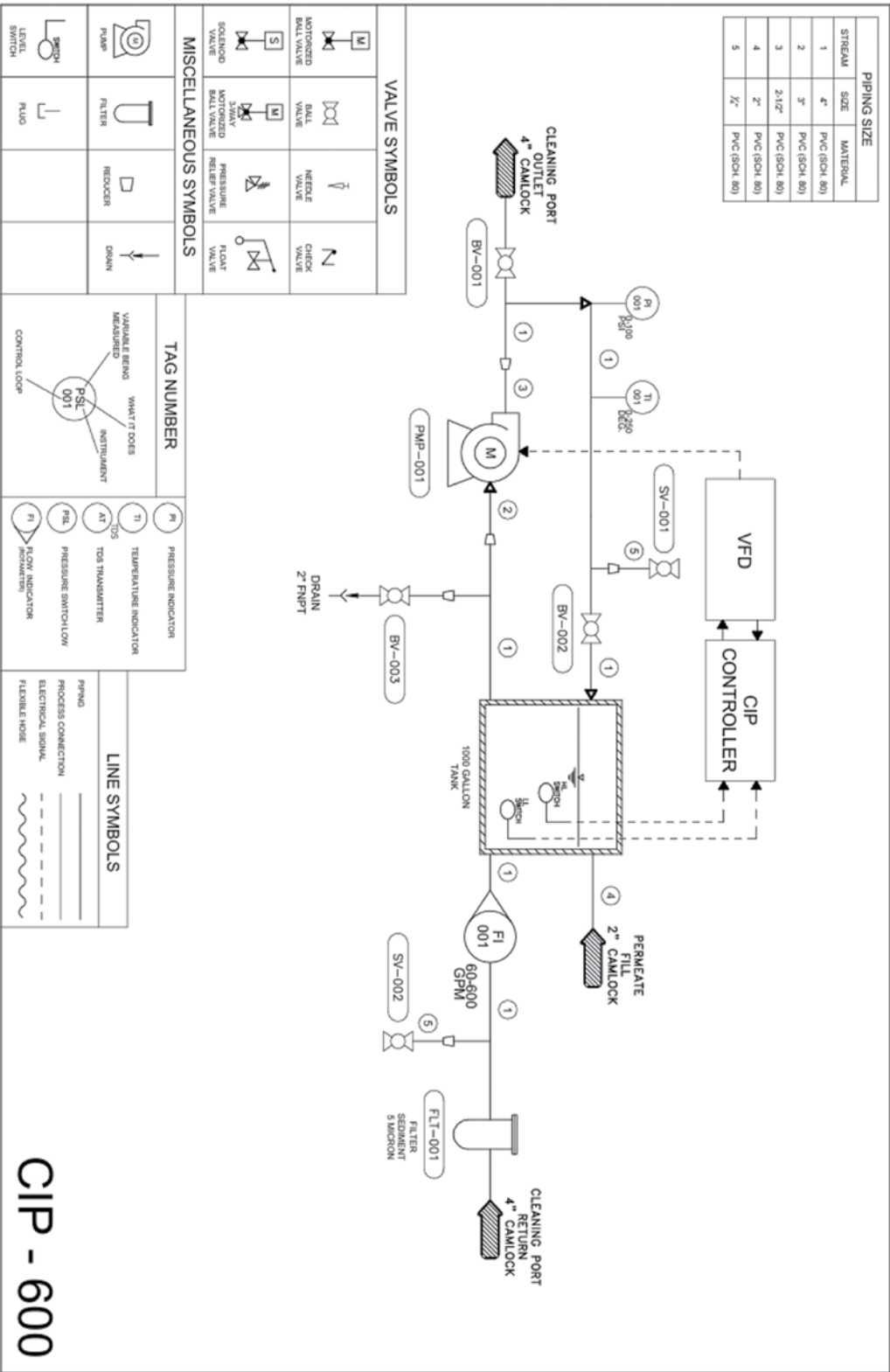
CIP-60 FLOW DIAGRAM



CIP-100 FLOW DIAGRAM



CIP-600 FLOW DIAGRAM



SYSTEM WARRANTY

Warranty Terms

Subject to the terms and conditions set forth hereinafter, the manufacturer (hereafter "Manufacturer") warrants to the original purchaser (hereafter the "Customer") that the systems and products manufactured by the Manufacturer are free from defects in material and in workmanship for twelve (12) months from the Warranty Commencement Date (as defined below) only when used strictly in accordance with the applicable operating instructions and within the range of the operating conditions specified by the Manufacturer for each such product.

This Warranty does not extend to systems, equipment, or components manufactured by others, nor to systems, equipment, or components manufactured by others and distributed by the Manufacturer. This Warranty does not extend to equipment or components manufactured by others which have been incorporated into a Manufacturer product but, if allowable the, Manufacturer hereby assigns, without warranty, to the Customer its interest, if any, under any Warranty made by the Manufacturer of such equipment or component. This Warranty does not cover disposable items such as fuses, O-rings, regeneration materials/chemicals, or other such disposable items, which must be replaced periodically under the normal and foreseeable operating conditions of the goods warranted hereby.

Warranty Commencement Date

The Warranty Commencement Date for each Manufacturer product shall be the later of the date of: (1) receipt by the Customer, or (2) the date of installation at the Customer's premises provided that such installation must occur within three (3) months of shipment from the Manufacturer's manufacturing facility. In no event shall the Warranty Commencement Date exceed three (3) months from the shipment from the Manufacturer's manufacturing facility. The Customer shall provide proof of purchase in order to exercise rights granted under this Warranty. If requested by the Manufacturer, the Customer must also provide proof of the installation date.

Warranty Service

THE MANUFACTURER'S OBLIGATION UNDER THIS WARRANTY IS LIMITED TO THE REPAIR OR REPLACEMENT (AT MANUFACTURER'S SOLE DISCRETION) OF ANY PRODUCT, OR COMPONENT THEREOF, PROVED TO BE DEFECTIVE IN MATERIAL OR WORKMANSHIP WITHIN THE COVERED WARRANTY PERIOD.

The Customer, at the Customer's risk and expense, shall be responsible for returning such product or component, only after obtaining a Return Goods Authorization (RGA) number from the Manufacturer, arranging for freight prepaid, and in conformance with any special packaging and shipping instructions set forth on the operation documentation or RGA instructions, or as otherwise reasonably required, to the Manufacturer, together with (1) RGA number issued by the Manufacturer at Customer's request; (2) proof of purchase and, if necessary, proof of installation date; (3) a Return Goods Authorization Form; (4) a description of the suspected defects; (5) the serial number of the Manufacturer product alleged to be defective; (6) a description of the type of water and pretreatment equipment which has been utilized in connection with the product, if any. The Manufacturer shall, in the Manufacturer's reasonable discretion, be the sole judge of whether a returned product or component is defective in material or workmanship. Required or replaced products or components shall be returned surface freight.

In genuine emergency situations, the Manufacturer will (at the Manufacturer's sole discretion) forward replacement parts to the Customer without waiting for authorized return of the questionable part(s). In such cases, Customer will issue a purchase order or other payment guarantee prior to shipment. If the returned part is found to have been misused or abused, or the defective part is not received by the Manufacturer within thirty (30) days; the Customer will be invoiced for the replacement part(s) provided. This Warranty does not cover or include labor and/or travel to the Customer's premise or location or any other location. Charges of \$2500 per day plus associated travel expenses will be incurred by the Customer in providing the Warranty Service at any location other than the Manufacturer's main headquarters; that is if the Manufacturer deems that the product is not covered by said Warranty. The Manufacturer reserves the right to precondition such travel to Customer's premises upon prepayment of the Manufacturer's anticipated costs of attending such premises.

Voidability of Warranty

This Warranty shall be void and unenforceable as to any Manufacturer product which has been damaged by accident, mishandling, abuse or has been repaired, modified, altered, disassembled or otherwise tampered with by anyone other than the Manufacturer or an authorized Manufacturer service representative; or, if any replacement parts are not authorized by the Manufacturer have been used, or, the product has not been installed, operated and maintained in strict accordance and adherence with the operating documentation and manuals for such product. Any expressed Warranty, or similar representation of performance set forth in the operation documentation for media or resin incorporated into the Manufacturer product shall be void and unenforceable unless the feed water requirements set forth in the operating documentation for such product are unequivocally and strictly adhered to.

Limitations and Exclusions

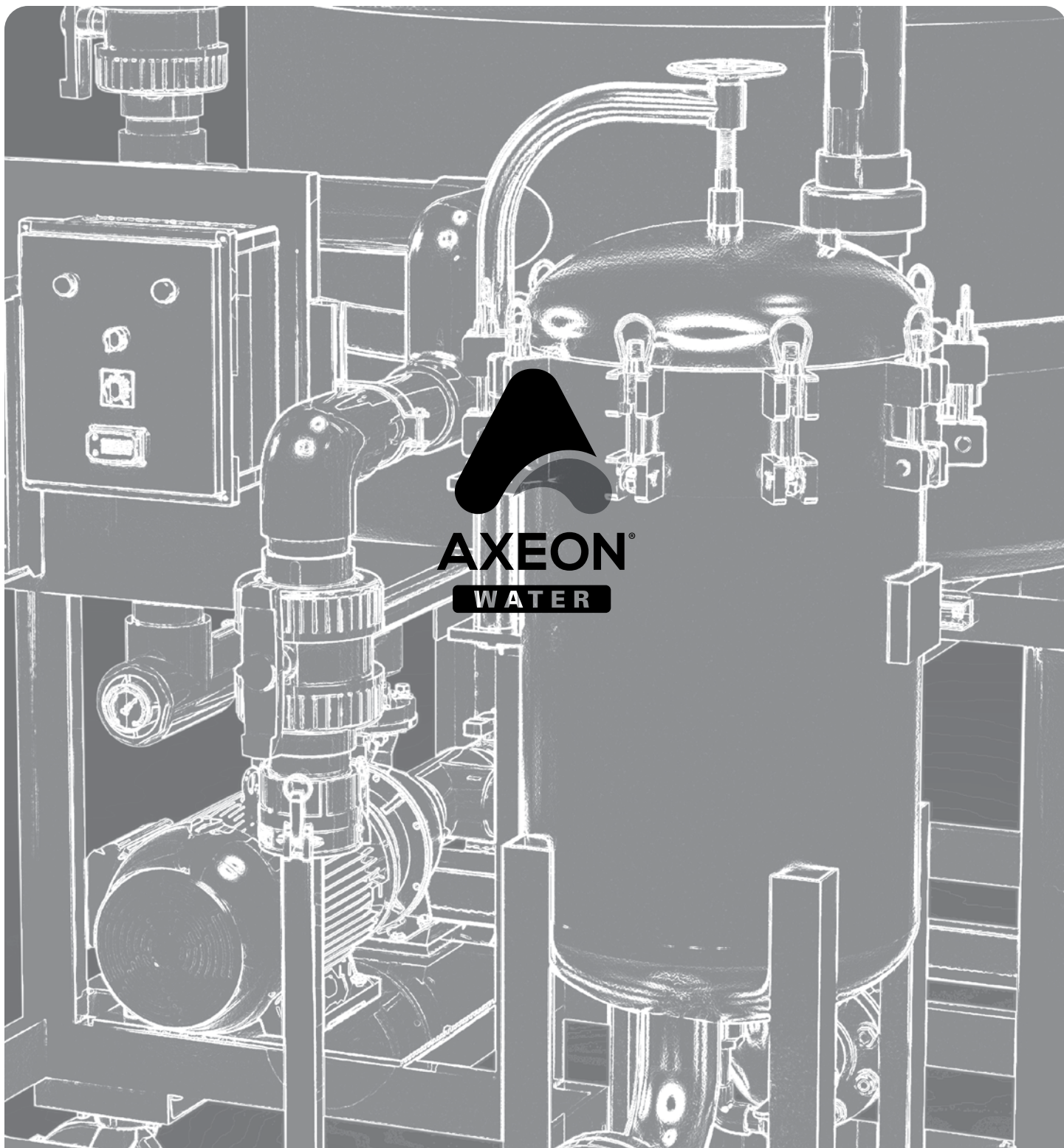
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