Scheduled Pumps driven with VFD

Example Implementation with Lonix Technologies

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1 Introduction

This document presents an implementation example for scheduled pumps driven with variable frequency drives. The system consists of three pumps. At maximum two of the pumps should be running at any one time while one is on reserve. A Lonix Duty Cycle Module (DCM) schedules the pumps so that the cumulative run time of each pump is approximately the same. If a pump fails then it is taken off the duty cycle. In this example the pumps are controlled according to a pressure difference measurement. The pumps are driven with variable frequency drives so that a constant system pressure is maintained. The controls are done using Lonix Modules, and system design and configuration utilizes the Lonix Project Creation Tool (PCT).

2 Scheduled pumps (VFD) example

This chapter introduces the control diagram and the functional description of scheduled pumps. This example is quite simple and is meant only to demonstrate the use and configuration of the respective module.

2.1 CONTROL DIAGRAM

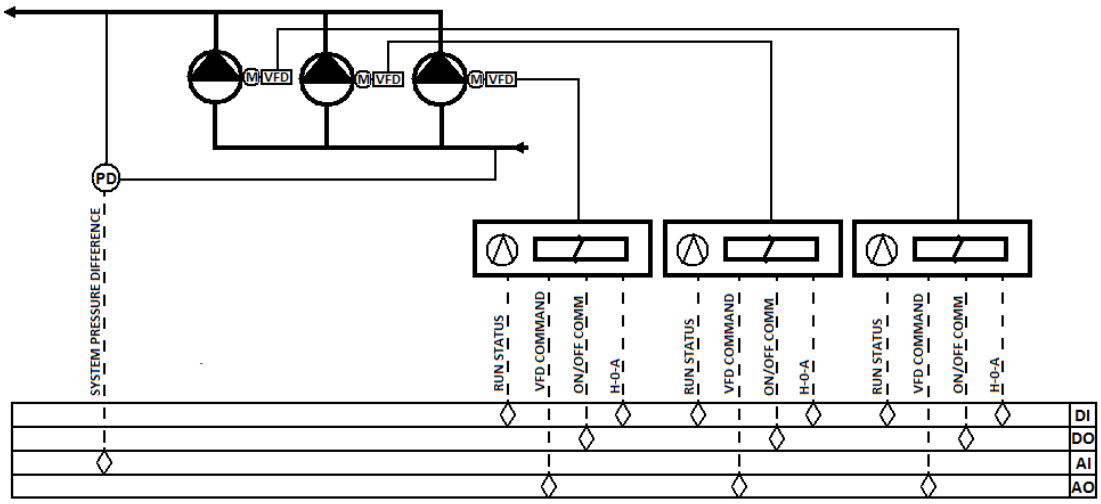

Figure 1. Control diagram of a simple pump set with three pumps

This example control diagram shows three pumps, each equipped with a variable frequency drive. The starter panel is also capable of supplying run status information of each pump. The system pressure is controlled according to a pressure difference measurement.

2.2 FUNCTIONAL DESCRIPTION

The pump set is responsible for maintaining the system pressure at a desired level. To achieve this not all the pumps need to be running at the same time, only as many as needed. To share the load only some of the pumps are allowed to be running at the same time, while the others are turned off (Usually the systems are designed so that e.g. two pumps out of three running on full speed are capable of maintaining the system pressure at a constant level in all situations). The pumps that have the permission to run are alternated so that the run times of each pump are balanced. The pumps that have the least amount of accumulated running time get the running permission first.

Running speeds of individual pumps are controlled with variable frequency drives according to a pressure difference measurement so that the system pressure stays constant. Lonix DCM allocates the controller's value to the pumps so that another pump will start running only when the first one is on full speed. For example in this case (two pumps out of three can be running simultaneously), when the control value from the controller to DCM is 20% only one pump is running at 40% speed. Only when the control value reaches 50%, the second pump will start running. E.g. with an 80% control value the first pump is running on full speed and the second at 60%.

If the DCM fails to receive a run status feedback from a pump that should be running, the pump is regarded as broken and it is taken off the duty cycle list. Setting the module's corresponding nviAuto-variable to zero cancels the fault indication, and once it is set back to a non-zero value the pump is taken back to the duty cycle. This is achieved easily with the H-0-A switches in the starter panel.

3 Solution with Lonix technologies

This chapter shows an example implementation using Lonix Modules and Lonix PCT. The following figure is a screenshot produced from Lonix PCT.

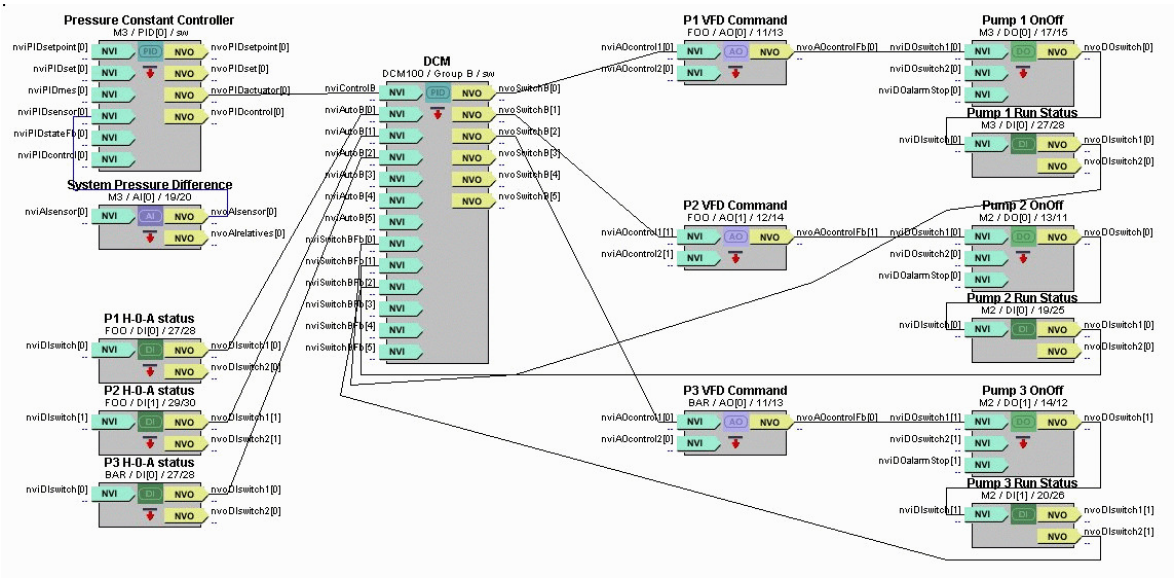

Figure 2. Pump set

Figure 2 shows an example implementation of a pump set that consists of 3 pumps. Each pump is equipped with a variable frequency drive, run status indication, a relay and hand/auto mode indication. A PID controller and a pressure difference sensor make sure the system pressure remains constant.

The pressure sensor is connected to an AI point of a 2242 Multi-purpose module. This is bound to a PID object acting as a constant controller. The PID supplies the DCM module a control value that is then used to operate the VFDs with a 0-10V control signal from an AO object. The AO object is also bound to a DO object controlling a relay that supplies power for a VFD so that it is powered only when needed. The run status indication informs the DCM that a pump is running. If this indication is not received, the pump will be regarded as broken and DCM will not try to use that pump until the corresponding nviAuto is set to zero, and then back to a non-zero value. The indication operates also as an alarming point by comparing its state to that of the DO.

Usually the pumps can be operated manually as well, and H-0-A signals should be available. These are connected to DI objects that inform the Lonix Duty Cycle Module if a pump is in AUTO mode and thus part of the duty cycle.

The Lonix Duty Cycle Module can handle two pump sets with a maximum of six pumps in each set. The duration of a duty cycle can be configured with one hour accuracy. Other parameters that can/need to be configured is the maximum number of pumps running simultaneously and the time DCM will wait for a run status feedback signal before a pump is considered to be broken. The number of pumps that are part of the duty cycle is determined by providing a non-zero value from H-0-A switch to corresponding network variable nviAutoA[0]..[5] or nviAutoB[0]..[5].

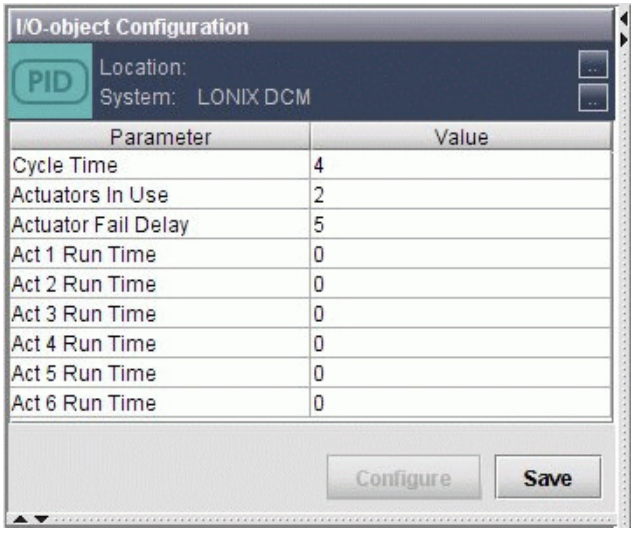

Figure 3. Configuration of the DCM object

Figure 3 shows an example configuration of a DCM object in PCT. In this case the cycle time is set to 4 hours and the maximum number of pumps running simultaneously is two (out of three). Actuator Fail Delay is the time that DCM will wait for a run status feedback signal, until that particular pump is regarded malfunctioning. It is now set to 5 seconds. The accumulated run times for each pump are stored in the Run Time variables and can be changed freely as well.

If the rotation of pumps need to be tested, then the duty cycle time can be set to 30 seconds by entering “TEST” to the nciPositio-variable of the duty cycle module. This needs to be done with a LON network management tool such as NL220.

4 Required devices

This chapter lists the required devices for the example implementation.

Table 1. I/O objects

I/O type	Amount
DI	6
DO	3
AI	1
AO	3

PID	1
DCM Group	1

As you can see in the above table, you will need one (1) Lonix Duty Cycle Module DCM, two (2) Lonix Multimodules 2242P and one (1) Digimodule 5400P. This leaves several AI-objects free which can be used for example temperature measurements.

Table 2. Lonix Modules

Module Type	Description	Units
Lonix Multimodule 2242P	2 DI, 2 DO, 4 AI, 2 AO, 2 PID	2
Lonix Digimodule 5400P	5 DI, 4 DO, 2 PID	1
Lonix Duty Cycle Module DCM	2 DCM Groups (A & B)	1

The following table lists the different sensors, transducers and actuators needed in the example implementation.

Table 3. Sensors and actuators

Device	Details	Model
System Pressure PD	0…5 bar	LX-PD-W-10
Variable frequency drives		e.g. Mitsubishi E500

Details of the suggested products are available at www.lonix.com.