Troubleshooting Control Panels (Electrical)

O&M (operation and maintenance) manuals are supplied with all our control panels and should be used as a guide for all troubleshooting. These manuals are specifically made up for the individual panel, and are generally sufficient for any or all problems which may be encountered.

Rather than repeat here what is already available in the manual, this section is a broad generalized procedure.

PRECAUTIONS

Anyone testing electrical systems should take precautions to assure the safety of themselves and others, as well as for protection of the equipment under test.

Always assume that all wiring and parts are energized.

Even though connections to the panel have been broken, it is possible that other circuits are still “hot”.

All work on the panel should be done by a qualified technician while standing on a rubber matt.

INDICATORS

The panel is equipped with indicator lights and an alarm horn.

These lights are a valuable aid in determining cause of trouble or malfunction. Operation counters and running time meters for monitoring motors are included on the panel. These are important aids in maintenance and troubleshooting panels.

By keeping a weekly log on these two items, a normal count and time of motor running may be established. Any great departure from the normal indicates a fault exists for some reason (oscillation of control circuitry, poor regulation of power line, undersized motors or pumps, broken water mains, faulty pilot devices).

ALARMS ARE OF THREE TYPES

1. Some alarms shut the system down until the fault is corrected and must be reset manually to restore operation.

   Included are low chlorine level, well pump overload, chlorinator pump overload, and low flow. All these have red panel lights.

2. Other alarms shut the system down temporarily and resume operation automatically if proper conditions are restored.
Among these are well low level (red light), D.C. power off (white light out), A.C. power off (white light out).

3. The outer alarm system is of a “warning” type which if not corrected would eventually lead to a problem. One would be tank high level alarm, which would indicate a defective “pump off” float switch. Flooding or overflow would occur, and cause the pump to run continuously thereby decreasing its life. Low level alarm indicates insufficient pump capacity or faulty “pump off” float switch. These three alarm systems and their indicator lights give a nearly complete status of the system, and give an immediate narrowing of the problem area.

COMMON PROBLEMS

Once a system has been installed and operating, properly adjusted, and maintained, few problems are expected.

Most troubles which come about are due to motor or pump overload. Dirty bearings, clogged pumps, binding shafts, or shorted turns in the motor are a few.

Other common problems are relay and pilot device failure.

Less common is moisture in pilot device wiring, causing leakage which sends false signals to the panel. Generally caused by slopping installation. Sometimes panel malfunction can be attributed to “soft” power lines to which the panel is connected, causing fluctuating or low operating voltages in the control circuitry and motors. This is a problem which has to be corrected by the power facility. Control A.C. and D.C. power supplies seldom cause trouble.

Selector switches (HOA), test switches, and circuit breakers sometimes become faulty and may cause problems. These are best tested by a voltmeter or ohmmeter by methods later described.

Do not discount the possibility of indicator light burn out. A condition could exist and not be displayed.

PROBLEM ISOLATION

LINE REFERENCE NUMBERS

Located to the right of the ladder schematic are line reference numbers. These numbers indicate other line numbers with which the controlled relay or device is associated. If there is more than one number, the relay or device is performing more than one function. By following these line numbers, the purpose of the relay or device can be identified and its complete function in the panel ascertained. It follows that if a relay is inoperative, all circuits associated with that relay will either be inoperative, or nonfunctional.
GENERAL OBSERVATION

Before grabbing your ohmmeter, there are several areas which you can check out merely by observing the panel:

1. Push alarm silence button (to save your ears).

2. What alarm lights are on? (Do not reset until you determine the cause of alarm).

3. Are pump “run” lights on?

4. Is pump “overload/BT” light on?

5. Are both D.C. and A.C. power lights on?

6. Has someone diddled with the switches?

7. Are relays energized which should be, and those not which should not be? (Many relays have Red lights on the socket when energized).

8. Is overheating evident? (Smoke, smell, discolored wiring).

TEST SWITCHES

Almost any circuit in the panel can be tested prior use of test switches. All pilot devices have as associated test switch which can simulate operation of the Device, thus immediately detecting faulty ones.

HOA HAND-OFF-AUTO SWITCHES

Similar to test switches except that they bypass or disconnect automatic circuitry. Flipping the HOA switch to “HAND” allows the controlled device to operate even if the controlling circuitry is inoperative.

SUBSTITUTION

By the use of above observation procedure, and thoughtful use of test and HOA switches, you will have found the fault or have it narrowed down to one or two schematic ladder lines.

If the fault is still unknown, relays are suspect. By substitution (swapping) relays of the same type, bad relays may be quickly determined because the bad one will take trouble along with it to the circuitry into which it is inserted. Be sure to substitute only relays that are the same type.
MEASUREMENTS

Sometimes it may become necessary to measure voltages at various components or points in the panel to find fault. Relays are again suspected. Even though a relay coil operates the contact blocks, or a switch is on, it is possible that the contacts may not be closing or opening as they should. A voltmeter can determine if relays or switches are operating properly, as well as checking power supplies, contactors, etc.

Ohmmeters can detect shorted, or open circuits.

A current probe is useful for detecting overload conditions in motors, pumps.

STUBBORN PROBLEMS

The above procedure generally will be sufficient in most cases to isolate faults.

However, sometimes it is necessary to dig it out.

We by now should have traced the problem to one or two circuits.

Point by point measurement may be performed on the suspected circuit.

Connect one lead of the voltmeter to the common line of the appropriate circuit to be tested, and proceed with the other lead to measure from left to right in that order at all devices in the circuit, using pin numbers indicated on schematic. Components that are closed (or should be closed) should give a reading on the voltmeter equal to the full control voltage. Those that are open will give a zero reading. By progressing in this manner across various components in the circuit we can identify where in the circuit the fault exists.

Use of an ohmmeter (with circuit power off) can be helpful by checking continuity of circuits. An infinite reading will be obtained when measuring across open relay contacts, circuit breakers, switches, pilots, etc. A reading close to zero will be obtained if they are closed. A reading somewhere between zero and full scale indicates that there is some resistance in the circuit (loose or oxidized terminals or contacts). A resistance between 50 & 100 ohms would be normal for A.C. relay coils.

D.C. relays are three terminal devices which contain a built-in solid state amplifier and are best tested by direct substitution with one known to be good.

By use of the above procedure, all parts of the system can be checked (contactors, motor starters, etc.)

Terminal blocks make it convenient for testing externally connected devices (pilots).
WIRING DIAGRAM

Included along with the schematic diagram is a wiring diagram and panel internal layout. These show the approximate physical layout of the control components and their wiring. All wires and components are numbered and are referenced on the schematic.

With these three diagrams, it is a simple matter to find the components and their connections for ease of testing.

All wiring with the same number are electrically connected and should show a zero reading on ohmmeter (power off).
LEAKAGE VOLTAGE VS SHUNT RESISTANCE FOR POTTER BRUMFIELD KUA 11615 RELAY

RELAY ON
RELAY OFF
DESENSITIZING GRAPH FOR D.C. RELAYS

LEAKAGE VOLTAGE VS SHUNT RESISTANCE FOR POTTER BRUMFIELD KUA 11615 RELAY

VOLTAGE ACROSS PINS 8 TO B
WITH INPUT OPEN (VOLTS)

LEAKAGE VOLTAGE (VOLTS)

SHUNT RESISTOR (KΩ)

R SHUNT

10V
9V
8V
7V
6V
5V
4V
3V
2V
1V
0V

1000KΩ
100KΩ
10KΩ
1KΩ
100Ω
10Ω
1Ω
DESENSITIZING DC RELAYS FOR LEAKAGE

If water gets into the wiring for a remote switch, leakage resistance may occur causing the switch to always appear closed to the controls. A sensitive D.C. relay such as the Potter Brumfield KUA relays used on this panel can be adjusted to still work by adding a resistor around the "Coil" of the relay.

FLOAT SWITCHES

Procedure to desensitize relay for external leakage due to leaky cable. A resistor is needed if relay will not turn off when float switches are open. Make voltage measurements with digital voltmeter with 10 meg ohm input impedance.

1. Make sure all float switches in relay circuit are open (in water tanks, floats tilted up out of water), (in sewage pump stations floats hanging down, water below floats).

2. Measure voltage across pins (B) to (B) on relay socket. If voltage is greater than 1.0 volts a resistor is required to desensitize relay.

3. Example: Voltage measured is 6 volts, graph says a 6 k resistor is required. Use a resistor 1/2 that of size indicated, 3 k ohms. Do not use below 2 k ohms. If graph indicates less than 4 k ohms resistor required.

4. Install resistor between pins 8 and B on relay socket. With float switches still open.

5. Remeasure voltage across pins 8 and B. Voltage should be less than 1.0 volt. If not, use next smaller size resistor until voltage is less than 1.0 volt when floats are open circuit.

PROBES

1. Procedure is the same as float switches except when probes are in water the voltage across pins 8 to B must be at least 3.0 volts to operate reliably. Voltage should be less than 1 volt when probes are out of water.

DESENSITIZING PROCEDURE FOR D.C. RELAYS