ECET 4530 - Spring 2019 **Due Date – 31 June 2018**

Industrial Motor Control **Laboratory Assignment #02**

INSTRUCTIONS:
- This assignment is to be completed ***individually*** such that you are not allowed to discuss this assignment with other students.
- You are expected to submit your completed assignment by the due date in the form of either a typed or a neatly-handwritten, ***single-sided*** document.
- The last page of this handout should be used as the cover-page for your results, and your name should appear at the top of every other page.
- All pages must be bound together by a single staple located in the upper-left corner of the document. Do **NOT** fold the pages or paperclip them together.

ASSIGNMENT: Analyze the system described on the following pages and complete the following tasks:

1) **Describe the proper Start-Up Procedure for the system**.

   Assuming that the key-switch was initially in the "OFF" position and that the machine was properly shut-down without incident after the last time that it was used, if the key is switched to the "ON" position and then removed from the panel:

   a) Show the initial status (on/off) of the indicator lamps on the control panel.
   b) List (in order) the exact set of steps that the operator must perform in order to completely activate the system.
   c) Show the final status of the indicator lamps on the control panel.

   Notes: If there are any conditions that must be met before a specific step can be successfully performed, state those conditions before describing that step.
   If the status of any indicator lamp changes during or after a step is performed, state those changes immediately after describing that step.

2) **Describe the proper Shut-Down Procedure for the system.**

   Assuming that the system is completely operational and functioning properly, with the key-switch in the "ON" position and the key removed from the panel:

   a) Show the initial status (on/off) of the indicator lamps on the control panel.
   b) List (in order) the exact set of steps that the operator must perform in order to properly and completely shut-down the system.
   c) Show the final status of the indicator lamps on the control panel.

   Notes: If there are any conditions that must be met before a specific step can be successfully performed, state those conditions before describing that step.
   If the status of any indicator lamp changes during or after a step is performed, state those changes immediately after describing that that.

3) **Describe the system's "Emergency Stop" function.**

   Assuming that the "Emergency Stop" button was pressed:

   a) List (in order) the exact set of events that occurred when the button was pressed.
   b) List (in order) the exact set of steps that must be performed in order to allow the system to be restarted.

4) Provide a "Fault Analysis" for the system.

The system is able to detect several different faults or conditions that can occur during system operation;

Motor Overload, ***Improper Water Pressure*** and ***Improper Temperature***

For each of these faults/conditions:

- **a)** Describe the importance of the fault or condition with respect to the safe and proper operation of the system.
- **b)** List (if any) the exact set of events that will occur if the fault or condition is detected and/or the changes in the system's operation due to the continued existence of that fault or condition.
- **c)** List (if any) the exact set of steps that must be performed and/or the conditions that must be met before the system can be brought back to normal operation.

SYSTEM DESCRIPTION

The system under consideration is a high-powered drilling tool that is used to drill holes through granite slabs.

During normal operation, the drill utilizes a continuous water spray to cool down the bit and to minimize the amount of particulate matter emitted from the drill site. A pressure sensor is utilized to monitor the water pressure and a temperature sensor is utilized to monitor the bit temperature.

The system was designed such that a "human" operator must initiate each step in the procedure required to either start-up or shut-down the machine by pressing one or more pushbuttons in the proper sequence.

A set of indicator lamps are provided along with the pushbuttons that allow the operator to monitor the basic operation of the system.

The control panel for the system is shown below:

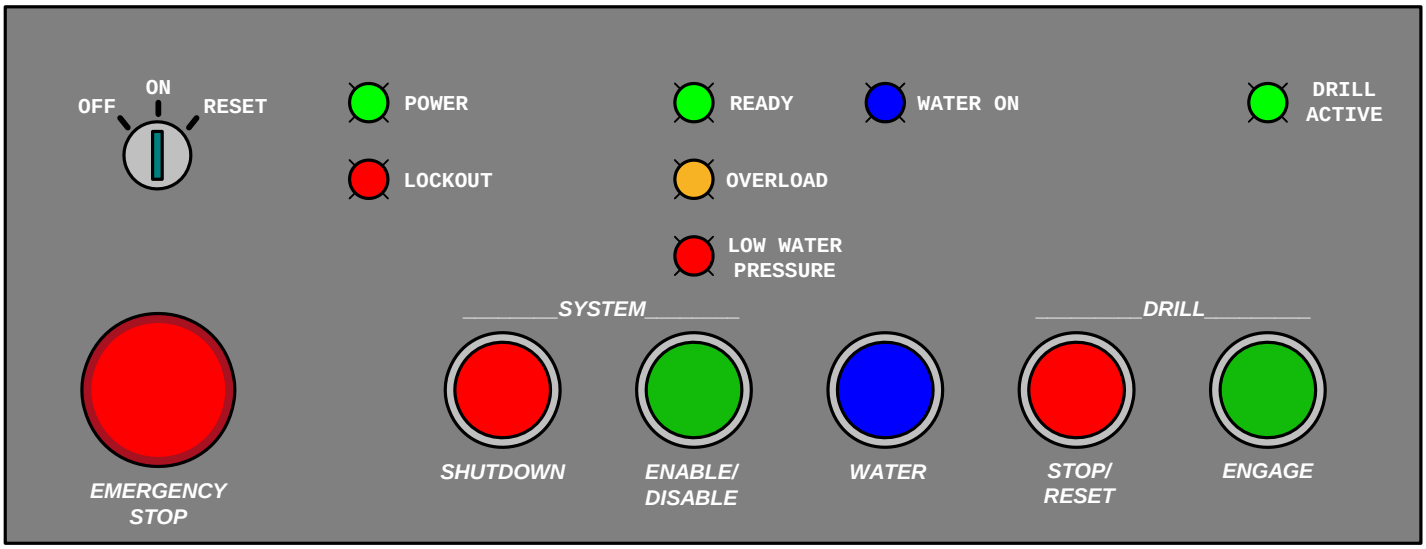


Figure #1 –System Control Panel

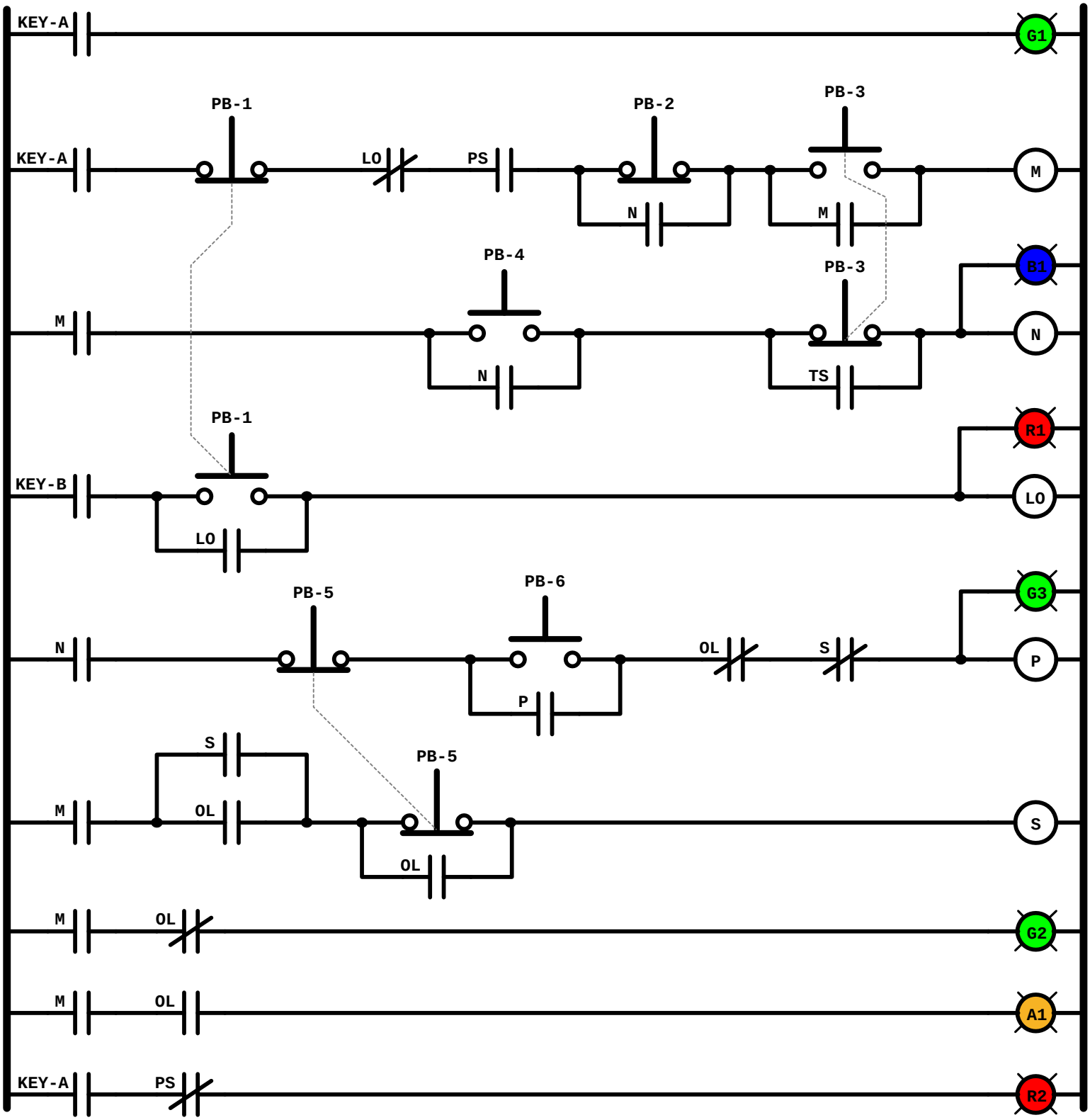
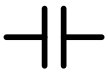


Figure #2 – Drill Control System Diagram

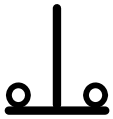
Motor Control System Components



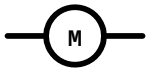
Normally Open (NO) Contact – Label next to contact associates the contact with the field coil that actives the contact.

Normally Closed (NC) Contact – Label next to contact associates the contact with the field coil that actives the contact.

NO Pushbutton



NC Pushbutton



Contactor/Relay Field Coil

Indicator Lamp

Label Specifies Color

A	Amber
B	Blue
G	Green
R	Red

Code	Device
M	Control Relay
N	Water Valve Relay (Valve opens when coil is energized)
LO	Control Relay
P	Drill Motor Contactor (Drill Starts when coil is energized)
S	Control Relay
PS	Pressure Sensor – Contacts in "normal" position when P_{water} < 10 p.s.i.
TS	Temperature Sensor – Contacts in "normal" position when T_{bit} < 120°F
OL	Drill Motor Over-Load Relay – Contacts in "normal" position during normal motor operation
KEY-A	Key Switch - "A" Contacts – Contacts in "normal" position when key switch set to "**OFF**"
KEY-B	Key Switch - "B" Contacts – Contacts in "normal" position when key switch set to "**RESET**"
PB-1	Emergency Stop
PB-2	System Shutdown
PB-3	System Enable/Disable
PB-4	Water
PB-5	Drill Stop/Reset
PB-6	Drill Engage