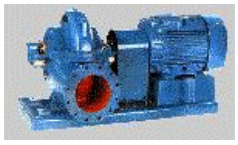
Application Notes for Energy Saving Variable Speed Drives On Pumps

These application notes are for general guidance and information only. Users will need to undertake independent analysis for specific sites if any of these measures are to be implemented. Consideration should be given to engaging the services of a suitable consultant to assist with this task.

Summary



As pumping systems often use fixed speed pumps, it is usual practice to install slightly oversized pump. During commissioning the system flow rates are adjusted by throttling the balancing valves. This leads to additional and unnecessary pressure losses remaining in the system and results in wasted pumping energy. The installation of variable speed drives allows the excess pump performance to be reduced or eliminated thereby saving energy. The payback period is usually around 6 years.

Variable speed drives or pumps should be incorporated into new and refurbished systems together with an appropriate control philosophy. In these circumstances energy savings are much greater and paybacks faster.

Background

Pumps are generally associated with the central plant of the heating, ventilation and air conditioning (HVAC) systems. In the past the pumps have often been constant speed with little account taken of the opportunity to reduce water flow rates during periods of low demand. Occasionally such systems continue to be offered and installed. Unless there is plant that needs a constant flow rate and requires what is known as “primary” pumping, variable speed drives or chilled and heating hot water systems should always be considered.

At the time of commissioning, around 10% excess water flow is not uncommon. This excess water flow is removed by closing down the balancing valves and creating unnecessary pressure drops and high pump power requirements.

Variable speed drives can even be installed or retrofitted as “primary” pumping systems to a lower pump pressure by reducing the pump speed. The same reductions in energy can also be achieved by reducing the pump impeller diameter, which also reduces the available pump head, while maintaining the fixed rotational speed.

Opportunities and Constraints

Within a hospital, the mechanical services pumps are associated with central plant, including heating hot water, chilled water and condenser water systems. These systems recirculate water around the hospital to distribute heating or cooling energy.

Traditionally the installed pump capacity is greater than required. During commissioning the required water flow is achieved through increased pressure losses by throttling the balancing valves. These additional pressure losses directly relate to increased pumping energy consumption and are continuously imposed on the system.

When retrofitting variable speed drives on the pumps, the design flow rates can be achieved by opening the balancing valves, reducing the pump speed and hence the pressure development of the pump. This directly relates to continuous energy savings while the plant is operating without a change to service delivery.

With upgrade or refurbishment programs fixed pumping systems can often be converted to a variable flow arrangement which can provide for greater energy savings.

Impact of Implementation

The installation of variable speed drives on the pumps associated with the air conditioning systems would not be expected affect the staff or the patients.

Care must be taken when connecting a large VSD load onto an electrical supply as “harmonic distortion” may occur which can only be controlled using special electronic filters.

Installing variable speed pumps may mean that systems need to be re balanced to suit the lower pumping pressures. During the process of re-balancing, some air conditioning equipment may not achieve full cooling or heating capacity. This situation can be addressed by scheduling the modifications and associated commissioning works for the spring and autumn months when full cooling and heating may not be required.

Analysis

It is expected that normal central pumping systems, including heating hot water and chilled water may have around 10% excess flow in the system or more. By utilizing a variable speed drive to reduce the pumping pressure in lieu of only using throttling balancing valves to control flow, it is expected that this may result in a reduction of up to 20 to 30% in pumping energy. Where the pumping energy equates to around 10% of the overall electrical energy, there can approximate up to a 3% reduction in overall consumption. A variable speed drive installed to a 30kW motor could cost around $15,000, with an allowance of additional $5,000 for rebalancing the water system. The expected payback can be around 6 years or even less.

Where the control philosophy for the pumping system can be modified to incorporate variable flow for low demand periods, further significant energy savings can be realised together with much shorter payback periods.

Conclusions

The implementation of variable speed to control system pressure in lieu of throttling balancing valves provides good energy savings. Once variable speed drives are installed, control philosophies can also be introduced to enhance the potential energy savings.

There are usually few physical constraints to incorporating variable speed drive controls into existing pumping systems.

References and Sources for Further Information

- The Sustainable Energy Authority Victoria have published energy and greenhouse management toolkit, VSD's are discussed under Module 5: Best practice design, technology and management. This toolkit is available through the SEAV website www.seav.vic.gov.au/advice/business/EGMToolkit.html
- SEAV "Model Technical Specification"