Paquin Tower
Category 4, Option 2: Creation of an Energy Efficient, Green Community

Program Narrative

Paquin Tower (MO-007-000004), is a 200 unit, 137,400 square foot, 15 story high rise residential public housing building built in 1973 and designated for mixed populations of persons with disabilities and the elderly living in Columbia, Missouri. The Columbia Housing Authority (CHA) is requesting CFRC funding under Category 4, Option 2: Creation of an Energy Efficient, Green Community – Moderate Rehabilitation. Current projected energy/water consumption savings achieved through this rehabilitation project is estimated at 41.98%.

The Columbia Housing Authority proposes to combine this CFRC grant with a HUD approved Energy Performance Contract to achieve even greater energy savings. The St. Louis HUD Field Office has approved our Request for Procurement/Qualifications (RFP/Q) for an Investment Grade Energy Audit and possible Energy Performance Contract. This will allow CHA to maximize the energy/water consumption savings achieved by this project.

The CFRC "Frequently Asked Questions" released by HUD on June 4, 2009 states in the Category 4 section that…

> "Recovery Act funds can be used in cooperation with an EPC. To maximize the benefits of Recovery Act Funds with an EPC, the PHA should consider using Recovery Act Capital Funds for slow or neutral payback improvements such as utility distribution systems, protective enclosures to house energy systems or building envelope improvements. Utility savings generated from the measures funded by Recovery Act Capital Funds may be not included in the cash flow savings used to amortize the debt to third party financing in an EPC. EPCs should be used for items that will generate sufficient savings to amortize the debt associated with third party financing. HUD incentives under an EPC will be applied only to the amount that is financed by a third party (e.g., ESCO or bank). PHAs with an approved Request for Procurement/Qualifications (RFP/Q) or further along in the EPC process, may use Recovery Act Capital Funds cooperatively with an EPC.

Projected energy/water consumption savings of 41.98% and hard development cost estimates were developed through the use of technically competent methodologies and are comparable to industry standards. Projected energy/water consumption savings and hard development cost estimates were developed by Peckham and Wright Architects, Inc. of Columbia, Missouri led by Mr. Nicholas Peckham, AIA and senior principal partner of the firm. Engineering services and projected energy/water consumption savings were provided by Larson Binkley, Inc. of Overland Park, Kansas, led by Mr. Chris Larson, P.E., LEED® AP. Peckham and Wright Architects, Inc. have been directly involved in several major building renovation projects with the Columbia Housing Authority.

Paquin Tower Facilities

Paquin Tower contains a central boiler plant that was upgraded 15 years ago. The building's housing units are cooled via window mounted unitary air conditioning units that operate from May through September. The first floor common area is conditioned by a multi-zone air handling

unit and ventilation air is served by a central station air handling unit. Both the ventilation air and multi-zone unit are provided with hot water and direct expansion coils served by the boiler plant an air cooled condensing units. Various exhaust systems are also provided; however, the fans of interest to this study are four roof mounted exhaust fans that serve the individual housing units. These systems in addition to the lighting system and exterior envelope were evaluated for potential energy saving improvements.

To quantify the different potential energy saving improvements, projected energy use is compared against baseline conditions. In this case the baseline condition is the existing building in its current operating condition. The baseline condition and different energy savings improvements were simulated over an entire year using a commercially available energy modeling software. In this case the Carrier Hourly Analysis Program version 4.4 (HAP v4.4) was used.

Energy Savings Recommendations

Several energy savings measures are proposed: water conserving plumbing fixtures, lighting retrofit in corridors and exterior, new low-e windows for the first floor, new condensing boilers for both domestic and heating hot water, new condensing units for the ventilation unit and first floor cooling system, new energy star window units, thermostatic control for each finned tube heater, improved ventilation and exhaust fan control, and a new HVAC system for the first floor.

1a. Boiler Plant

Replace boilers, building pipes and boiler control system; decouple domestic hot water, snow melt and building heating systems.

Condensing boilers, that are more efficient at capturing the heat of combustion than the existing atmospheric combustion boilers, will be installed. In addition to the boilers, new intake and exhaust flues will be included. Most of this work will be confined to the mechanical room.

Another heating energy saving solution involves changing the way the existing boiler plant is controlled. Instead of controlling the loop temperature via the outdoor temperature, the amount of hot water delivered can be allowed to vary according to the load. This involves installing control valves and a thermostat for each dwelling unit.

1b. Cooling Plant

Replace existing air cooled condensing units and install new energy star compliant units.

The existing ventilation air handling unit (AHU) and first floor AHU are cooled by existing air cooled condensing units. These air cooled condensing units will be replaced with new energy star compliant units.

1c Unit upgrades

Replace finned tube heaters and clogged branch piping, and integrate heat/cool thermostat with newly replaced existing window cooling units.

Each unit in the tower is cooled by a window air conditioning unit and hot water baseboard finned tube heaters. The vertical risers of hot water piping will be retained, but due to corrosion residue that has settled out in the smaller branch piping and finned tube which results in reduced efficiency and serviceability, the smaller branch hot water piping will be removed along with the finned tube heaters. The existing heaters lack control valves and operate whenever hot water is circulating. This can cause occupants to open windows to reduce temperature wasting energy. New thermostats will be provided to provide control of the finned tube in each unit. The thermostats will be interlocked with the existing newly replaced air conditioning units to prevent simultaneous heating and cooling.

1d Ventilation System

Provide scheduling control and variable volume operation for ventilation air and building exhaust.

The existing building is ventilated through use of the corridors via an air handling unit located on the first floor. Since the ventilation load represents a large portion of the building's cooling and heating load, adjusting the amount of time this unit operates will save a tremendous amount of energy. This involves installing variable frequency drives on the exhaust fans to only use the energy needed to exhaust from the units. As the exhaust fans modulate according to demand, the ventilation AHU will also modulate in unison, thereby saving not only fan energy but heating and cooling energy as well.

1e First Floor HVAC

Provide a new single duct VAV system.

The first floor is currently conditioned via a multi-zone air handling unit. This unit contains a constant speed fan and is always providing a mix of heated and cooled air to first floor zones to meet temperature set point. This system would be replaced with a single duct VAV system with reheat. This will reduce fan energy usage and a majority of the simultaneous heating and cooling that is currently occurring when this system is operating.

2. Lighting - Replace T-12 fixtures with T-8 and others.

There is opportunity to save energy on lighting in three areas: corridor lighting, exterior lighting, and emergency lighting. The corridor lighting retrofit consists of replacing the approximately 21 T-12 florescent lamps with more efficient T-8 fixtures saving approximately 33 watts per fixture or 693 watts per floor. In addition, there is opportunity to replace the 8 incandescent fixtures mounted in the exterior CMU wall with compact florescent fixtures. This will save approximately 35 watts per fixture or 280 watts total.

3. Plumbing - Install 1.1 GPF toilets, water saver shower heads and faucet fixtures

The facility contains kitchen sinks and lavatories at 2.2 gallons per minute (GPM), 3.5 gallons per flush (GPF) toilets, and 2.5 GPM showerheads. New water conserving fixtures will use 1.8 GPM for kitchen sinks, 0.5 GPM for lavatories, 1.1 GPF for toilets, and 1.8 GPM for showerheads. Typical water usage characteristics were assumed in order to establish an existing annual baseline water usage and a proposed water usage.

Glazing and building insulation

The existing windows on the first floor of the building are single pane clear glazing, and the windows on the tenant floors are low-e dual pane clear units that have been recently replaced. Low emissivity (low-e) dual pane glazing units will be provided throughout the first floor. Additional energy savings is available if the glazing on the residences is changed too, but the energy saving is relatively small in comparison to the overall project and very costly to implement. Building insulation for walls and roof were simulated but found to suffer the same condition (relatively small energy saving compared to other options and cost) as the glazing.

Options ruled out

Other systems considered for energy efficiency included air cooled water chilling units, ground coupled heat pump chillers, stack fan coil units for the residences, desuperheaters for preheat and domestic water system energy recovery. Each of these options was eliminated due to excessive cost when implementing them in an existing facility. The ground grid of wells for geothermal heat rejection would have been $400,000 and would have required additional costs for asphalt replacement and landscaping repair. Each system option resulted in marginal efficiency savings of less than a few percent more that the final systems selected. Air to air heat recovery was also eliminated due to the proximity of systems being at totally opposite ends of the building.

Water and Energy Savings

Estimated annual water and energy usage for these proposed building changes is listed below compared to the existing building.

	Existing Building	Proposed Changes
Electric Consumption (kWh)	1,677,543	1,636,085
Water Consumption (Gal)	3,298,459	1,668,259
Gas Consumption (Therm)	135,301	61,973
Total Energy Consumption (kBtu)	19,253,877	11,779,622

----------Energy Savings ----------

Electrical Energy Savings (kWh)	41,458
Water Savings (Gal)	1,630,200
Gas Savings (Therm)	73,328
Total Energy Savings (kBtu)	7,474,255

Percentage Energy Savings (%)……...38.8%
-----(38.8% x .70 = 27.16%)

Percentage Water Savings (%)……49.4%
-----(49.4% x .30 = 14.82)

Total Percentage of energy/water consumption saving…….....41.98%
-----(27.16% + 14.82% = 41.98%)

Other Recommendations

4. Windows

Replace 9 first floor single-pane windows with energy efficient, low-E, double glazed windows in thermal break frames.

5. Roof

Replace worn black roof and deteriorated roof insulation with a white TPO roof and new insulation.

6. Doors

Install 200 interior accordion doors with door pairs and ADA pull hardware in each apartment. Patch, repair and paint adjacent walls. Replace 200 exterior doors to each apartment.

7. Lobby

Renovate 1st floor (8,000 s.f.) lobby, kitchen and mailboxes to UFAS standards.

LINE ITEM	ITEM #	CFRC COST	EPC COST	TOTAL COST
[----------HARD COSTS---------]				
Boiler Plant	1a	395,000.00		395,000.00
Cooling Plant	1b	141,000.00		141,000.00
Unit Upgrades	1c	658,000.00		658,000.00
Ventilation System	1d	41,000.00		41,000.00
First Floor HVAC	1e	162,000.00		162,000.00
Lighting	2	50,000.00		50,000.00
Plumbing	3	185,000.00		185,000.00
9 New 1st Floor Windows	4	40,000.00		40,000.00
Install New white Roof	5	160,000.00		160,000.00
Replace 400 Doors	6	100,000.00		100,000.00
Lobby Renovation	7	55,000.00		55,000.00
[----------SOFT COSTS----------]				
10% Contingency		121,600.00	77,100.00	198,700.00
General Requirements		107,008.00	67,848.00	174,856.00
Overhead		53,504.00	33,924.00	87,428.00
Profit		66,880.00	42,405.00	109,285.00
A/E Fee…/…ESCo Fee		156,499.20	148,841.55	305,340.75
Management Improvements		9,128.80		9,128.80
Administration		66,880.00		66,880.00
TOTAL		1,797,500.00	1,141,118.55	2,938,618.55
		CFRC	EPC	TOTAL

Program Schedule for Paquin Tower

- Grant Award and Acceptance: September 30, 2009 – October 31, 2009
- Investment Grade Energy Audit Conducted: September 15, 2009 – October 31, 2009
- Architectural and Engineering Design Complete: November 1, 2009 – January 31, 2010
- Construction Documents Developed: February 1, 2010 – April 30, 2010
- Construction Bidding Period: May 1, 2010 – May 31, 2010
- Open and Review Construction Bids: June 1, 2010 – June 30, 2010
- Award/Finalize Construction Contract: July 1, 2010 – July 31, 2010

100% Obligation of CFRC Funds: July 31, 2010

- Construction Period: August 1, 2010 – December 31, 2011
  - Lighting: September 1, 2010 – September 30, 2010
  - Cooling plant replacement: October 1, 2010 – October 31, 2010
  - Ventilation system and first floor HVAC: November 1, 2010 – December 31, 2010
  - Plumbing: January 1, 2011 – March 31, 2011
  - Replace 400 doors: January 1, 2011 – March 31, 2011

60% Expenditure of all CFRC Funds: April 1, 2011

  - Boiler plant and unit upgrades: April 1, 2011 – September 30, 2011
  - First floor window replacement & lobby renovations: April 1, 2011 – September 30, 2011
  - Install new white roof: April 1, 2011 – September 30, 2011
  - Punch List: October 1, 2011 – October 31, 2011
- Project Completion: November 1, 2011

100 % Expenditure of all CFRC Funds: December 31, 2011

CFRC Obligation and Expenditure Schedule

- 100% Obligation of CFRC Funds: July 31, 2010
- 60% Expenditure of all CFRC Funds: April 1, 2011
- 100 % Expenditure of all CFRC Funds: December 31, 2011

PRELIMINARY COST ESTIMATE

Item	Cost	Sub-total	Notes
1a	395,000		Boiler Plant
1b	141,000		Cooling Plant
1c	658,000		Unit Upgrades
1d	41,000		Ventilation System
1e	162,000		First Floor HVAC
2	50,000		Lighting
3	185,000		Plumbing
		1,632,000	Sub-total M/E/P
4	25,000		9 New 1st Floor Window Assemblies
5	50,000		Intall Insulated Drapes on 355 windows
6	120,000		Install New white Roof
7	200,000		Replace 200 Doors
8	90,000		Painting Exterior
9	400,000		Lobby Renovation
10	50,000		ADA Modifications to Elevators
		935,000	Sub-total General Construction
		2,567,000	Sub-Total
	256,700		10% Contingency
		2,823,700	Sub-Total Construction
	225,896		General Requirements
	112,948		Overhead
	141,185		Profit
		3,303,729	Sub-total General Contractor
	330,373		A/E Fee
		3,634,102	Sub-total
			CHA Administrative expense
			TOTAL