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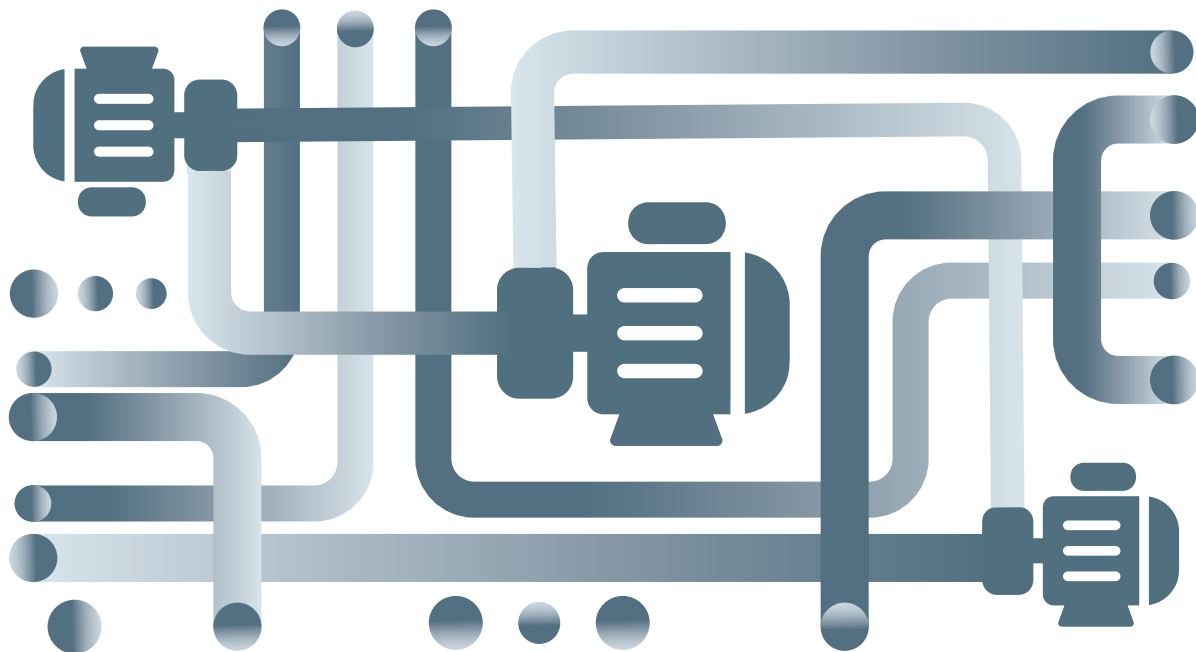
White paper

Pump alternating with failing pump detection

A straightforward solution to reduce down time in pumping stations

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Pump alternating.
A straightforward solution to reduce down time in pumping stations.

ABSTRACT

Managing alternating pumps may be complex and can be made much simpler as soon as the task is under the correct focus. We'll introduce some alternating pumps application examples, together with some ways to ensure correct working mode even in case of failure. As a bonus, the solution highlighted doesn't require investments or programming skills being plug and play.

▶ INTRODUCTION

Pump alternating is a very common function used in two scenarios.

1. When a backup pump is required in case of main pump failure. A typical example is heating or cooling water circuits, where pump replacement time may be long and the cost of lack of service high, as the one due to having to empty the building, because it quickly becomes too hot or too cold.

2. When the expected flow isn't fixed, so more than one pump may be required to work at the same time. Usually the number of pumps is driven by float switches measuring the level of the basin to fill or empty.

In both cases, if one pump works all the time, the backup pump may fail when called into action. To avoid this issue, the pumps are alternated at every start, so they are ready when required. Finally, since in some cases service may be 24/7, the pumps must be alternated anyway automatically at regular intervals.

We want to show a simple solution to get the backup pump start automatically and have an alarm signal generated to trigger the maintenance team and fix the issue.
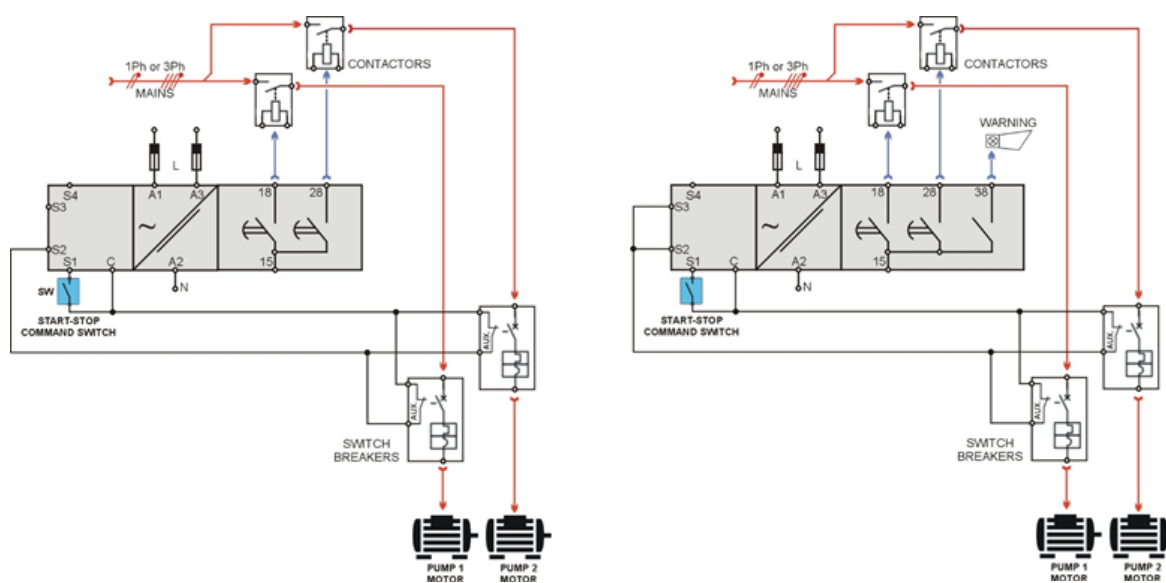
▶ WHEN AND WHY PUMPS NEED TO BE ALTERNATED

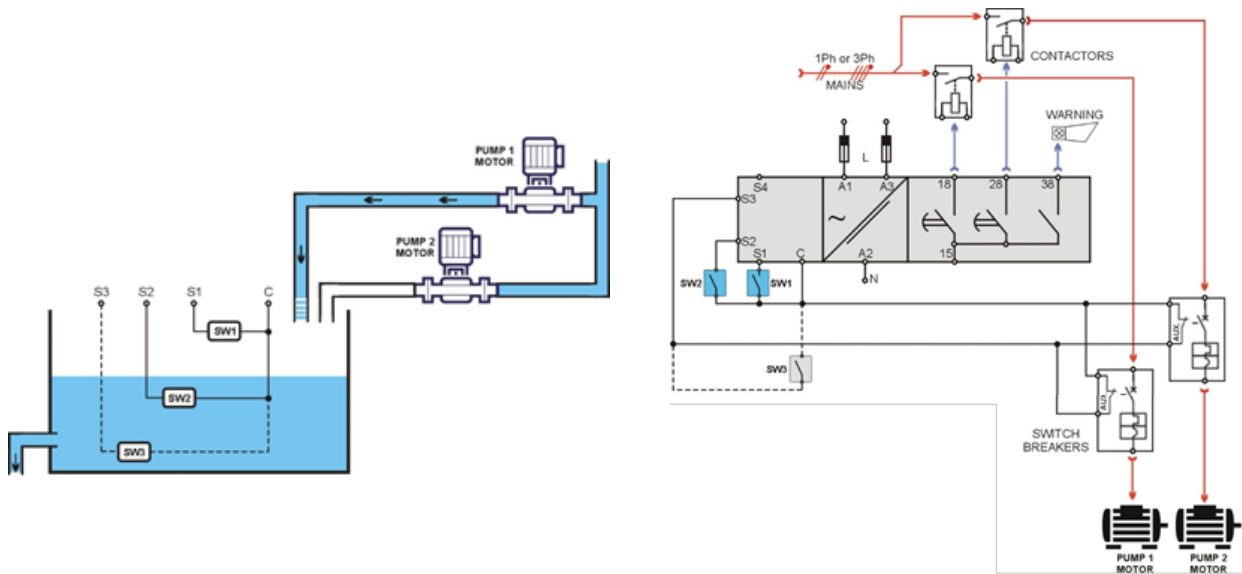|	
Reduce the down time of the pumping station	In a building where there is a big chiller for water cooling, service must be ensured, and the cost of a pump failure is so high to suggest duplicating the pump. There are two pumps, and they never need to run together.
Modulate the pumping capacity to follow the flow variations	Avoiding using a single pump sized for the maximum expected flow. When the water flow isn't constant, it makes more sense to use two or three smaller pumps and activate more than one at the same time if needed. In case of small flow, the pumps work one at a time and they alternate, while with larger flow two or three pumps work together. The down time reduction target is reached as much as the system is redundant. For instance, if a station is required to run with all pumps at the same time very often, with a failing pump there is the risk to go out of service (i.e.: empty basin or water overflow) than a station where all pumps seldom run together.
Have both primary and backup pumps always ready to work	Beyond avoiding to have a dead backup pump when needed, the target is to have uniform wear and tear on all the pumps, to increase the overall service life of the pumping equipment.

HOW TO DETERMINE THAT A PUMP FAILED

Pumps may fail in different ways. The enemy of the state is always dry running. Blocked outlet is also a big problem. These problems, together with most of the failures, lead to the magnetic or thermal protection of the pump to trip, so we can consider thermal and magnetic protection trip as the exhaustive signal of pump failure.

▶ CASE 1: PUMPS DON'T NEED TO RUN TOGETHER

Typical application	Cold or hot water circulation to control the ambient temperature in a building. Usually the system is sized for one pump (variable heat demand is managed via water temperature or flow). The second pump is a real backup.
The Carlo Gavazzi solution	To manage this system, DLA71 is used. It is a pump alternating relay built to manage two pumps. A connection example is shown in the figure above on the left. Closing the contact between C and S1 activates one pump. Relay contacts 15-18 and 15-28 are closed alternately every time S1 is activated to start the respective pump through the contactors. In case S1 remains close long (some cooling systems are active 24/7) the pumps are alternated automatically every six hours, reversing the status of 15-18 and 15-28.
Managing pump failure	What happens when a pump fails? In the figure above on the left, circuit breakers with an auxiliary normally open contact are used so that, in case the breaker opens, the auxiliary contact is closed. The protection which matters and trips the breaker is usually the thermal one. The auxiliary contacts of the two pumps are connected in parallel and to S2. S2 is the input of DLA71 to activate both pumps at the same time. The result is that, when a pump fails, DLA71 activates both pumps, resulting in having the service operating as requested. In case the user wants to relay the alarm from the circuit breakers, DLA73 can be used. The only difference is shown in the figure above on the right, where the aux contacts are also connected to S3. Being triggered by the auxiliary contacts of the circuit breakers, the 15-38 output informs the supervisor to activate the maintenance team to organise pump repair. This may happen via a light, a main panel, or connected to a PLC which can relay the information remotely.

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◣ CASE 2: PUMPS MAY NEED TO RUN TOGETHER

Typical application	The most common cases are filling a basin with clear water or emptying one from dirty water. In the connection example shown in the figure above on the left, SW1 and SW2 are float switches in the basin and we consider the task of the pumps to refill the basin when it is emptying.
The Carlo Gavazzi solution	To manage this system, DLA73 is used. It is a pump alternating relay built to manage two pumps with an additional alarm contact output. A connection example is shown in the figure above on the right. **SW1** manages the low level of the basin, below which one pump starts to refill. When the level goes above SW1, the switch opens and the pump stops. Opening and closing SW1 (and so S1) causes the two pumps to alternate at every start. As before, if the pump remains active for more than six hours, the two pumps are alternated automatically. **SW2** detects the alarm level for the basin, which is lower than SW1, meaning that one pump is already running, but the outflow is more than the pumping capacity and the basin keeps emptying rather than filling. When SW2 is closed, DLA73 activates both pumps at the same time to recover more quickly the basin level. When SW2 is disengaged, one pump is turned OFF and when SW1 is also disengaged both pumps are off. The start and stop sequence of the pumps follows the logic that the pump started earlier is stopped earlier.
Managing pump failure	When one pump fails, the auxiliary contacts of the circuit breakers also close S3 to trigger the alarm output, so maintenance is called for action. In this condition the system works with the remaining pump activated by SW2 (the alarm level switch) and turned OFF by SW1 (the low level switch). It goes without saying that there is a higher risk to run out of water due to the reduced pumping capacity.
Adding a float switch for level alarm	Optional float switch SW3 may be used to further signal empty basin alarm both in normal conditions and in pump failure condition.

◣ ALTERNATING VARIABLE SPEED PUMPS

What if the pumps are managed via variable speed drives or softstarters? Everything is very much the same. If the drive provides a reliable pump failure contact, it can be used to have the other drive start the second pump with the same logic explained above. The case where one pump is at variable speed and one isn't doesn't change the landscape.

In case 1: the variable water flow is managed by the main controller to ensure the correct heat flow.

In case 2: switch SW3 can also be connected to an input on the drive to trigger max speed and reduce the risk of emptying the basin.

THE CARLO GAVAZZI SOLUTIONS

► HEATING OR COOLING WATER CIRCULATION

SOLUTION	The requests are to alternate the pumps regularly and to provide service also when one pump fails. DLA71 and DLA73 are quick and simple solutions to perform the task. DLA73 provides an additional relay output to be used for alarm signalling. The total size of the solution in the electrical panel is also highly reduced against PLC-based ones. Proper connection of the pump thermal protections ensure operation in case of pump failure. Using DLA73, an alarm signal is present to alert maintenance. Both solutions are offered in setting free 35.5 mm DIN-rail housing.
ADVANTAGES	• Space saving • Easy to install • No settings and no programming steps

Suggested device	DLA71DB232P or DLA73TB232P DLA71DB482P or DLA73TB482P
Power supply voltage	115, 230 V ac or 24, 48 V ac in two variants
Housing type	35.5 mm DIN-rail housing
Standard function	2 pumps alternating with automatic function if a pump is left ON for more than 6 hours
Main purpose	Ensure water circulation also in case of one pump failure without service interruption

► WATER LEVEL MANAGEMENT

SOLUTION	DLA73 delivers the task of having to empty or fill a basin using two pumps. One or two pumps may work at the same time according to the requested water flow. An additional alarm float switch can be connected to provide alarm for all cases when pumping capacity isn't sufficient. The total size of the solution in the electrical panel is also highly reduced against PLC-based ones. Proper connection of the pump thermal protections ensure operation in case of pump failure and an alarm signal is available. Both solutions are offered in setting free 35.5 mm DIN-rail housing.
ADVANTAGES	• Space saving • Easy to install • No settings and no programming steps

Suggested device	DLA73TB232P or DLA73TB482P
Power supply voltage	115, 230 V ac or 24, 48 V ac in two variants
Housing type	35.5 mm DIN-rail housing
Standard function	2 pumps alternating with automatic function if a pump is left ON for more than 6 hours
Main purpose	Provide the correct water flow activating one or two pumps and keeping one pump active when the other one fails

CONCLUSIONS

Pump alternating can be solved quickly and easily with simple and small apparatus. The application doesn't need programming skills, being ready to work. Also fault monitoring can be included with little effort to reduce the down time and the consequences for the users.

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