PLC Programming Rules #1-3

1) Ladder diagrams are drawn vertically with inputs on the left and outputs on the right.

2) Each rung of the ladder has an individual output.

3) An individual output device can appear on the ladder diagram.

PLC Programming Rules #4-5

4) An individual physical input device (limit switch, push-button, pressure switch, etc.) may be used in both N.O. and N.C. configurations.

5) Internal contacts of the PLC are represented as conventional control relays and contacts.

PLC Programming Rules #6-8

6) Control relay coils (outputs) appear on the ladder diagram.

7) Control relay contacts are inputs and may be used as many times as necessary on the ladder diagram in both N.O. and N.C. configurations.

8) Any rung of the ladder diagram may be "OR"ed with a following rung at "OR" Connections.

“OR” Connections

Invalid “OR” Connections

Valid “OR” Connections

General Logic Design

Basic Logic Design

▶ What conditions to turn on output Y_i?
  □ Use these conditions in series to activate the control relay C_i

▶ What happens to turn output Y_i?
  □ Use these conditions in parallel to deactivate the control relay C_i

▶ Use safety interlocks to activate simultaneous outputs
PLC In-Class Problem #1

Task Description – IC #1

► If the cylinder is fully retracted, pressing either pushbutton will fully extend the cylinder (by activating Sol. B).

► If the cylinder is fully extended, pressing either pushbutton will fully retract the cylinder (by activating Sol. A).

► Once the cylinder reaches either the fully extended or fully retracted position, ”center the valve” by turning off both solenoids to unload the pump.
PLC In-Class Problem #2

Task Description – IC #2

► When the “Fill” button is pressed, run the Fill Pump until Float Switch #1 is activated or the Stop button is pressed.

► When the “Empty” button is pressed and Float Switch #2 is activated, run the Empty Pump until Float Switch #2 is de-activated or the Stop button is pressed.

PLC Wiring Diagram – IC #2
PLC Design Tips #1 & 2

- Dedicate control relays for specific functions (such as starting the system, activating a solenoid, etc.)
- Control relays are essentially “free” once a programmable controller has been purchased, so don’t be miserly!

PLC Design Tips #3 & 4

- Control relays use a holding circuit, so design in terms of both a “turn ON” and a “turn OFF” rung with an “OR” connection between them.
- Note that some circuits will require ______________ for turning ON or OFF, which must be connected through the OR structure.

PLC Design Tips #5 & 6

- Be absolutely certain that any holding circuit formed will be ________________ ______________ by your system.
  – Do not depend on a power shutdown to release and holding circuits.
- Provide safety interlocks either on the “turn ON” rung before the control relay or on the associated solenoid activation rung.