Industrial Automation (EPM422s)

Assignment 1

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Objectives:

Application 3 – **Batching Control**

1. Two ingredients, A and B, will be mixed in the reactor tank. The reactor tank must be empty (indicated by the normally closed liquid level switch LLS) before ingredient A can be added.

2. The mixer motor must be off to avoid liquid precipitation, and the finished product tank should be in a set position, which the limit switch detects.

3. The controller will add ingredient A by opening solenoid valve 1 (SOL1) until LLS1, which is normally open, detects the quantity of ingredient A in the tank. At this point, the controller will add ingredient B by opening SOL2. LLS2 detects the quantity of ingredient B.

4. When the reactor tank contains both ingredients, the controller will turn ON the mixer for two minutes and raise the temperature to 100°C.

5. SOL3 will activate the drain valve when the mixing is completed and the temperature sensor detect that the temperature of mixture equal to 100°C.

6. This operation will reset the process until another finished product tank is placed in position, and the cycle starts again.

Application 3 – **Batching Control**

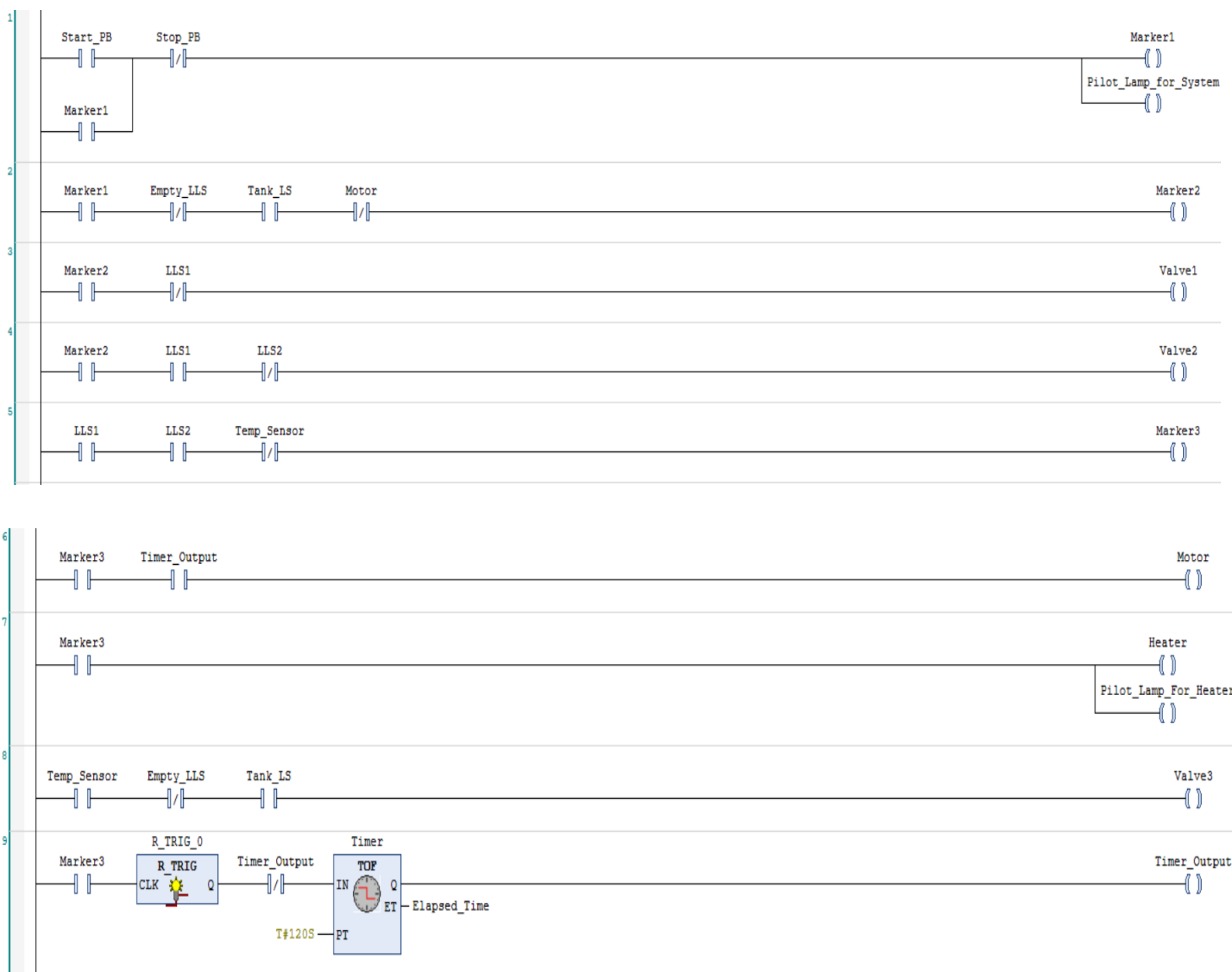| Input	Device	Output	Device
I0.0	Start PB (NO)	Q0.0	Solenoid valve 1 (A)
I0.1	Stop PB (NC)	Q0.1	Solenoid valve 2 (B)
I0.2	Tank position LS	Q0.2	Mixer Motor (M1)
I0.3	Empty LLS (NC)	Q0.3	Solenoid valve 3 (drain)
I0.4	Low Level LLS1	Q0.4	Heater coil
I0.5	High Level LLS2	Q0.5	Start System PL
I0.6	Temperature Sensor	Q0.6	PL Heater ON
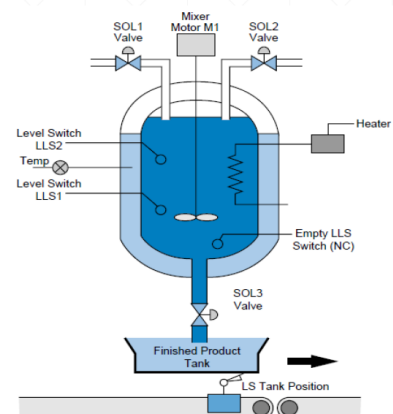
Answer Using Code Sys:

1- Defining Variables:

```
1   PROGRAM PLC_PRG
2   VAR
3       //Inputs I
4       Start_PB AT %IX0.0: BOOL := FALSE;
5       Stop_PB AT %IX0.1: BOOL := TRUE;
6       Tank_LS AT %IX0.2: BOOL := FALSE;//True when the tank is in place under the mixer
7       Empty_LLS AT %IX0.3: BOOL := TRUE; //True when tank is not empty, False when tank is empty
8       LLS1 AT %IX0.4: BOOL := FALSE;//True when the water is above this leve
9       LLS2 AT %IX0.5: BOOL := FALSE;//True when the water is above this leve
10      Temp_Sensor AT %IX0.6: BOOL := FALSE;//True when Heat is 100 C degrees or more
```

```
13      //Outputs Q
14      Valve1 AT %QX0.0: BOOL := FALSE;
15      Valve2 AT %QX0.1: BOOL := FALSE;
16      Motor AT %QX0.2: BOOL := FALSE;
17      Valve3 AT %QX0.3: BOOL := FALSE;
18      Heater AT %QX0.4: BOOL := FALSE;
19      Pilot_Lamp_For_System AT %QX0.5: BOOL := FALSE;
20      Pilot_Lamp_For_Heater AT %QX0.6: BOOL := FALSE;
```

```
23      //Markers M
24      Marker1 AT %MX0.0: BOOL := FALSE;
25      Marker2 AT %MX0.1: BOOL := FALSE;
26      Marker3 AT %MX0.2: BOOL := FALSE;
```

```
29      //Timers T
30      Timer: TOF;
31      Elapsed_Time: TIME;
32      R_TRIG_0: R_TRIG;
33      Timer_Output: BOOL;
34
35   END_VAR
```

2-Ladder Diagram:

Rung 1:
```
Start_PB    Stop_PB                                              Marker1
  ┤├          ┤/├                                                ( )
                                                         Pilot_Lamp_for_System
Marker1                                                          ( )
  ┤├
```

Rung 2:
```
Marker1   Empty_LLS   Tank_LS    Motor                          Marker2
  ┤├         ┤/├        ┤├         ┤/├                           ( )
```

Rung 3:
```
Marker2    LLS1                                                  Valve1
  ┤├        ┤/├                                                  ( )
```

Rung 4:
```
Marker2    LLS1      LLS2                                        Valve2
  ┤├        ┤├        ┤/├                                        ( )
```

Rung 5:
```
LLS1       LLS2    Temp_Sensor                                   Marker3
  ┤├        ┤├        ┤/├                                        ( )
```

Rung 6:
```
Marker3   Timer_Output                                           Motor
  ┤├          ┤├                                                 ( )
```

Rung 7:
```
Marker3                                                          Heater
  ┤├                                                             ( )
                                                         Pilot_Lamp_For_Heater
                                                                ( )
```

Rung 8:
```
Temp_Sensor   Empty_LLS   Tank_LS                                Valve3
  ┤├            ┤/├          ┤├                                  ( )
```

Rung 9:
```
Marker3   R_TRIG_0                    Timer                  Timer_Output
  ┤├       R_TRIG      Timer_Output    TOF                       ( )
          CLK    Q        ┤/├         IN    Q
                                      ET — Elapsed_Time
                               T#120S — PT
```

3-Simulation:

Step1: At Start.

Step2: Start Button Pushed and Tank is put in place under the mixer.

Step3: LLS1 is triggered.

Start_PB   Stop_PB

Motor   Pilot Lamp for System

Tank LS   Empty LS

Heater   Pilot Lamp for Heater

LLS1   LLS2   Temp_Sensor

Valve1   Valve2   Valve3

Step4: LLS2 is triggered.

Start_PB   Stop_PB

Motor   Pilot Lamp for System

Tank LS   Empty LS

Heater   Pilot Lamp for Heater

LLS1   LLS2   Temp_Sensor

Valve1   Valve2   Valve3

Step5: Timer counted 2 minutes.

Start_PB
Stop_PB

Motor
Pilot Lamp for System

Tank LS
Empty LS

Heater
Pilot Lamp for Heater

LLS1
LLS2
Temp_Sensor

Valve1
Valve2
Valve3

Step5: Temperature Reached 100 c triggering the temperature sensor.

Start_PB
Stop_PB

Motor
Pilot Lamp for System

Tank LS
Empty LS

Heater
Pilot Lamp for Heater

LLS1
LLS2
Temp_Sensor

Valve1
Valve2
Valve3

Step6: Mixer is empty.

Step7: Stop Button Pushed.

Hand Writing Answer:

Note: I did minor edits in the simulation version on Code Sys.