

# CHAPTER/REGIONAL TECHNOLOGY AWARD - SHORT FORM

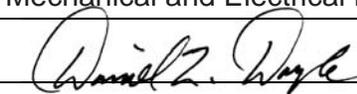
**1. Category (Check one and indicate New or Existing, if applicable)**

- |   |                              |   |
|---|------------------------------|---|
| <input type="radio"/> Commercial Buildings                  | <input type="radio"/> New or | <input type="radio"/> Existing            |
| Institutional Buildings:                                    |                              |   |
| <input type="radio"/> Educational Facilities                | <input type="radio"/> New or | <input type="radio"/> Existing            |
| <input type="radio"/> Other Institutional                   | <input type="radio"/> New or | <input type="radio"/> Existing            |
| <input checked="" type="radio"/> Health Care Facilities     | <input type="radio"/> New or | <input checked="" type="radio"/> Existing |
| <input type="radio"/> Industrial Facilities or Processes    | <input type="radio"/> New or | <input type="radio"/> Existing            |
| <input type="radio"/> Public Assembly                       | <input type="radio"/> New or | <input type="radio"/> Existing            |
| <input type="radio"/> Residential (Single and Multi-Family) |                              |   |

**2. Name of building or project:** Advocate Illinois Masonic Medical Center  
City/State: Chicago, IL

**3. Project Description:** Chiller Replacements  
Project Study/Design Period: 09/2011 to 09/2013  
Begin date (mm/yyyy) End date (mm/yyyy)  
Percent Occupancy at time of submission: 100%

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

a. Name: Doyle Daniel L  
Last First Middle  
Membership Number: 192578  
Chapter: Illinois  
Region: IV  
b. Address (including country): 820 Davis St., Suite 300  
Evanston IL 60201 United States  
City State Zip Country  
c. Telephone: (O) 847-316-9219 d. Email: didoyle@grummanbutkus.com  
e. Member's Role in Project: Mechanical and Electrical Design  
f. Member's Signature: 

**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.

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# 2013 AWARD ENTRY

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## Illinois Chapter of ASHRAE Excellence in Engineering

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### Advocate Illinois Masonic Medical Center

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### Chiller Plant Replacement

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#### Grumman/Butkus Associates

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## Illinois Masonic Medical Center Chiller Plant Replacement

### Project Narrative

Grumman/Butkus Associates

Advocate Illinois Masonic Medical Center (AIMMC) is a 1,143,379 square foot hospital located on the north side of Chicago. AIMMC is part of the Advocate Health Care network of hospitals and has been serving the neighborhood for over 100 years. AIMMC pursued this project in order to provide a more reliable cooling system, improve energy efficiency, reduce staff labor related to maintaining the chiller plant, and modernize the equipment in regards to refrigerant management in compliance with the Montreal Protocol.

The project included replacement of the three main chillers serving the hospital, as well as new pumps and cooling towers. An additional air-cooled surgery chiller was replaced. Budget remained at the end of the project allowing for replacement of three additional air-cooled chillers, bringing all of the major chillers at the main hospital into compliance with the Montreal Protocol and significantly improving energy efficiency.

Implementation of the project began with AIMMC in consultation with Grumman/Butkus Associates (G/BA) in developing a master plan for the cooling systems, as well as creation of an infrastructure report card to prioritize replacement of major HVAC equipment at the hospital. The project proceeded through design utilizing and equipment pre-purchase arrangement in order to reduce total costs of the project as well as shorten the timeline and optimize energy efficiency. This required cooperation between the owner, G/BA, and the contractor.

G/BA provided assistance after the project's installation to verify energy performance reductions in conjunction with Advocate, as well as recouping over \$260K in project costs through incentives from ComEd which assisted in obtaining high-efficiency chillers.

### Energy Efficiency

AIMMC installed three very efficient magnetic bearing chillers to replace the existing machines. The new chillers are rated at a full load efficiency of 0.572 kW/ton and an NPLV of 0.339 kW/ton. The smaller air cooled chillers also qualified for ComEd incentives for exceeding IECC 2009 requirements.

Actual metered data shows that total plant (including chillers, pumps, cooling towers) running at 0.672 kW/ton on a design day. During milder weather, the plant can be seen operating around 0.46 kW/ton.

The full load electric demand of the main chiller plant dropped by 200 kW (see attached graph), with the new air-cooled machines and primary only pumping configuration, this is further reduced. Whole facility electricity usage data indicated a large reduction during the 2013 cooling season, approximately 1,000,000 kWh for the period covering June, July, and August. Additional savings will accrue in September 2013 due to the hot weather that extended into the fall period for which the billing data is not yet available. Energy savings are just under \$80,000 to date. See the two attached graphs to further illustrate the savings.

### Indoor Air quality

The project increases the reliability of the cooling systems so that patient care may be maintained with continued high level of indoor air quality in support of the overall health care environment.

### Innovation

Three new high efficiency, 700 ton chillers with VFD's and magnetic bearing compressors were installed. The design included the conversion of the cooling system to variable primary flow configuration from a primary/secondary arrangement. This reduced the project cost and saved space by eliminating half the existing CHW pumps. The design also included the installation of all new premium efficiency motors. The design of the new cooling towers included the installation of new variable frequency drives. The full load design temperature difference was increased from 10° F to 12° F to further reduce flow and pumping energy usage. Four existing air-cooled chillers were replaced w/ new high efficiency chillers. The new chillers include:

- 250 tons (EER 9.9, IPLV EER 19.3)

- Two 170 ton units (EER 9.4, IPLV EER 17.3)
- 90 tons (EER 9.7, IPLV EER 15.4)

The innovative design aided in solving spatial constraint issues, as the project included the re-use of the existing chiller mechanical room. The conversion to variable-primary flow eliminated one set of pumps from the replacement design. Additionally, in-line pumps were used to save space where new base-mounted pumps would not fit in the available area. The installation of the three identical chillers, minimization of floor space, fresh paint and new LED lighting resulted in an aesthetically attractive chiller room.

### Operation & Maintenance

The new chillers were selected using life-cycle cost analysis to minimize total cost of ownership over the next 30 years.

The new design includes a number of features to enhance flexibility by the facility operations staff.

1. Main chiller plant now has N+1 redundancy on refrigeration machines.
2. Three main chilled water pumps installed on a header allowing any one pump to be out of service at any time. One pump is always available as a standby pump.
3. Condenser water pumps are also on a common header so that any one pump may be out of service. These also were installed with VFD's to minimize pressure losses related to balancing of the system.
4. Air-cooled chiller for the surgery AHU may be cross-tied to the main chilled water system as a backup for the surgery AHUs. The chiller has multiple compressor circuits which allows for part-load operation of the chiller if one compressor is out of service.
5. Air-cooled chillers with capacities of 170 tons, 170 tons, and 90 tons were installed for other high internal load areas of the hospital so that the main chiller plant does not need to operate year-round. These chillers also have multiple circuits which allow a level of redundancy that was not available in the existing equipment.

Control upgrades installed with the new chillers will allow more efficient use of operations staff resources, in addition to improved reliability requiring fewer service tickets.

### Cost Effectiveness

Advocate revised the project to better meet the needs of the hospital with the available budget of \$4,420,000. Remaining budget towards the end of the project allowed for replacement of additional air-cooled chillers that was in the original project scope.

G/BA assisted the client in obtaining ComEd rebates as a result of the new energy efficient design. The rebates included:

	<u>ComEd Incentives</u>
• 250 ton-air-cooled chiller & pump VFD's -	\$ 28,525
• 170 ton air-cooled chillers -	\$ 31,640
• 90 ton air-cooled chillers -	\$ 5,252
• Three 700 ton centrifugal chillers, pump VFD's and cooling tower fan VFD's -	\$203,700.

The project resulted in estimated energy savings of over \$85,000 per year.

Cooling coil condensate from the air handlers in the fan room adjacent to the cooling towers is used for cooling tower make-up water. This feature saved 450,563 gallons of water during the last cooling season, and reduced the amount of chemicals used for water treatment.

### Environmental Impact

The new chillers utilize refrigerant with no ozone depletion potential.

## Illinois Masonic Medical Center Chiller Plant Replacement

### Project Narrative Graphics

The linear curve fit shows approximately 200 kW reduction on average when temperatures are 95 °F outside. This does not include the air-cooled chillers.

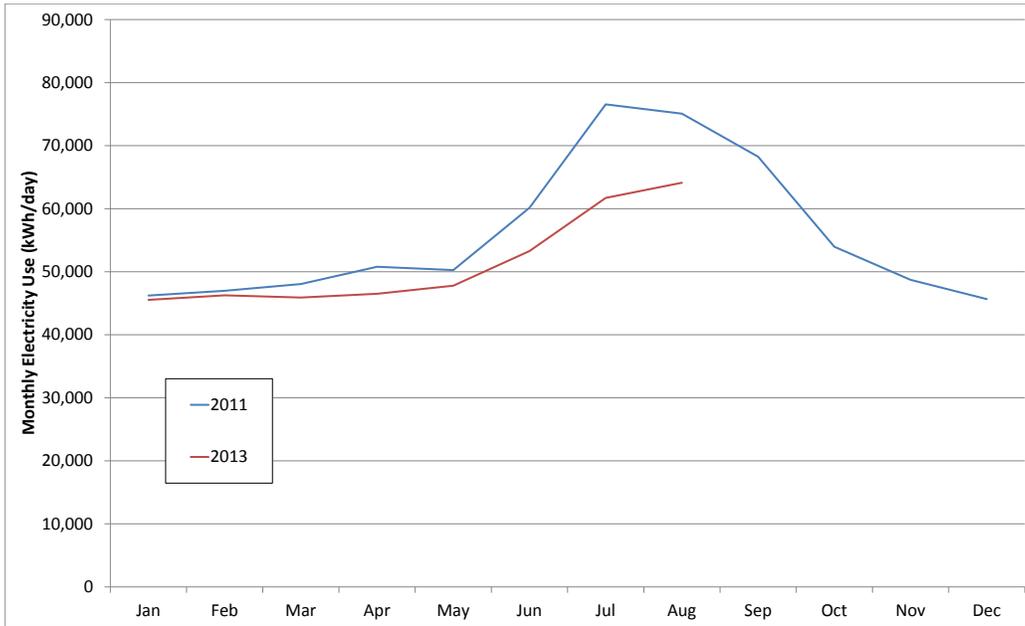


Figure 1: IMMC Monthly Electricity Usage per Day

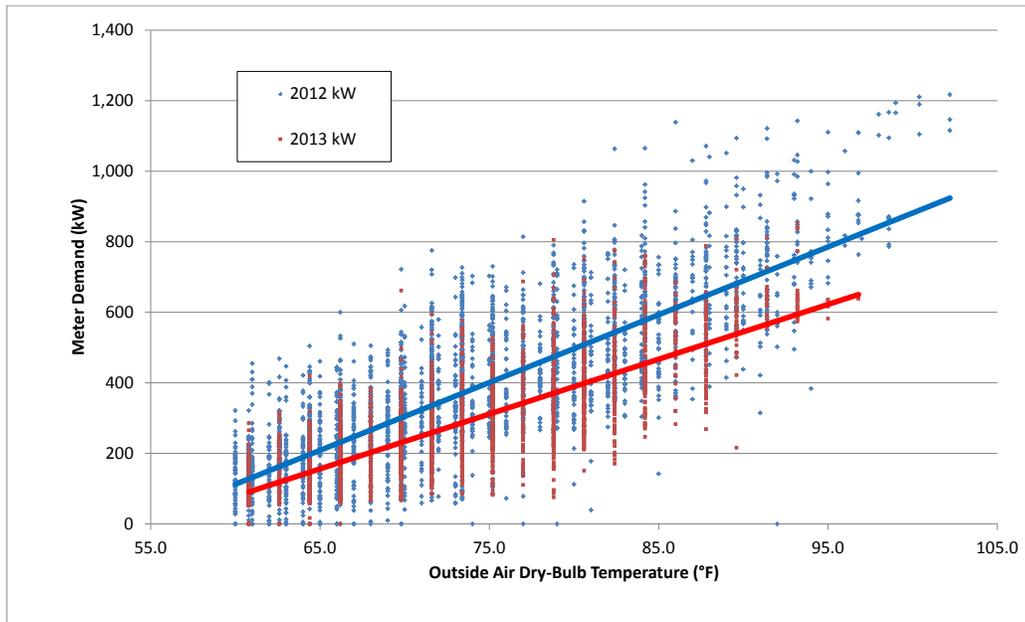


Figure 2: Hourly Power and Temperature

Illinois Masonic Medical Center Chiller Plant Replacement  
Attachment – Project Photos



New Cooling Towers



Space-saving Pump Design and Installation

