CHAPTER/REGIONAL TECHNOLOGY AWARD - SHORT FORM

1. Category (Check one and indicate New or Existing, if applicable)

○ Commercial Buildings	○ New or ○ Existing	
Institutional Buildings:		
○ Educational Facilities	○ New or ○ Existing	
○ Other Institutional	○ New or ○ Existing	
● Health Care Facilities	○ New or ● Existing	
○ Industrial Facilities or Processes	○ New or ○ Existing	
○ Public Assembly	○ New or ○ Existing	
○ Residential (Single and Multi-Family)		

2. Name of building or project: NorthShore University Health System - Skokie Hospital

City/State: Skokie, IL

3. Project Description: Patient Tower Renovation

Project Study/Design Period: November 2011 (Begin date (mm/yyyy)) to June 2012 (End date (mm/yyyy))

Percent Occupancy at time of submission: 100%

4. Entrant (ASHRAE member with significant role in project):

a. Name: Gibbons (Last) Jean (First) O'Brien (Middle)

Membership Number: 2046831

Chapter: Illinois

Region: IV

b. Address (including country): Grumman/Butkus Associates 820 Davis St., Suite 300

Evanston (City) IL (State) 60201 (Zip) United States (Country)

c. Telephone: (O) 847-316-9238 d. Email: jgibbons@grummanbutkus.com

e. Member's Role in Project: Principal in Charge

f. Member's Signature: Jean O Gibbons

5. Engineer of Record: Grumman/Butkus Associates

By affixing my signature above, I certify that the information contained in this application is accurate to the best of my knowledge. In addition, I certify that I have discussed this entry with the owner and have received permission from the owner to submit this project to the ASHRAE Technology Awards Competition.

2013 AWARD ENTRY

Illinois Chapter of ASHRAE Excellence in Engineering

NorthShore University Health System Skokie Hospital

Patient Tower Renovation

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NorthShore Skokie Hospital Patient Tower Renovation

Project Narrative

This project is a complete HVAC replacement associated with the renovation of four floors of a five story patient tower at Skokie Hospital. The area and occupancy of the areas served are as follows:

Floor	Gross Area (ft^2)	Net Area (ft^2)	Occupancy Type
5th	29,100	28,050	Standard patient rooms
4th	29,100	28,050	Standard patient rooms
3rd	29,100	28,050	Standard patient rooms
2nd	7,900	7,450	Intensive care
Total	95,200	91,600	

The existing HVAC system is a high pressure induction unit system consisting of one 28,000 cfm constant volume air handling unit (AHU) with heating and cooling induction units in each room. Project challenges include: 1) since induction units are no longer allowed by the Illinois hospital code, a different system had to be installed; the limited ceiling space of a original induction units served building provided a significant challenge 2) only one-half of a floor could be shut down at one time; all other areas had to remain occupied and operational.

The limited existing ceiling cavity height could not accommodate the ductwork required for an all air variable air volume (VAV) system. Both in-room ceiling-mounted heating and cooling active chilled beams and fan coil units were, therefore, evaluated. The Illinois Department of Public Health (IDPH) requires that chilled beams used in hospital be equipped with filters and piped drain pans (not a requirement in non-hospital) applications. Since the chilled beam is the supply diffuser, it must be located within the patient area rooms. Having to get above patient beds to maintain the chilled beams, led the client to select the fan coil unit option. The fan coils are located above the door in the patient room entrance area with supply air ducted to supply diffusers in the patient area.

The existing AHU is located mechanical room adjacent to the patient tower with ductwork feeding up from the 2nd to 5th floors. In order to allow the existing AHU to remain operational, a rooftop penthouse was constructed for a new AHU and the renovations phased from top to bottom of the building. This allowed the new ductwork to be brought down from above to serve the renovated ½ floor while the old ductwork and system could continue to feed the non-renovated areas on lower floors.

The construction of this new penthouse made up part of Phase 1 of this multi-phase project. The penthouse houses two 18,000 cfm dedicated outside air AHUs that provide ventilation air to the patient floors below. The AHUs have supply and exhaust side-by-side. The supply side consists of, in the order of airflow, preliminary filters, secondary filters, a heat pipe heat recovery coil, a hot water heating coil, a steam humidifier, a chilled water cooling coil, a supply fan array, and final filters. The exhaust side consists of preliminary filters, a heat pipe heat recovery coil, and an exhaust fan array. The fans in the fan arrays will be staged on and off during the phasing of the project to optimize the energy usage based on the required ventilation airflow. Heating water is supply from a steam to hot water heat exchanger located in the penthouse. Chilled water and steam are provided from the hospital's central plant.

The fifth floor renovation was also part of Phase 1. Each patient room has a four-pipe chilled water, hot water fan coil unit that recirculates air from the space and receives ventilation air from a central dedicated outside air AHU. Fan coils use energy efficient electrically commuted (ECM) motor rather than a standard fan coil unit motor. Air is exhausted from each patient room toilet room and ducted to the heat recovery system in the penthouse. Patient support areas are grouped according to load and provided with a similar fan coil unit system to the patient rooms. Isolation rooms utilize a supply and exhaust VAV pressure control system utilizing 100% outside air. Isolation exhaust is HEPA filtered and then reintroduced into the regular exhaust system prior to entering the heat recovery system.

The fourth floor is Phase 2 and second and third floors are Phase 3 of the project. These remaining floors, when complete; will have the same systems as the 5th Floor.

Energy Efficiency

- ECM motors on fan coil units (30% more efficient at low speeds than traditional motors) result in an estimated annual energy savings of 28,350kWh per floor as compared to traditional motors.
- Staged fan array for phased project

Phase	Fan Array Operational Motor BHP	Single fan BHP	Annual energy savings
1	8	15	45,000kWh
2	31.8	37	33,000kWh
3	64.8	69	33,000kWh

- Heat pipe energy recovery between all exhaust air (toilet and filtered isolation room exhaust) and outside air at dedicated outside air handling units reduces annual energy consumption by 15,600 Therms of gas for heating and 3,700 kWh of electricity for cooling per floor as compared to a unit without heat recovery.
- Total annual energy and energy dollars saved is:
    - At completion of Phase 1: 77,050 kWh, 15,600 therms, $15,050
    - At completion of Phase 2: 97,000 kWh, 31,200 therms, $ 24,950
    - At completion of Phase 3: 129,150 kWh, 46,800 therms, $ 35,960

Indoor Air Quality

- Dedicated OA unit provides fully dehumidified air to zones
- Guaranteed OA delivery to each zone by the dedicated OA system
- Filters as fan coils provide zone filtration

Innovation

- Scheme with penthouse AHUs to accommodate phased installation
- Staged fan array use for a phased project
- HEPA filtering of isolation room exhaust for use in heat recovery system

Operation & Maintenance

- Location of fan coil units above patient room door entry area allows for maintenance outside of the patient bed area.
- FCU filters located at return grille for easy inspection and maintenance

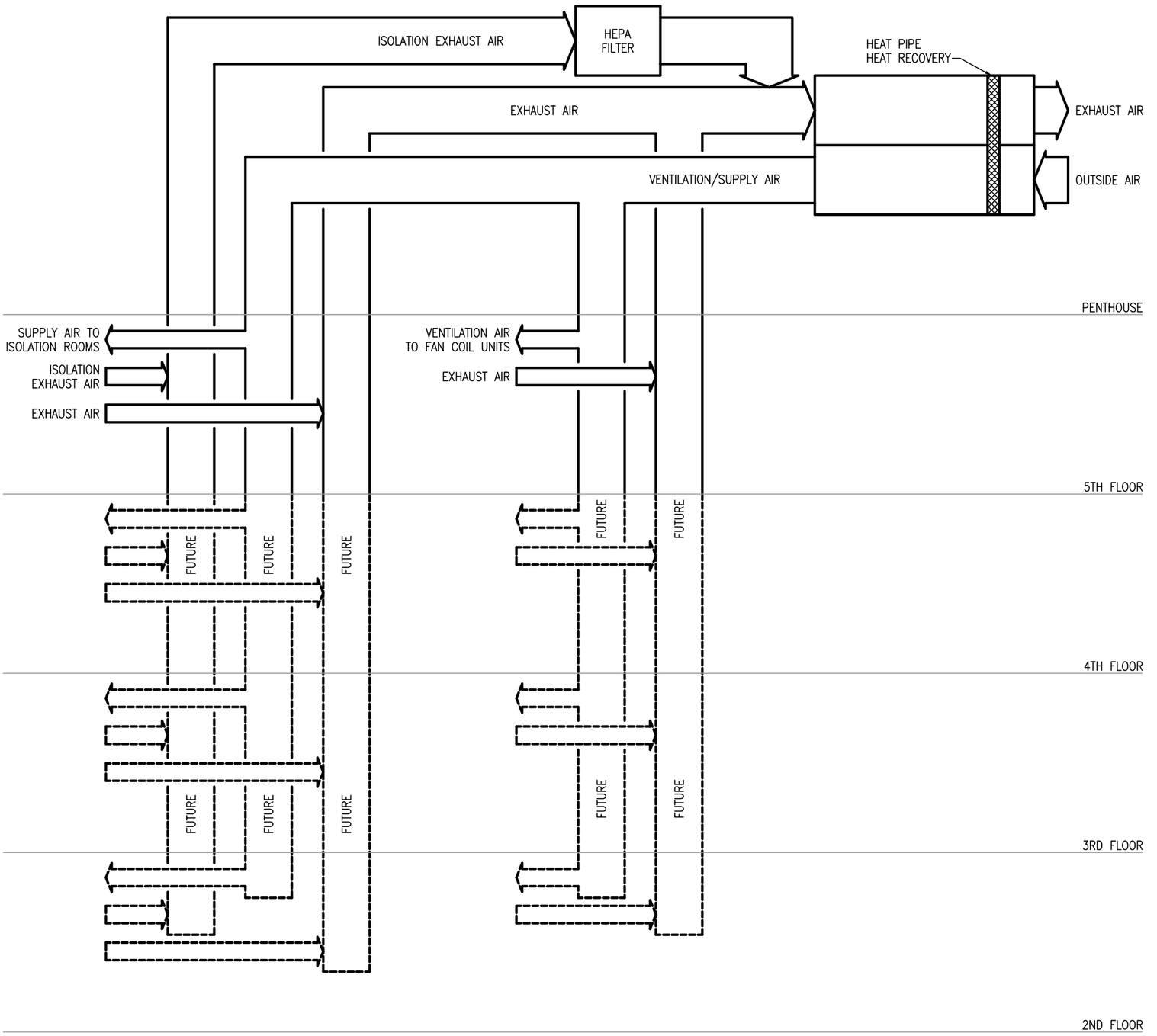
Cost Effectiveness

- Fan coil unit ECM motor upgrade: increased cost of $4,324 per floor, annual energy savings of $2,552 per floor; 1.7 year payback
- Staged fan array – no first cost increase
- Heat recovery: increased costs $40,000, cumulative savings at completion of Phase (year) 3 - $50,670; paid for before end of year 3

Environmental Impact

- Energy reduction saves 282 tons of greenhouse gases annually (after completion of all three Phases) or the equivalent of removing 59 passenger vehicles from the road.
- Duct size (material) reduction through DOAS with local FCU

NorthShore Skokie Hospital Patient Tower Renovation
Project Photos


ISOLATION EXHAUST AIR
HEPA FILTER
HEAT PIPE HEAT RECOVERY
EXHAUST AIR
EXHAUST AIR
VENTILATION/SUPPLY AIR
OUTSIDE AIR
PENTHOUSE
SUPPLY AIR TO ISOLATION ROOMS
ISOLATION EXHAUST AIR
EXHAUST AIR
VENTILATION AIR TO FAN COIL UNITS
EXHAUST AIR
5TH FLOOR
FUTURE
FUTURE
FUTURE
FUTURE
FUTURE
FUTURE
4TH FLOOR
FUTURE
FUTURE
FUTURE
FUTURE
FUTURE
3RD FLOOR
2ND FLOOR