

Elevator Modernization in Brisbane

by Donald Vollrath and Ted Schaar

Two renovation projects in Brisbane, Australia include the installation of Magnetek, Inc.'s Quattro™ DC Drive to improve elevator performance. These projects are the first instances of the product's installation in the world. The most recognizable of the projects is the modernization of the Northbank Plaza Building, located at 69 Ann Street, and the other involves an adjoining pair of buildings at 239 George Street and 15 Adelaide Street. The Northbank Plaza Building employs Otis elevators (Model 155HT), and the adjoining buildings use KONE elevators (Models 12C and 23B).

The Northbank Plaza Building

Although one might nominally conclude that the Northbank Plaza Building is home to a financial institution, the name actually comes from its location on the north bank of the Brisbane River. The river is the primary reason for the entire city of Brisbane's growth. Like Sydney, Brisbane was founded to be one of the nation's largest urban centers as a penal colony in 1834. The waterway helped transport convicts who were literally sent "up the river" from the coast. Today, Brisbane is the third largest city in Australia with a population near 1,775,000. Along with its role as the capital of the state of Queensland, it is known for industries ranging from information technologies to petroleum refining.

The Northbank Plaza Building opened in 1977 and housed municipal office workers for decades. When the city required larger quarters, it was purchased by the Charter Hall Group. Currently, the building is being converted into a commercial office building with plans to offer approximately 285,243 square feet (26,500 square meters) of rental space.

The goal is to transform the structure into a facility that measures up to modern edifices in both functionality and comfort. The first five floors of the renovated building will house commercial tenants. The upper 17 floors will be home to Telstra, one of the largest telephone companies in Australia.

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worked almost exclusively in designing and perfecting several generations of custom OEM and general-purpose drive equipment for elevators. Vollrath has more than 40 years of experience developing the Eddy Current clutch, and AC and DC motor drives and controls for industrial applications. He has a BS in Electrical Engineering from the University of Illinois.

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Three Otis 155HT hoist motors in the Northbank Plaza's low-rise machine room.

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The building has 22 stories above the lobby landing and 3 lower levels. Ten Otis elevators transport people up and down the tower. Five are low rise with passenger service up to floor 13, while five are high rise with an express zone from the lobby to floors 13-22, with one high-rise service elevator serving all landings. The low-rise elevators are powered by 39-horsepower motors and travel at 500 fpm (2.5 mps). Motors for the high-rise elevators are rated at 44 horsepower and travel at 700 fpm (3.5 mps). Capacity of the high-rise elevators is 23 persons, while that of the low-rise units is rated at 20. Together, the elevators are designed to serve 2,200 people per day.

The Asset Audit

Modernization began with an asset audit, which found that the elevator machines' technology was aging, parts were becoming harder to find and the existing systems did not comply with modern energy standards. Relatively new in Australia, the standards were enacted under the name "Environmentally Sustainable Design and Construction Guidelines" by the Department of Sustainability and Environment in the years following the building's dedication.

"Before Charter Hall purchased the building, Norman Disney & Young was hired to do an asset audit," noted Greg Smith, senior associate and manager of Norman Disney and Young. "We discovered, among other things, that the elevators were in need of modernization."

Smith's reasoning was primarily due to trouble with older technology, including silicon-controlled rectifier (SCR) DC drives from the 1980s. "There were a lot of problems, including drive-system errors, trip outs and anomalies

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(l-r) The Northbank Plaza with adjacent buildings 239 George Street and 15 Adelaide Street.

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The Importance of “Clean Harmonics”

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between the drives and the software,” recalled Smith. “All of these things meant that the elevators were out of service almost on a daily basis; worse, sometimes two or more elevators were out of service at the same time.”

Elevator Recommendations

Norman Disney & Young recommended a variety of appearance, mechanical and control improvements to the Northbank Plaza Building, including updated cabin finishes; modern wall cladding; new ceilings and flooring; improved lighting; and other upgrades to put the installation in compliance with the latest safety codes and disability-access requirements. Other specified improvements include rebuilt motors and new powered door operators, entrance-door locks, buttons, chimes and arrival lanterns.

Smith explained that the Quattro DC Drives were specified for a number of reasons. First, they incorporate new technology that takes power to the motors more effectively. Additionally, ride smoothness is increased thanks to the smoother acceleration and deceleration. Efficiency is also improved due to power factor (.95 compared to the .65 of the old drives), regeneration (a 5-10% improvement) and harmonics, which Smith described as “clean.” He explained, “Among other advantages, this means it is unlikely to cause interference on computer screens or other sensitive equipment.” The clean harmonics and high power factor reduced installation costs because there was no need to upgrade the building’s utility feeder supply.

The Modernization Underway

One of the challenges of the project was completing the elevator work while renovation was taking place throughout the building. The Quattro DC Drives helped during installation in simplifying and reducing the cost of installation by not requiring an isolation transformer or ripple filter. Fewer cabinets were required to be wired on site, as well, and thus cabinets occupy less overall space in the machine room.

Smith remarked:

Nearly everything in the facility is undergoing refurbishment, from the carpets to the ceiling tiles. In addition, the heating, ventilation and air-conditioning system is being upgraded, and a number of other changes are underway that will bring the building up to current codes for fire and smoke.

On the status of the elevators, he states, “Although not finished in every detail, we now have five elevators operating – a mix of low and high rise.” Two operational elevators was the minimum number required by the contractor to transport demolition debris down to the lobby, and move new materials, equipment and furniture up the tower. With the project on schedule, commercial tenants are expected to occupy the lower floors by the end of 2007, and Telstra should move into the upper floors at the end of the first quarter of 2008.

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Opposite page: (l-r) The 15 Adelaide Street and 239 George Street buildings

Additional heating loss occurs when harmonic current passes through utility lines and other distribution apparatuses. This creates the need for distribution lines, circuit breakers and transformers to be larger than necessary. Furthermore, as harmonic current passes through the impedance of utility lines and transformers, it can distort the voltage presented to other users. This can cause problems such as static on computer screens that are tapped into the same circuit. Significantly large voltage distortions due to motor drives with poor harmonic performance may even cause additional equipment heating or outright malfunctions of other equipment connected to the same power-distribution system.

The primary advantages of clean drive harmonics are reduced heating, better utilization of existing distribution-line equipment and prevention of interference with similarly supplied devices. Consequently, the Institute of Electrical and Electronic Engineers (IEEE) in conjunction with the American National Standards Institute has published *Standard 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems*.

A utility power-distribution system that meets the harmonic guideline criteria is considered to be “clean” and free of harmonic interference. Likewise, equipment that operates within the suggested guidelines of IEEE Standard 519, Table 10.3 is considered to draw clean harmonic current.

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Adjoining Buildings Project

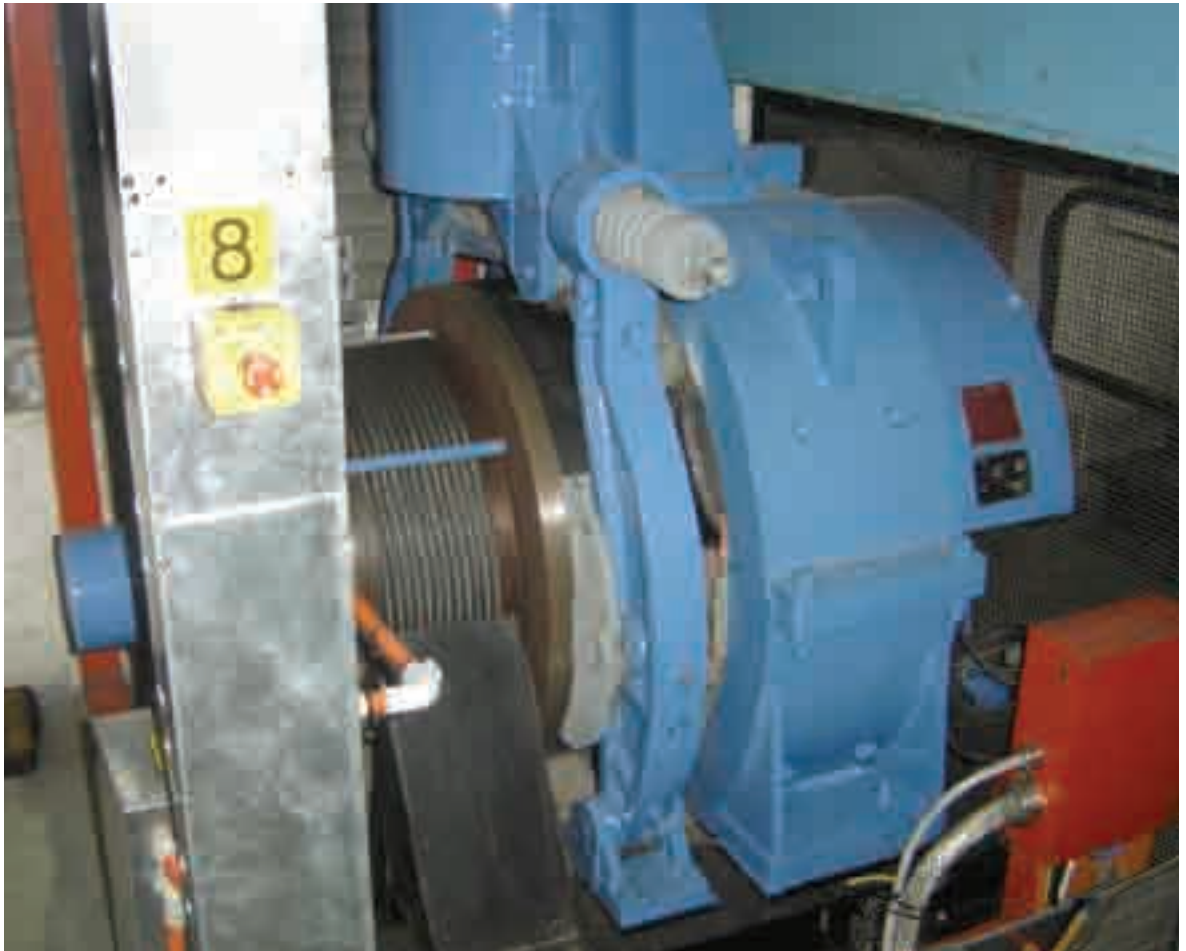
Another elevator modernization project is underway within walking distance of the Northbank Plaza Building. Owned by ING Management Ltd., these adjoining buildings have housed a variety of commercial tenants, including law firms and some government offices, since they opened for business more than 25 years ago. With 19 floors and approximately 123,784 square feet (11,500 square meters) of space, the 15 Adelaide Street building is the smaller of the two. Now home to an international building school, it opened in 1981 and relies on a bank of five KONE elevators. Each is powered by a 42-horsepower motor, and has a capacity of 16 persons and speed of 700 fpm (3.5 mps).

The larger structure is 239 George Street, with approximately 269,097 square feet (25,000 square meters) of space on 32 floors. It was built in 1975 and is served by 10 KONE elevators, five low-rise units that travel to floor 17 and five high-rise systems that serve the remainder of the building.

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A close-up view of an Otis 155HT hoist motor in the Northbank Plaza's low-rise machine room



A Bull 23B hoist motor in the 239 George Street high-rise machine room



Top: A Quattro controller in the Northbank Plaza's high-rise machine room, along with an Otis E413M machine. An old Schindler Miconic V12 Pulse DC controller is in the background.



Left: A Quattro controller in the 239 George Street high-rise machine room

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The transfer floor is on 17, and each elevator has a capacity of 16 persons. The high- and low-rise elevators are powered by 28-horsepower and 44-horsepower motors. The low-rise units travel at 600 fpm (3 mps), and the high-rise elevators travel at 800 fpm (4 mps).

Tenant Complaints

Building owners launched the modernization project because of tenant complaints centered on the elevators' reliability. Brisbane weather varies from cool and dry to hot and humid, and the elevators were especially "temperamental," Smith (also consultant on this project) recalled when the heat and humidity went up.

Smith explained:

The verdict [of this audit] was that reliability would remain a problem, spare parts would be increasingly difficult to find and the elevators did not meet new requirements for

energy efficiency. Moreover, tenants viewed the elevators as 'old and tired' and said they 'looked bad and felt bad.' This was also reflected in the Norman Disney & Young analysis of the ride the aging machines provided, which judged it to be 'lumpy and inconsistent,' primarily due to the previous drives. Ward-Leonard motor-generator-type elevator controls were used prior to the modernization project. All these factors motivated us to recommend a modernization, and the owner, who was already leaning in that direction, agreed.

Challenges

One major challenge on this project was the reality that the buildings were occupied by busy office workers throughout the modernization who didn't take kindly to any reduction in elevator availability or service.

Smith detailed the process:

*Clearly, you have to shut lifts down to modernize them, but that's not much of an excuse to people who need to get somewhere in the building **right now**. We gave fair warning, modernized one lift at a time in each of the buildings [and] minimized disruption as much as we could. . . Everything is going smoothly.*

Improvements

Modernization upgrades in this project were similar to those made at the Northbank Plaza Building, from the installation of new lanterns and chimes to Quattro drives. Work on a number of the elevators is now complete, and personnel from ING Management Ltd. are pleased with the look and performance of the modernized elevators. As in the previous project, the ride quality (acceleration, deceleration and floor leveling) was improved.

Concerning the Quattro DC Drives, Smith remarked:

We haven't been disappointed in any way. I would encourage customers who are contemplating modernizing their elevator systems to take up this technology. The potential for Quattro is enormous, and I believe it will transform the modernization market. It will make existing DC drives redundant.



The Importance of Power Factor

Power factor measures the effectiveness of current flowing in an electrical circuit. It is reported on a scale of 0 (0% effective) to 1.0 (100% effective). The definition of work, as it applies to electricity, is the absorption of energy that is transformed into heat, light, sound, movement or another non-electrical form.

Power is the rate at which such work is performed. The mathematical definition of power factor is the ratio of real power (which performs desirable, useful work) versus apparent power, which is simply the product of volts multiplied by amperes. All current that flows in an electrical circuit causes losses in the distribution wiring system. If it does no useful work, those additional losses caused by current that does no work represent wasted effort provided by the utility company at the expense of the electric-bill payer.

A high power factor means that the energy is being used to produce useful work as effectively as possible rather than simply causing wasted heat in the electrical-distribution system.