Application Note - AN-105

3 Pump Sequencer & Alternator / Lift Station

NOTICE

This application note is provided for use as a general example and a guide. Divelbiss assumes no responsibility, liability or warranty regarding this application, its use, functionality or reliability to meet application needs. User assumes all responsibility to ensure all safety precautions are taken when using this application note. This application must not be used alone in applications which would be hazardous to personnel in the event of a failure. Precautions must be taken by the user to provide mechanical and/or electrical safeguards external to this application and controllers shown.

Application Description

This application will control the start sequence of 3 pumps. Tank level is monitored via three float switches. The high level switch identifies when the tank level has risen to the level when one pump is needed to decrease the level to normal levels. The Level Ok float switch identifies when the tank level has fallen the level where pump operation is no longer required. The over level float switch identifies an overfill condition.

Pump sequence is alternated to equalize the operation hours of each pump as much as possible. The 'Lead' pump is the pump that will operate the next the level rises and pumping is required. The 'Lead' pump is alternated between all three pumps(once each time the level rises and then drops to normal).

In the event a single pump cannot meet the demand (OK level not reached within 10 minutes), a second pump is started to accomodate the load condition. After an additional 10 minutes without reaching the OK level the third pump is also started.

After 10 minutes with all three pumps started, if the level OK has not been reached, the alarm output will pulse on and off in two second intervals.

If at any time an over fill is detected, all pumps will continue to operate, and the alarm output will be on steady.

Equipment Used

Solves-it	
Controller P/N:	SI-100 or SI-200
Programming Software:	Divelbiss EZ LADDER
Digital I/O	On-Board
Application Program Filename:	AN-105_SI.dld
Programming Cable:	SI-PGM
Connection Diagram:	Figure 1

Harsh Environment Controller	
Controller P/N:	HEC-1000
Programming Software:	Divelbiss EZ LADDER
Digital I/O	On-Board
Application Program Filename:	AN-105_HEC.dld
Programming Cable:	HEC-910
Connection Diagram:	Figure 2

PCS	
Controller P/N:	PCS-100 (All Models)
Programming Software:	Divelbiss EZ LADDER
Digital I/O	Using ICM-HDIO-03P
Application Program Filename:	AN-105_PCS.dld
Programming Cable:	ICM-CA-34
Connection Diagram:	Figure 3

Enhanced Baby Bear	
Controller P/N:	ICM-EBB-100 (All Models)
Programming Software:	Divelbiss EZ LADDER
Digital I/O	On-Board
Application Program Filename:	AN-105_EBB.dld
Programming Cable:	ICM-CA-34
Connection Diagram:	Figure 4

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Input / Output Description

Tank_Hi : Real world input. Tank Level High Switch. Normally open. Indicates when tank level has risen to when a pump will be required. Input address: EBB-XXX = DI1.04, PCS-XXX = DI0.01, HEC-1000 = GPI1, SI-XXX = GPI1

Tank_Lo : Real world input. Tank Level OK Switch Normally closed. Indicates when tank level has fallen to when a pump will no longer be required. Input address: EBB-XXX = DI1.03, PCS-XXX = DI0.00, HEC-1000 = GPI0, SI-XXX = GPI0

Tank_Over :Real world input. Tank Overfill Switch Normally open. Indicates when tank level has risen too high and an alarm should be given. Input address: EBB-XXX = DI1.05, PCS-XXX = DI0.02, HEC-1000 = GPI2, SI-XXX = GPI2

PUMP1: Real world output. Pump 1 Start Signal. Indicates for pump 1 to start and operate. Output address: EBB-XXX = DO1.03, PCS-XXX = DO0.00, HEC-1000 = GPO0, SI-XXX = GPO0

PUMP2: Real world output. Pump 2 Start Signal. Indicates for pump 2 to start and operate. Output address: EBB-XXX = DO1.04, PCS-XXX = DO0.01, HEC-1000 = GPO1, SI-XXX = GPO1

PUMP3: Real world output. Pump 3 Start Signal. Indicates for pump 3 to start and operate. Output address: EBB-XXX = DO1.05, PCS-XXX = DO0.02, HEC-1000 = GPO2, SI-XXX = GPO2

ALARM: Real world output. Alarm Signal. Steady indicates over fill , while pulsing indicates unable to satisfy load. Output address: EBB-XXX = DO1.06, PCS-XXX = DO0.03, HEC-1000 = GPO3, SI-XXX = GPO3

Program Variables

Tank_Hi: Boolean (Normally open contact). Type: Input. Default value = 0. Description: Tank level High Float Switch

Tank_Lo: Boolean (Normally closed contact). Type: Input. Default value = 0. Description: Tank level OK Float Switch

Tank_Over: Boolean (Normally open contact). Type: Input. Default value = 0. Description: Overfill Float Switch.

PUMP1: Boolean (Direct Coil). Type: Output. Default value = 0. Description: Pump 1 Start Signal

PUMP2: Boolean (Direct Coil). Type: Output. Default value = 0. Description: Pump 2 Start Signal

PUMP3: Boolean (Direct Coil). Type: Output. Default value = 0. Description: Pump 3 Start Signal

Level_Ok: Boolean. Type: Internal. Default value = 0. Description: Tank Level Ok (low) Point Detected.

Level_Hi: Boolean. Type: Internal. Default value = 0. Description: Tank Level Hi (pump operation needed) Point Detected.

Over_Fill: Boolean. Type: Internal. Default value = 0. Description: Overfill Point Detected.

Pump_Start: Boolean. Type: Internal. Default value = 0. Description: Start Pump Flag.

Stg1Enable: Boolean. Type: Internal. Default value = 0. Description: Pump Enable Flag for Stage 1 (1 Pump).

Stg2Enable: Boolean. Type: Internal. Default value = 0. Description: Pump Enable Flag for Stage 2 (2 Pumps).

Stg3Enable: Boolean. Type: Internal. Default value = 0. Description: Pump Enable Flag for Stage 3 (3 Pumps).

PMP1Lead: Boolean. Type: Internal. Default value = 0. Description: Pump # 1 Lead Flag.

PMP2Lead: Boolean. Type: Internal. Default value = 0. Description: Pump # 2 Lead Flag.

PMP3Lead: Boolean. Type: Internal. Default value = 0. Description: Pump # 3 Lead Flag.

PU_Reset: Boolean. Type: Internal. Default value = 0. Description: Used to Pulse ALARM output.

PU_Reset2: Boolean. Type: Internal. Default value = 0. Description: Used to Pulse ALARM output.

Time_Alarm: Boolean. Type: Internal. Default value = 0. Description: Flag to identify when load not met after timeout.

PmpNum: Integer. Type: Internal. Default value = 1. Description: Lead Pump Number for next time pumping needed.

One: Integer. Type: Internal. Default value = 1. Description: # 1 used for comparisons.

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Two: Integer. Type: Internal. Default value = 2. Description: # 2 used for comparisons.

Three: Integer. Type: Internal. Default value = 3. Description: # 3 used for comparisons.

Four: Integer. Type: Internal. Default value = 4. Description: # 4 used for comparisons.

DelayTime: Type: Timer. Default value = 10 Minutes. Description: Delay time between adding pump stages.

Alarm_Elap: Type: Timer. Default value = none. Description: Holds the elapsed time for the Alarm Timer.

Stg2Elap: Type: Timer. Default value = none. Description: Holds the elapsed time for the Stage 2 Timer.

Stg3Elap: Type: Timer. Default value = none. Description: Holds the elapsed time for the Stage 3 Timer.

TwoSec: Type: Timer. Default value = 2 Seconds. Description: Time Delay for the Alarm Pulsing Timers.

Pulse_Elap: Type: Timer. Default value = none. Description: Holds the elapsed time for the PULSTIM Timer.

Pulse2_Elap: Type: Timer. Default value = none. Description: Holds the elapsed time for the PULSTIM2 Timer.

Program Description

Rungs 5-7: Monitors the tank float switches and update coils based on level conditions.

Rungs 9-10: If conditions are met, pump starting is called for.

Rungs 12-14: When a pump cycle is stopped, the lead pump is incremented. When incremented to 4, the lead pump is automatically reset to 1.

Rungs 16-17: Stage 2 Timing. If timer reaches 10 minutes, the Stage 2 requirement is met and a second pump is called for.

Rungs 18-19: Stage 2 Timing. If timer reaches 10 minutes, the Stage 2 requirement is met and a third pump is called for.

Rungs 20-21: Alarm Timing. If timer reaches 10 minutes, the Alarm requirement is met and the alarm to warn that all pumps have been operating, but the OK level cannot be reached is activated.

Rungs 23-25: Identifies if Pump 1 is lead pump.

Rungs 26-28: Identifies if Pump 2 is lead pump.

Rungs 29-31: Identifies if Pump 3 is lead pump.

Rungs 33-35: Based on Lead Pump and Stage conditions, start pump 1 signal is controlled.

Rungs 36-38: Based on Lead Pump and Stage conditions, start pump 2 signal is controlled.

Rungs 39-41: Based on Lead Pump and Stage conditions, start pump 3 signal is controlled.

Rungs 43-44: Based on conditions, the ALARM output is controlled.

Rungs 46-49: Timers to pulse the ALARM output for OK pressure not reached alarm.

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Connection Diagrams

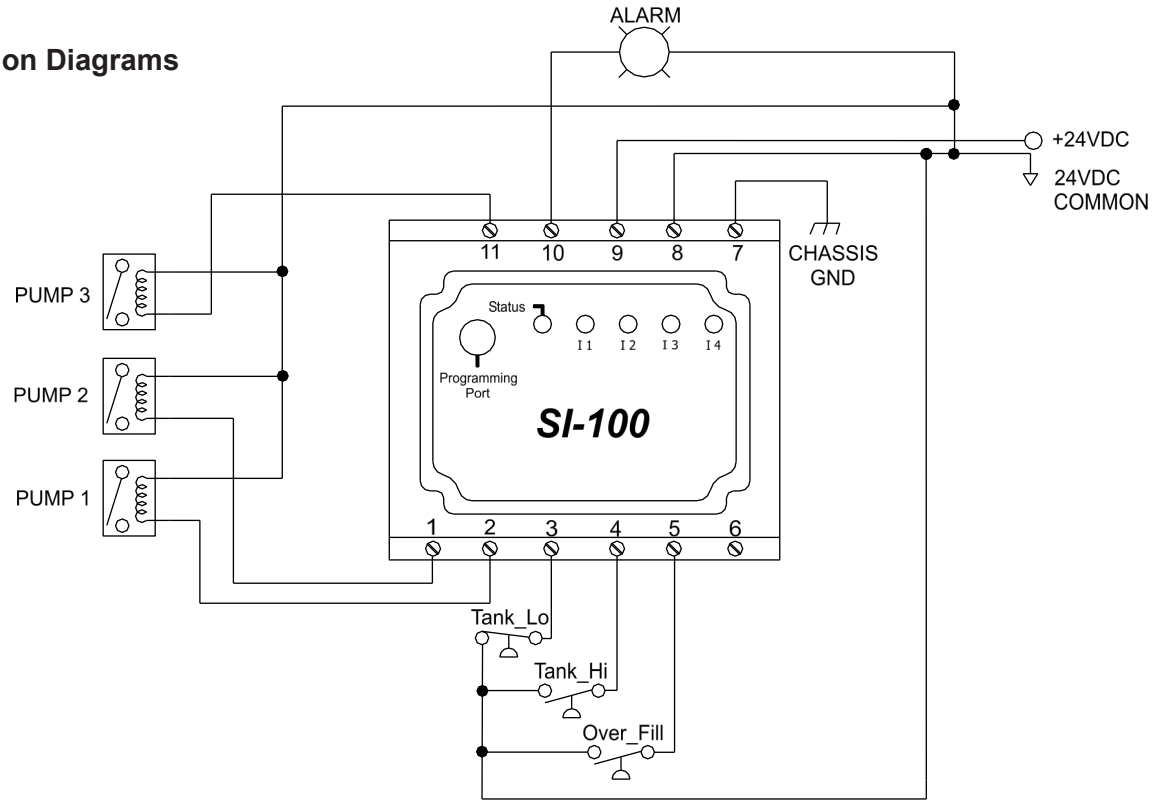

FIGURE 1 - SOLVES-IT CONNECTIONS

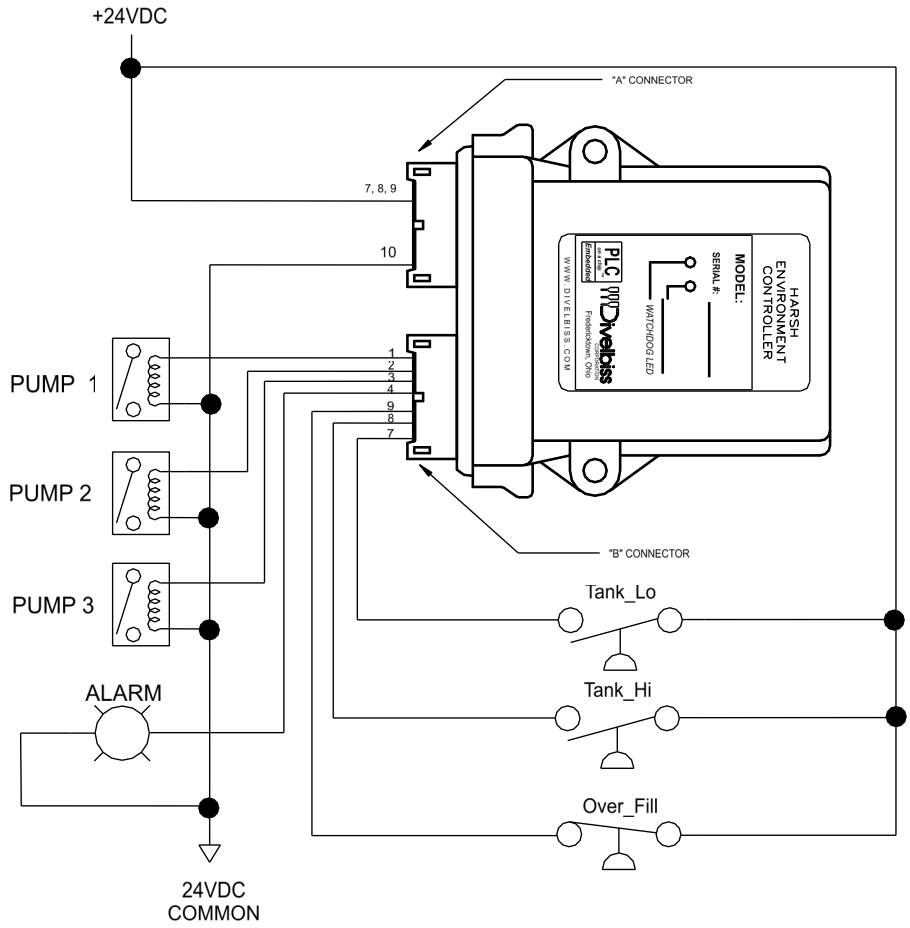

FIGURE 2 - HEC-1000 CONNECTIONS

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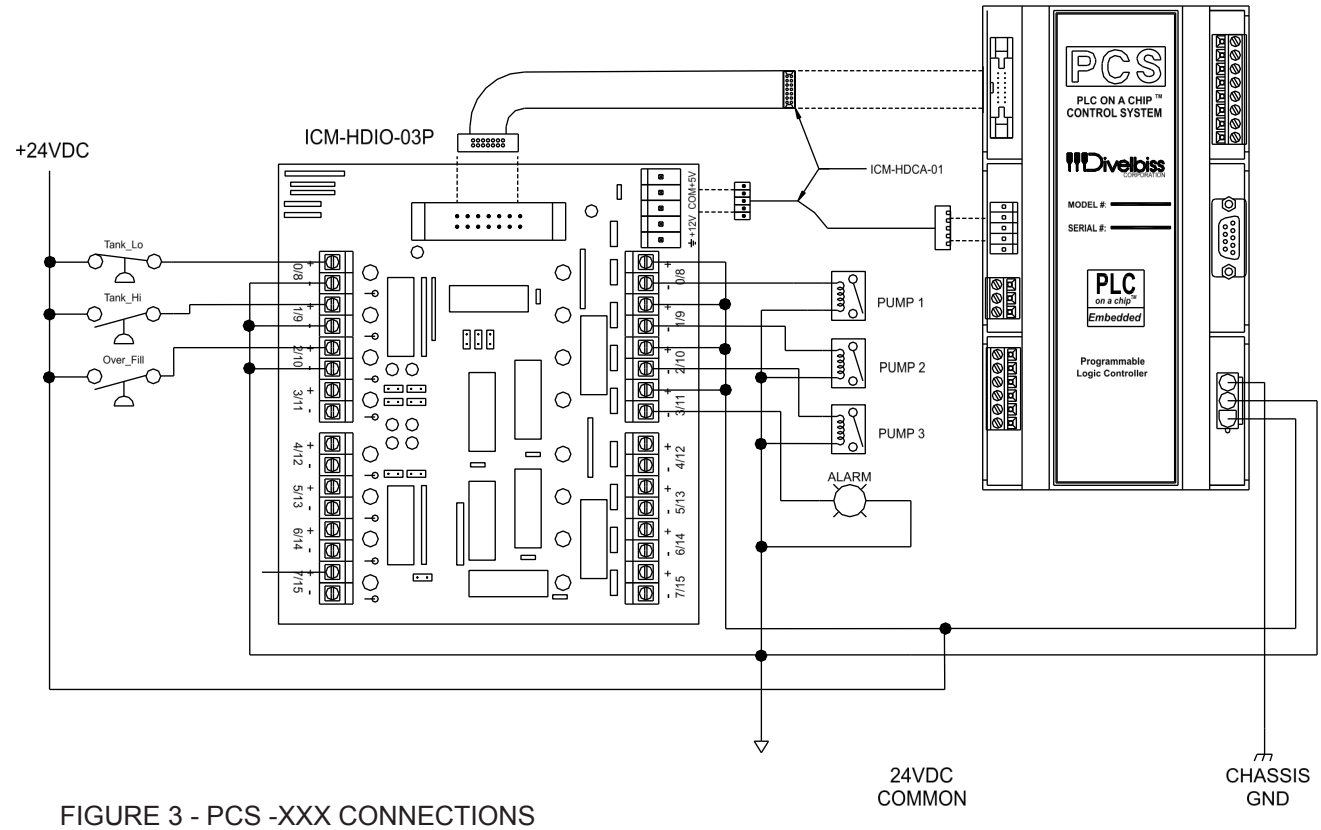

FIGURE 3 - PCS -XXX CONNECTIONS

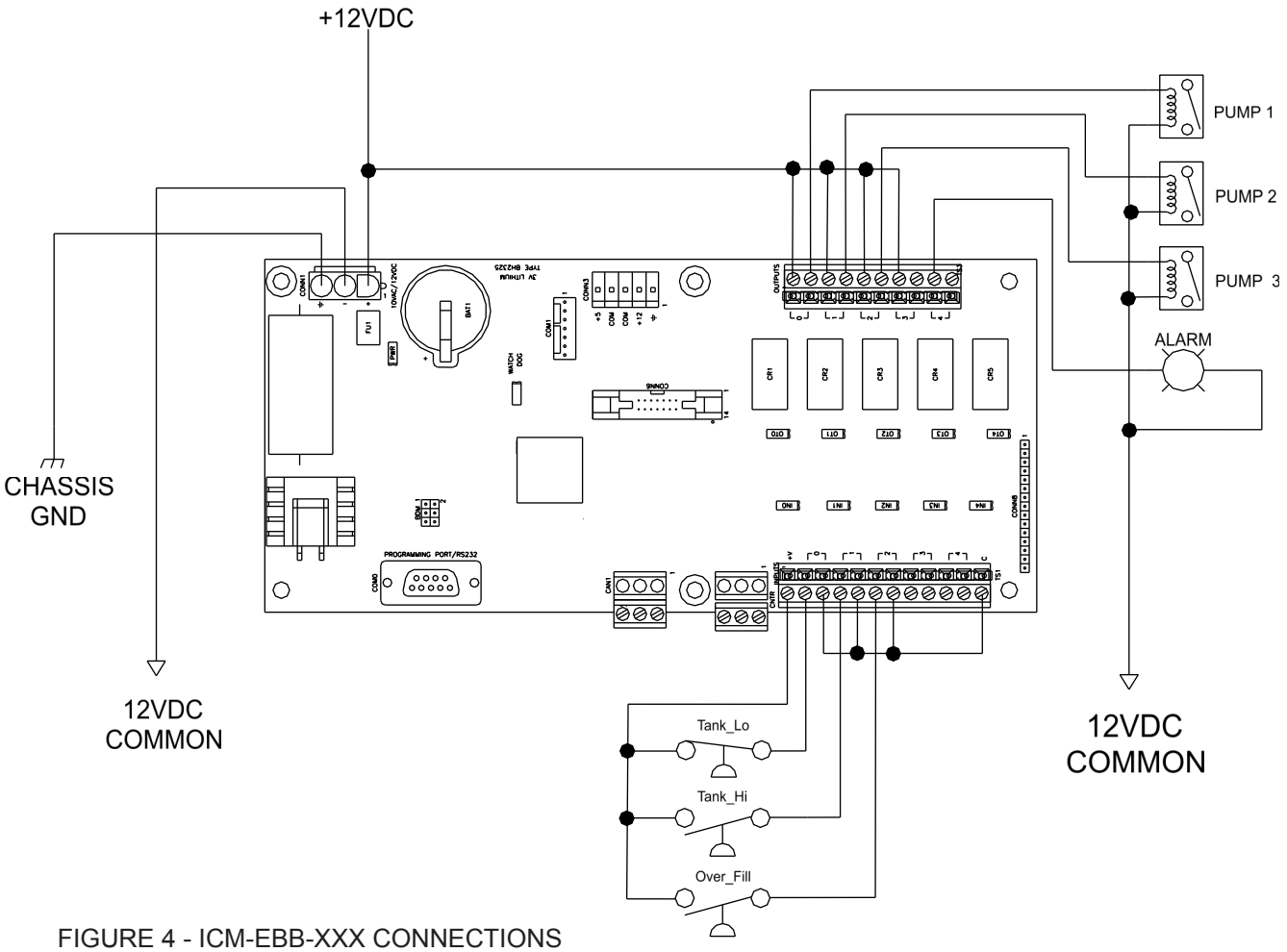

FIGURE 4 - ICM-EBB-XXX CONNECTIONS

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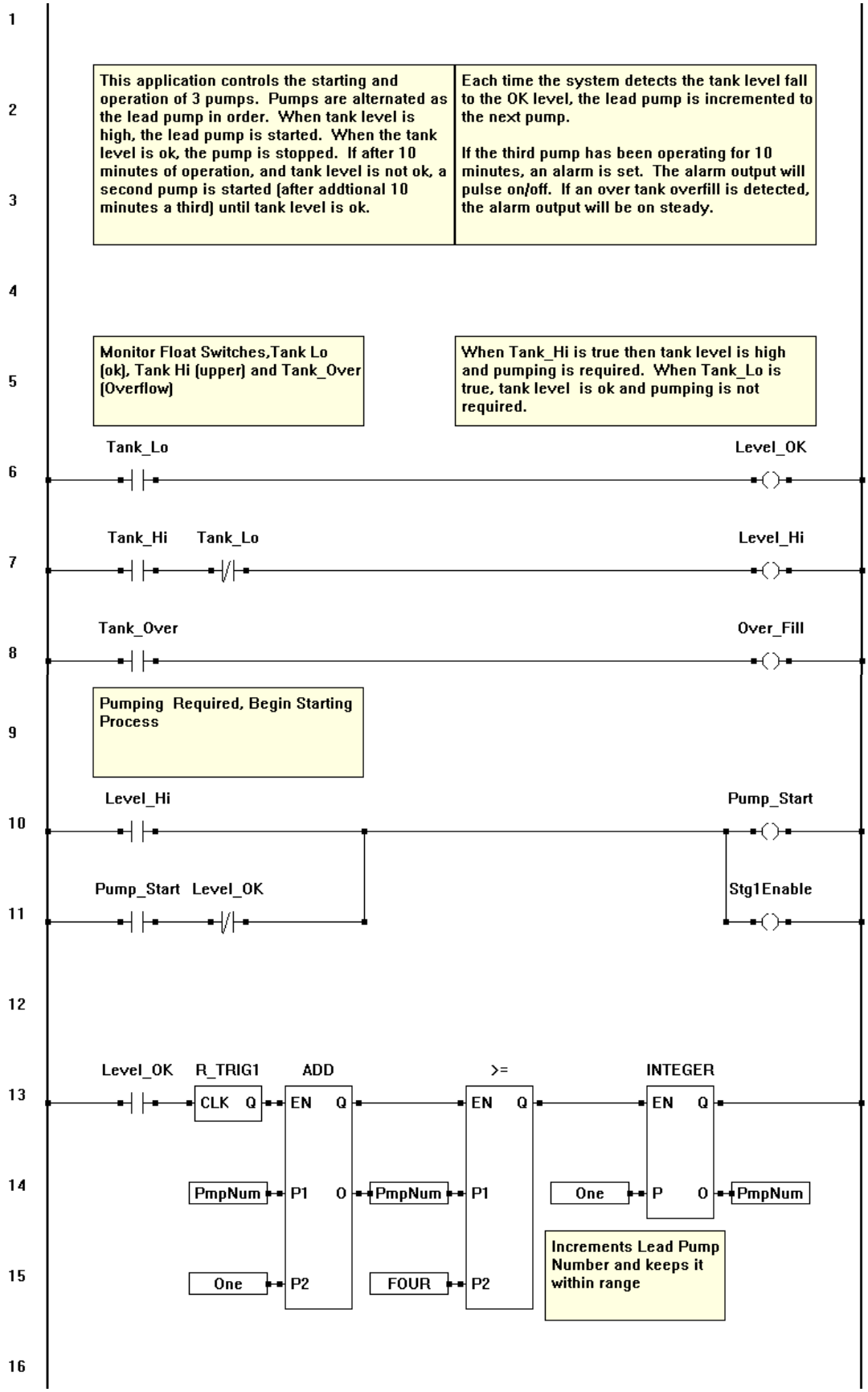
Ladder Diagram



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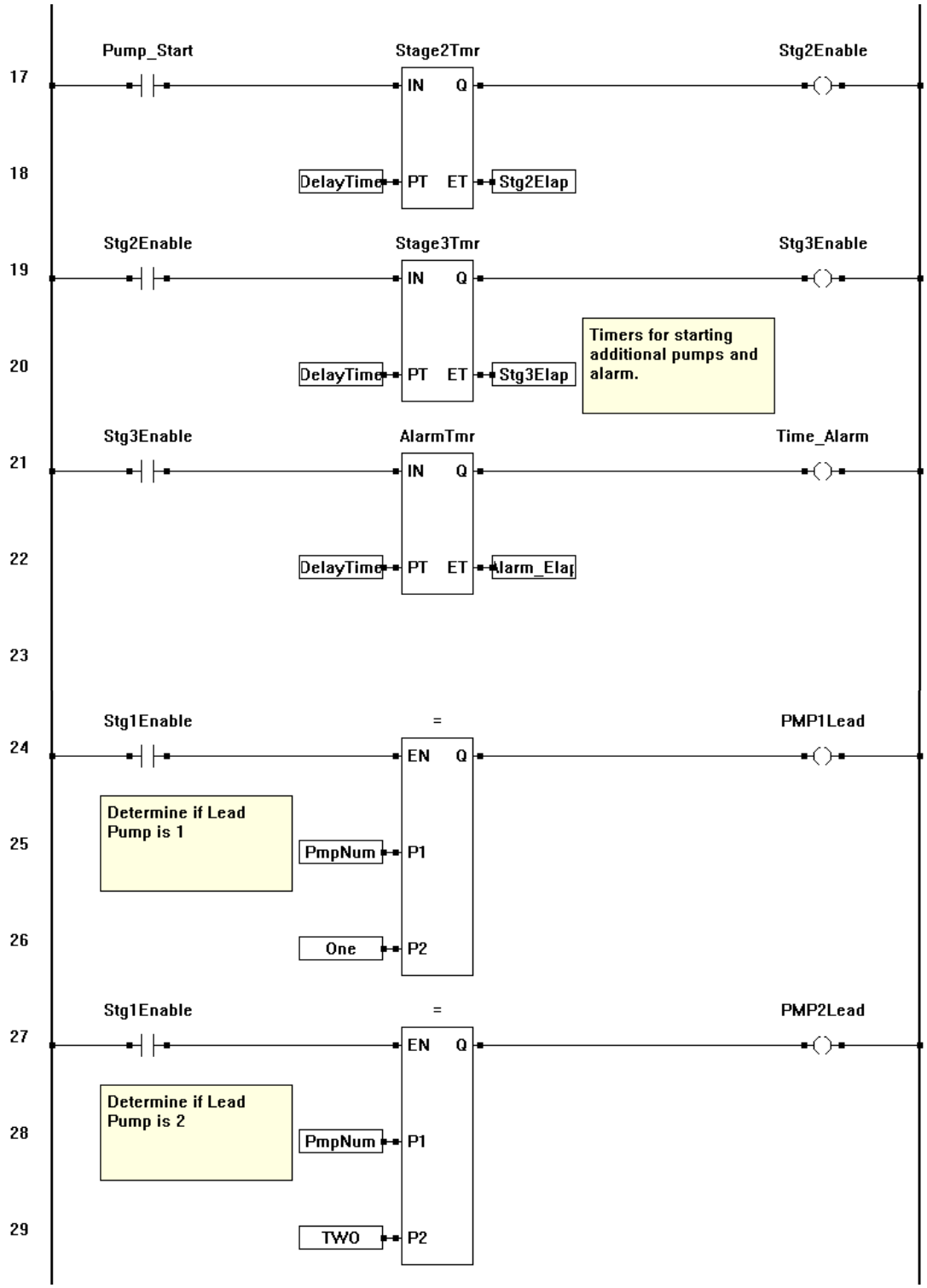

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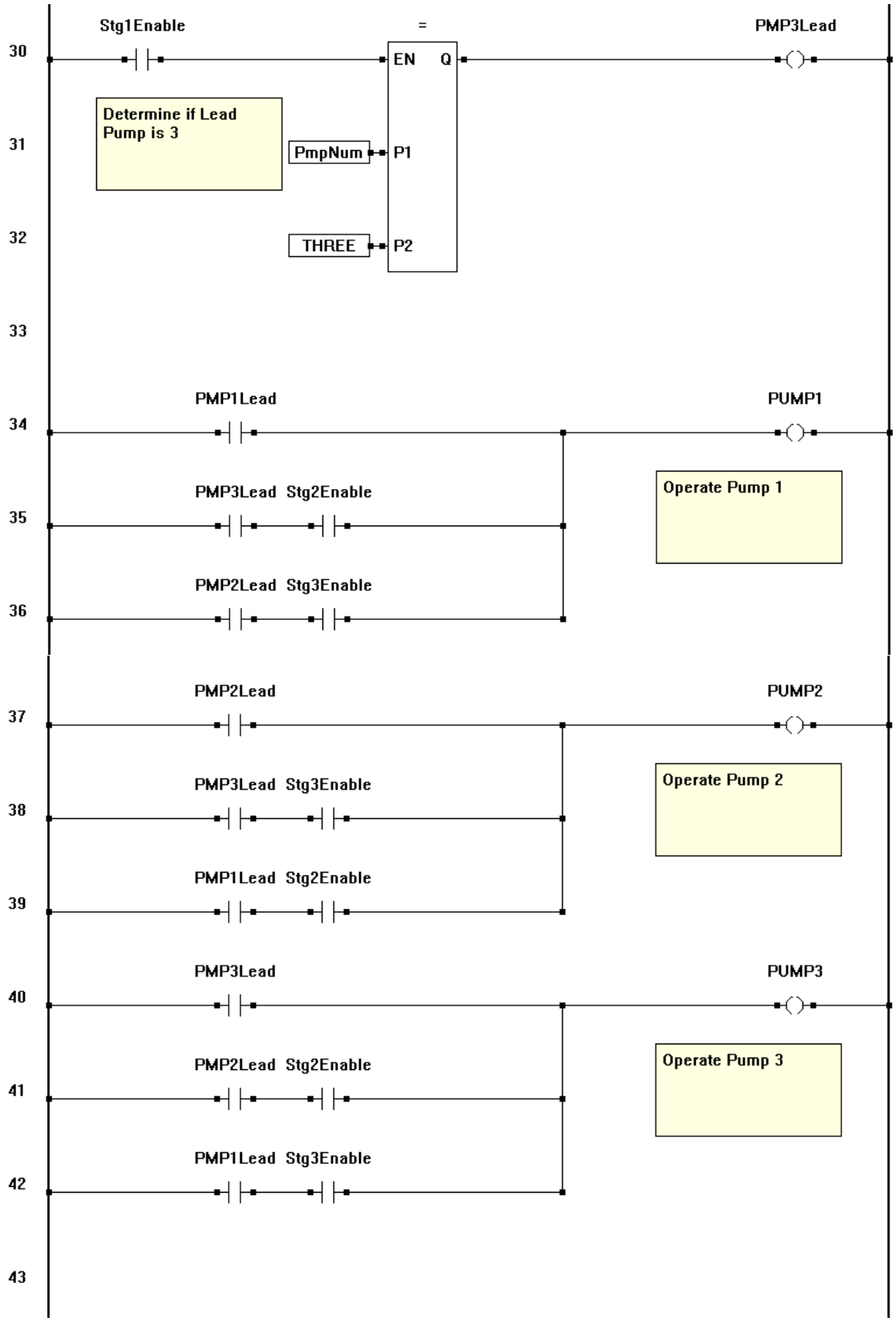

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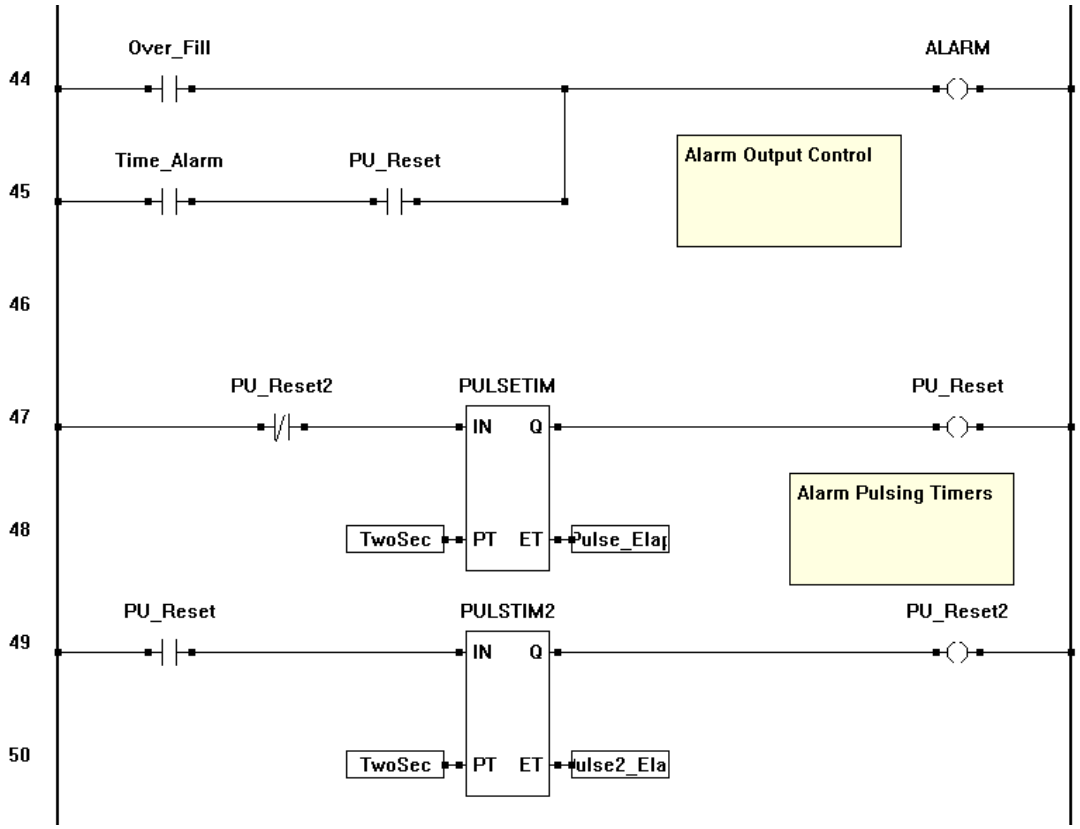

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