A Major Cogeneration System Goes in at JFK International Airport

Low-visibility Privatization in a High-impact Environment

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This article describes the first major privatization effort to be completed at John F. Kennedy International Airport. The airport owner and operator, the Port Authority of New York and New Jersey, decided to seek private sector involvement in a capital-intensive project to expand and upgrade the airport's heating and air conditioning facilities and construct a new cogeneration plant. Kennedy International Airport Cogeneration (KIAC) Partners, a partnership between Gas Energy Incorporated of New York and Community Energy Alternatives of New Jersey, was selected to develop an energy center to supply electricity and hot and chilled water to meet the airport's growing energy demand.

Construction of a 110 MW cogeneration plant, 7,000 tons of chilled water equipment, and 30,000 feet of hot water delivery piping started immediately. JFK Airport's critical international position called for this substantial project to be developed almost invisibly; no interruption in heating and air conditioning service and no interference in the airport's active operations could be tolerated. Commercial operation was achieved in February 1995.

A new "energy center" includes two energy efficient aeroderivative gas turbines with inlet air cooling, two heat recovery steam generators, a steam turbine, steam absorption chillers, and a real time economic optimization routine. Airport growth includes a new 600,000-square-foot terminal building and a light rail system to be in service by the year 2001.

BACKGROUND

JFK International Airport is one of the world's most heavily trafficked and most highly profiled airports. The airport's terminals and facilities serve more than 28 million passengers each year. More than two million airline employees and airport personnel staff the ground and flight operations, maintain the airport's extensive and sophisticated infrastructure, and depend on the airport's air traffic management systems, aircraft fueling and maintenance resources, and passenger and cargo handling capabilities.

The airport is also a major local economic force. It contributes $20.4 billion in annual economic activity to the New York/New Jersey metropolitan region. Over 200,000 jobs related to airport services and operations generate $6.6 billion annually in wages and salaries. In size, the airport is equivalent to roughly one third the area of Manhattan, and encompasses nearly nine miles of runways, over 25 miles of taxiways, and 26 miles of roadways.

The Central Terminal Area consists of eight airline passenger terminals and the International Arrivals Building. The Tower Air Terminal brings the total number of passenger terminals to ten. These terminals are served by 108 gate positions; another 65 remote positions—including commuter airline spots—brings this number to 173 total positions.

The airport's location—fifteen miles by highway from Manhattan—places it close to the heart of one of the world's most active media centers. Deviations from the consistently smooth operation of the airport draw the immediate attention of the country's largest news and information systems. Significant emergencies instantaneously reach an international audience. Both the intensity and the immediacy of this exposure make the airport one of the most highly profiled commercial facilities in the world.

In addition to its high domestic and international visibility, the airport is a critical hub in a worldwide air traffic network. Airports are unique among commercial and industrial facilities in that an interruption of their ability to operate poses the risk of impact well beyond their fencelines. An incident at JFK International significant enough to interrupt its ability to operate-to field a high volume of air traffic-poses the risk of throwing this worldwide network into chaos and impacting cities as distant as Tokyo, Calcutta, and Moscow.

A NEW PRIVATIZATION EFFORT

The Kennedy International Airport's Energy Center, the first major privatization effort at the airport, is the engine at the heart of this sprawling, busy, and highly visible international operation. Strategically situated in the airport's Central Terminal Area, the energy center provides electricity, heating, and air conditioning for more than 30 million passengers, airline employees, and airport personnel who use and operate the airport each year.

Energizing an operation as large, complex, economically important, and internationally visible as JFK Airport presents challenges which in many ways are unique in the privatization of district energy. As this article describes, these challenges come into play not only in the initial negotiation of all the requisite power, lease, and fuel agreements but also in the design, construction, and operation of a district energy plant.

Chief among these challenges is the high visibility and wide-ranging impact of the airport's operations. This visibility and impact place the factor of electrical and thermal reliability in a new and highly critical light.

Few district energy producers, for example, serve the range of domestic and international clients that comprise JFK's tenants. Few producers risk the kind of attention the New York and international media could bring to bear on a heating outage. Few producers run the risk of having a plant outage affect business and operations in places as distant as Beijing and Oslo.

The developers of the energy center were handed one overriding mandate when they walked into this high-profile environment: provide power and space conditioning for the 30 million people who use and operate the airport's facilities annually without letting the airport know that you're here. This mandate encompassed not only the energy center's design, construction, and transition to privatization, but also its operation.

First, the energy center could not look like a district energy plant; its design had to reflect the airport's purpose as a modern international air traffic center and emulate the airport's forward-looking architectural theme. Second, the mandate applied to the construction of the center. Construction called for integrating new energy systems and facilities with existing electric and thermal distribution systems; all project activities had to be planned and scheduled to accommodate the airport's 24-hour operating schedule and high volume of road and air traffic.

Construction was also not allowed to interrupt heating and air conditioning service to the airport. Finally, the mandate of low visibility addresses the center's operation. The range of impact of an interruption in the airport's operation call for the center's operating and maintenance staff to pay critical attention to the center's ongoing reliability with a strong predictive maintenance program.

The energy center meets the power demand of the airport using two combined cycle gas turbine generator packages and a waste heat steam turbine generator package with a total rated output of 100 MW. Power is distributed via four substations with a combined capacity of 281,000 kV and a distribution system networked across the airport's 4930 acres of runways, taxiways, roadways, and terminal and service facilities.

To meet the airport's heating and cooling demand, the energy center uses a central heating and refrigeration plant (CHRP) with a 28,000-ton refrigeration capacity and a heating capacity of 225 MMBtu/hr. The CHRP operates almost exclusively on waste heat extracted from the exhaust of the cogen plant's two gas turbines, generating and distributing hot and chilled water to the airport's dispersed terminals over a thermal distribution system (TDS).

State-of-the-art emission control technology was designed into the cogen plant from the outset. This investment has resulted in stack emissions levels which are lower in key air pollutants than the background levels of the surrounding area.

Since 1992, when KIAC Partners and the Port Authority initially undertook the privatization of the airport's energy services, the mandate of low visibility and transparent operation has consistently guided the development and operation of the energy center. For more than two years of commercial operation the center has maintained a thermal reliability of 100% and an electrical reliability of 98%.

The story behind the negotiation, design, construction, and operation of the energy center is one of the more compelling privatization stories of the energy industry. This article begins by describing the owning and operating organization behind the energy center. Then, beginning with the Port Authority's decision to privatize, the article moves through the development of the energy center, describing the center's design, construction, and current operation. It concludes with a discussion of the airport's anticipated growth and the energy center's continuing role in responding to the energy that growth will demand.

THE ORGANIZATION BEHIND THE ENERGY CENTER

The energy center is owned and operated by Kennedy International Airport Cogeneration (KIAC) Partners. KIAC Partners was formed in February of 1990 as a New York General Partnership between Gas Energy Incorporated (GEI) and Community Energy Alternatives (CEA) to develop the energy center and fulfill a 25-year agreement with the Port Authority of New Jersey and New York, the owner of the airport, to meet the airport's existing and future energy demand. GEI and CEA each hold a 50% interest in KIAC Partners.

GEI and CEA are the private sector subsidiaries of two of the metropolitan area's largest and most experienced utilities. GEI is an independent subsidiary of The Brooklyn Union Gas Company of New York. CEA is a subsidiary of Public Service Enterprise Group of New Jersey and an affiliate of Public Service Electric & Gas (PSE&G), the nation's seventh largest utility in the nation. Both GEI and CEA were created in the 1980s to position their parent companies for competition in the private sector of the deregulated arena.

The energy center is operated and maintained under a contract awarded by KIAC Partners to CEA Kennedy Operators (CKO). CKO is a wholly owned subsidiary of CEA's operations organization and was expressly created to fulfill the contract with KIAC Partners to operate and maintain the energy center. As a subsidiary of CEA, CKO has a strong ownership interest in the energy center.

The existing heating and refrigeration plant required an operating and maintenance staff from the beginning of the project to ensure that the airport continued to receive heating and air conditioning while construction of the energy center went forward. As a result, CKO was retained as the operating company at the onset of the project, immediately following the transition of the existing plant from control by Port Authority to KIAC Partners. CKO and KIAC Partners worked together from the beginning of the energy center project through construction and commercialization to ensure continuity of services to the airport.

PRIVATIZATION: CREATING A PUBLIC-PRIVATE ENTERPRISE

During the late 1980s, faced with the need to renovate and expand the airport's 25-year-old CHRP and TDS, the Port Authority addressed the possibility of privatization for the first time in its long history of maintaining ownership and control over projects under its jurisdiction. Following vigorous discussion on both sides of the issue, the Port Authority chose the route of contracting a qualified private vendor, KIAC Partners, to design, construct, and operate an integrated CHRP/Cogeneration Plant to provide JFK Airport a state-of-the-art system for the generation and distribution of electrical and thermal energy. The factor which most influenced the Port Authority in its decision was the ability, offered by privatization, to shift certain primary risks from the Port Authority to a private vendor. These shifted risks included:

1. Capital investment on the part of the Port Authority. The project would be financed not by the Port Authority's Consolidated bonds but by Special Project bonds. Port Authority assets would not be pledged.

2. Completion risks during the construction of the project. These risks, including the risk of cost overruns, would be assumed by the vendor.

3. Performance risks inherent in operating the center. The vendor would assume the risk of mechanical failure and environmental compliance during operation.

4. The cost risk inherent in operating the energy center. The vendor would assume the risk of having the operating cost of the center exceed expectations.

As a first step, the Port Authority's engineering staff prepared detailed performance specifications for the new cogeneration plant. KIAC Partners was required to submit its design plans, drawings and specifications to the Chief Engineer of the Port Authority for approval to ensure that the proposed designs were consistent with the Port Authority's performance specifications and complied with applicable building laws and ordinances. The procedure of approval by the Chief Engineer was to be followed during every phase of the cogeneration plant's construction.

The Port Authority also retained unique "step in" rights in the event of failure to deliver on the part of the vendor. Port Authority, for example, retained the right to take control of the plant's operation in emergencies which the vendor failed to swiftly and appropriately resolve. Port Authority was also authorized to take temporary or permanent control of the cogeneration plant's operation in the event of the vendor's bankruptcy.

The public-private partnership between the Port Authority and KIAC Partners has been very successful. The spirit of public-private cooperation has resulted in a highly reliable and efficient means of generating and distributing power and thermal energy to the airport.

PROJECT DEVELOPMENT

In 1989 the Port Authority made the decision to seek private involvement in the renovation and expansion of JFK's existing heating and air conditioning facility and distribution system. The planned renovation and expansion also included the development of a cogeneration plant dedicated to the airport's demand for electric power. Bids for the project were solicited from qualified private sector developers in the energy industry.

In February of 1990, in response to the Port Authority's call for private involvement in the development of a new electric and thermal plant and distribution system for the airport, GEI and CEA created KIAC Partners as a general partnership for the development of the project. KIAC Partners was awarded the project and immediately began putting the various components of the project into place.

Among the first of these components were a host of energy, lease, and fuel agreements KIAC Partners had to negotiate with the Port Authority and other private, municipal, and state organizations to optimize the energy center's ability to produce and sell thermal and electric energy. These agreements included:

- Energy Purchase Agreements
- Lease Agreement
- Construction Operations Agreement
- Con Edison Delivery Agreement
- New York Power Authority Agreement
- Gas Sales Agreement
- Gas Transportation Agreements
- City of New York/New York State 138 kV Transmission Line Consent Agreement

These agreements had to be negotiated before the project itself could be considered feasible enough to develop.

KIAC Partners began the construction of the energy center and the renovation and expansion of the existing CHRP and TDS in July of 1992. EnergyPro Construction Partners (EPC) was formed by KIAC Partners to coordinate and manage construction.

In April of 1993, KIAC Partners negotiated and signed a 25-year Energy Purchase Agreement with the Port Authority. The agreement committed KIAC Partners to provide electric power and thermal energy sufficient to meet both the existing demand and future growth of the airport over the term of the agreement. Its terms called for 76.3 MW of electricity, 28,000 tons of refrigeration for air conditioning, and 225 million Btu/hour of hot water for space heating. One month later, the Port Authority created $175 million in Special Project bonds for the project and obtained backing for the bonds by a Line of Credit.

Over the development of the project, KIAC Partners and CEA's Environmental Office worked together to address the energy center's environmental obligations. These included stack testing, continuous emissions monitoring certification, waste management planning, spill plan development, and the negotiation of the center's air and water permits.

The new CHRP and TDS entered commercial operation in August, 1994. The new cogen plant went commercial in February, 1995.

CONSTRUCTION AND DESIGN

The design and construction agreement between KIAC Partners and the Port Authority included the following major projects:

1. Construction of a new cogeneration plant based on two 42.5 MW combustion turbine generators, two heat recovery steam generators (HRSGs), and a 25 MW steam turbine generator.

2. Construction of a new chiller addition and the installation of five 1,400-ton York steam absorption chillers configured to operate on intermediate pressure (IP) steam from the cogeneration plant's HRSGs and steam turbine.

3. Full overhaul and renovation of the existing six auxiliary boilers and electric centrifugal chillers in the original CHRP and the installation of three new steam to water heat exchangers.

4. Construction of a new closed medium temperature thermal distribution system (TDS) based on two 8,000-foot loops and four lateral lines into each of the central terminal buildings.

5. Replacement of existing heat exchangers in each of the airport's central terminal buildings with plate and frame heat exchangers designed to accommodate the new medium temperature TDS.

6. Installation of new metering equipment, remote control and monitoring systems, and domestic hot water generating equipment in each of the airport's central terminal buildings.

7. Construction of a new three-mile 300-psi gas main to fuel the cogeneration plant and two on-site gas compressors to boost pressure to 650 psi for delivery to the combustion turbines.

The Challenge of Low-Profile Construction and Continuous Service

The most formidable challenge presented by the project involved the construction of a major district energy facility at the heart of one of the world's most active airports.

The construction of the energy center called for a low-profile effort in a high-profile environment. Construction was prohibited from interfering in any way with the airport's ground and flight traffic operations. This prohibition acknowledged the critical importance of the airport's 24-hour schedule and recognized that any deviation from that schedule could create a ripple effect that could quickly escalate and become international in scale.

EPC and CKO worked together to schedule all project activities to accommodate a second critical provision of the contract: no interruption in heating and cooling services to the airport during construction. The construction of the cogen plant and the renovation and expansion of the CHRP and TDS had to be carefully staged to ensure the uninterrupted delivery of hot and chilled water and electrical service to all airport terminals and facilities, all existing airport utilities, and all airport operations during the respective heating and cooling seasons.

The location of the construction site—at the heart of the Central Terminal Area—called for careful planning to ensure that deliveries of systems and equipment did not impact air operations. Airport road bridges lacked adequate clearance to accommodate components such as the combustion turbines, the HRSGs, and the steam turbine. These components were delivered by barge to the airport and then trucked during off-hours across airport runways and taxiways to the site.

KIAC Partners worked with the Port Authority and the Federal Aviation Administration to coordinate these deliveries with air operations. A remote lay-down area two miles from the site was designated to store construction material and components. Construction and operations personnel used a remote parking area and were transported to the site by bus.

A 700-foot portion of the five mile 138 kV feed line was directionally bored underneath intervening taxiways and runways to avoid any interruption in air operations. An additional 400 feet were directionally bored under the Van Wyck Expressway to minimize impacts on the airport's congested highway system.

Construction, renovation, and expansion of heating and cooling systems of the CHRP and TDS, including the adaptation of these systems to each terminal building, were scheduled during the respective off-season for each system. Tight completion schedules during these periods called for personnel to work extended hours.

Energy Center Architecture

The architectural design of the energy center was driven by the Port Authority's mandate for the low-visibility integration of the airport's district energy services into the airport's function and operation. This mandate specifically called for the energy center's architecture to complement the TWA International Arrivals Terminal, a terminal whose design led to its designation by New York City as a historical landmark.

The final design is a highly contemporary balance between form and function; the balance integrates the function of both the airport and the energy center. The roof line of the center reflects an airfoil. The space frames around the Heat Recovery Steam Generators (HRSGs) and the curtain windows over the CHRP exhibit the energy center's equipment and maintain the theme of the curved roof.

The Cogeneration Plant

Prior to the construction of the cogen plant, the Port Authority obtained electrical power for the airport from the New York Power Authority through 18-27 kV feeders from Consolidated Edison's Brooklyn and Jamaica plants.

The cogen plant is a combined cycle plant with two aeroderivative combustion turbine generators and a steam turbine generator with a total rated output of 110 MW. The plant is designed to power the CHRP and TDS and to also provide uninterrupted electrical power to all airport terminals and facilities, all airport utilities, and all airport operations. Each combustion turbine package is based on a GE LM6000 gas turbine coupled to an electric generator with a nominal 42.5 MW gross output.

The GE LM6000 was selected for its proven efficiency and reliability. It is derived from the core of General Electric's most powerful and reliable jet aircraft engine. In aircraft trim, the engine is used in such aircraft as the MD-11, the 747, 767, and the A300 and A310 series; it has logged a dispatch reliability of 99.9 percent and holds commercial aviation's lowest shop visit rate. In cogeneration trim, the engine, rated at 60,150 shaft horsepower, offers a competitive heat rate for a machine of its size, and will operate at over 50 percent efficiency in the combined cycle mode.

Combustion air heating and cooling is used to maintain maximum turbine performance when ambient temperatures are greater or less than 50°F. It operates on natural gas as its primary fuel and light distillate oil as its backup fuel.

Exhaust gas from each combustion turbine feeds a dedicated HRSG. Each HRSG uses a triple level boiler/pressure design to produce high pressure (HP) superheated steam at 685psig/750°F, intermediate pressure (IP) process and superheated steam at 85psig/420°F, and low pressure (LP) process steam at 35psig/237°F. The HP boiler/superheater is designed to produce high purity steam for the steam turbine generator.

The IP boiler/superheater is designed to operate with sliding pressure (85 to 150 psig) to meet airport heating demand and to generate IP superheated steam for injection to the steam turbine when heating demand is reduced. The LP boiler generates steam for the feedwater deaerating heater, the ammonia stripper, and other auxiliary systems.

Each HRSG is equipped with a supplementary gas fired duct burner designed to supplement and boost steam production during periods of high thermal demand.

The steam turbine generator is rated at a nominal 25 MW. The turbine itself is a condensing double auto extraction unit. 150 psig extraction steam is used by the CHRP's absorption chillers and as air ejector and gland sealing steam. 60 psig extraction steam is used by the CHRP's heat exchangers to provide medium temperature water for airport heating.

The air emission control systems for the cogen plant are designed to meet limits of 9 ppm NO_X and 1 ppm CO and ensure that the center meets applicable permit limits. Water injection in the gas turbine combustors reduces NO_X formation in the turbine exhaust. Each HRSG is equipped with a dual function catalyst system strategically positioned in the optimum flue gas temperature zone for nitrogen oxide (NO_X) and carbon monoxide (CO) reduction. An ammonia injection grid upstream from the catalyst allows plenum space for evenly distributing ammonia across the exhaust. NO_X concentration at the stack outlet is continuously analyzed and fed back to the ammonia injection control loop to maintain the stack NO_X concentration at a constant level.

Installed control technology also includes a continuous emissions monitoring system and other necessary controls for ammonia injection, CO, NO_X, and ammonia slip to satisfy state and federal stack testing requirements.

Central Heating and Refrigeration Plant

The CHRP's original refrigeration capacity of 21,000 tons was provided by four 1,000-ton chillers, two 5,500-ton chillers, and one 6,000-ton chiller. All existing chillers were electric centrifugal chillers. The project called for five new 1,400-ton steam absorption chillers to expand refrigeration capacity to 28,000 tons. An extension was added to the main CHRP building to house the new chillers. The two existing 5,500-ton units were reconditioned to improve plant reliability.

The five new 1,400-ton absorption chillers serve as base load refrigeration capacity. The four existing 1,000-ton units and 6,000-ton unit are used for intermediate duty in various combinations. One of the two reconditioned 5,500-ton units is used to meet peak requirements on very hot days; the other serves as standby.

The original heating capacity of the CHRP was comprised of six dual fuel fired hot water heaters. These heaters fed an existing high-temperature (390°F) hot water distribution system to airport terminals and facilities.

The new design called for the installation of a new medium temperature hot water system, capable of delivering 225 MMBtu/hr at a maximum supply temperature of 250°F. The system's normal operating temperature is between 220°F and 240°F. Three new heat exchangers were installed to supply the system with hot water. These exchangers use IP steam from the HRSGs and steam turbine to heat the supply water for the medium temperature system.

The three exchangers each have a capacity of 112.5 MMBtu/hr. The critical importance of reliability drove the selection of three exchangers to provide 50 percent spare capacity.

The existing dual fuel fired hot water heaters were modified for medium temperature operation and rated at 225 MMBtu/hr to provide 100 percent backup to the exchanger-based steam heated system. The heating plant design also called for the existing steam pressurization system to be converted to a pumped nitrogen pressurization system. Piping, pumps, and auxiliary equipment within the heating plant were modified to accommodate medium temperature water operation.

Medium Temperature Thermal Delivery System

The original TDS was a radial high temperature (390°F) hot water underground system which was initially installed in the 1950s and substantially replaced in the early 1970s. The new design called for a medium temperature hot water TDS consisting of two parallel 8,000-foot loops (one supply line and one return line) and four lateral lines into each of the central terminal buildings. The direct buried system circulates hot water from the CHRP at a maximum temperature of 250°F. Normal operation is 220°F to 240°F supply temperature and 160°F to 180°F return temperature for an average differential of 60°F.

Approximately 6,120 gallons per minute (gpm) of medium temperature hot water is circulated at peak load to satisfy the current demand; a circulation rate of 7,950 gpm will be required to meet future peak demand. The secondary circuit can be operated with a constant supply temperature by varying the volume of hot water circulated; it can also be operated with a sliding temperature as a function of the outdoor temperature.

The TDS piping is pre-insulated, bonded piping made of a thin-walled carbon steel carrier pipe, polyurethane foam insulation with embedded alarm wires and an outer casing of rigid high density polyethylene.

For over 15 years, this type of system has been widely used, with great success, in district heating and cooling applications throughout Europe. Systems of this type have also been installed in the U.S. in locations such as Buffalo and Jamestown, NY, and St. Paul, MN. The advantages of the lower circulating temperature system include a reduced interior corrosion rate, the virtual elimination of expansion loops, providing savings in piping trenching, welding, shoring and land use cost, as well as a reduced interior corrosion rate.

Chilled Water Thermal Delivery System

The chilled water TDS is a radial supply and return system designed to deliver 45-55°F chilled water to the terminals with a supply and return temperature differential of 10°F. The system provides chilled water to the terminal buildings for cooling purposes in summer. It is designed as a primary system with chilled water pumps in the CHRP circulating water to the cooling coils in the terminal buildings. Most of the terminal buildings contain booster pumps that are rarely used except during peak cooling periods.

Terminal Building Space Heating

KIAC Partners replaced the shell and tube primary and secondary water heat exchanger systems in the mechanical equipment room of each central terminal building with new plate and frame type heat exchangers to provide the necessary heat transfer surface area required with the new medium temperature hot water system. Each mechanical equipment room was also retrofitted with an energy management and control system including meters, isolation and balancing valves, and necessary controls. Connections for four pipes at each terminal were also installed for isolating the terminal's lateral in case of a leak. New domestic hot water generating equipment was also installed in each terminal building.

The peak demand of the terminals connected to the new medium temperature water distribution system is currently 155 MMBtu/hr. The future peak heat demand of the airport's terminals is anticipated to reach 225 MMBtu/hr.

TDS Control and Monitoring System

A central system was installed to control and monitor energy consumption of the medium temperature hot water and chilled water TDS from a central station in the CHRP. CKO operators can monitor temperatures of the TDS and terminal secondary systems and the chilled water delivered directly to the air handlers in the terminal buildings. Flow and temperature alarms notify operators of imminent problems. In the event of an emergency, individual terminals can be remotely isolated from the CHRP to prevent a system-wide shutdown.

OPERATION AND MAINTENANCE

CKO assumed operating and maintenance responsibility for the energy center prior to construction and played a critical role in its development. This role focused the Port Authority's central mandate for the project: keep the development of the project transparent to the continuous delivery of thermal energy to the airport and its tenants.

As the project developed, and came to include the cogen plant, CKO also assumed responsibility for the electric side of the center. This included an absolutely transparent transition from utility-provided electric power for the airport to on-site power generation. CKO saw that the transition from the center's construction to its commissioning and commercial operation was smooth, focused, and efficient.

CKO is staffed with 21 employees. Shifts during the summer months are staffed by three operators; winter shifts use two operators. Additional personnel are used during the winter to support the maintenance of the chilled water system.

CKO's operating and maintenance responsibility extends beyond the energy center to encompass the TDS. CKO personnel are routinely dispatched to the airport's terminals for routine as well as emergency situations.

As a subsidiary of CEA, one of the owning partners, CKO has a strong ownership interest in the energy center. This interest extends to CKO's operating and maintenance policy and to its workforce. CKO strives to bring together skilled, resourceful, and motivated individuals in an atmosphere that encourages creative and effective problem solving, promotes cooperation and teamwork, and rewards dedication, competence, integrity, and productivity.

CKO places top priority on the well-being of plant personnel and environmental compliance. CKO's extensive safety and health program addresses all regulatory mandates and provides guidelines for safe conduct. The program is backed by extensive training which stresses prevention and response at all levels of plant activity. A new integrated environmental and safety program combines annual redundant training requirements into one training course.

Plant operating and maintenance procedures and programs are also backed by intensive training. Operation is supported by a plant optimization software program to efficiently schedule plant production. The program uses production costs, energy rates, airport load data, and ambient conditions to optimize the center's revenue stream. Third party electrical sales are also scheduled based on daily negotiated energy sales with local utilities and power brokers.

The maintenance of the center is managed using a computerized maintenance management system and a comprehensive predictive maintenance program. CKO personnel perform routine predictive and preventive maintenance; the workforce is augmented with outside contractors for annual system outages. The New York area has a large pool of readily available and highly skilled contractors. This enables CKO to keep its maintenance force at an optimum level. CKO closely coordinates all daily and seasonal activities including routine shutdowns with airport and terminal operating personnel.

GROWTH

The airport currently uses 48 MW of electricity, 150 million Btus of hot water, and 13,500 tons of refrigeration. The energy center's extra production capacity was included to cover the growth of the airport over the 25-year term of the Energy Purchase Agreement. The challenge for the energy center team is to find near-term uses for the center's unused production capacity. The answer of choice is to build a partnership with the Port Authority whereby KIAC Partners develops innovative solutions to the airport's energy problems.

The ongoing redevelopment of the airport provides new avenues of use for the energy center's production capacity. The following sections highlight several projects in development at the airport.

New Terminals

A 650,000-square-foot airline terminal is under construction and scheduled to be in service by the spring of 1998. The terminal will be owned and operated by Air France, Korean Air, Japan Airlines, and Lufthansa German Airlines. It will have a peak demand of 3.5 MW, 13 million Btus of heating, and 2,500 tons of cooling. The estimated impact on the energy center's revenues is an increase of 13%.

Renovated International Arrivals Building

The existing International Arrivals Building is being completely demolished and rebuilt to serve a growing international customer base. The new building will require new and expanded thermal and electrical service.

New Light Rail System

A new Light Rail System (LRS) will allow passengers and employees to transfer between buildings, access long-term parking areas, and reach New York City's boroughs via connections to the New York City rail system. The LRS will begin operation in 2000. The energy center will provide electricity to power the rail cars, and hot and cold water to condition the LRS stations. The LRS will have a peak demand of 9 MW, 6 million Btus of heating, and 1,200 tons of cooling. Revenues to the energy center are estimated to increase 14%.

Future Energy Center Activities

All existing chillers at the CHRP have been retrofitted to meet the current chlorofluorocarbon (CFC) refrigerant standard. Next year one of the CHRP's 25-year-old 5,500-ton Carrier DA17 R-500 chillers will be retrofitted to R-134 refrigerant. The second 5,500-ton chiller is being evaluated for retrofit or replacement in 1999.

AEE AWARD

The JFK Energy Center was awarded the "Cogeneration Project of the Year" (over 25 MW) by the Association of Energy Engineers last August, at the Competitive Power Congress. Accepting the award was Ray Luxton, General Manager of Kennedy International Airport Cogeneration (KIAC) Partners, a partnership between Gas Energy Incorporated of New York and Community Energy Alternatives of New Jersey.

The District Heating Energy Center at JFK International Airport