

CASE STUDY

Check Out the Energy Savings at Hotel Lisboa

Hotel Lisboa replaced three of their eleven Carrier chillers with ozone friendly McQuay chillers.

The Hotel Lisboa is one of the landmark sites in Macau. Located just south west of Hong Kong, this beautiful hotel and casino known as the "Oriental Monte Carlo," is the favorite stop of jetsetters and celebrities around the world.

In an effort to reduce energy costs while addressing environmental concerns, the Hotel Lisboa replaced three of their eleven Carrier chillers with ozone friendly McQuay chillers. The chillers represented Phase One of a planned total chiller replacement.

The STDM Group, who owns the Hotel, had originally considered retrofitting their Carrier R-11 chillers with R-123 compressors.

Unfortunately, they had tried that particular solution at one of their other properties and the end result did not meet their expectations. Retrofitting those R-11 chillers with R-123 resulted in a 10% reduction in capacity, and a 6% loss of efficiency. In addition, the retrofit costs amounted to almost 50% of what new replacement chillers would cost.

Constructed in 1984, the hotel is a complex of casinos and 1,240 guest rooms. Since 1996, the hotel had planned to replace the existing chillers with more ozone-friendly machines, however due to budget constraints and

technical considerations, the owners opted not to begin Phase One until October 1997. Because of the budget constraints, first cost considerations were critical. In addition, the owners specified that they wanted the pay-back period not to exceed five years.

Since the building was fairly new, it was also necessary that the replacement chillers fit into the current physical space available in the plant room. The replacement chillers could not be more than 12ft. length shells and their operating weight could not exceed that of the existing units.

After establishing those parameters, the contractors, Fair Engineering Co. Ltd., met with McQuay International. McQuay presented three water cooled centrifugal chillers using R-134a refrigerant with 0.734 kW/ton at full capacity to replace three existing R-11 units each at 0.85 kW/ton at full capacity.

McQuay presented this solution as a compromise between lower costs and COP and APLV performance that improved upon the existing units. Even though the first cost was higher than the owners wanted, the McQuay units offered better long-term efficiency.



Payback Analysis

The McQuay chillers recommended provided a full load COP of 4.791 (0.734 kW/ton), and APLV of 4.61 (IPLV 0.763). Unfortunately, the Hotel Lisboa did not have a detailed data base of the annual operating cost records of the existing chillers and actual building load profile.

However, even a preliminary and basic economic analysis using (a) full load kW/ton comparison of the old and new chillers, and (b) assumptions of a typical diversity factor, resulted in a theoretical pay-back period sufficiently attractive for STDM to decide on proceeding with the replacement works. The following summarizes the process of calculations resulting in a payback period of less than five years.

The maintenance cost savings of 100,000 M\$ (12,532 USD) per year was estimated comparing the existing and the new chillers.

Therefore the pay-back period was calculated as: $440,000 / (79,866 + 12,532) = 4.76$ years.



Hotel Lisboa lobby and bedroom

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Annual operating hours	=	5,000 hrs
Diversity factor	=	0.87
Electricity rate	=	0.6 Macau \$/kWH (= 0.075USD/kWH) = 0.87 kW/ton
Old chiller efficiency	=	0.734 kW/ton
New McQuay chiller efficiency	=	0.87×5000 $\times (0.87 - 0.734)$ $\times 1800 \times 0.075$
Annual energy saving projected	=	USD 79,866

Even though the calculated pay-back period slightly exceeded 5 years for the Phase One replacements, STDM has in fact decided to proceed with the second phase of chiller replacement on another three sets of 600TR machines by the year end of 1999.

The Phase One replacement installation works were completed in May 1998, and the chillers fully commissioned in mid-August 1998. Meantime, the actual operating cost savings are being monitored.