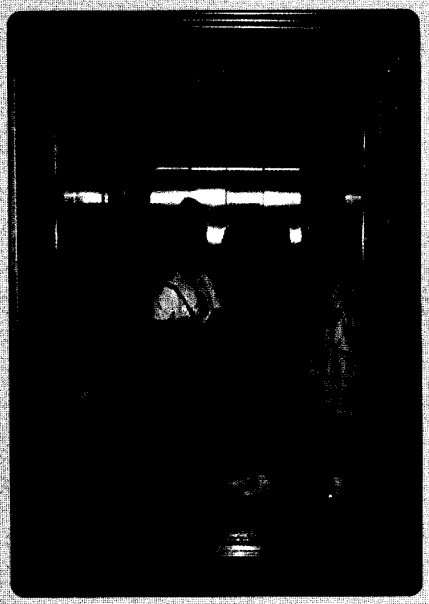
MODERNIZATION

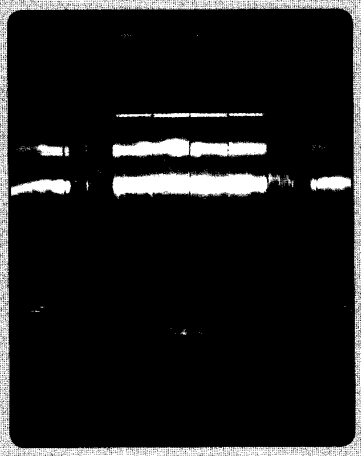
DRIVE TO THE TOP

SECOND PLACE
ELEVATOR WORLD
Project of the Year 2000

by Robert Baamonde, Jr.

At a time when new construction is dominating the market, ACE Elevator undertook what was perhaps, one of the largest, most sophisticated elevator modernization programs in the industry's history. This "towering" achievement took place at New York City's prestigious World Trade Center (WTC), with the completion of the first six members of the elite "Shuttle Fleet."





Partial loading of elevator (above)
The towers (left)
Interior of shuttle elevators (center)

Indicates an Online Feature

Shuttle elevator hoist machine

Top of shuttle elevator car

This project was originally intended to operate with the existing 275kW motor-generator sets that were specifically designed for the WTC project. However, both the Port Authority of New York and New Jersey and ACE Elevator Co. Inc. had the collective vision of utilizing cutting-edge, solid-state-drive technology to replace the existing motor generator sets.

All the parties involved felt that implementing this innovation would significantly enhance the elevators' operation and eliminate countless problems associated with the motor generator rotating elements. Although similar technology is used every day throughout the elevator industry, no equipment available at the time met the power requirements demanded by this type of installation.

New technology had to be developed to achieve what was in mind. The WTC shuttle fleet represents, arguably the largest, fastest and most menacing equipment in the industry. The dynamics of the shuttle cars, together with unique logistical obstacles from within the complex, posed challenging engineering and installation scenarios far exceeding the typical modernization program.

Towers A and B consist of a total of 46 shuttle elevators, capable of moving up to 460,000 pounds, at speeds of 1,600 feet per minute. Within a 60-second time frame, as many as 4,000 passengers travel distances exceeding 100,000 vertical feet in a single roundtrip and some 75 miles of large diameter hoist cable are used to lift these vertical beasts.

Yet, with an installation abundant in highly specialized componentry, the heart and soul of this operation remains the highly customized "Motor-Drive System." Although having endured a tedious, and at times exasperating, engineering evolution, ACE Elevator prevailed in implementing and installing new silicon-controlled rectifier (SCR) drives on the shuttle fleet. This upgrade made a positive impact on both the fleet's efficiency and overall operation.

The contribution this innovation made was instrumental in the WTC's recognition as Building Owners and Managers Association's (BOMA) "Building of the Year." This honor was bestowed upon the Port Authority at both the regional and national levels.

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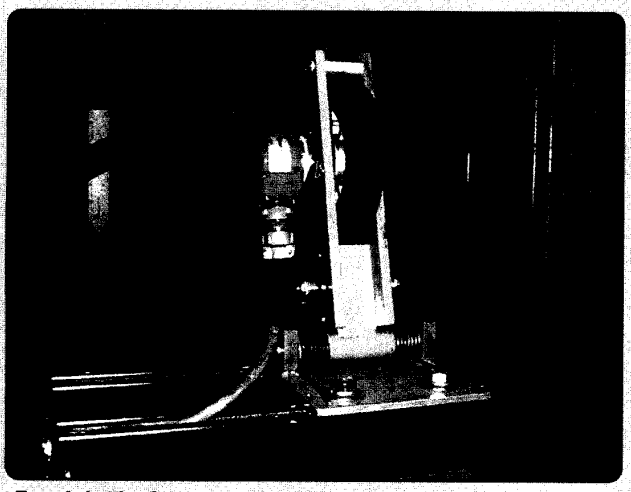

Top of shuttle elevator car showing rail-mounted encoder

Governor-mounted encoder

DRIVE TO THE TOP

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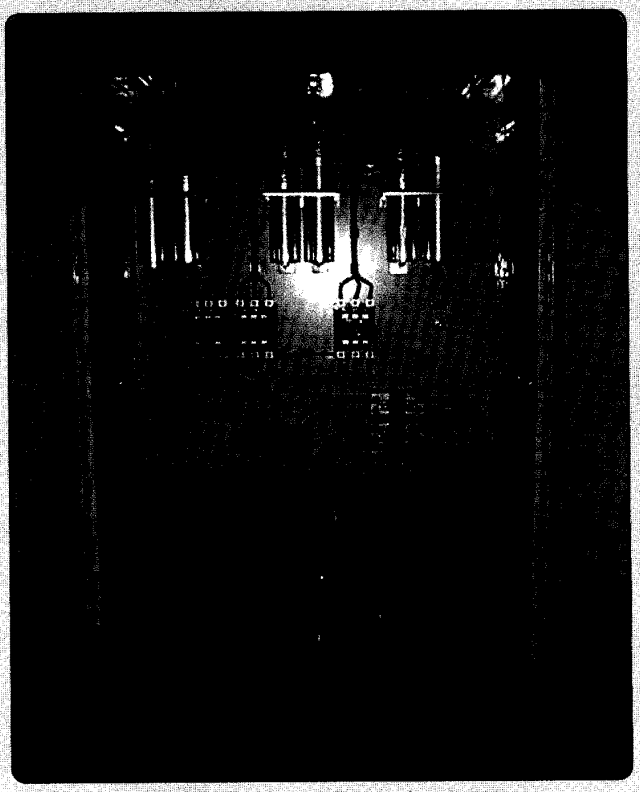


The harmonic filter installed in motor generator room

Original Technical Specifications

The existing generator sets were replaced with SCR drives. Due to the power requirements of the aforementioned equipment, new drive componentry would be design-specific to WTC. ACE engineers, in conjunction with outside vendors, developed a system capable of powering the massive equipment with no negative effects to the building's power supply.

The use of SCRs for this installation required an isolation transformer, choke and harmonic filter as outlined below.

Isolation Transformer: 450 KVA-4250 lbs. (WPI)

Choke: 5MH-500A-2280 lbs. (WPI)

Harmonic Filter: 210KVAR-1280 lbs. 350BP(TVI)

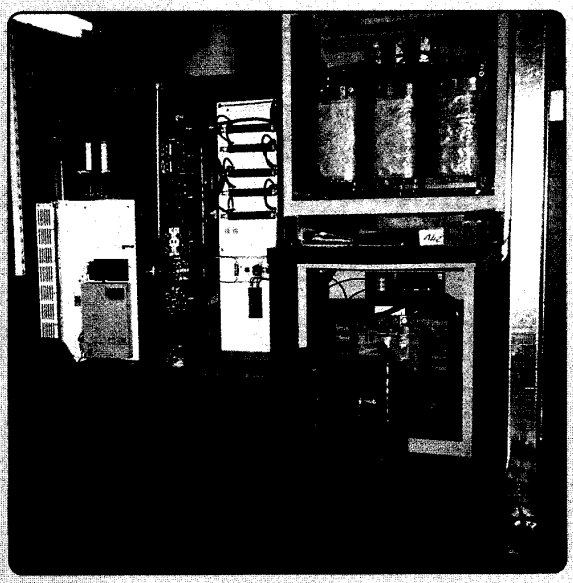
SCR Drive: DSD-412 10 to 1250 amp (MagneTek)

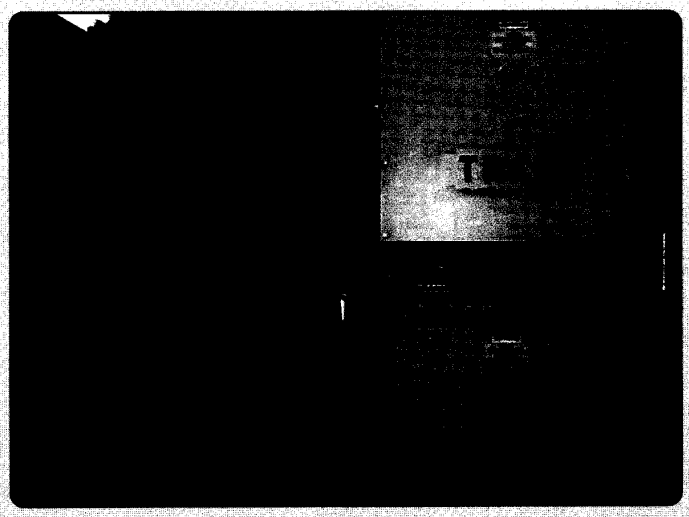
The size of the new SCR drive enclosure was too large to fit in the elevator machine room. The choke and isolation transformer were also too large to be installed within the machine room space. The original motor-generator room, which could house this equipment, was located seven floors below the machine level. In order to support the combined weight of the new equipment in the existing motor generator room, a steel platform had to be erected, consisting of steel I-beams welded to the building steel and steel plates attached to the I-beams forming a mounting foundation. All the above equipment was isolated from the building steel by special high tensile rubber pads.

Installations of two separate trough runs (one high voltage and one communication) from the elevator motor room to the motor generator room seven floors away, proved a challenge. A run of approximately 80 vertical feet, employed over 300 running feet of 2-1/2" x 8" and 2"x 2" trough raceway. This run traveled through plaster ceilings, concrete floors and around structural steel. The remote location necessitated the installation of a new 800 amp service disconnect switch with a remote shunt trip, installed in each motor generator room.

The following represents the tasks encountered by the modernization teams of ACE Elevator. The WTC shuttle fleet would present engineering obstacles both technical and logistical. Unique in design, prior to the modernization, equipment of choice would have to interface with one of the most technically challenging elevator installations industry wide.

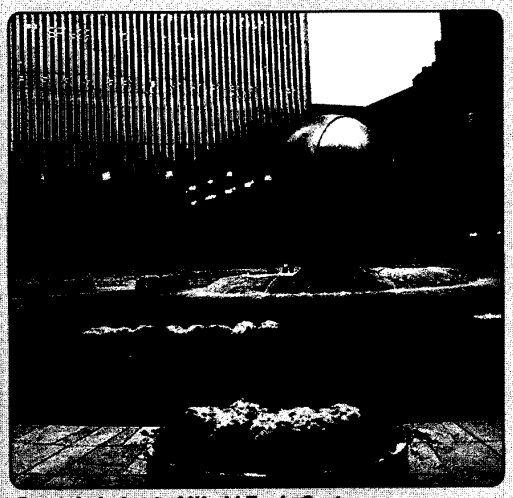
Capacity (lbs.):	10,000
Speed (fpm):	1,600
Travel in Feet:	1,350
Hoist Motor:	339 HT 52,000 (lbs.)
Horsepower:	350
Generator (Original):	276kW 10,000 (lbs.)
Roping:	1:1 double wrap
Hoist Ropes:	13/16"
Comp Ropes:	1-1/2"
Safety:	Duplex wedge clamp (car and counterweight)
Buffers (oil type):	84" stroke car and cwt. (2) car (2) counterweight
Operation:	Group Automatic
Door Configuration:	2 SPD center opening (62" x 84") front and rear
Cab (Platform) size:	7'3" X 13'3"





Motor generator room installation of the drive, choke and isolation transformer

Elevator machine room showing typical installation of SWIFT controller



Fountain in front of World Trade Center

A harmonic filter was installed for the purpose of dissipating and reducing harmonics thereby preventing electrical contamination of building power that is often caused by SCR drive systems. In addition, installation of line starters and circuitry were also utilized, preventing the in-rush of 480v to the primary side of multiple isolation transformers. If and when the building went to an emergency power condition, line starters could provide the sequential re-energizing of the fleet.

The CEC-built controller originally utilized a tape reader for position; however, high rise and speed warranted modifications to a tapeless system. Special proximity limits were designed for reliability and reduced maintenance. High capacity and rise along with rope stretch necessitated the development of special circuitry to facilitate proper relevelling during the loading and unloading process.

As with any high-rise steel building, high winds can raise havoc with high-rise elevators. During windy days when the sway of the building is greater than 1 mG, the speed of all the shuttle elevators are automatically reduced to 1,000 feet per minute, with a degraded speed curve. Also due to the building design, two express elevators share a common hoistway enclosure, therefore special software was designed to insure that the two shuttle cars sharing the same hoistway enclosure would never start to run in the same direction at the same time. An adjustable software delay allows the cars to run in the same direction after a minimum gap of 20 floors.

The capacities and speed at which the WTC shuttle cars operate, made the replacement of the motor generator sets with SCR drives quite a challenge.