1) Connect a power supply and motor for a final control element to the proper place in the relay circuit on the left. The objective is to have the motor run when an active high Temperature Sense low device, an active high Pressure Sense High device, or a Flow Sense High device goes into alarm. Show proper connections to the coil and contact portions of the circuit. Assume that the logic components used are TTL devices.

2) The control idea you created as a function diagram in problem 1 can also be implemented in a Programmable Logic Controller (PLC). Show the correct wire connections of the devices to the programmable control shown to the right.

3) Write the correct line of Ladder Logic program code to meet the control requirements of question 1.
4. When is the next test? __________________________

5. What is the Defense department symbol for a NOR device

6. Examine the TSH shown as item 17;
   (a) if it is an N.C. device, it is an active low device. Yes _ No _
   (b) if it is an N.C. device, a line is needed over the TSH. Yes _ No _
   (c) if it is an N.O device, a line is not needed over the TSH. Yes _ No _
   (d) if it is an N.O. device, it is an active high device. Yes _ No _

7. Item (23) is a TTL device. Yes _ No _

8. The LED (item 13) is OFF when both inputs are passive. Yes _ No _

9. Which item above is the best symbol to represent a decoder? _______

10. The R3 in item (14) is an example of a "current limiting" resistor. Yes _ No _

11. Item (16) is a cartoon diagram for a high power npn transistor package. Yes _ No _

12. Item (4) is a NOR device. Yes _ No _

13. Item (19) is a npn transistor? Yes _ No _

14. The motor starter circuit in Item (24) is active low. Yes _ No _

15. The motor starter circuit in Item (19) is active low. Yes _ No _

16. If R1 (14) is very much smaller than R2 or R3, voltage at node = V1/2 Yes _ No _

17. The motor relay is energized in Item (21) if the start P.B. is engaged. Yes _ No _

18. The motor relay is energized, Item (22), if the start P.B. is not engaged. Yes _ No _

19. The control relay in Item (21) remains energized after P.B. is released. Yes _ No _

20. The control relay in Item (22) remains energized after P.B. is released. Yes _ No _

21. Item (23) is a NAND device. Yes _ No _

22. Which item on page 2 is probably a flip-flop ______

23. The motor control circuit in Item 19 is an active low circuit Yes _ No _

24. Item (21) seems strange because of the use of the CR 1 symbol. Yes _ No _

25. Item (11) is a npn diode Yes _ No _

26. Does item (5) function like a counter? Yes _ No _

27. Is item (7) a closed set of normally open contacts? Yes _ No _

28. All item (13) inputs must be active for the LED to be ON. Yes _ No _
(I) The total voltage drop in item (14) is 9 volts and the value of R1 is very very large. The current in the circuit is to be limited to 1 amp. What resistance values are needed to have a voltage value of 6 volts at the node where the three resistors intersect?

(II) LED's do not have to have a current that exceeds 16 milliamps. Calculate the resistor value for the TTL circuit in item (13) that meets this design constraint and when there is no appreciable voltage drop across the LED?

(III) OSHA requires that Stop Push buttons be active low normally closed push buttons. Draw the function diagram of a Stop Push Button that meets this requirement.

(IV) Examine the decoder provided to the right knowing that the 1G input is at logic "0".

(A) Channel 1Y2 (pin 6) will be active when both the pressure sensor (pin 3) and the level sensor (pin 2) are passive. If this condition exists is the LED labeled 1L2 ON or OFF? _____

(B) Is the level sensor connected to pin 2 in its active or passive state if The LED labeled 1L3 is OFF? ____________