Application Notes for Energy Saving
Power Factor Correction

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

A hospital's power factor is a measure of how effectively that hospital uses the energy supplied by its utility. Hospitals with poor power factor are placing an undue demand on the State's electricity supply, and causing unnecessary greenhouse gas emissions. Some utilities structure their tariffs so those customers with a poor power factor pay higher charges for their electricity.

Special equipment can be installed to improve a hospital's power factor and hence save energy, reduce greenhouse gas emissions, and provide a good return on investment. It also increases the capacity of a hospital's electrical infrastructure and consequently the need for more costly upgrades can be deferred. Even those hospitals that are not currently paying for poor power factor could well find that their utility will charge them for it in the future.

Background

The amount of power supplied by the utility is known as the 'Apparent Power' and this is measured in kVA. The amount of power capable of doing useful work is measured in kW and is known as 'Active Power'. The closer the ratio of Apparent Power to Active Power is to unity (1), the more effective the hospital's energy use. This ratio is known as 'Power Factor'.

Poor power factor in hospitals is caused by the majority of equipment being 'inductive' (such as transformers, fluorescent lights, motors and similar including clinical and diagnostic equipment used in patient care). Inductive equipment requires both active power (kW) and reactive power (kVAR). The latter performs no actual work but sustains the operation of the equipment. It is the apparent power (that is Active + Reactive), which must be accommodated by the electricity utility. Hence, a system with poor power factor needs the utility to supply far more power from its network.

Although not all Victorian hospitals are paying a penalty for poor power factor, energy market trends from interstate and overseas show that electricity utilities are keen to recoup the money they spend on reactive power by charging the users a kVA style tariff. This means that hospitals may be penalised for having a poor power factor, and they could well be forced by the utilities to address this issue in the future.

The most cost effective and straightforward way to install power factor correction facilities would be at the main switchboard during the construction of a new hospital. However it is possible to retrofit equipment into an existing building. Also, reviewing the selection of plant and equipment, by choosing motors and/or light fittings with a high power factor can help minimise the sources of poor power factor and reduce the amount of power factor correction required.

Typical components of a power factor correction facility include a cubicle (near the main switchboard) which would contains capacitors, controller, contactors, protection and harmonic reactors.

Opportunities and Constraints

Before installing power factor correction, it is important to determine the actual power factor being experienced by the hospital and determine the approach to be taken. Some hospitals may choose to implement power factor correction simply because there is a business case for it, and others may be forced to do it because of electricity utility penalties and/or guidelines.

Power factor correction should be considered if the hospital's power factor is less than 0.9 and it could be applied in a number of ways:

- On the main high voltage supply. (This reduces utility costs, but does not provide downstream benefits).
- At the main switchboard or distribution boards. (This provides additional downstream benefits, and is the most likely option).
- At the source of the inductive load. (This is usually only economical for very large loads).

Power factor correction components need to be carefully selected. Issues include:

- Exceeding temperature ranges may reduce equipment lifetime.
- Low cost components can introduce losses into the system, resulting in higher energy use and costs.

Impact of Implementation

The advantages of implementing power factor correction include the following:

- Total energy supplied by the electricity utility is decreased, reducing greenhouse gas emissions and can be financially viable depending on the hospital's electricity tariff.
- Cables, switchboards and substations capacity is increased.
- In conjunction with other equipment it can filter 'spikes', which are known to cause equipment failures.
- Poor power factor can result in sluggish operation, and in excessive heat being generated, which can damage or shorten equipment life. This can also lead to higher maintenance costs.
- Hospital staff would not notice the difference in day to day operations.

The cost to implement power factor correction depends on a number of factors including the following:

- Size of the load to be corrected.
- Whether the hospital is existing or new.
- How poor the hospital's power factor is (this would need to be determined initially).

The payback period would also be dependent on those items above, in addition to the following:

- The type of electrical tariff that the hospital is on (ie. whether they are on a kVA or kW tariff).
- The penalties imposed by supply utilities for poor power factor.

If power factor correction is installed in a new site, the system should be designed so that it can be taken off line for maintenance without disturbing the power supply to the hospital. If power factor correction is being retrofitted into an existing hospital however, it is likely that there would need to be some 'down time' during the installation. The cost to install would also be higher in a retrofit situation compared with a new hospital.

Analysis

The following example illustrates the possible savings, although this depends on the factors outlined above:

If the electricity utility imposes demand charges of $58 000 per annum based on kVA demand, increasing the hospital's power factor from 0.8 to 0.9 would result in savings of over 10%. For a hospital on a kVA demand tariff, this would mean a saving of approx. $6 500 annually. Power factor correction for a hospital with this size demand would be around $27 000, giving a payback period of approximately 4 years.

Further savings would be achieved if the resultant demand placed the hospital in a lower tariff band, and by mitigating upgrade costs (as system capacity would be enhanced).

Although the hospital would not measure a reduction in their active power consumption; the utility would see savings in the overall generation of apparent power of over 10%.

Conclusions

Improvement in a hospital's power factor will have an immediate impact on the environment by reducing the demand on electricity supply utilities, and hence reducing greenhouse gas emissions. Significant savings in energy costs would be seen if hospitals are on kVA tariffs (its likely that this will be the case in the future). Power factor correction can improve the quality of power supply to sensitive hospital equipment, and it can increase electrical switchboard and cabling capacity.

References and Sources for Further Information

- Sustainable Energy Authority Victoria (SEAV) have published an information sheet on Power Factor correction: www.seav.vic.gov.au
- The Office of the Regulator General publishes guidelines for consumers and suppliers which states minimum power factor for customers: www.reggen.vic.gov.au
- Power Supply Utilities can also assist with information on Power Factor and Power Factor Correction.
- Defence Energy efficiency guide 'Energy efficiency guide 09 – Electrical Management, control and measurement Power Factor Correction 07.205 Rev 01'.