New Boston Courthouse Energy Award Information

The new United States Courthouse design consists of a 10-story, 765,000 gross square foot building located at the Boston Harbor Fan Pier, at the mouth of the Fort Point Channel. The building contains twenty-seven courtrooms for the U.S. District Court and the U.S. Court of Appeals which overlook the waterfront and a public park. The building also houses the U.S. Marshals Service, U.S. Probation and Pre-Trial Services, U.S. Attorney, and a Day Care Center.

The development of a Harbor Walk and Park embraced by the Courthouse has enjoyed the participation of the public and a City of Boston/State of Massachusetts Special Task Force. GSA and the U.S. Courts have successfully completed a project that will serve as a model for future waterfront development.

The Project Office Team, spearheaded by the efforts of Paul Curley and Frank Saviano, began negotiations in September, 1993 with Boston Edison to enter into an agreement with their "Energy Efficiency Partnership New Construction Program". The program, a national example of demand-side planning, encourages consumers to pursue conservation and install state of the art technologies which may have been cost prohibitive without subsidy. For most of 1994, negotiations continued for this ground breaking agreement. In August of 1994, nearly one year after negotiations began, an agreement was finally signed. Construction of the Boston Courthouse began on October 25, 1994.

Under the terms of the agreement, Boston Edison's consulting engineer, Shooshanian Engineering Associates Inc., prepared a written report concerning potential ECO's at the new courthouse. As a result of this study, four ECO's were negotiated by the Project Office for implementation at no cost to the GSA, saving 1,072,812 kWh of electricity per year. This savings translated to an estimated annual bill reduction of $158,354.

The keystone to these dramatic savings, thermal storage, is a relatively simple concept, often used in private enterprise and one now being implemented in Government buildings. The system includes an icemaker/chiller, a storage tank, ancillary pumps and a heat exchanger. The system operates at night and during off peak utility hours, when energy costs are lower and outdoor air conditions are cooler. This allows the system to generate and store ice in a storage tank for use by the base air conditioning systems during the day.

The on peak cooling load at the Courthouse approaches 1,800 tons on a design summer day. Daily load leveling and solid ice storage will enable the system to shift 50% of the peak summer cooling load, level 74% of the average summer load, and level 100% of the spring and fall load.

A solid ice storage system was chosen over a chilled cater or dynamic ice harvester storage because it requires relatively small installation area, and has the capability to satisfy large cooling loads. This small installation size is given top consideration at the new Courthouse since mechanical areas are limited. The original basement footprint has been increased, and will be extended by the excavation of a second level, partial basement to accommodate this ECO. The basement storage system will be made up of eighteen 1,135 cubic feet tanks to supply the solid ice storage.

No winter load is included in the ice storage analysis because computer and equipment rooms are part of a secondary cooling system that utilizes a plate & heat exchanger and cooling condenser water. This secondary cooling system, consumes minimal energy,

particularly during the winter, spring and fall, when minimal cooling tower fan energy is needed to cool condenser water.

During off-peak hours, two 600 ton ice chillers will produce and store ice for use during the on-peak utility billing periods. Ice is produced in the tanks by circulating 24-28 degree brine, pumped through the tanks during the build cycle. During on-peak hours, all the ice-building mode is cycled off. The on-peak cooling load will be met through the stored ice charge and a reduced chilled water load. The brine pump and the chillers will supply low temperature brine to the plate and frame heat exchanger, serving the role of a heat sink to generate chilled water. The entire ice system will be located in the low point of the building, below sea level.

Annual Demand Savings:	Summer:	998.39 kW
	Winter:	46.55 kW
Annual Dollar Savings:		$85,394.00
Construction Costs:		$1,391,699.00
Boston Edison Incentive:		$1,391,699.00
Cost to GSA:		**$00.00**
Simple Payback:		**Immediate**

A high efficiency Trane Centrvac HCFC 123 Chiller was ordered in July of 1995 as the result of a value engineering proposal made by the Trane Corporation. The .64 kw /ton chiller came with a simple payback of 2.7 years and kWh savings of 381,164 annually. Project contingency funds covered first costs of just $85,000 for the upgrade, and netted another $500,000 in savings over the life of the chiller.

Annual kWh Savings	381,164 kWh
Annual MBtu's Saved	1,296 MBtu's
Annual Dollar Savings	$ 21,000.00
Estimated Project Cost	**$ 85,000.00**
Simple Payback	**2.7 years**

The project office has considered the New Courthouse Building in its entirety and worked hard to make it a showcase building. Other, more standard energy conserving measures include variable speed drive motors on chilled and hot water pumps and air handling units, as well as T-8 lamps and electronic ballasts with occupancy sensors in general office areas and conference rooms.

Variable speed drives will be installed to control the motors on four chilled water pumps rated at 1800 gpm at 95' head and three hot water pumps rated at 750 gpm at 125' head. Energy savings are calculated by assuming that required flow volume varies linearly with outdoor air temperature. Average hourly temperatures for Boston for each season are used to calculate percent speed. Slight reductions in pump speed dramatically reduce the power input required by the pumps. Constant speed consumption minus proposed VFD motor consumption equals the energy savings:

Annual kWh Savings	40 HP pumps (heating)	129,486 kWh
	60 HP pumps (cooling)	124,630 kWh
	TOTAL:	154,116 kWh

Annual Mbtu's Saved		525,998 MBtu's
Annual Dollar Savings	40 HP pumps (heating)	$10,326.00
	60 HP pumps (cooling)	$7,652.00
	TOTAL:	$17,978.00
Estimated Project Cost	40 HP units	$32,916.00
	60 HP units	$59,848.00
	TOTAL:	$92,764.00
Boston Edison Incentive	40 HP units	$35,629.00
	60 HP units	$64,781.00
Cost to GSA		**$ 00.00**
Simple Payback		**Immediate**

There are thirty-five (35) air handling units (AHUs) at the new Courthouse. Installing variable frequency drives here in place of the designed pressure sensors and inlet vanes will also result in significant energy savings.

Annual kWh Savings	960,052 kWh
Annual MBtu's Saved	3,276,657,47 MBtus
Annual Dollar Savings	$49,403.00
Estimated Project Cost	$336,263.00
Boston Edison Incentive	$364,005.00
Cost to GSA	**$00.00**
Simple Payback	**Immediate**

In accordance with GSA specifications, most areas of the new Courthouse will be illuminated by T-8 and compact fluorescent lamps with electronic ballasts.

Lighting wattages per square foot at the Courthouse range from 1.32 watts/sq ft to 2.39 watts/sq ft, with office space estimated at 1.5 watts/sq ft.

Infrared and ultrasonic doppler occupancy sensors will be used in general offices, computer rooms, break rooms and conference rooms. This will again, result in significant energy savings.

Annual kWh Savings	47,647 kWh
Annual MBtus Saved	16,261,921 MBtu's
Annual Dollar Savings	$5,579.00
Estimated Project Cost	$23,560.00
Boston Edison Incentive	$25,502.00

Cost to GSA	**$00.00**
Simple Payback	**Immediate**

When all the above described Energy Conservation Opportunities are implemented, an estimated total of 1,453,976 kWh of electricity will be saved per year, and demand will be reduced by 1330 kw in the summer and 301 kW in winter. This amounts to an annual dollar savings of $179,354.00. Implementation costs are being fully funded by Boston Edison through their Energy Efficiency Partnership's New Construction Program, and will result in a zero year customer payback period with immediate energy savings.

To facilitate commissioning of the building systems as well as conditioning of the space for millwork installation, the Project Office brought the building on line in September of 1997. This has proved a wise decision, that also allowed for phase in of the CFM contractor, and myriad community planning issues.

Environmental benefits of all measures described are estimated to result in an annual 1,093 tons of avoided greenhouse gas emissions of CO_2, SO_2, and NO.

In addition to negotiation and implementation of the above "no cost" measures, the PO Team negotiated with local utility, Boston Gas, to lay a new gas supply line to the site for two 300 horsepower gas boilers. These boilers will provide the building's heat and hot service water, eliminating the use and storage of petroleum.

The Project Office strove for a balance between Courthouse decorum and energy efficiency. They can be proud of their achievements and should be recognized for the savings and technology demonstration in such a high focus public building.

The New England Region and Boston Courthouse Project Office are confident that Thermal Storage Technology will become a model for other government owned buildings.

Fig. 1

View looking North across the mouth of the Fort Point Channel from the new Courthouse.

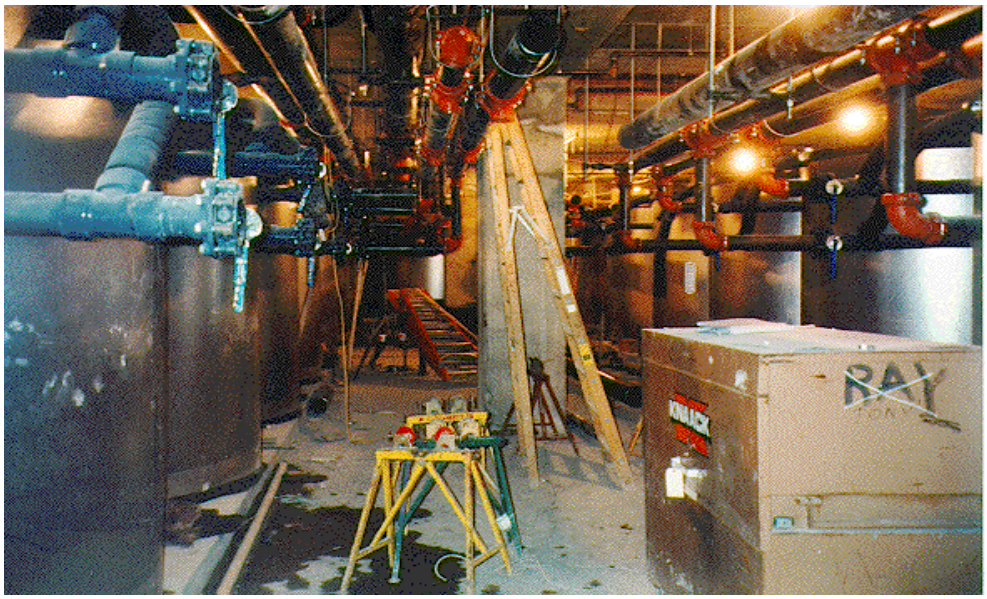

Fig 2

Above: The thermal storage system is comprised of eighteen 1,135 cubic feet tanks that supply the solid ice storage.
Below: Basement storage tanks, dwarf GSA project officer.

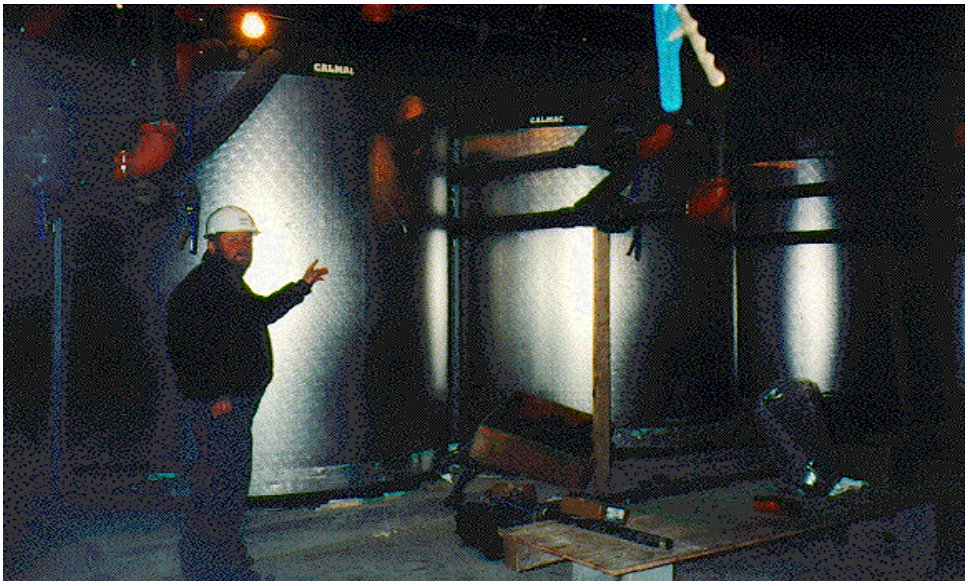
Fig 3