EET 365 Experiment Guide

Title: Experiment 9

Topic: Programmable Logic Controllers

Lecture Presentation: View Experiment 9 from the CD-ROM
Appendix A - Lab Handout: pages 9-1 through 9-5

Length of Video: 53:45.2

Type of Report: Formal Report – submit with reports 7 and 8

Software Requirement:
- TRiLOGI (distributed with EET 360).

Lab Assignment Sample Problem:
- Three-phase Wye-to-Delta switchover.
- Hydraulic dump valve under timed control
- Inputs
  - IN6: START pushbutton
  - IN7: STOP pushbutton
  - IN1: Centrifugal switch
- Outputs
  - OUT12: DELTA changeover contactor
  - OUT16: DUMP valve
- Internal Relays
  - CR11: Start latch relay
- Timers
  - T901: Dump valve time, 5 sec.

Lab Assignment:
- Write an Input/Output Assignment Table
  - Use the assigned input and output names and numbers
- Write the program
  - Determine the additional internal relays needed
  - Determine the timer(s) needed
- Input the program into the simulator
- If possible, "test as you go"
- Verify proper complete operation of the program
- Be sure to test for "unusual" input combinations
- When complete, document all results.

EET 365 ELECTRICAL POWER AND MACHINERY LAB
EXPERIMENT 9

Programmable Controller

PURPOSE: To introduce the student to programmable controller hardware, ladder logic, and the procedure required to enter and debug programs on the programmable controller.

REFERENCES:

a. Allen-Bradley SLC Programmable Controller User's Manual

b. Allen-Bradley SLC Programmable Controller Self-Teach Manual

c. Electric Machines; Theory, Operation, Applications, Adjustment, and Control by Charles I. Hubert, or Electrical Machines, Drives, and Power Systems by Theodore Wildi.

DISCUSSION:

_____A briefing on Programmable Logic Controllers (PLC's) will be given during the laboratory period and the students will then be given time to work the SAMPLE PROBLEM below during the lab period as a group. No lab report will be required for the SAMPLE PROBLEM. Each student will then be given two weeks to perform his/her own design and debugging of the PROBLEM ASSIGNMENT. This is an individual project, not a team project. Each student will perform the experiment on his/her own time. The laboratory and PLC's will be available during times when other classes are not meeting in the lab. No PLC's or manuals shall be removed from the laboratory and no other equipment will be operated (motors, generators, etc.) for any reason.

SAMPLE PROBLEM:

A sheet metal rolling press has a hydraulic system that is supplied by a high pressure hydraulic pump driven by a 50 horsepower motor. The motor is a 480 VAC three-phase induction motor that can be wired in either delta or Y configuration. In order to keep the starting currents at manageable levels, the motor is started in a Y configuration and then automatically switched to a delta configuration. The Y-to-delta switchover point is determined by a centrifugal switch in the motor. The starting load on the motor is kept to a minimum by opening a hydraulic dump valve on the pump. After the motor has been switched to delta configuration and reaches proper speed, the hydraulic dump valve is closed and hydraulic pressure is applied to the machine.

A programmable controller operates the press including the motor starting sequence. The starting sequence is as follows.

1) The momentary START pushbutton is pressed. The controller internally latches the pushbutton on.

2) The contactors are closed that apply power to the motor in the Y configuration.

3) The controller monitors the centrifugal switch. When it closes, the controller switches the contactor that reconfigures the motor for delta.

4) Four seconds later, the hydraulic dump valve is closed (energized) applying hydraulic pressure to the machine.

Solution:

Figure 1 shows the ladder diagram that implements the motor controller. To gain experience in operating the keyboard of the Allen-Bradley controller, each lab group should enter the program in Figure 1 into their controller and verify its proper operation.

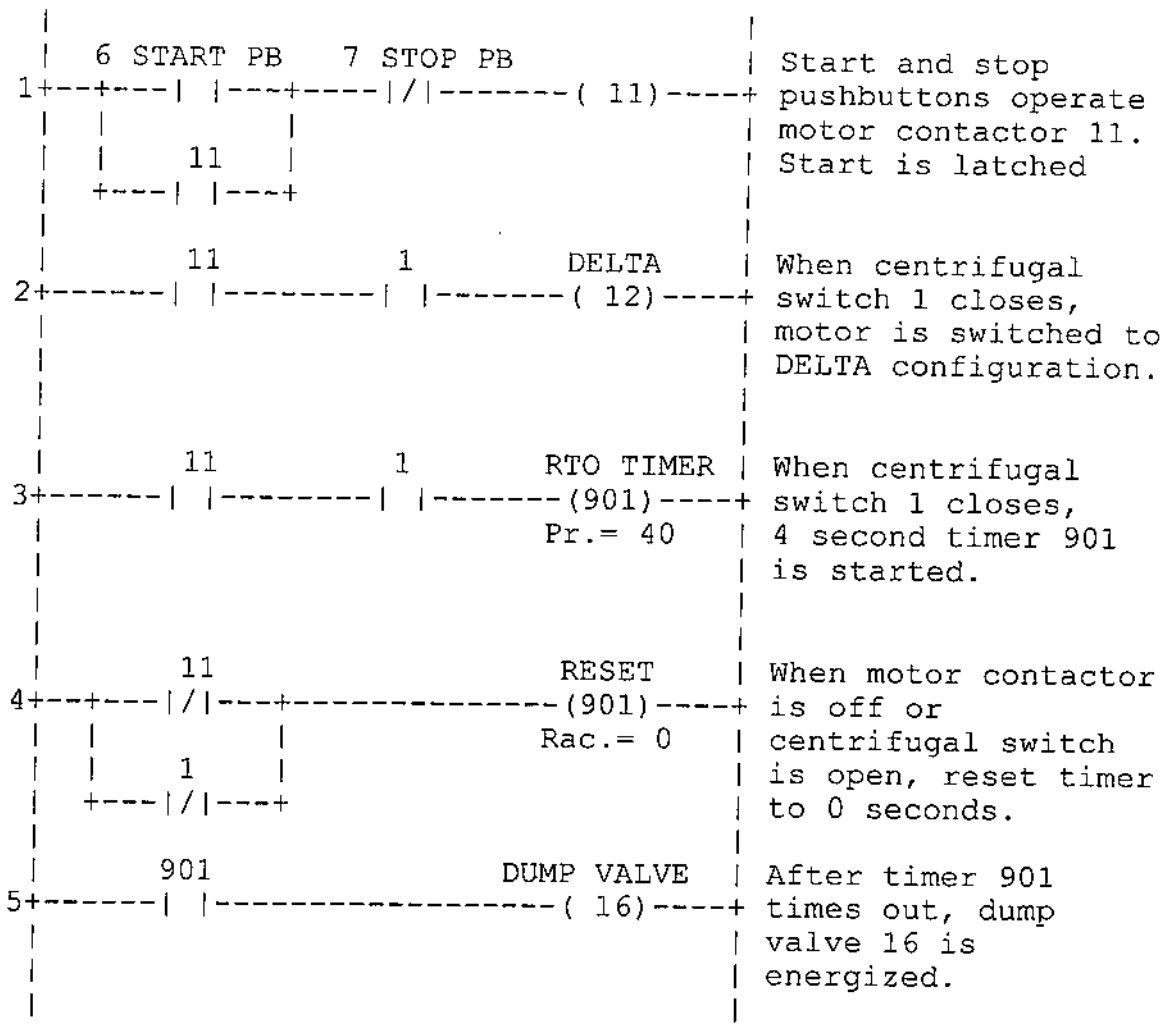

Figure 1. Motor Start Sequencer
Ladder Diagram

PROBLEM ASSIGNMENT:

This project is a simulation of a garage door controller. All inputs in this simulation will be by switches on the controller and all outputs will be through the indicator lamps. The device should operate as follows:

1. A normally open momentary down (INPUT 7) pushbutton causes the door to move in the down direction until either the down limit switch or the E-switch (emergency switch) is encountered.

2. A normally open momentary up (INPUT 6) pushbutton causes the door to move up until the up limit switch is encountered.

3. Both the up limit switch (INPUT 1) and the down limit switch (INPUT 2) are normally open (OFF) contacts and are closed (ON) by the door when the door reaches their respective end of travel.

4. Outputs to energize the drive motor up (OUTPUT 11) and down (OUTPUT 12) must be provided.

5. A normally open tape-type emergency switch (E-switch, INPUT 10) is fastened to the bottom of the door and is used to sense an obstruction. If an obstruction is encountered, the door should reverse and move to the full up position. Pressing the down pushbutton while the door is performing an emergency reverse should have no effect until the full up position is reached. Note that it is possible that the E-switch may be pressed in the full down position when the door touches the floor and this condition should not cause an emergency reverse.

6. An output should be provided for a courtesy light (OUTPUT 16). For simplicity in this project, the lamp should come on when the door is opened and go off 5 seconds after the door is fully closed.

7. To avoid damage, the motor should never receive an up and down signal simultaneously. These outputs from the PLC must be mutually exclusive.

8. Note that the UP and DOWN pushbuttons are normally open momentary contacts, i.e. when the operator releases the button, the contact returns to the open position. Therefore, the program must latch the inputs so that the operator does not have to continue pressing the buttons to keep the door moving.

9. To summarize, the inputs to and outputs from the PLC are:

INPUTS	OUTPUTS
(6) Up Pushbutton	(12) Motor Down
(7) Down Pushbutton	(11) Motor Up
(10) E-switch	(16) Courtesy Light
(1) Up Limit Switch	
(2) Down Limit Switch	

PRESENTATION OF RESULTS:

1. Develop a ladder diagram for the SLC-100 Programmable Controller to implement the system on the simulator. The diagram should be drawn in the order of execution with the rungs numbered and all inputs, outputs, and internal relays and contacts labeled.

2. Implement your design on the lab controller. When it is working properly, demonstrate its operation to an instructor.

   DEMONSTRATED_____ DATE_____

3. Prepare a formal lab report including the following:

   a. Cover page (title, your name, course name/number, date submitted, instructor's name)

   b. Abstract (a one paragraph summary of what is in the report)

   c. Assumptions, optional (If assumptions have to be made to implement the design, they should be stated here.)

   d. Analysis (a review of the design, a ladder diagram, a rung-by-rung description of the program, definitions of inputs and outputs, and instructions on how to run the program on the lab PLC)

   e. Discussion (suggestions: problems encountered, if any; how this project could be modified to make an actual door opener; the advantages of PLC's over wired relay logic and vice versa; some other suitable applications for PLC's).

   Any tables, figures, or graphs should be numbered and have titles. The report must be printed or typed.