HOSPITAL ASSESSMENT FINAL REPORT

Smart Ideas for Your Business®

Hospital Technical Assistance Services

NorthShore University HealthSystem
Glenbrook Hospital
2100 Pfingsten Road
Glenview, IL 60026

Presented to:
Mike Fiore

Located at:
2100 Pfingsten Road
Glenview, IL 60026

ComEd Project Number: #006
G/BA Project Number: P14-0190

Submitted by:
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DISCLAIMER

This report is intended to provide a preliminary estimate of the potential energy and demand savings available at the project site and identify recommendations for energy conservation measures from the performed investigative activities. While the preliminary findings in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the actual results may vary. As a result, ComEd, Willdan Energy Solutions (Willdan), and/or Grumman/Butkus Associates are not liable if estimated savings or economics are not realized. All savings and cost estimates in the report are for informational purposes, and are not to be construed as a design document or as guarantees. In order to qualify for incentives available through the Smart Ideas program, the findings and measurement and verification plan in this report will be required to be reviewed and potentially modified by ComEd under a separate application to the Smart Ideas program.

NorthShore University HealthSystem shall independently evaluate any advice or suggestions provided in this report. In no event will ComEd, Willdan, and/or Grumman/Butkus Associates be liable for the failure of the customer to achieve a specified amount of energy or demand savings, the operation of the customer's facilities, or any incidental or consequential damages of any kind in connection with this report or the installation.

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EXECUTIVE SUMMARY

Grumman/Butkus Associates (G/BA) is pleased to submit this energy management study to NorthShore University HealthSystem (NSUHS) regarding a comprehensive audit of Glenbrook Hospital. This report was prepared by Heather Beaudoin, Dave Nelson, Alex Schultz, and David Eldridge of G/BA, as part of the ComEd *Smart Ideas for Your Business*® Technical Assessment Services (TAS) program.

Glenbrook Hospital is a 699,550 square foot, 173-bed hospital offering comprehensive inpatient and outpatient services including cancer care, cardiology, physical medicine and rehabilitation, and radiology. The North and South MOBs were included in this study, but the Ambulatory Care Center which opened in January 2013 was not, bringing the total included area to 522,288 square feet

Based on results from the comprehensive energy audit, it was determined that some energy cost reductions can be achieved at relatively low investment levels, while others will require substantial capital investment. Cost-effective projects are identified in the areas of occupancy sensors for lighting control, installation of variable frequency drives (VFDs), and improving building controls.

G/BA visited the facility in June 2014 to tour the facility, collect nameplate data, review control settings, review drawings and specifications, and interview facility staff.

Objectives of the Study

The objective of the energy management study was to identify and analyze energy efficiency opportunities at NSUHS. All of the recommendations identify measures and technologies that deliver immediate and/or long-term energy savings. Every effort has been made to collect meaningful information, to provide you with accurate information, and to make recommendations that will not only improve the performance of the facility but make economic sense as well.

As part of the study, energy usage baselines were developed based on type, size, quantity, and operating schedules of the equipment of various energy systems and practices observed at the time of the study. These baselines were used to evaluate changes in practices and equipment and to predict energy savings resulting from those changes.

G/BA is available to answer questions and will follow up with NSUHS to identify any barriers to implementation that may arise.

The energy management study included the following activities:

- Walk-through of the facilities to review major energy systems
- Collection of energy-use and equipment data
- Analysis of electricity and gas consumption for previous 24 months
- Assessment of potential energy efficient equipment and practices to identify cost-saving measures
- Estimation of the energy and peak demand impacts, avoided costs, implementation costs, and payback of recommended measures

Energy Conservation Measures

Nine projects were identified that reduce energy consumption. The implementation of the energy conservation measures will result in reduction of purchased electricity and natural gas.

The energy savings and costs summarized in the following table are detailed in the Recommendations section of this report. The savings estimate is based on current average or marginal energy prices as appropriate to each recommendation. The payback period shown is "simple payback," calculated by dividing the net implementation costs by the annual dollar savings. Energy use impacts of Low Cost Measures (LCMs) and Energy Conservation Measures (ECMs) on one another are taken into account in the following summary table. Energy reduction impacts of each measure assume previous measures in the table have been implemented.

Table 1: Summary of Measures

ID	Measure Description	Electrical Energy Savings (kWh/yr)	Gas Savings (Therms/yr)	Total Cost Savings ($/yr)	Estimated Project Cost ($)	Estimated Incentive Amount ($)	Simple Payback with Incentives Applied (yrs)
LCM 1	Reset Condenser Water Temperature	144,000	0	$10,700	$5,000	$0	0.5
LCM 2	Reset Chilled Water Temperature	111,000	0	$8,400	$5,000	$0	0.6
LCM 3	Occupancy Sensors for Lighting Control - Corridors and Large Rooms	8,000	0	$490	$2,120	$470	3.4
LCM 4	Occupancy Sensors for Lighting Control - Private Offices	2,000	0	$120	$930	$240	5.8
ECM 1	Convert S-2 to Variable Volume	137,000	(290)	$8,700	$25,000	$1,740	2.7
ECM 2	Variable Kitchen Exhaust and Reactivation of Heat Recovery System	132,000	30,900	$26,900	$70,000	$14,000	2.1
ECM 3	Variable Primary CHW Flow	109,000	0	$6,900	$60,000	$10,800	7.1
ECM 4	Setback OR Airflows When Not in Use	26,000	3,100	$3,500	$26,000	$5,700	5.8
ECM 5	Parking Lot Lights Upgrades	198,000	0	$12,700	$130,000	$17,610	8.8
ECM 6	Street Light Upgrades	20,000	0	$1,650	$10,000	$1,740	5.0
ECM 7	Remove Triple Duty Valves and Install VFDs on Pump Motors	40,000	0	$3,400	$29,000	$7,200	6.4
	Total	**927,000**	**33,710**	**$83,460**	**$363,050**	**$59,500**	**3.6**

The amounts and applications of the ComEd Smart Ideas Incentives are subject to the terms and conditions of the ComEd Smart Ideas Programs. This document in no way implies approval of incentive amounts or applications.

The table on the next page lists the recommendations by simple payback and includes the cumulative cost savings, project costs, potential incentives, and simple payback.

Table 2: Summary of Measures Ranked by Simple Payback

ID	Description	Individual				Cumulative			
		Total Cost Savings ($)	Project Cost ($)	Incentive ($)	Simple Payback (yrs)	Total Cost Savings ($)	Project Cost ($)	Incentive ($)	Simple Payback (yrs)
LCM 1	Reset Condenser Water Temperature	$10,700	$5,000	$0	0.5	$10,700	$5,000	$0	0.5
LCM 2	Reset Chilled Water Temperature	$8,400	$5,000	$0	0.6	$19,100	$10,000	$0	0.5
ECM 2	Variable Kitchen Exhaust and Reactivation of Heat Recovery System	$26,900	$70,000	$14,000	2.1	$46,000	$80,000	$14,000	1.4
ECM 1	Convert S-2 to Variable Volume	$8,700	$25,000	$1,740	2.7	$54,700	$105,000	$15,740	1.6
LCM 3	Occupancy Sensors for Lighting Control - Corridors and Large Rooms	$490	$2,120	$470	3.4	$55,190	$107,120	$16,210	1.6
ECM 6	Street Light Upgrades	$1,650	$10,000	$1,740	5.0	$56,840	$117,120	$17,950	1.7
LCM 4	Occupancy Sensors for Lighting Control - Private Offices	$120	$930	$240	5.8	$56,960	$118,050	$18,190	1.8
ECM 4	Setback OR Airflows When Not in Use	$3,500	$26,000	$5,700	5.8	$60,460	$144,050	$23,890	2.0
ECM 7	Remove Triple Duty Valves and Install VFDs on Pump Motors	$3,400	$29,000	$7,200	6.4	$63,860	$173,050	$31,090	2.2
ECM 3	Variable Primary CHW Flow	$6,900	$60,000	$10,800	7.1	$70,760	$233,050	$41,890	2.7
ECM 5	Parking Lot Lights Upgrades	$12,700	$130,000	$17,610	8.8	$83,460	$363,050	$59,500	3.6

Recommendations and Implementation

As the table above demonstrates, the measures identified result in significant energy cost savings. We suggest that NSUHS review the recommended energy conservation measures and consider implementing them as soon as possible. We recommend that the facility interview and engage a reputable, experienced mechanical engineer and controls designer/contractor to assist with design and installation of the new equipment in order to achieve expected energy savings.

ComEd's *Smart Ideas for Your Business®* program provides financial incentives to encourage the implementation of energy efficiency projects. NSUHS staff is encouraged to consult with the Smart Ideas program staff to find out what incentives are available for each recommended measure. See the Next Steps section of this report for more information.

Contacts for Further Information

If there are any questions about this report or ComEd's *Smart Ideas for Your Business®* program please contact:

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FACILITY DESCRIPTION

General

Glenbrook Hospital is a 699,550 square foot, 173-bed hospital offering comprehensive inpatient and outpatient services including cancer care, cardiology, physical medicine and rehabilitation, and radiology. The North and South MOBs were included in this study, but the Ambulatory Care Center which opened in January 2013 was not, bringing the total included area to 522,288 square feet. It is located in Glenview, Illinois. The hospital dates back to 1977 with various additions and renovations over its history. It is a Level II Trauma Center and is certified by the Joint Commission as a Primary Stroke Center.

The following figure shows an aerial photo and the location of Glenbrook Hospital.

Figure 1: Glenbrook Hospital Aerial View

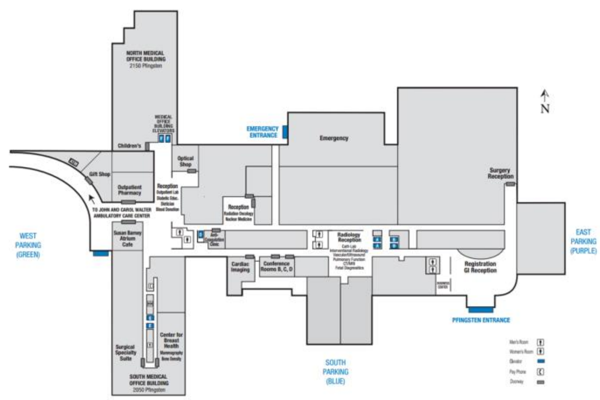

Figure 2: Glenbrook Hospital First Floor Plan

Building Occupancy

Glenbrook Hospital offers comprehensive inpatient and outpatient services including cancer care, cardiology, physical medicine and rehabilitation, and radiology. The building is occupied 24 hours per day. Exceptions to this include administrative areas and specialized hospital units such as physical therapy, which are generally occupied during normal office hours, approximately 7:00 a.m. to 5:00 p.m., Monday through Friday, with some weekend hours. The Employee/Visitor Dining Room is open daily from 6:30 a.m. to 6:45 p.m.

Primary Heating

The central plant is comprised of three fire-tube, forced draft gas fired boilers that can also operate on No. 2 oil as a backup fuel source. They are each 400 bhp. The following table details the boilers.

Table 3: List of Steam Boilers

Unit Tag	Location	Type	Manufacturer	Model	Capacity (boiler hp)
B-1	Boiler Room T1032	Fire Tube, High Pressure Steam Boiler	Cleaver Brooks	CBI-200-400-150	400

Unit Tag	Location	Type	Manufacturer	Model	Capacity (boiler hp)
B-2	Boiler Room T1032	Fire Tube, High Pressure Steam Boiler	Cleaver Brooks	CBI-200-400-150	400
B-3	Boiler Room T1032	Fire Tube, High Pressure Steam Boiler	Cleaver Brooks	CBI-200-400-150	400

The following figures show a front and side view of the one of the boilers.

Figure 3: Boiler Front View

Figure 4: Boiler Side View

Steam from the boilers is used in air-handling unit heating coils. It is also used directly for humidification in air-handling units with humidifiers. The steam plant supplies steam to sterilizers around the hospital, with most being in Central Sterile.

There are multiple steam-to-hot water heat exchangers located throughout the hospital which use steam from the steam plant to produce hot water for use in hydronic heating coils in air-handling units, VAV terminal units that have reheat, and for perimeter radiant heating. Various hot water pumps are located throughout the hospital, oftentimes near the steam-to-hot water heat exchangers.

The Ambulatory Care Center has its own condensing hot water boilers for heating.

Primary Cooling

Description of Central Cooling Plant

The central cooling plant is comprised of four chillers: one steam absorption chiller and three electric centrifugal chillers. Two of the electric centrifugal chillers are rated at 500 tons each, while the remaining is at 600 tons. The absorption chiller is rated at 650 tons. The plant has a total capacity of 2,250 tons. The absorption chiller, which uses steam generated from the main steam boilers, is used for backup.

There is an additional air-cooled chiller on the 5th floor roof that provides chilled water for air-handling units AHU-1 and AHU-2 that are located in Mechanical Room TP002. The supplemental OR cooling air-handling units of AHU-OR2 and AHU-OR3 each have their own small air-cooled chiller.

Table 4: List of Chillers

Unit Tag	Location	Type	Manufacturer	Model	Capacity (tons)
CH-1	Boiler Room T1032	Water-Cooled, Centrifugal	Carrier	19XRV4547383	500
CH-2	Boiler Room T1032	Water-Cooled, Centrifugal	Carrier	19XRV4547383-	500
CH-3	Boiler Room T1032	Water-Cooled, Centrifugal	Carrier	19XRV5557446	600
CH-4	Boiler Room T1032	Double-Effect Absorber	Carrier	16JB054STM	650
Chiller-1	5th Floor Roof	Air-Cooled	Carrier	Aquasnap	170
CH-OR2	OR Roof	Air-Cooled	Motivair	-	-
CH-OR3	OR Roof	Air-Cooled	Motivair	-	-

The central plant peak cooling load is around 2,000 tons. In general, the chillers are staged with the electric chillers coming on first and the absorption chiller is almost never run.

The following figures show two of electrical centrifugal chillers, CH-1 and CH-2, as well as the absorption chiller, CH-4.

Figure 5: CH-1 & CH-2

Figure 6: CH-4

The chilled water system is set up as constant flow primary with various booster pumps throughout the hospital.

Heat from CH-1 through CH-4 is rejected to two cooling towers located on grade outside the central plant. Each cooling tower has two cells. The following table details the cooling towers.

Table 5: List of Cooling Towers

Unit Tag	Location	Type	Manufacturer	Model	Number of Cells	Fan Motor Power per Cell (HP)	Capacity (tons)
CT-1	On-Grade Outside Central Plant	Counterflow, VFD on Fan Motor	Evapco	-	2	-	-
CT-2	On-Grade Outside Central Plant	Crossflow, VFD on Fan Motor	BAC	33803	2	-	-

The following figures show the cooling towers.

Figure 7: Evapco Cooling Towers

Figure 8: BAC Cooling Towers

CH-1 and CH-2 are served by three constant speed chilled water pumps which are headered together. One pump runs for each running chiller with the third as standby. The three condenser water pumps for CH-1 and CH-2 operate in the same manner. CH-3 is served by two chilled water pumps (one is standby) that are variable volume with their own VFDs. CH-3 also has two condenser water pumps (one is standby) that are constant volume but each has its own VFD which is set in hand to 100% for operation. CH-4 has its own set of chilled water and condenser water pumps (2 each with 1 as standby) that are constant speed pumps. There are additional chilled water pumps that act as booster pumps located throughout the hospital in select locations.

The following table details the cooling system pumps, excluding the various booster pumps.

Table 6: List of Cooling System Pumps

Unit Tag	Location	Service	Type	Flow (gpm)	Head (ft)	Motor Power (hp)
CHWP-1	Boiler Room T1032	Chilled Water CH-1 and CH-2	Constant Speed	1,200	140	60
CHWP-2	Boiler Room T1032	Chilled Water CH-1 and CH-2	Constant Speed	1,200	140	60
CHWP-3	Boiler Room T1032	Chilled Water CH-1 and CH-2	Constant Speed	1,200	140	60
CHWP-4	Boiler Room T1032	Chilled Water CH-3	Variable Volume with VFD	1,200	140	75

Unit Tag	Location	Service	Type	Flow (gpm)	Head (ft)	Motor Power (hp)
CHWP-5	Boiler Room T1032	Chilled Water CH-3	Variable Volume with VFD	1,200	140	75
CHWP-7	Boiler Room T1032	Chilled Water CH-4	Constant Speed	1,200	140	60
CHWP-8	Boiler Room T1032	Chilled Water CH-4	Constant Speed	1,200	140	60
CWP-1	Boiler Room T1032	Condenser Water CH-1 and CH-2	Constant Speed	1,500	75	40
CWP-2	Boiler Room T1032	Condenser Water CH-1 and CH-2	Constant Speed	1,500	75	40
CWP-3	Boiler Room T1032	Condenser Water CH-1 and CH-2	Constant Speed	1,500	75	40
CWP-4	Boiler Room T1032	Condenser Water CH-3	Constant Speed with VFD	1,800	75	50
CWP-5	Boiler Room T1032	Condenser Water CH-3	Constant Speed with VFD	1,800	75	50
CWP-9	Boiler Room T1032	Condenser Water CH-4	Constant Speed	1,676	45	30
CWP-10	Boiler Room T1032	Condenser Water CH-4	Constant Speed	1,676	45	30

The following figures show the chilled and condenser water pumps for CH-1 and CH-2.

Figure 9: CHWP-1 thru CHWP-3

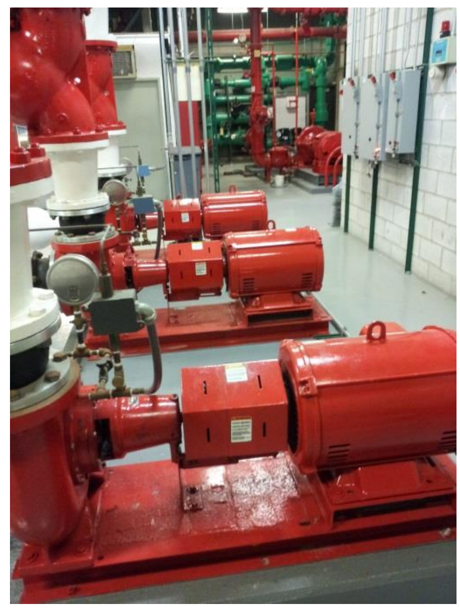

Figure 10: CWP-1 thru CWP-3

Description of Other Cooling Systems/Equipment

The Ambulatory Care Center has its own electric chiller in its mechanical penthouse and its own cooling towers outside the penthouse on the roof. It also has a small air-cooled chiller for data room cooling systems.

The South MOB has two packaged rooftop air-handling units.

Additionally, there are chillers to provide cooling for the cold domestic drinking water as well as for medical equipment.

There are also small direct expansion cooling systems located throughout the building for supplementary cooling or to be able to provide year-round cooling.

Air Systems

There are 28 major air-handling units (AHUs) which serve the hospital which can be seen in the following table. These units are controlled by the building automation system (BAS). There are also numerous exhaust fans which remove air from the kitchen, toilet rooms, isolation rooms, and other areas of the facility.

Unit Tag	Location	Service Areas	System Type	Supply Fan Capacity (cfm)
AHU-1	MER T2034	East Corridors, Loading Dock and Area, Volunteers and Corridors	VAV, Recirc	7,500
AHU-2	MER T2003	Kitchen Stove Area, Kitchen Offices, East Kitchen Corridors, Central Sterile Supply, North Corridor for Central Supply	VAV, Recirc	10,000
AHU-3	MER T2003	Ground Floor Labs, Cafeteria, Dept of Nursing, Central Strerile, Dietary	VAV, 100% OA	22,000
AHU-4	MER T2034	Surgery Rooms 1, 2, 7, & 8, Critical Care, Level 2 East	VAV, Recirc	25,000
AHU-5	MER T2003	Corridors, Waiting Rooms, Entire Southwest Section Level 2, South Entrance Area	VAV, Recirc	16,000
AHU-6	MER T2003	Entire Central Section of Level 2, Emergency, Outpatients, Elevator Lobby, Elevator Corridor Areas	VAV, Recirc	22,000
AHU-7	MER T2003	Floors 3 & 4 East Half of South Patient Rooms	VAV, Recirc	12,000
AHU-8	MER T2003	Floors 3 & 4 East Half of North Patient Rooms	VAV, Recirc	12,000
AHU-9	MER T2003	Floors 3 & 4 West Half of South Patient Rooms	VAV, Recirc	22,000
AHU-10	MER T2003	Floors 3 & 4 West Half of North Patient Rooms	VAV, Recirc	22,000
AHU-12	MER T2035	1st Flr Surgery Suite	VAV, Recirc	30,000
AHU-13	MER B053	Basement North	VAV, Recirc	8,000
AHU-14	MER T2003	Ground Floor GI	VAV, Recirc	17,000
AHU-15	MER T2003	2nd Floor North, Ground Floor Lobby, Basement South	VAV, Recirc	33,000
AHU-16	MER T2003	Flrs 3 & 4 East Tower	VAV, Recirc	50,000
AHU-17	MER B200	Basement	VAV, Recirc	10,000
AHU-18	MER T2003	1st Floor	VAV, Recirc, with Heat Recovery Coil tied to EF-1	30,000
AHU-19	MER 2309	2nd Floor Radiology Infill	VAV, Recirc	8,000
AHU-20	MER 2309	1st Floor	VAV, Recirc	30,500

Unit Tag	Location	Service Areas	System Type	Supply Fan Capacity (cfm)
AHU OR-2	1st Floor Surgery Roof	Operating Rooms Supplemental Cooling	AHU-4 Supplemental Cooling	-
AHU OR-3	1st Floor Surgery Roof	Operating Rooms Supplemental Cooling	AHU-12 Supplemental Cooling	-
AHU-1	MER TP002	5th Floor North	VAV, Recirc	18,000
AHU-2	MER TP002	5th Floor South	VAV, Recirc	18,000
S-1	MER B129A	Annex 1st Floor Office Area, Basement Annex, MRI Served by AC-1	VAV, Recirc	35,000
S-2	MER B129A	Annex 1st Floor Lobby	CV, Single-Zone, Recirc	19,100
S-3	MER B260	North MOB South Basement thru 3rd Floor	VAV, Recirc (VFD in hand)	30,000
S-4	MER B260	North MOB North Basement thru 3rd Floor	VAV, Recirc (VFD in hand)	30,000
F18	MER T2003	Kitchen Hood Make-Up	CV, 100% OA, with Heat Recovery Coil tied to F-3	12,000
N-RTU	South MOB Roof	South MOB North Half of Building	Packaged RTU	-
S-RTU	South MOB Roof	South MOB South Half of Building	Packaged RTU	-

As the above table indicates, most of the air-handling units are variable air volume (VAV). Two of the air-handling units, AHU-18 and F18, have heat recovery systems that have run-around coils to exhaust fan airstreams EF-1 and F-3, respectively. The heat recovery system for F18 is no longer operational. AHU-18 serves the first floor and has return air, while F18 provides make-up to the kitchen hood and is 100% outside air. AHU OR-2 and AHU OR-3 are 100% recirculation units that provide supplemental cooling for the operating rooms.

The main hospital contains constant volume air-handling units as well as variable volume units. The air-handling units are spread throughout the building in various mechanical rooms and penthouses. Most of the units consist of a mixed air section, a pre-filter, a hot water preheat coil with an inline coil pump, a steam humidifier connected directly to the building steam, a supply fan, a chilled water coil, and secondary filters. The units use DDC actuators on valves and dampers. Downstream of the units are terminal units with hot water reheat coils. AHU-5, 6, 7, 9, and 10 were replaced in 2010. AHU-1, 3, and 8 were replaced in 2012.

The North MOB is served by two air-handling units located in the building's basement mechanical room. The units have VFDs on the fan motors, but the VFDs are set in hand to a specific speed.

The South MOB is served by two packaged rooftop air-handling units.

Finally, while not included in this study, the ACC is served by its own five variable air volume air-handling units, with a sixth VAV AHU serving the ACC connector to the main hospital.

The following figures show AHU-4 and AHU-5.

Figure 11: AHU-4 Figure 12: AHU-5

Control Systems

Most of the building HVAC systems are controlled directly by the Siemens APOGEE building automation system (BAS). Some of the older equipment still runs on Staefa controls with most of this equipment mapped into the Siemens APOGEE system. Controls in general are DDC.

The following figure shows the screenshot for air-handling unit AHU-12 on the Siemens APOGEE BAS as an example of the front end graphics.

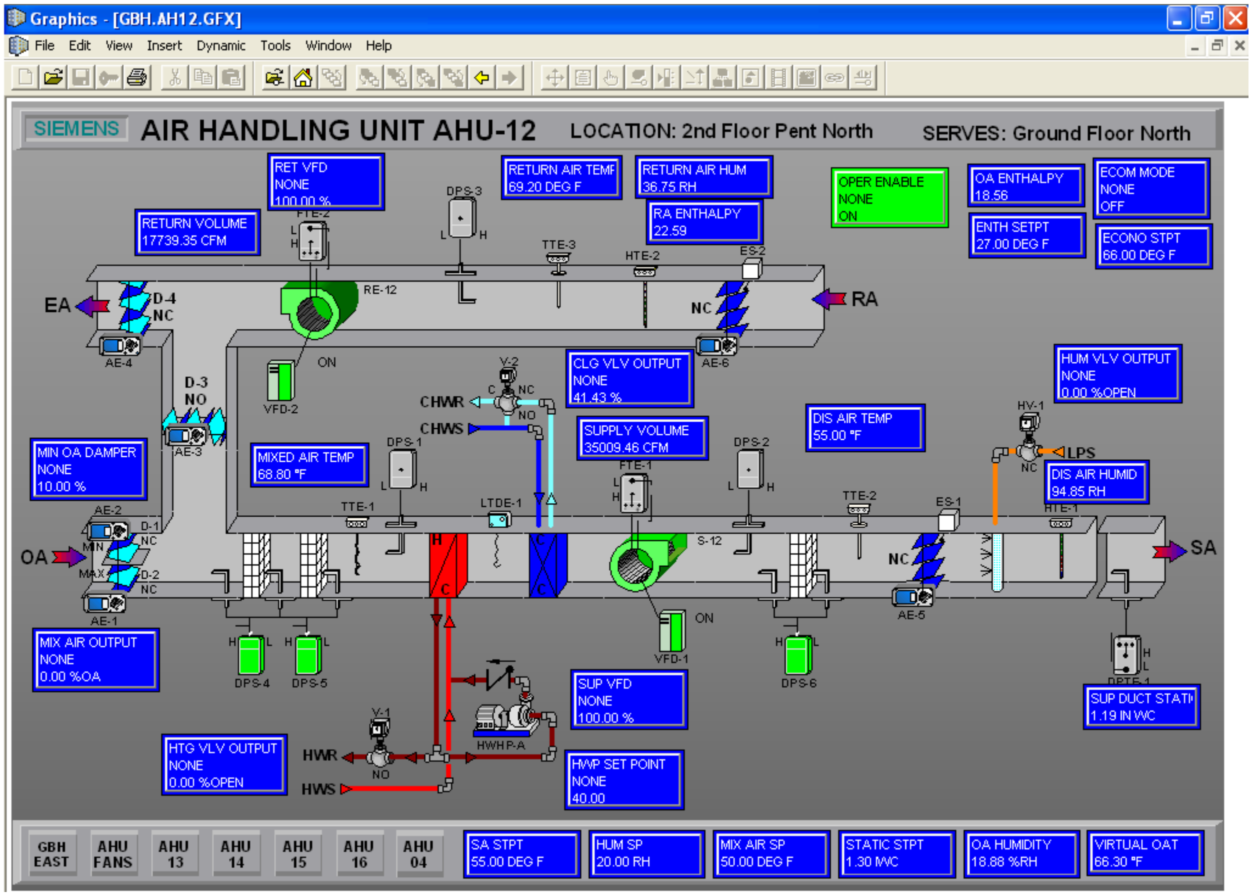

Figure 13: AHU-12 BAS Screenshot

Lighting Systems

The majority of general lighting in the building has been converted to T8 lamps with electronic ballasts. Many office spaces have occupancy sensor wall switches.

Plumbing Systems

The hospital has various steam-to-hot water heat exchangers for domestic hot water located throughout the hospital. Most of these systems have a storage tank as well for the domestic hot water.

Other Equipment and Systems

Other electrical equipment includes medical equipment, medical-surgical air compressors, medical-surgical vacuum pumps, medical washers/sterilizers, refrigeration compressors for the large food refrigerators and freezers, kitchen equipment, vending machines, temperature control air compressors, office equipment, drinking fountains, laboratory equipment, elevators, and miscellaneous appliances. No detailed data was recorded for this equipment.

The hospital has emergency, standby, diesel fueled generators.

Previous Upgrades Conducted at Glenbrook Hospital

Glenbrook Hospital completed a ComEd Retro-Commissioning Project in July 2011. Recommendations implemented during the RCx project include equipment operation scheduling, nighttime zone volume setback, economizer optimization, and discharge static pressure setback. Condenser water supply temperature reset was also implemented as an addendum to the final report.

Other projects completed by the hospital include lighting replacements, conversion to variable volume on multiple air-handling systems, and replacement of air-handling units AHU-1, AHU-3, and AHU-5 thru AHU-10.

HISTORICAL ENERGY USE

The unit cost of energy is an important factor in any energy management study. Energy savings in this study are based on incremental cost of energy. To perform this study, we reviewed historical energy use and costs and gathered information on the facility's systems, equipment, and operation to identify cost-effective measures that will reduce energy use. This section describes the facility and its energy loads.

The following table shows the energy usage intensity (EUI) for the hospital as well as the regional average.

Table 7: Annual Energy Use Index (EUI)

Energy Type	Glenbrook Hospital 2013	Industry Average*
Electricity (kWh/ft²)	24.3	31.6
Natural Gas (therms/ft²)	1.4	1.4
Total Energy (kBtu/ft²)	**224.7**	**252.0**

*Industry average from G/BA's survey of Illinois hospitals' 2012 electricity and natural gas consumption; 54 hospitals were included.

The following table shows the annual energy use type in calendar year 2013.

Table 8: Annual Energy Use by Type

Type	Natural Gas	Electricity	Total
Usage (MMBtu)	99,260	57,921	157,181

Energy Using Systems

This section contains estimates for electricity use allocated to particular end-uses. These are used as guidelines for further developing energy reduction measures. No sub-metering of electrical or natural gas usage is currently taking place and the values presented are based on a combination of G/BA's survey along with our experience at similar properties and are calculated values. The following table shows the estimated end-use breakdown by type of energy.

Table 9: Annual Energy End-Uses

End-Use	Estimated Natural Gas Usage		Estimated Electricity Usage	
	therms/yr	MMBtu/yr	kWh/yr	MMBtu/yr
Heating	266,200	26,620	0	0
Reheat	558,900	55,890	0	0
Cooling	19,600	1,960	1,366,400	4,664
Fans	0	0	5,423,000	18,509
Lighting	0	0	5,055,700	17,255
Pumps	0	0	1,958,600	6,685
Domestic Hot Water	118,100	11,810	0	0

End-Use	Estimated Natural Gas Usage		Estimated Electricity Usage	
	therms/yr	**MMBtu/yr**	**kWh/yr**	**MMBtu/yr**
Plug Loads	0	0	2,298,100	7,843
Miscellaneous	49,700	4,970	848,600	2,896
Total	**1,012,500**	**101,250**	**16,950,400**	**57,852**

The following figure shows the breakdown of annual natural gas and electric energy end usage. The major energy usage is natural gas for reheat and heating with a smaller portion for domestic hot water. Miscellaneous natural gas usage includes kitchen usage, humidification, sterilization, and any other miscellaneous usage. The biggest user for electrical energy is the HVAC system, specifically fan use, cooling, and pumps. Lighting, plug loads, and other miscellaneous uses make up the rest of the electricity usage.

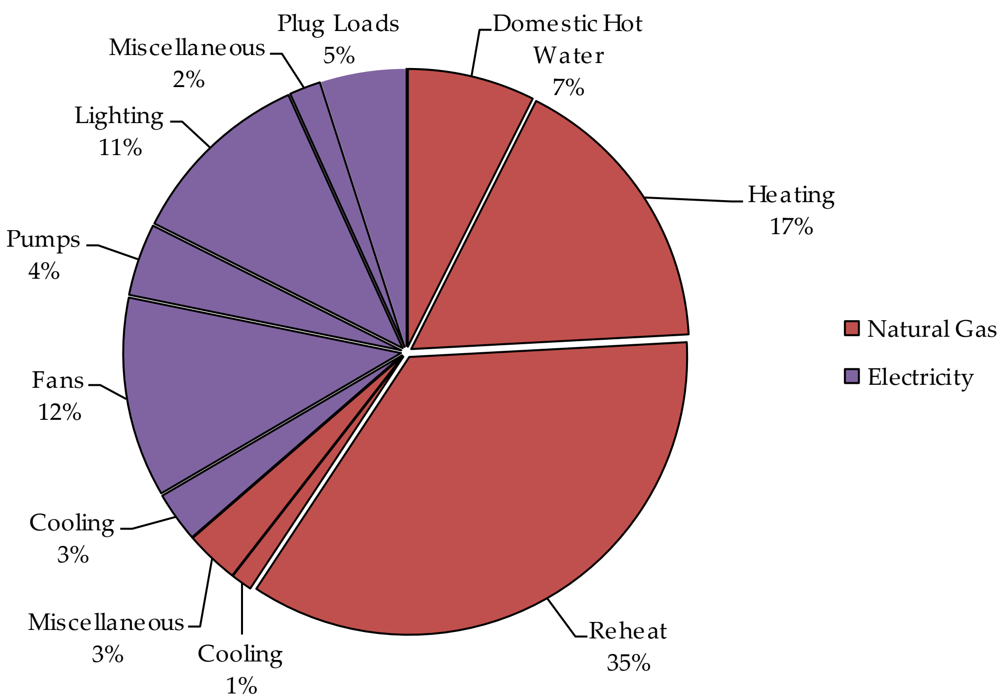

Figure 14: Energy End Usage Breakdown

Reheat forms a large basis of energy usage as is expected with the hospital's constant volume systems.

Facility Electrical Energy Use and Cost

Glenbrook Hospital has one main electrical account, 0198190000, and takes delivery service from ComEd under rate schedule R76, Retail Delivery Service – 1,000 kW to 10 MW and commodity supply from Constellation. Two additional smaller accounts serve the North and South MOBs.

Total electricity use for this account during the 24-month period ending in April 2014 was obtained from the Customer and ComEd billing records. Fixed costs typically include service, metering, credits, or other fixed chargers. Varied costs typically include environmental cost recovery, franchise, taxes, municipal, transmission or unconstrained capacity (UCAP), or other varied charges. The average annual electricity usage for over this time was 16,821,207 kWh. The following figure shows the month-to-month demand.

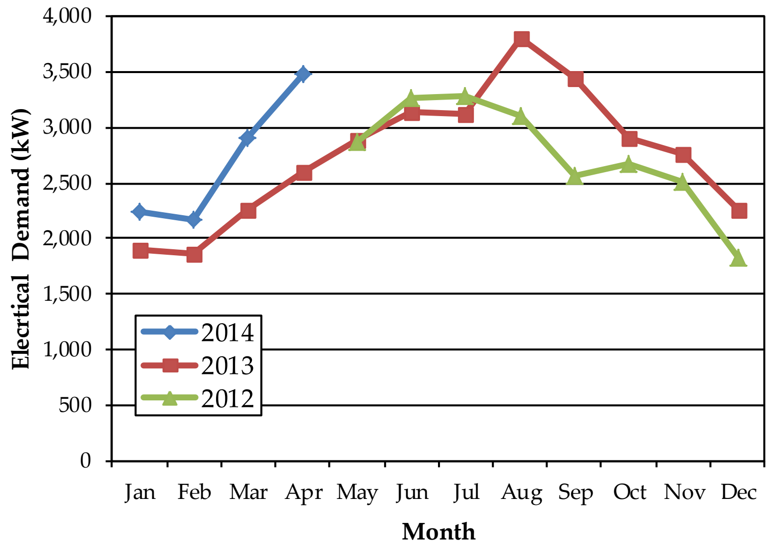

Figure 15: Monthly Electrical Demand

Variations in peak demand from year-to-year are expected as the weather variations result in changes for energy usage of the building and its systems. The following figure shows the monthly electrical usage over the same period. The ACC opened in January 2013 and tenants have moved in over time, increasing overall electricity usage.

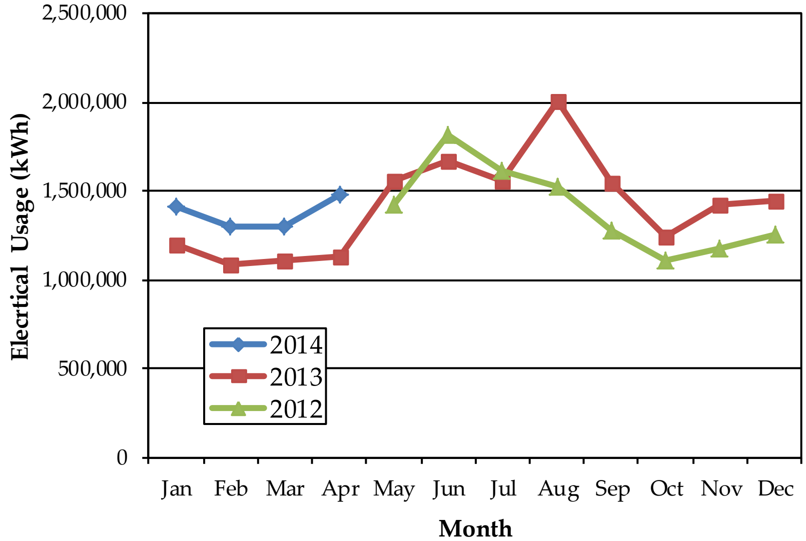

Figure 16: Monthly Electrical Usage

As is expected, electrical usage increases over the summer months for chilled water production and increased fan airflows for cooling. The spike in usage for August 2013 corresponds to a similar spike in peak demand as well in the earlier figure. This spike corresponds to an increase in cooling and electrical needs for additional tenants in the ACC.

The following figure shows a linear regression of the monthly electrical usage vs. cooling degree days. Increases in CDD typically result in increased electrical usage for cooling. The baseload shown by the y-intercept is for plug loads, lighting, and other weather independent loads.

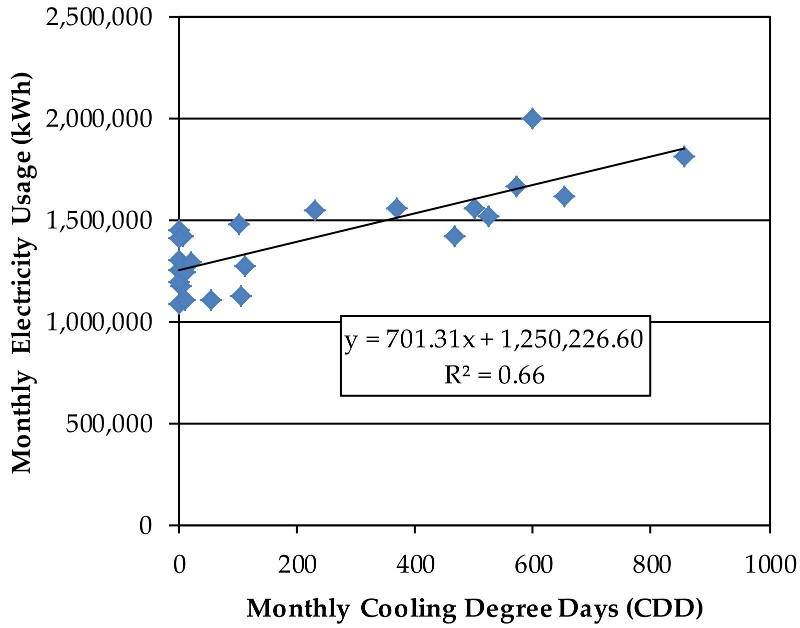

Figure 17: Monthly Electrical Usage vs. Cooling Degree Days (CDD)

Overall the usage shows a weak relationship to weather with a R^2 value of 0.66. A R^2 value of 1.0 would indicate a direct correlation, but rarely do electrical usage R^2 values approach such correlation because of the varying uses for electricity outside of cooling. The ACC, with its additional electrical load, would impact this curve fit as some data points are from before the ACC opened.

Energy Insights Analysis

Energy Insights Online is a program through ComEd that allows users to access electrical usage and demand by meter. The following graph shows the total demand from 2013 of available meters with hours 1 to 24 on the y-axis and days 1 to 365 on the x-axis, with color changing as demand increases. Some data is missing in November and December.

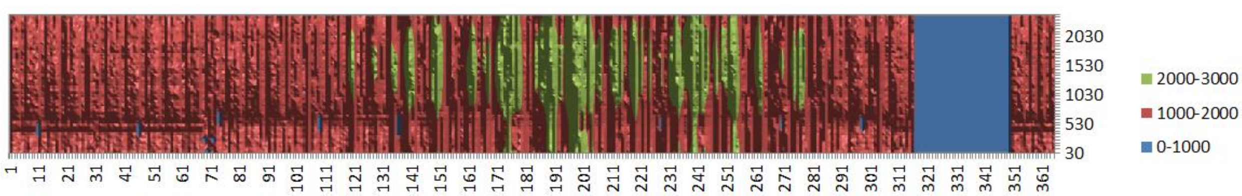

Figure 18: Annual Electric Meter Use

Several patterns can be observed from the data:

1. A portion of the systems and equipment are shutting off or going into setback mode overnight, and starting in the early morning as demonstrated from the lower demand overnight.
2. Higher summer temperatures cause an increase in electricity demand. Little effect is indicated related to heating.

The following graphs show the kWh and kW per month over the 2013 calendar year as well as the average demand. Demand shown includes the cumulative total for all meters on the account.

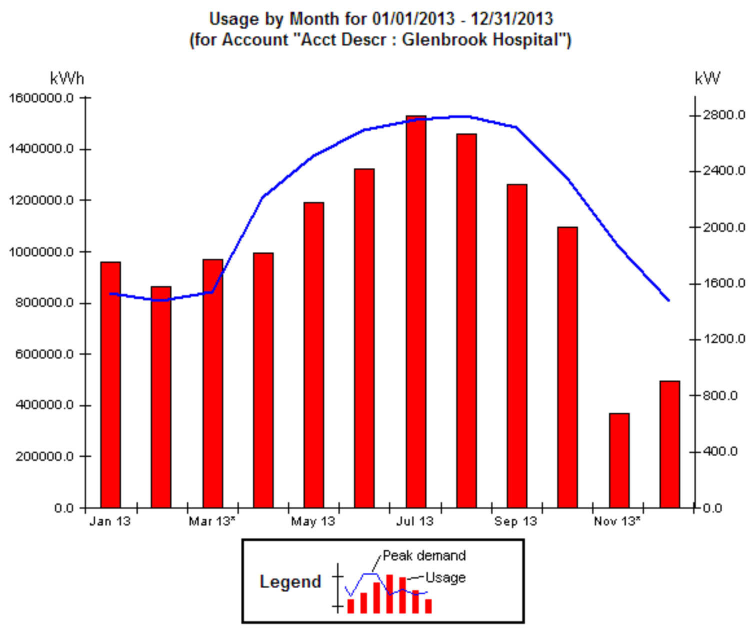

Figure 19: Monthly Electricity Use/Demand

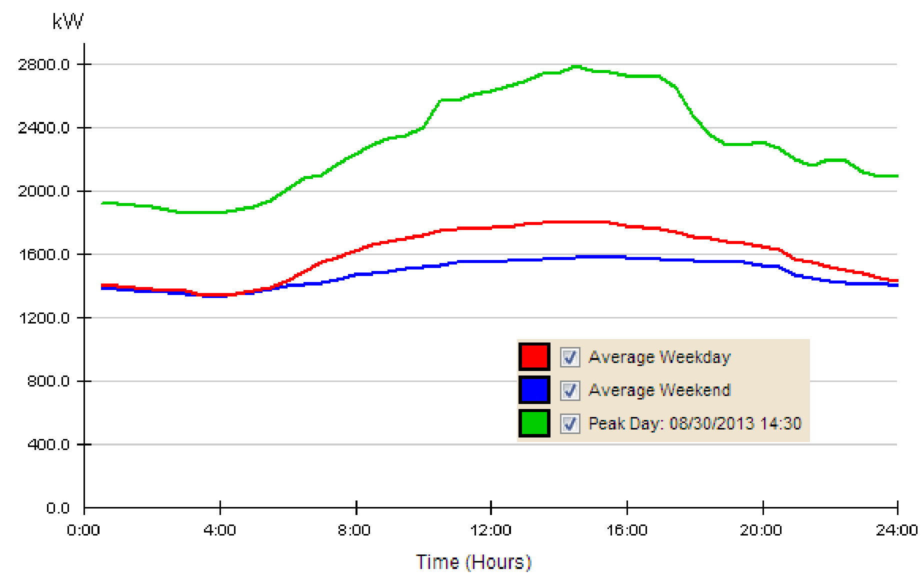

Figure 20: Average Demand Profile

The two following graphs indicate the difference between cooling and heating season electricity usage. In August the peak demand is 2,790 kW and in January it is 1,522 kW.

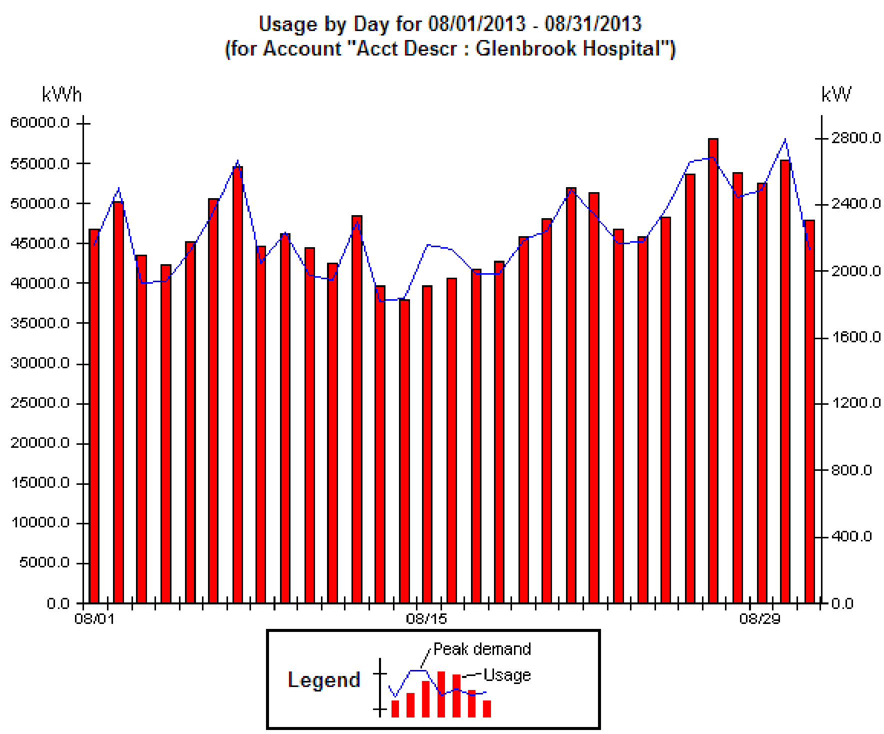

Figure 21: August 2013 Demand Profile

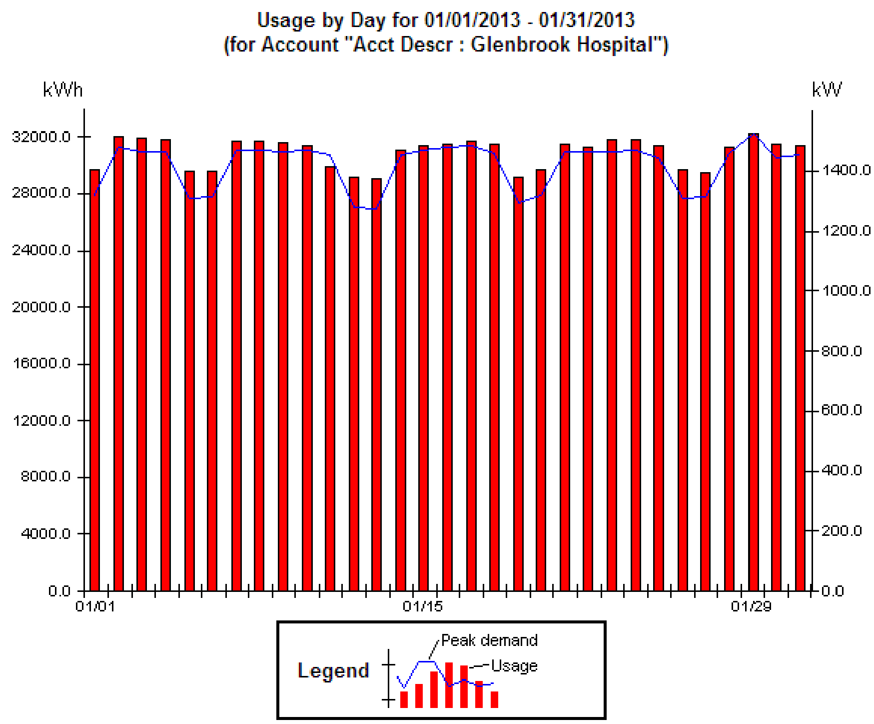

Figure 22: January 2013 Demand Profile

Facility Natural Gas Use and Cost

Glenbrook Hospital has one main natural gas account, 0934650000, and takes delivery from Nicor Gas and commodity from ProLiance Energy. A smaller account serves the ACC.

Total natural gas use for this account during the 24-month period ending in April 2014 was obtained from billing records over that period. As billing for the ACC over the last four months in this time period was not available, usage for those months was estimated based on previous ACC usage. The average annual natural gas usage for the most recent 2-year period over this time was 968,249 therms.

The following figure shows the monthly natural gas usage over that period.

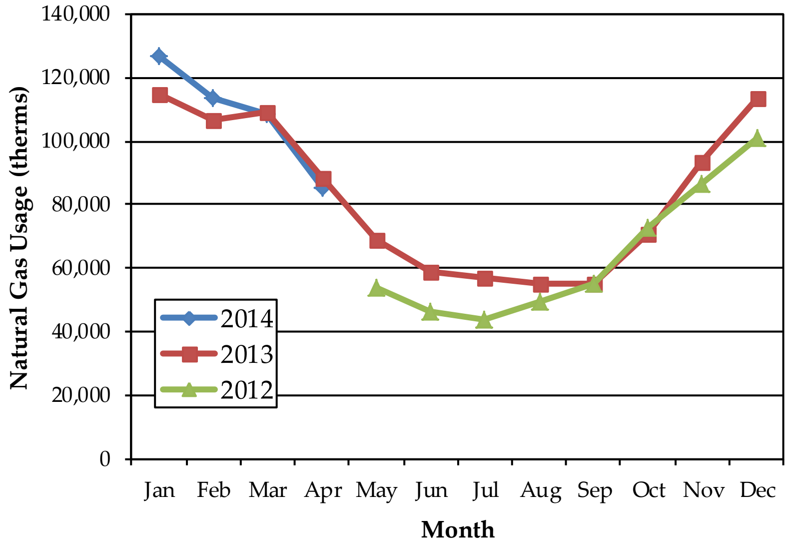

Figure 23: Monthly Natural Gas Usage

Natural gas is used mainly in the steam boilers serving the hospital. The steam in turn is used in air-handling unit coils, steam sterilizers, and steam-to-hot water converters. Hot water is then used in reheat coils. Domestic hot water is also produced through steam-to-hot water converters. The on-site kitchen uses natural gas directly in ranges and ovens. Natural gas usage is highest in the winter, as is to be expected as heating loads increase. Steam is also used in the absorption chillers for cooling. There does not appear to be an appreciable increase in steam usage over the summer months, but instead the absorption chiller usage appears to be somewhat limited, or at least base loaded in such a way that it is consistent across the cooling season.

The following figure shows a linear regression of the monthly gas usage vs. heating degree days. Gas usage is expected to track reasonably well with heating degree days. The base load shown by the y-intercept is for domestic water heating, steam sterilizers, kitchen usage, and reheat.

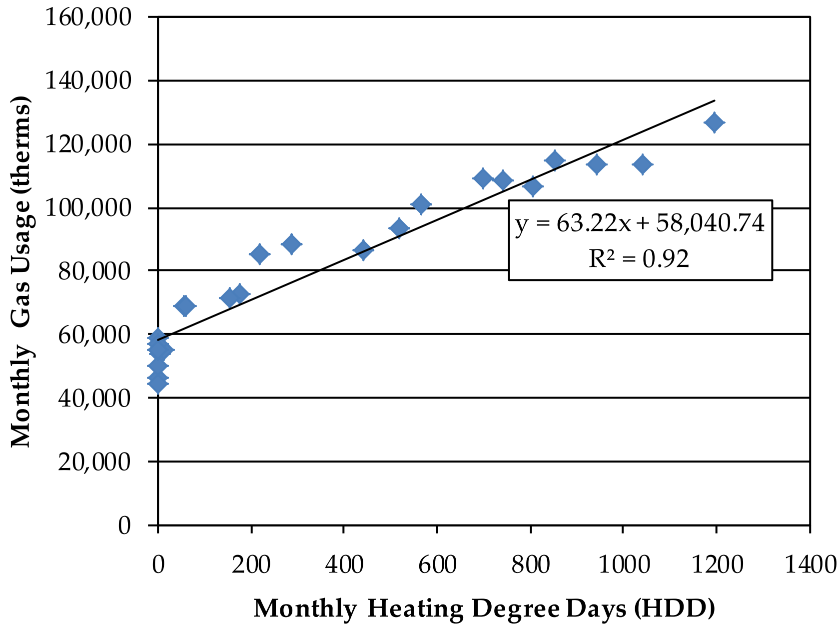

Figure 24: Monthly Natural Gas Usage vs. Heating Degree Days (HDD)

Overall the usage shows a strong relationship to weather with a R^2 value of 0.92. A R^2 value of 1.0 would indicate a direct correlation. The linear regression indicates a baseline load of about 58,000 therms each month. A large portion of this usage is reheat, indicating the potential benefit of limiting the amount of reheat in the hospital.

RECOMMENDATIONS

Overview

This section discusses the opportunities for reducing energy costs that were discovered from the study. The energy management recommendations are described and summaries of savings and cost analyses are presented.

Energy use impacts of Energy Conservation Measures (ECMs) on one another are taken into account in the ECM summary table. In general, unless otherwise noted, the impacts assume previous ECMs have been implemented. The energy use impacts provided are conservative estimates. Exact impacts may depend on the specific conditions following implementation.

The costs to implement the recommendations are estimates and are intended to be conservative. Although every reasonable effort is made to be accurate, exact conditions may vary. We suggest obtaining qualified, firm quotes from a consulting engineer/architect, equipment supplier, or contractor prior to actual implementation, particularly for high-cost recommendations. Measure costs are equipment costs plus installation labor costs.

G/BA visited the facility in June 2014 to tour the facility, collect nameplate data, review control settings, review drawings and specifications, and interview facility staff.

The specific systems of interest include:

- Air-handling units
- Chilled and hot water systems
- Pumps
- Lighting (general review, not a full lighting audit)
- Miscellaneous energy using equipment

Operating schedules and data used in this evaluation are based on current building control system observations made during the on-site visit and descriptions of the operation by building staff. Generally, the estimates of savings are intended to be conservative.

The following sections detail recommended measures categorized by measure cost and type. The following table details the utility costs used for savings estimates. The costs are the incremental costs meaning base fees are not included.

Table 10: Unit Energy Costs for Building ERM Savings

Energy Type	Unit Cost
Electricity, Commodity	$0.061/kWh
Electricity, Demand	$6.47/kW
Natural Gas	$0.61/therm

Energy Conservation Measures

Some energy reductions can be achieved at no cost or relatively low investment levels, while others will require substantial capital investment. Ten cost-effective projects, when taken as a whole, are identified that reduce the use of electricity and natural gas while still maintaining necessary comfort levels.

The energy savings and costs summarized in the following table are detailed in this section. The cost savings estimates are based on current average or marginal energy prices, as appropriate to each recommendation. The payback period shown is "simple payback," calculated by dividing the net implementation cost by the annual dollar savings.

Table 11: Summary of Measures

ID	Measure Description	Electrical Energy Savings (kWh/yr)	Gas Savings (Therms/yr)	Total Cost Savings ($/yr)	Estimated Project Cost ($)	Estimated Incentive Amount ($)	Simple Payback with Incentives Applied (yrs)
LCM 1	Reset Condenser Water Temperature	144,000	0	$10,700	$5,000	$0	0.5
LCM 2	Reset Chilled Water Temperature	111,000	0	$8,400	$5,000	$0	0.6
LCM 3	Occupancy Sensors for Lighting Control - Corridors and Large Rooms	8,000	0	$490	$2,120	$470	3.4
LCM 4	Occupancy Sensors for Lighting Control - Private Offices	2,000	0	$120	$930	$240	5.8
ECM 1	Convert S-2 to Variable Volume	137,000	(290)	$8,700	$25,000	$1,740	2.7
ECM 2	Variable Kitchen Exhaust and Reactivation of Heat Recovery System	132,000	30,900	$26,900	$70,000	$14,000	2.1
ECM 3	Variable Primary CHW Flow	109,000	0	$6,900	$60,000	$10,800	7.1
ECM 4	Setback OR Airflows When Not in Use	26,000	3,100	$3,500	$26,000	$5,700	5.8
ECM 5	Parking Lot Lights Upgrades	198,000	0	$12,700	$130,000	$17,610	8.8
ECM 6	Street Light Upgrades	20,000	0	$1,650	$10,000	$1,740	5.0
ECM 7	Remove Triple Duty Valves and Install VFDs on Pump Motors	40,000	0	$3,400	$29,000	$7,200	6.4
	Total	**927,000**	**33,710**	**$83,460**	**$363,050**	**$59,500**	**3.6**

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General O&M Measures

The following section of this report lists general Operations and Maintenance (O&M) Measures that are considered good practice and may only marginally improve energy efficiency, if at all. No savings are estimated for these measures and in general they are considered good practice.

O&M#1 Clean Chiller-1 Condenser Coils

The condenser coils of the air-cooled chiller, Chiller-1, located on the 5th floor roof are full of lint and dust. See the following figure for a picture of the condenser coils.

Figure 25: Chiller-1 Condenser Coils

This lint and dust covering impedes heat transfer and airflow and can affect capacity as well as chiller efficiency. Cleaning the coils on a regular basis is recommended, and may prove to be required more often than manufacturer recommendations as the chiller's location may make it more prone to collecting lint and dust.

O&M#2 Remove Triple Duty Valves and Install VFDs on Pump Motors

Investigate and identify possible pumps that would benefit from removing their triple duty valve and installing VFDs on their motors.

A triple duty valve is adjusted during balancing so that the proper flow at the proper static pressure is provided to the water loop. The valve acts as a pressure drop as the pump is essentially oversized for system needs. Removing the pressure drop by removing the valve and adding a variable frequency drive will save energy, as the pump will be sized appropriately for the system and the extra pressure drop can be removed. For additional savings, the system could be converted to variable volume by closing down bypasses and installing a differential pressure sensor, but this would require additional capital cost.

A more cost effective option may be to leave the triple duty valves in place and simply open them to 100% open, but this allows for the possibility of being closed again in the future. A small pressure drop associated with the triple duty valve would remain even at 100% open. Another option would be to trim the pump impeller so that it is a different size. An impeller can be trimmed to within manufacturer recommended limits. Some pump efficiency is sacrificed as the casing remains the same size while the impeller size is decreased, leaving more of a gap between the impeller and the casing, and savings would be less than with a VFD.

Our survey did not identify any attractive candidates which have mostly closed triple duty valves and run most of the year. A comprehensive survey of every pump in the hospital was not performed, however, as part of this study and such candidates may be found with further investigation. Simple paybacks may be as low as a few years depending on the application.

O&M#3 Specify Low Energy Appliances

General practice for the departments operating in the building should be to specify low energy appliances. This includes computers, copiers, scanners, refrigerators, and vending machines. Many low energy appliances are specified on the US EPA's ENERGY STAR website, www.energystar.gov.

Employees should be encouraged to shut down equipment in the evening or at least change operation to standby mode. A typical computer with monitor operates at between 20-40 watts in standby mode. While this doesn't seem like much individually, in aggregate this can add up to significant consumption. Chargers and accessories can be connected to a power strip to switch them off overnight.

O&M#4 Desktop Computer Power Management

Install desktop power management (DPM) software on PCs that are not used overnight. DPM software installation cost ranges from $8 to $30 per computer, with incentives available from ComEd through its custom incentive program. Installing energy saving software on 100 computers will save an estimated $2,334 in energy savings every year going forward.

O&M#5 Infrared Thermography

Infrared thermography can be a useful technique for locating thermal "leaks" in a building, whether by conduction through building materials, air leakage around windows/doors or through other physical gaps in the wall and roof. Gaps in the building envelope can be found more easily by positively pressurizing the building. Consultants that specialize in this imaging process should be hired first to establish a baseline reference and then periodically to record subsequent progress. This process can also be used to detect "hot spots" in electrical panels.

O&M#6 Steam Trap Audit Program

Fix or replace failed steam traps as part of a steam trap maintenance program. Steam traps typically fail open, leaking dry steam into the condensate system and essentially wasting the steam. We recommend that a steam trap maintenance schedule be strictly followed.

The U.S. Department of Energy suggested steam trap testing intervals are as follows:

- High-Pressure Steam (150 psig and above): Weekly to Monthly
- Medium-Pressure Steam (30 to 150 psig): Monthly to Quarterly
- Low-Pressure Steam (below 30 psig): Annually

Steam trap monitoring may be a useful upgrade to ensure traps are replaced soon after failure.

O&M#7 Fix Broken Dampers on AHUs

No broken dampers were identified during the site visit; however this O&M recommendation should be noted for continued practice. Having functioning outdoor air dampers is essential to maintain proper ventilation. Operational outdoor air dampers are required for code to bring in the minimal amount of outdoor air to the space. It also allows for economizer mode of the AHU which saves energy by bringing in more outdoor air, when temperature and humidity allow, to reduce cooling and heating loads of the system.

Replace broken dampers and pneumatic or electronic actuators to allow for fully functional AHU control. Damper linkages should be adjusted and pneumatic actuator diaphragms and lines should be checked for leaks during routine maintenance.

O&M#8 Equipment Schedule

Continuously investigate the facility for equipment that can be scheduled off automatically by the BAS. Examples of such equipment include air-handling units which serve office spaces which are only occupied during typical weekday business hours. These units can be scheduled off on the weekend and overnight without impacting occupants. The units can be cycled on as needed to maintain set back temperatures in the space during unoccupied periods and a period of warm-up/cool-down can be implemented leading up to occupied times to ensure occupant comfort. The minimum outside air should be reset to zero at these times as spaces are unoccupied but economizer function should still be enabled. Exhaust fans which serve spaces only occupied during specific times are also candidates for scheduling.

O&M#9 Replace or Install Insulation on Piping and Steam Traps

Replace or install insulation on steam traps and sections of steam, hot water, chilled water, and domestic water piping missing insulation. Insulation on piping and steam traps in multiple locations has fallen off or may never have been installed. Insulating the piping will reduce undesired heat transfer. Due to the high temperature of steam, uninsulated steam traps and steam piping can be a safety hazard.

O&M#10 Low Pressure Drop Filters for AHUs

Installing low pressure drop filters in air-handling units in place of standard pressure drop filters can save fan energy usage provided the fan is adjusted for the lower pressure drop. Consider installing low pressure drop filters as existing filters near the end of their service life.

O&M#11 Premium Efficiency Motors

Replace standard efficiency motors with premium efficiency motors upon motor failure.

Low-Cost Measures

Low-cost measures are energy efficiency projects with a capital cost of less than $10,000. These measures significantly reduce energy consumption and costs while requiring relatively little capital investment.

LCM#1 Reset Condenser Water Temperature

Baseline Operation

The condenser water temperature minimum set point is 78°F.

Proposed Operation

Reset the condenser water temperature set point down to a minimum of 65°F with a tower approach of 10°F when no absorbers are running. Absorbers typically require a higher minimum entering condenser water temperature and the 78°F minimum set point will remain for whenever the absorption chiller is running. Tower approach is the difference between the outside wet bulb temperature and the condenser water temperature.

The minimum set point would decrease to 65°F and an electric chiller, in general, is more efficient at lower entering condenser water temperatures. Using an offset from the current outside wet bulb temperature is in an important part of the control strategy. When outside wet bulb temperatures are above the condenser water set point, or closer than the tower design approach, the cooling tower fans run at 100% and are very unlikely to meet the 65°F set point even at low partial loads. The amount of evaporation that can occur, and thus the amount of heat rejection possible, is limited by the wet bulb temperature. Trying to maintain a set point too close to the wet bulb temperature will cause the fans to use more energy without a corresponding decrease in the condenser water temperature.

Impact on Occupant Health, Comfort, and Safety

Properly implemented this measure will have no appreciable impact on occupant health, comfort, and safety.

Technical & Physical Feasibility

An accurate outdoor temperature sensor is necessary for proper implementation of this measure. Chillers have a minimum allowable entering condenser water temperature preventing lower condenser water temperatures. The minimum condenser water temperature set point will remain 78°F whenever the absorber is running as absorbers typically require warmer condenser water temperatures.

Capital Cost

The capital cost includes the cost of modifying the BAS programming.

Incentives

The ComEd Smart Ideas custom incentive savings rate of $0.07/kWh may apply. Depending upon actual project cost, the limit of not exceeding 100% cost may also apply. To qualify, the simple payback before applying the incentive must fall between 1 and 7 years. As the estimated simple payback is less than 1 year without an incentive, no incentive is applied here. Verify the actual project cost and savings for incentive eligibility.

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Savings and Project Cost Summary

Type of Savings	Energy Savings (utility units)	Energy Savings (MMBtu)	Annual Cost Savings ($)
Electricity	144,000 kWh/yr	490	$8,800
Average Peak Electrical Demand	24 kW/mo	---	$1,900
Natural Gas	---	---	---
Operations and Maintenance	---	---	---
Total	**---**	**490**	**$10,700**
Environmental Impact Savings			
Equivalent Tons of CO_2			103.4
Project Economics			
Total Capital Cost			$5,000
Simple Payback (years)			0.5
Incentives			---
Simple Payback with Incentives (years)			0.5

LCM#2 Reset Chilled Water Temperature

Baseline Operation

The chilled water temperature set point is 42°F.

Proposed Operation

Reset the chilled water temperature set point higher under low load conditions and when outside air temperature and humidity allows. In general, a chiller is more efficient at higher chilled water temperatures. The savings estimate assumes a reset of 5°F under the lowest load conditions.

Impact on Occupant Health, Comfort, and Safety

Properly implemented this measure will have no appreciable impact on occupant health, comfort, and safety. Special consideration must be made to ensure proper humidity levels in the hospital with the higher chilled water temperature.

Technical & Physical Feasibility

The cooling capacity of the cooling coils will decrease with the higher chilled water temperature. Latent cooling is impacted as well as higher cooling coil temperatures could result in less condensation and thus higher space humidity. Outside air conditions as well as the cooling load should be taken into account when resetting the chilled water temperature and the temperature should selected so as to minimize any increase in chilled water pumping as well as providing enough sensible and latent cooling capacity.

Capital Cost

The capital cost includes the cost of modifying the BAS programming.

Incentives

The ComEd Smart Ideas custom incentive savings rate of $0.07/kWh may apply. Depending upon actual project cost, the limit of not exceeding 100% cost may also apply. To qualify, the simple payback before applying the incentive must fall between 1 and 7 years. As the estimated simple payback is less than 1 year without an incentive, no incentive is applied here. Verify the actual project cost and savings for incentive eligibility.

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Savings and Project Cost Summary

Type of Savings	**Energy Savings (utility units)**	**Energy Savings (MMBtu)**	**Annual Cost Savings ($)**
Electricity	111,000 kWh/yr	380	$6,800
Average Peak Electrical Demand	20 kW/mo	---	$1,600
Natural Gas	---	---	---
Operations and Maintenance	---	---	---
Total	**---**	**380**	**$8,400**
Environmental Impact Savings			
Equivalent Tons of CO_2			79.7
Project Economics			
Total Capital Cost			$5,000
Simple Payback (years)			0.6
Incentives			---
Simple Payback with Incentives (years)			0.6

LCM#3 Occupancy Sensors for Lighting Control – Corridors and Large Rooms

Baseline Operation

Lighting in most corridors and some large rooms are controlled by local wall switches. This calculation uses 10 rooms to show the economics behind occupancy sensors for lighting control as this ECM can be implemented on a room-by-room basis, initially targeting those rooms with high lighting usage and varying occupancies. It assumes 6 hours of lighting saved a day for a corridor or large room occupancy sensor which controls 6, 4' fixtures with 2 T8 lamps each

Proposed Operation

Install ceiling-mounted occupancy sensors to control lighting in corridors or large rooms.

Occupancy sensor controls turn lights off when the room has been left empty, thus saving lighting energy by automating the process by which the lights are turned off. When people return to the room, the sensor turns the lights back on. Sensitivity and time-delay adjustments help to detect small movements and prevent rapid cycling of the lights due to transitory occupancy.

Occupancy sensors work by using ultrasonic and/or passive infrared sensors. Ultrasonic sensors fill the room with high-frequency sound. Movement causes the reflected sound to shift frequency, which in turn sets off the sensor. This type of sensor is well-suited to areas with tall obstacles, as it does not rely on line-of-sight. Ultrasonic sensors should not be confused with acoustic sensors which require a person to make noise in order to be detected. Passive-infrared sensors rely on moving body heat. A person must move between the vanes created by the sensor's lens in order to trigger the sensor.

Multi-tech sensors that use both infrared and ultrasonic technologies can come as a wall-mounted switch or ceiling-mounted sensor. Ceiling type sensors are more appropriate for larger open spaces.

Impact on Occupant Health, Comfort, and Safety

Properly implemented, this measure should have no appreciable impact on occupant health, comfort, or safety. Lights will switch off automatically when occupants are not present and turn back on when they are.

Technical & Physical Feasibility

Install and integrate ceiling-mounted occupancy sensors into the lighting control in appropriate spaces that currently do not have occupancy sensors. Those spaces with large lighting loads and that see the most intermittent use with lights often left on with no occupants present should be prioritized.

It may also be necessary to rewire the fixtures in corridors, to allow for some fixtures to remain independent of the occupancy sensors to provide a basic level of lighting at all times. Final lighting design should be based upon the lighting needs of the area and aesthetic preferences. A manual override may prove necessary to allow the lights to be turned off for presentations or other space uses when occupants are present.

Implementation can be done on a space-by-space basis to minimize interruption of normal operation. The more frequent turning on and off of lamps may impact lamp lifetimes but the total time spent running should decrease. Building staff should be made aware of the features of the new lighting control.

Capital Cost

The capital cost includes the cost of the ceiling-mounted occupancy sensors in 10 spaces and associated labor costs. No special considerations were made to the installation of manual overrides or corridor rewiring.

Incentives

There is a ComEd Smart Ideas incentive for occupancy sensors of $0.12 per Watt controlled. There is another incentive for bi-level stairwell/hall/garage fixtures with integrated sensors of $25 per fixture installed.

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Savings and Project Cost Summary

Type of Savings	Energy Savings (utility units)	Energy Savings (MMBtu)	Annual Cost Savings ($)
Electricity	8,000 kWh/yr	30	$490
Average Peak Electrical Demand	---	---	---
Natural Gas	---	---	---
Operations and Maintenance	---	---	---
Total	**---**	**30**	**$490**
Environmental Impact Savings			
Equivalent Tons of CO_2			5.7
Project Economics			
Total Capital Cost			$2,120
Simple Payback (years)			4.3
Incentives			$470
Simple Payback with Incentives (years)			3.4

LCM#4 Occupancy Sensors for Lighting Control – Private Offices and Small Rooms

Baseline Operation

Lighting in most private offices and small rooms are controlled by local wall switches. This calculation uses 10 rooms to show the economics behind occupancy sensors for lighting control for private offices as this ECM can be implemented on a room-by-room basis, initially targeting those rooms with high lighting usage and varying occupancies. It assumes 3 hours of lighting saved a day for a private office or small room occupancy sensor which controls 3, 4′ fixtures with 2 T8 lamps each.

Proposed Operation

Install switch-mounted occupancy sensors to control lighting in private offices and small rooms.

Occupancy sensor controls turn lights off when the room has been left empty, thus saving lighting energy by automating the process by which the lights are turned off. When people return to the room, the sensor turns the lights back on. Sensitivity and time-delay adjustments help to detect small movements and prevent rapid cycling of the lights due to transitory occupancy.

Occupancy sensors work by using ultrasonic and/or passive infrared sensors. Ultrasonic sensors fill the room with high-frequency sound. Movement causes the reflected sound to shift frequency, which in turn sets off the sensor. This type of sensor is well-suited to areas with tall obstacles, as it does not rely on line-of-sight. Ultrasonic sensors should not be confused with acoustic sensors which require a person to make noise in order to be detected. Passive-infrared sensors rely on moving body heat. A person must move between the vanes created by the sensor's lens in order to trigger the sensor.

Multi-tech sensors that use both infrared and ultrasonic technologies can come as a wall-mounted switch or ceiling-mounted sensor. In smaller spaces, switch-mounted sensors would prove a lower first cost option as they can typically be handled by in-house staff.

Impact on Occupant Health, Comfort, and Safety

Properly implemented, this measure should have no appreciable impact on occupant health, comfort, or safety. Lights will switch off automatically when occupants are not present and turn back on when they are.

Technical & Physical Feasibility

Install and integrate switch-mounted occupancy sensors into the lighting control in appropriate spaces that currently do not have occupancy sensors. Those spaces with large lighting loads and that see the most intermittent use with lights often left on with no occupants present should be prioritized.

Final lighting design should be based upon the lighting needs of the area and aesthetic preferences. A manual override may prove necessary to allow the lights to be turned off for presentations or other space uses when occupants are present.

Implementation can be done on a space-by-space basis to minimize interruption of normal operation. The more frequent turning on and off of lamps may impact lamp lifetimes but the total time spent running should decrease. Building staff should be made aware of the features of the new lighting control.

Capital Cost

The capital cost includes the cost of the switch mounted occupancy sensors in 10 spaces and associated labor costs. No special considerations were made to the installation of manual overrides.

Incentives

There is a ComEd Smart Ideas incentive for occupancy sensors of $0.12 per Watt controlled.

All incentive amounts are estimates. The amounts and applications of ComEd Smart Ideas Incentives are subject to the terms and conditions of the ComEd Smart Ideas Programs. This document in no way implies approval of incentive amounts or applications.

Savings and Project Cost Summary

Type of Savings	Energy Savings (utility units)	Energy Savings (MMBtu)	Annual Cost Savings ($)
Electricity	2,000 kWh/yr	10	$120
Average Peak Electrical Demand	---	---	---
Natural Gas	---	---	---
Operations and Maintenance	---	---	---
Total	**---**	**10**	**$120**
Environmental Impact Savings			
Equivalent Tons of CO_2			1.4
Project Economics			
Total Capital Cost			$930
Simple Payback (years)			7.8
Incentives			$240
Simple Payback with Incentives (years)			5.8

Capital-Intensive Measures

Capital-intensive measures are energy conservation, energy efficiency, or time-of-use management projects with a capital cost of greater than $10,000. These measures significantly reduce energy consumption and costs but also require significant capital investment.

ECM#1 Convert S-2 to Variable Volume

Baseline Operation

Air-handling unit S-2 is a constant volume, single zone system that serves the annex first floor lobby. It runs continuously to provide conditioning for the space.

Proposed Operation

Install VFDs on the supply and return fan motors and convert the air-handling unit to variable volume. Modify the controls of the unit so that the airflow is reset first down to a minimum before resetting the supply temperature. This type of control will typically result in higher dehumidification and increased cooling loads when dehumidifying as the supply air will typically be set at a lower temperature than when operating at constant volume. The decrease in fan energy heat gain helps to offset this increase in cooling load, however this same decrease in fan energy heat gains does slightly increase the heating load in the winter.

Variable volume systems save fan energy as most systems only see cooling loads that call for peak airflow a few times a year and at all other times airflows can be decreased.

Impact on Occupant Health, Comfort, and Safety

Properly implemented, this ECM should have no appreciable impact on occupant health, comfort, or safety. Airflows will decrease at partial loads but the minimum airflows should be selected so as to still meet code requirements. Additionally, the space will see better humidity control with a colder supply air temperature in the summer.

Technical & Physical Feasibility

As the unit serves a single zone, installation of variable volume terminal units is not necessary and all control of the airflow can take place through varying the speed of the fans.

Capital Cost

The capital cost includes the cost of installing the VFDs and tying them into the BAS.

Incentives

There is a ComEd Smart Ideas standard incentive for VFDs on motors under 200 hp of $60 per horsepower, not including redundant/backup motors.

All incentive amounts are estimates. The amounts and applications of ComEd Smart Ideas Incentives are subject to the terms and conditions of the ComEd Smart Ideas Programs. This document in no way implies approval of incentive amounts or applications.

Savings and Project Cost Summary

Type of Savings	**Energy Savings (utility units)**	**Energy Savings (MMBtu)**	**Annual Cost Savings ($)**
Electricity	137,000 kWh/yr	470	$8,400
Average Peak Electrical Demand	7 kW/mo	---	$500
Natural Gas	(290) therms/yr	(30)	($200)
Operations and Maintenance	---	---	---
Total	**---**	**440**	**$8,700**
Environmental Impact Savings			
Equivalent Tons of CO_2			96.9
Project Economics			
Total Capital Cost			$25,000
Simple Payback (years)			2.9
Incentives			$1,740
Simple Payback with Incentives (years)			2.7

ECM#2 Variable Kitchen Exhaust and Reactivation of Heat Recovery System

Baseline Operation

Currently, the kitchen hoods are served by a 100% outside air, constant volume make-up air-handling unit, F18, along with a constant volume exhaust fan. Another 100% outside air, variable volume unit, AHU-2, provides additional make-up air to the kitchen and also serves surrounding areas. The kitchen hood make-up unit can provide heating but not cooling to the supply air while the variable volume unit can provide both cooling and heating to the supply. This unit also has a heat recovery coil that is tied to

F-3. The heat recovery is currently inactive and has not worked in 20 years. Building staff indicates F18 and the kitchen exhaust fan continue to run overnight while the kitchen is not in use.

Proposed Operation

Schedule the make-up air-handling unit F18 and the kitchen exhaust fan off overnight when no cooking is taking place. A schedule of 4:00 a.m. to 7:00 p.m. daily is used in the savings estimate. Install a new pump for the heat recovery system and install new controls to reactivate the system.

Use heat and opacity sensors in the kitchen hoods to modulate exhaust and corresponding make-up airflow rates depending on usage in the kitchen, and schedule off the equipment during unoccupied periods.

Fan speed would be modulated according to exhaust air temperatures, increasing as more heat is given off by the cooking appliances. When smoke or vapor is present, the exhaust fans would go to maximum speed until these particulates are removed. A minimum speed can be set so that at all other times, a base airflow is maintained. The make-up air unit and the cafeteria unit can be controlled in conjunction with the exhaust fan so as to provide only the necessary outside air for make-up. A control system as described above will save fan electricity usage. Additionally, there will be energy savings associated with conditioning less outside air. Reactivation of the heat recovery system will provide additional savings in energy used for conditioning outside air. Control for the existing variable volume air-handling unit would need to be adjusted to match make-up air needs in the kitchen.

Impact on Occupant Health, Comfort, and Safety

Properly implemented, this ECM should have no appreciable impact on occupant health, comfort, or safety. Exhaust airflow and the corresponding make-up airflow will be adjusted based upon exhaust needs.

Technical & Physical Feasibility

Install heat and opacity sensors in kitchen hoods to modulate exhaust and corresponding make-up airflow rates. Install VFDs on the exhaust fan motor and the supply fan motors. Final control strategies should incorporate pressurization considerations for the kitchen make-up air unit and the surrounding area supply systems, ensuring the kitchen remains negatively pressurized in relation to the surrounding area by the proper amount. Scheduling of the equipment should be based on actual kitchen occupancies. Install a new pump for the heat recovery system and modify the BAS for this heat recovery system. The existing coils in place and the piping between coils are assumed to be re-used and only the pump is replaced.

The kitchen will need to be shut down for the system to be installed. Building staff should be made aware of the new system and kitchen staff should be instructed on how to use the keypad correctly.

Capital Cost

The capital cost includes the cost of installing the variable volume controls and tying them in the BAS. The VFDs for the kitchen make-up air unit and the main exhaust fan is included in the capital cost. The variable volume controller along with its opacity and temperature sensors are included in the capital cost as is an allowance for VFDs on the smaller exhaust fans. Installation of the new pump for the heat recovery system is also included. BAS programming is included for the new sequence of operations.

Incentives

There is a ComEd Smart Ideas standard incentive for kitchen demand ventilation controls of $350 per exhaust fan motor hp. There is also a Nicor Gas prescriptive rebate of $350 per exhaust fan motor

All incentive amounts are estimates. The amounts and applications of ComEd Smart Ideas Incentives are subject to the terms and conditions of the ComEd Smart Ideas Programs. This document in no way implies approval of incentive amounts or applications.

Savings and Project Cost Summary

Type of Savings	Energy Savings (utility units)	Energy Savings (MMBtu)	Annual Cost Savings ($)
Electricity	132,000 kWh/yr	450	$8,100
Average Peak Electrical Demand	---	---	---
Natural Gas	30,900 therms/yr	3,090	$18,800
Operations and Maintenance	---	---	---
Total	**---**	**3,540**	**$26,900**
Environmental Impact Savings			
Equivalent Tons of CO_2			249.3
Project Economics			
Total Capital Cost			$70,000
Simple Payback (years)			2.6
Incentives			$14,000
Simple Payback with Incentives (years)			2.1

ECM#3 Variable Primary CHW Flow

Baseline Operation

Currently, the central chilled water plant is arranged as a primary constant flow system. Whenever a chiller is in operation, it has a constant flow regardless of actual cooling loads in the system.

Proposed Operation

Add variable frequency drives to the existing primary pumps serving the electric chiller. The BAS programming should be modified, so the flow through the chillers would be varied in line with the secondary flow. The secondary pumps would continue to operate similar to the current operation.

The chilled water flow through an electric chiller can be varied within manufacturer recommended ranges. Varying the chilled water flow decreases the pumping energy associated with the chilled water. The chilled water flow through the chiller is sized for the peak capacity of the chiller and can be reduced whenever a chiller is operating at partial loads.

Impact on Occupant Health, Comfort, and Safety

Properly implemented, this ECM should have no appreciable impact on occupant health, comfort, or safety.

Technical & Physical Feasibility

A minimum flow through the chiller would need to be maintained for proper chiller operation. It is assumed to be 50% in this case. The absorption chiller would remain as constant primary flow as absorption chillers are typically not suitable for variable primary flow. The chilled water pump serving CH-3 already has a VFD, but it is set in hand. The control of this pump will need to be changed.

Three-way valves at chilled water coils would need to be modified by replacement with two-way valves or plugging the bypass port. Any other piped bypasses in the system would also need to be modified to ensure that chilled water is only bypassed to maintain minimum flows through the chillers.

Capital Cost

The capital cost includes the BAS control changes cost and the cost of installing VFDs on the three, 60 hp pumps that do not currently have VFDs. A more cost effective measure would be to install VFDs on only one or some of the pumps and preferentially run the associated chiller.

Incentives

There is a ComEd Smart Ideas standard incentive for VFDs on motors under 200 hp of $60 per horsepower, not including redundant/backup motors.

All incentive amounts are estimates. The amounts and applications of ComEd Smart Ideas Incentives are subject to the terms and conditions of the ComEd Smart Ideas Programs. This document in no way implies approval of incentive amounts or applications.

Savings and Project Cost Summary

Type of Savings	**Energy Savings (utility units)**	**Energy Savings (MMBtu)**	**Annual Cost Savings ($)**
Electricity	109,000 kWh/yr	370	$6,600
Average Peak Electrical Demand	4 kW/mo	---	$300
Natural Gas	---	---	---
Operations and Maintenance	---	---	---
Total	**---**	**370**	**$6,900**
Environmental Impact Savings			
Equivalent Tons of CO_2			78.3
Project Economics			
Total Capital Cost			$60,000
Simple Payback (years)			8.7
Incentives			$10,800
Simple Payback with Incentives (years)			7.1

ECM#4 Setback OR Airflows When Not in Use

Baseline Operation

Currently, airflow to the operating rooms is held constant at all times whether a surgery is being performed or not. There are 8 ORs at this hospital, however, only four of the eight ORs are to be included in this measure.

Proposed Operation

Install occupancy sensors and allow for the airflow rate to decrease to 15 air changes per hour when no occupants are present for four of the eight ORs. Four of the ORs are not being included as they are served by a different AHU which does not have a way to actively control the return air from the OR. The temperature and humidity set points would remain the same, allowing for the ramping up of the airflow quickly when an operating room is first occupied while maintaining the desired space conditions.

Impact on Occupant Health, Comfort, and Safety

Properly implemented, this ECM should have no appreciable impact on occupant health, comfort, or safety. The airflow to each room would be increased as necessary to provide the proper airflows.

Technical & Physical Feasibility

Install occupancy sensors and allow for the airflow rate to decrease to 15 air changes per hour when no occupants are present, and a further decrease to 7 air changes per hour if the operating room remains unoccupied for long periods. The temperature and humidity set points would remain the same, allowing for the ramping up of the airflow quickly when an operating room is first occupied while maintaining the desired space conditions.

There are two additional air-handling units that provide supplemental cooling to the ORs. Controls strategies should include considerations for these units as well. They do currently have VFDs, but they are set in hand to a specific speed. Only one of the two should need modifications as they should each be associated with a specific AHU, but the system arrangement should be verified in the field.

The remaining four ORs could be included with additional VAV terminal units on the return, but the other areas served by the air-handling unit would also require VAV terminal units, impacting project economics.

Capital Cost

The capital cost includes the cost of installing the occupancy sensors, tying them into the BAS, and adjusting the BAS control sequences.

Incentives

The ComEd Smart Ideas custom incentive savings rate of $0.07/kWh may apply. Depending upon actual project cost, the limit of not exceeding 100% cost may also apply. To qualify, the simple payback before applying the incentive must fall between 1 and 7 years. As the project cost for the simple payback can be only the incremental cost associated with achieving the energy savings and is dependent on the actual project cost and not just estimated cost, the custom incentive is still applied here.

There is an additional Nicor Gas custom rebate of $0.75 or $1 per annual therm saved depending on the total saved.

All incentive amounts are estimates. The amounts and applications of ComEd Smart Ideas Incentives are subject to the terms and conditions of the ComEd Smart Ideas Programs. This document in no way implies approval of incentive amounts or applications. Any ECM submitted for a ComEd Smart Ideas custom incentive will be subject to measurement and verification (M&V) in order to determine the savings. The calculated savings here are theoretical estimates and will require verification through pre and post implementation measurements or analyses of utility bills / meters.

Savings and Project Cost Summary

Type of Savings	Energy Savings (utility units)	Energy Savings (MMBtu)	Annual Cost Savings ($)
Electricity	26,000 kWh/yr	90	$1,600
Average Peak Electrical Demand	---	---	---
Natural Gas	3,100 therms/yr	310	$1,900
Operations and Maintenance	---	---	---
Total	**---**	**400**	**$3,500**
Environmental Impact Savings			
Equivalent Tons of CO_2			34.2
Project Economics			
Total Capital Cost			$26,000
Simple Payback (years)			7.4
Incentives			$5,700
Simple Payback with Incentives (years)			5.8

ECM#5 Parking Lot Lights Upgrades

Baseline Operation

Currently, the parking lot has approximately 190 short pole lights and 1 wallpack. The lights are off during the day.

Proposed Operation

Replace the parking lot lighting with LED fixtures. See Exhibit 3 for more information on the LED fixtures. LEDs use less energy to produce light than metal halide fixtures.

Impact on Occupant Health, Comfort, and Safety

Properly implemented, this ECM should have no appreciable impact on occupant health, comfort, or safety. Lighting levels and aesthetics may change slightly but should remain acceptable to users of the parking lots.

Technical & Physical Feasibility

Consider the lighting needs of the space and aesthetic preferences before replacement. Fixtures that see the most runtime are the best candidates for replacement as they will pay back the quickest. The savings estimate assumes a run-time of approximately 5,620 hours a year, which corresponds to when outside parking lighting would be needed to provide adequate lighting at all times, including overnight periods. The savings estimate includes the cost associated with replacement as lamps burn out.

Capital Cost

The capital cost includes the costs associated with fixture retrofit, including the labor costs.

Incentives

The ComEd Smart Ideas standard incentive for outdoor LED fixture installation of $0.50 per Watt reduced.

All incentive amounts are estimates. The amounts and applications of ComEd Smart Ideas Incentives are subject to the terms and conditions of the ComEd Smart Ideas Programs. This document in no way implies approval of incentive amounts or applications.

Savings and Project Cost Summary

Type of Savings	**Energy Savings (utility units)**	**Energy Savings (MMBtu)**	**Annual Cost Savings ($)**
Electricity	198,000 kWh/yr	680	$12,100
Average Peak Electrical Demand	---	---	---
Natural Gas	---	---	---
Operations and Maintenance	---	---	$600
Total	**---**	**680**	**$12,700**
Environmental Impact Savings			
Equivalent Tons of CO_2			142.2
Project Economics			
Total Capital Cost			$130,000
Simple Payback (years)			10.2
Incentives			$17,610
Simple Payback with Incentives (years)			8.8

ECM#6 Street Light Upgrades

Baseline Operation

Currently, the street adjacent to the parking lot has approximately 15 tall pole lights. The lights are off during the day.

Proposed Operation

Replace the street lights with LED fixtures. LEDs use less energy to produce light than metal halide fixtures.

Impact on Occupant Health, Comfort, and Safety

Properly implemented, this ECM should have no appreciable impact on occupant health, comfort, or safety. Lighting levels and aesthetics may change slightly but should remain acceptable to drivers.

Technical & Physical Feasibility

Consider the lighting needs of the space and aesthetic preferences before replacement. Fixtures that see the most runtime are the best candidates for replacement as they will pay back the quickest. The savings estimate assumes a run-time of approximately 5,620 hours a year, which corresponds to when outside street lights would be needed to provide adequate lighting at all times, including overnight periods. The savings estimate includes the cost associated with replacement as lamps burn out.

Capital Cost

The capital cost includes the costs associated with fixture retrofit, including the labor costs and the added cost of a lift to replace the lights at the top of the tall poles.

Incentives

The ComEd Smart Ideas standard incentive for outdoor LED fixture installation of $0.50 per Watt reduced.

All incentive amounts are estimates. The amounts and applications of ComEd Smart Ideas Incentives are subject to the terms and conditions of the ComEd Smart Ideas Programs. This document in no way implies approval of incentive amounts or applications.

Savings and Project Cost Summary

Type of Savings	**Energy Savings (utility units)**	**Energy Savings (MMBtu)**	**Annual Cost Savings ($)**
Electricity	20,000 kWh/yr	70	$1,200
Average Peak Electrical Demand	---	---	---
Natural Gas	---	---	---
Operations and Maintenance	---	---	$450
Total	**---**	**70**	**$1,650**
Environmental Impact Savings			
Equivalent Tons of CO_2			14.4
Project Economics			
Total Capital Cost			$10,000
Simple Payback (years)			6.1
Incentives			$1,740
Simple Payback with Incentives (years)			5.0

ECM#7 Remove Triple Duty Valves and Install VFDs on Pump Motors

Baseline Operation

Currently, the triple duty valves on constant speed condenser water pumps CWP-1, CWP-2, and CWP-3 are all approximately 70% closed. These pumps serve chillers CH-1 and CH-2.

A comprehensive survey of every pump in the hospital was not performed as part of this study, and additional candidates may exist which are currently constant speed pumps with mostly closed triple duty valves.

Proposed Operation

Remove the triple duty valves and install VFDs on the pump motors. With the removal of a static pressure drop, the pump would need to be rebalanced at a lower speed while maintaining the correct flow. The pump can be set in hand to a specific speed and the system would continue to operate as a constant volume system. It may be possible to convert the system to a variable volume system, but chiller condenser water systems are typically constant volume.

A more cost effective option may be to leave the triple duty valves in place and simply open them to 100% open, but this allows for the possibility of being closed again in the future. A small pressure drop associated with the triple duty valve would remain even at 100% open. Another option would be to trim the pump impeller so that it is a different size. An impeller can be trimmed to within manufacturer recommended limits. Some pump efficiency is sacrificed as the casing remains the same size while the impeller size is decreased, leaving more of a gap between the impeller and the casing, and savings would be less than with a VFD.

Impact on Occupant Health, Comfort, and Safety

Properly implemented, this ECM should have no appreciable impact on occupant health, comfort, or safety.

Technical & Physical Feasibility

A triple duty valve is adjusted during balancing so that the proper flow at the proper static pressure is provided to the water loop. The valve acts as a pressure drop as the pump is essentially oversized for system needs. Removing the pressure drop by removing the valve and adding a variable frequency drive will save energy, as the pump will be sized appropriately for the system and the extra pressure drop can be removed.

Capital Cost

The capital cost includes the cost of removing the existing triple duty valves, installing VFDs on the pump motors, and rebalancing the system. Three, 40 hp VFDs are included in the cost. It may be more cost effective to install VFDs on only 2 of the 3 pumps and let one remain as back-up and preferentially run the other two pumps.

Incentives

There is a ComEd Smart Ideas standard incentive for VFDs on motors under 200 hp of $60 per horsepower, not including redundant/backup motors. As the system is not being converted to variable volume, the standard VFD incentive may not apply but is included here.

All incentive amounts are estimates. The amounts and applications of ComEd Smart Ideas Incentives are subject to the terms and conditions of the ComEd Smart Ideas Programs. This document in no way implies approval of incentive amounts or applications.

Savings and Project Cost Summary

Type of Savings	Energy Savings (utility units)	Energy Savings (MMBtu)	Annual Cost Savings ($)
Electricity	40,000 kWh/yr	140	$2,400
Average Peak Electrical Demand	13 kW/mo	---	$1,000
Natural Gas	---	---	---
Operations and Maintenance	---	---	---
Total	**---**	**140**	**$3,400**
Environmental Impact Savings			
Equivalent Tons of CO_2			28.7
Project Economics			
Total Capital Cost			$29,000
Simple Payback (years)			8.5
Incentives			$7,200
Simple Payback with Incentives (years)			6.4

Other Measures Considered

The following section of this report indicates those measures which require a capital investment and pertain to projects that are either outside the scope of the study or would result in energy savings that would not justify implementation based on the information currently available.

Sequence Chillers Automatically through the BAS

Currently, the chillers are sequenced manually by building staff. Automating the start/stop sequences of the chillers would allow for optimal staging of the chillers based on maximizing plant efficiency. The current control system would most likely not allow for BAS automation and new controllers would be needed. As typical current manual operation is to run the newest, most efficient chiller first, savings are somewhat limited, but an automated process may simplify plant operation for building staff.

Install Larger RO System for Steam Boilers

Currently, the reverse osmosis (RO) water filtering system serving the steam boiler feedwater system is only roughly 30% of the needed capacity. A larger RO system would allow for a reduction in blowdown, saving both water and heating energy. Blowdown is needed to remove impurities left behind as water is evaporated. An RO system helps to remove these impurities before water is sent to the boiler and reduces the needed blowdown. As this ECM would not directly save electricity usage, it was not included in this report.

BAS Lighting Control

Integrate lighting control into the BAS to allow for automatic scheduling of lighting to match building occupancies. As the cost of initial BAS connection is high and re-wiring of lighting fixtures may prove necessary, this ECM has a long payback. Consider using local timers instead of BAS integration to save on cost. In general, lighting needs should be monitored on a regular basis to avoid areas where lighting is consistently on when no occupants are present.

Addressable Ballasts and Lighting Controls

Install addressable ballasts to allow for additional lighting controls. Such ballasts can also be dimmable, to allow for daylighting and reduced lighting levels when appropriate. As the cost of addressable ballasts is initially high, expected savings will not pay back quickly. If future retrofits are being done which include installing new lighting, consider using addressable ballasts.

Install Med Gas Compressors with Variable Frequency Drives

The hospital contains a number of medical gas compressors of varying sizes. As med gas compressors are replaced with new systems due to failure, consider installing compressors outfitted with VFDs.

Envelope Upgrades

Typically, the high initial cost of envelope upgrades does not pay back solely from an energy savings perspective but anytime upgrades are necessary, from either an infrastructure standpoint or to limit infiltration, select the upgrades with considerations for energy usage.

Heat Pump DHW Production

An efficient method of producing DHW is to utilize a heat pump chiller. Although this approach will increase electricity consumption, the incremental savings for installing a high-efficiency heat pump compared to a conventional unit may be eligible for incentives from ComEd. Steam usage would also be reduced. Obstacles to implementation are the hot water storage needed to match heat pump capacity with DHW demands, as well as additional electricity supply requirements.

Convert Hot Water Circulation Pumps to Variable Volume with VFDs

Convert water circulation loops to variable volume by using VFDs. As most of the hot water circulation pumps are relatively small, potential savings are low compared to the capital cost.

Cooling Coil Condensate Recovery

Condensate formed on cooling coils can be recovered and used for landscaping or cooling tower purposes. The installation of such a system would require new pumps as well as additional piping to tie the systems together. Such installation costs are high compared to the water cost savings available by recovering the condensate.

NEXT STEPS

This report has identified a number of measures to reduce energy consumption and energy costs. As you prioritize your energy efficiency projects, keep in mind that many energy efficiency projects will qualify for incentives from ComEd's *Smart Ideas for Your Business*® program.

"Standard" or predetermined incentives are available for a wide range of standard lighting, HVAC, refrigeration, and other types of equipment upgrades. "Custom" incentives are available for projects tailored to your situation and are based on the project's actual kWh savings.

If enough measures are implemented to receive $50,000 in incentives, then the amount of Service Provider fee that was contributed by the Owner will be refunded. This only applies to ComEd electricity incentives. Gas incentives are not applicable toward the refund.

On the ComEd website (www.ComEd.com/BizInentives) you'll find:

- Fact sheets about energy efficiency measures and how to participate in *Smart Ideas for Your Business*®
- Case studies that show how companies in the ComEd service area have reduced energy consumption and energy costs with incentives to improve their projects' ROI
- Applications for incentives, with instructions and equipment specifications

Receiving incentives is a straightforward process:

1. Reserve your incentive funds
2. Complete your project
3. Submit final application
4. Receive your check

The Smart Ideas team is available at no cost to help you at all stages of your energy efficiency efforts:

- To help you identify the project(s) that will give you the fastest savings and payback.
- To help you locate and get proposals from Smart Ideas Trade Allies—experienced contractors that are trained on the *Smart Ideas for Your Business*® program and paperwork.
- To help you use the incentives you can get from Smart Ideas to "sell" your project internally and get internal approvals.
- To help you complete and submit your paperwork.

Contact the *Smart Ideas for Your Business*® team at 888-806-2273 or SmartIDeasBiz@ComEd.com.

ACKNOWLEDGEMENTS

Grumman/Butkus Associates (G/BA) would like to express its appreciation to Richard Palmer, Daniel Fleming, Jorge DeSousa, Samuel Alasu, Bogdan Hanek, Kevin O'Hagen, Mike Fiore, John Franke, Cedric Everett, and Mike Roy for their assistance in the collection and/or provision of data and information on which this study is based.

Additional engineering analyses and assistance with the preparation of this report were provided by Heather Beaudoin, Alex Schultz, David Eldridge, and David Nelson of G/BA.

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EXHIBIT 1

Recent Utility Bills

Constellation
An Exelon Company

North Shore University Health System
Po Box 351
Evanston, IL 60204

CNE CUSTOMER ID	STATEMENT NO.	PAGE
IL_37380	0011957582	1 of 8
CNE ACCOUNT ID	**STATEMENT DATE**	**DUE DATE**
1-EC-3708	10/17/2013	11/06/2013

For questions or comments, please contact Customer Care at (888)635-0827 Monday through Friday 7:00 am to 7:00 pm Central Standard Time, or email us at customercare@constellation.com.

When contacting Constellation, please reference the CNE ACCOUNT ID found at the top of this page.

ACCOUNT BALANCE	
PREVIOUS STATEMENT DATE	09/20/2013
PREVIOUS BALANCE	$117,852.97
PAYMENTS SINCE LAST INVOICE	$-117,852.97
DEBITS/CREDITS SINCE LAST INVOICE	$0.00
LATE/FINANCE FEE	$0.00
CURRENT CHARGES	$93,856.09
TOTAL AMOUNT DUE	$93,856.09

Pay

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Cedric Everett AP# 1052129

Cedric Everett 10-21-13

WIRE TRANSFER INFORMATION:
Constellation NewEnergy, Inc.
ABA-ACH #111000012, ABA-WIRE #026009593
ACCT;#4426223690
BANK: Bank of America

REMITTANCE ADDRESS:
Constellation NewEnergy, Inc.
14217 Collections Center Dr.
Chicago IL, 60693

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Payment Due

November						
S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

CNE CUSTOMER ID	STATEMENT NO.	DUE DATE
IL_37380	0011957582	11/06/2013
CNE ACCOUNT ID	**STATEMENT DATE**	**AMOUNT DUE**
1-EC-3708	10/17/2013	$93,856.09

Additional charges per the terms of your contract will be applied to the Total Amount Due if payment is not received on or before the due date.

Aramark Evanston Hospital
NorthShore University HealthSystem - 0198190000
Po Box 351
Evanston, IL 60204

NORTH SHORE UNIVERSITY HEALTH SYST000000000001-EC-3708001195758200093856092

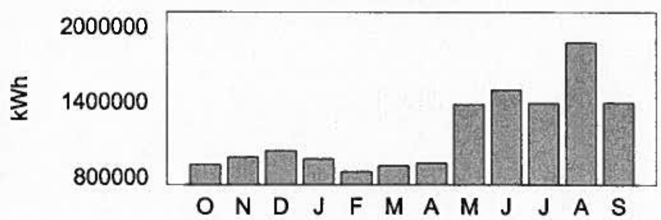
Constellation.
An Exelon Company

North Shore University Health System
Po Box 351
Evanston, IL 60204

CNE CUSTOMER ID	STATEMENT NO.	PAGE
IL_37380	0011957582	
CNE ACCOUNT ID	**STATEMENT DATE**	**DUE DATE**
1-EC-3708	10/17/2013	11/06/2013

SITE NAME	NorthShore University HealthSystem - 0198190000
SERVICE LOCATION	2100 Pfingsten Rd Glenview, IL 60026-1301
COMED ACCOUNT ID	0198190000
INVOICE ID	0011957582-0001
kWh	1,370,428.86
SERVICE PERIOD	09/16/2013 to 10/14/2013
PRODUCT	Electric Full Requirements ATC

12 MONTH HISTORY



METER NO(S). 140279173

Contract Charges						
Contract Energy Charge ATC	1,370,428.86	kWh at	0.0347400	$/kWh	$47,608.70	
Subtotal Contract Charges					**$47,608.70**	
Line Losses						
Line Loss Charge ATC (5.37% Loss)	73,592.03	kWh at	0.0347400	$/kWh	$2,556.59	
Subtotal Line Losses					**$2,556.59**	
Market Charges						
Fixed RTO Charge	1,370,428.86	kWh at	0.0073400	$/kWh	$10,058.95	
Subtotal Market Charges					**$10,058.95**	
Subtotal Charges from Constellation NewEnergy						**$60,224.24**
Charges from UDC Charges						
Utility Charges (see attached statement for details)					$33,631.85	
Subtotal Charges from UDC Charges						**$33,631.85**
Total Amount Due To Constellation NewEnergy						**$93,856.09**

1221 Lamar St., Suite 750, Houston, TX 77010
FOR CUSTOMER SERVICE CALL (888) 635-0827
customercare@constellation.com

ComEd
An Exelon Company

Utility Distribution Charges

Name	NorthShore University HealthSystem - 0198190000
Service Location	2100 Pfingsten Rd
COMED Account ID	0198190000
Amount Due	$33,631.85

Read	Meter	Load	Reading	Meter Reading			
Date	Number	Type	Type	Previous	Present	Mult x	Usage
10/15/2013	079034582	General Service	Total kWh	ACT	ACT		278,715.74
10/15/2013	079034582	General Service	Off Pk kWh	ACT	ACT		157,670.86
10/15/2013	079034582	General Service	On Pk kW	ACT	ACT		459.65
10/15/2013	093726442	General Service	Off Pk kWh	ACT	ACT		46,179.94
10/15/2013	093726442	General Service	Total kWh	ACT	ACT		84,031.49
10/15/2013	093726442	General Service	On Pk kW	ACT	ACT		189.29
10/15/2013	097138565	General Service	Off Pk kWh	ACT	ACT		113,245.85
10/15/2013	097138565	General Service	Total kWh	ACT	ACT		210,021.48
10/15/2013	097138565	General Service	On Pk kW	ACT	ACT		795.89
10/15/2013	141180826	General Service	Off Pk kWh	ACT	ACT		4,028.23
10/15/2013	141180826	General Service	Total kWh	ACT	ACT		7,304.34
10/15/2013	141180826	General Service	On Pk kW	ACT	ACT		10.13
10/15/2013	141375702	General Service	Off Pk kWh	ACT	ACT		121,549.18
10/15/2013	141375702	General Service	Total kWh	ACT	ACT		214,168.43
10/15/2013	141375702	General Service	On Pk kW	ACT	ACT		337.39
10/15/2013	141375703	General Service	Total kWh	ACT	ACT		135,832.57
10/15/2013	141375703	General Service	Off Pk kWh	ACT	ACT		67,699.91
10/15/2013	141375703	General Service	On Pk kW	ACT	ACT		379.22
10/15/2013	141375704	General Service	Total kWh	ACT	ACT		78,249.13
10/15/2013	141375704	General Service	Off Pk kWh	ACT	ACT		43,815.06
10/15/2013	141375704	General Service	On Pk kW	ACT	ACT		159.26
10/15/2013	141461160	General Service	Off Pk kWh	ACT	ACT		37,477.80
10/15/2013	141461160	General Service	Total kWh	ACT	ACT		66,467.16
10/15/2013	141461160	General Service	On Pk kW	ACT	ACT		111.60
10/15/2013	141461203	General Service	Total kWh	ACT	ACT		63,912.18
10/15/2013	141461203	General Service	Off Pk kWh	ACT	ACT		38,255.82
10/15/2013	141461203	General Service	On Pk kW	ACT	ACT		94.44
10/15/2013	141468072	General Service	Off Pk kWh	EST	ACT		114,769.62
10/15/2013	141468072	General Service	Total kWh	EST	ACT		230,918.76
10/15/2013	141468072	General Service	On Pk kW	EST	ACT		548.64
10/15/2013	141536781	General Service	Off Pk kWh	ACT	ACT		41.34
10/15/2013	141536781	General Service	Total kWh	ACT	ACT		41.34
10/15/2013	141536781	General Service	On Pk kW	ACT	ACT		0.00
10/15/2013	141600622	General Service	Off Pk kWh	ACT	ACT		350.57
10/15/2013	141600622	General Service	Total kWh	ACT	ACT		766.23
10/15/2013	141600622	General Service	On Pk kW	ACT	ACT		1.67

Rate Class - Retail Delivery Service - 1000 kW to 10 MW			Service 09/16/2013 To 10/15/2013 - 29 Days	
Customer Charge	0.00			$592.17
Standard Metering Charge	0.00			$20.04
Distribution Facilities Charge	3,087.19	kW	5.15	$15,899.03
Single Bill Option Credit	0.00			$-0.45
IL Electricity Distribution Charge	1,370,429.00	kWh	0.0012	$1,644.51
Meter Lease	0.00			$180.63
Nonstandard Facilities Charge	0.00			$2,945.99
Environmental Cost Recovery Adj	1,370,429.00	kWh	0.00039	$534.47
Energy Efficiency Programs	1,370,429.00	kWh	0.00175	$2,398.25
Franchise Cost	21,277.07	DO	0.03741	$795.98
State Tax	0.00			$3,929.38
Municipal Tax	0.00			$4,691.85
Total Current Charges	0.00			$33,631.85

THIS IS NOT AN INVOICE - DO NOT PAY

We are required by your utility to include these charges for informational purpose only.
Constellation NewEnergy, Inc. is responsible for payment of the Total Current Charges.
Questions? 24 hours a day, call 1-800-Edison-1(1-800-334-7661)

Invoice Date:	18-Jun-2014	**Invoice Number:**	201405-I-001663
Due Date:	28-Jun-2014	**Customer ID:**	NORTHSHOREUN
Production Month:	5 / 2014	**Account Number:**	5000004821
		Customer Number:	50243
PO Number(s):			

Northshore University Healthsystem
Attn: Accounts Payable
C/O ARAMARK Healthcare
P.O. Box 351
Evanston, IL 60203

Please see bottom of invoice for remittance information.

ETC ProLiance Energy, LLC
is now Constellation ProLiance, LLC

Pipeline	Meter	Description	Stat.	Quantity	Price	AmountDue
MAY 2014						
NICOR GAS	C&I Pool	C&I Nicor Pool	Act	20,898 Dth	$4.86800	$101,731.46
NICOR GAS	C&I Pool	C&I Nicor Pool	Act	3,969 Dth	$4.64100	$18,420.13
		Burner Tip Bills				$27,289.50
		Late Charge For March Production				$366.67
		Current Totals		24,867 Dth		$147,807.76

Recap:

Total Actual	$120,151.59
Total Other Cost	$27,656.17
Net Amount Due	$147,807.76

If you have any questions or concerns on this invoice, please contact Customer One at our toll free number 1-8PROLIANCE (1-877-654-2623) or e-mail ProlianceCustomerOne@Constellation.com.

Please Send EFT Transactions To:
Wells Fargo Bank
Houston, TX
Bank Account #9651481492
WIRE ABA #121000248
ACH ABA #041203824

Please Remit Check by US Mail To:
Constellation ProLiance, LLC
PO Box 951439
Dallas, TX 75395-1439

Please Remit Check by Overnight To:
Constellation ProLiance, LLC
PO Box 951439
2975 Regent Blvd
Irving, TX 75063

ACCOUNT DETAIL

Account #	Account Address	Metered Therms	Therms Grossed Up For Fuel Loss	Quantity (Dth)	ProLiance Charges	Utility Charges	Total Charges
0638350000	1301 Central St - Evanston	6,383.29	6,504.27	650	$3,150.23	$856.71	$4,006.94
5599350000	2650 Ridge Ave - Evanston	132,154.71	134,659.37	13,466	$65,263.16	$12,133.36	$77,396.52
0934650000	2100 Pfingsten Rd - Glenview	63,680.82	64,887.73	6,489	$31,449.03	$8,224.04	$39,673.07
9804350000	9600 Gross Point Rd - Skokie	991.19	1,009.98	101	$489.50	$184.51	$674.01
7981204231	9600 Gross Point Rd (Power Plant) - Skokie	40,839.12	41,613.12	4,161	$20,166.34	$5,890.88	$26,057.22
		244,049.13	248,674.47	24,867	$120,518.26	$27,289.50	$147,807.76

Nicor Gas

Gas Transportation Customer Service Center P.O. Box 190 Aurora, IL 60507-0190 (630) 983-4040

CURRENT CALCULATIONS

SET #: 7322

NAME: GLENBROOK HOSPITAL
MAILING ADDRESS: 111 MONUMENT CIR STE 2200
INDIANAPOLIS IN 46204-5112

FOR SERVICE AT: 2100 PFINGSTEN RD
GLENVIEW

SERVICE
FROM: 05/01/14
TO: 06/01/14
ISSUED: 06/03/14

GROUP: 5513
ACCOUNT NO.: 0934650000

RATE: 74

TRANSPORT ID: 5513

OF DAYS: 31

METER READINGS PRESENT	PREVIOUS	GAS METERED	DISPL	FACTORS TEMP	PRESS	SUPER	GAS DELIVERED	BTU	THERMS
4528030E	4465720	62310	1.0000	1.000	1.000	1.000	62310	1.022	63,680.82 (1)

TOTAL METERED	63,680.82
LESS NOMINEE TRANSPORTATION THERMS	63,680.82 (2)
NI-GAS SUPPLIED	0.00
MAXIMUM DAILY CONTRACT QUANTITY	5,191.00
STORAGE BANKING SERVICE CAPACITY	166,112.00
CRITICAL DAY SBS RIGHTS (THERMS)	2,682.71

MAILING ADDRESS:

GLENBROOK HOSPITAL
111 MONUMENT CIR STE 2200
INDIANAPOLIS IN 46204-5112

Nicor Gas

Gas Transportation Customer Service Center P.O. Box 190 Aurora, IL 60507-0190 (630) 983-4040

CURRENT CALCULATIONS

SET #: 7322

CUSTOMER: GLENBROOK HOSPITAL
ACCOUNT NO.: 0934650000

SERVICE FROM: 5/01/14
TO: 6/01/14

	THERMS	RATE		DOLLARS
TRANSPORTATION ADMINISTRATION				10.00
MONTHLY CUSTOMER CHARGE				137.11
RECORDING DEVICE CHARGE				17.00
GOV. AGENCY COMPENSATION ADJ				.02
ENERGY EFFICIENCY PROGRAMS	63,680.82	.0211		1,343.67
FRANCHISE COST ADJUSTMENT				.23
DISTRIBUTION CHARGE:				
STEP 1	150.00	.1071	16.07	
STEP 2	4,850.00	.0420	203.70	
STEP 3	58,680.82	.0349	2,047.96	
TOTAL DISTRIBUTION CHARGE				2,267.73
STORAGE BANKING SERVICE CHARGE	166,112.00	.0035		581.39
ENVIRONMENT COST	63,680.82	.0082		522.18
TRANSPORTATION SERV ADJUSTMENT	63,680.82	-.0003		19.10-
TOTAL CHARGES BEFORE TAXES				4,860.23
	DOLLARS	RATE		
STATE REVENUE TAX	4,860.23	.0500		243.01
STATE UTILITY FUND TAX	4,860.23	.0010		4.86
MUNICIPAL TAX	4,860.23	.0515		250.30
MUNICIPAL GAS USE TAX	63,680.82	.0450		2,865.64
CURRENT TOTAL - SEE GAS SERVICE BILL FOR ACCOUNT BALANCE				$8,224.04

FOOTNOTES:

(1) SEE SUMMARY OF STORAGE ACTIVITY FOR DETAIL.

(2) DETERMINED BY GROUP TRANSPORTATION THERMS DELIVERED DIVIDED BY TOTAL THERMS DELIVERED. SUBJECT TO SUPPLIER BILLING.

NOTE: ALL QUANTITIES ARE IN THERMS.
FOR COMPARISON PURPOSES, THE GAS SUPPLY CHARGE (GSC) FOR THIS BILLING PERIOD IS .6800 PER THERM.

Nicor Gas

Gas Transportation Customer Service Center P.O. Box 190 Aurora, IL 60507-0190 (630) 983-4040

SUMMARY OF DAILY USAGE

SET #: 7322

CUSTOMER: GLENBROOK HOSPITAL
ACCOUNT NO.: 0934650000

SERVICE FROM: 5/01/14
TO: 6/01/14

DATE	DAILY USAGE	NOMINEE SUPPLIED THERMS	ACCUMULATED COMPANY SUPPLIED	AUTHORIZED EXCESS RECEIVED	UNAUTHORIZED EXCESS RECEIVED
5-01	2,360.82	2,360.82	0.00	0.00	0.00
5-02	2,391.48	2,391.48	0.00	0.00	0.00
5-03	2,503.90	2,503.90	0.00	0.00	0.00
5-04	2,565.22	2,565.22	0.00	0.00	0.00
5-05	2,565.22	2,565.22	0.00	0.00	0.00
5-06	2,299.50	2,299.50	0.00	0.00	0.00
5-07	1,992.90	1,992.90	0.00	0.00	0.00
5-08	1,849.82	1,849.82	0.00	0.00	0.00
5-09	1,972.46	1,972.46	0.00	0.00	0.00
5-10	1,829.38	1,829.38	0.00	0.00	0.00
5-11	1,911.14	1,911.14	0.00	0.00	0.00
5-12	1,808.94	1,808.94	0.00	0.00	0.00
5-13	2,166.64	2,166.64	0.00	0.00	0.00
5-14	2,279.06	2,279.06	0.00	0.00	0.00
5-15	2,503.90	2,503.90	0.00	0.00	0.00
5-16	2,575.44	2,575.44	0.00	0.00	0.00
5-17	2,514.12	2,514.12	0.00	0.00	0.00
5-18	2,013.34	2,013.34	0.00	0.00	0.00
5-19	1,992.90	1,992.90	0.00	0.00	0.00
5-20	1,757.84	1,757.84	0.00	0.00	0.00
5-21	1,798.72	1,798.72	0.00	0.00	0.00
5-22	1,819.16	1,819.16	0.00	0.00	0.00
5-23	1,982.68	1,982.68	0.00	0.00	0.00
5-24	1,931.58	1,931.58	0.00	0.00	0.00
5-25	1,737.40	1,737.40	0.00	0.00	0.00
5-26	1,706.74	1,706.74	0.00	0.00	0.00
5-27	1,645.42	1,645.42	0.00	0.00	0.00
5-28	1,768.06	1,768.06	0.00	0.00	0.00
5-29	1,829.38	1,829.38	0.00	0.00	0.00
5-30	1,839.60	1,839.60	0.00	0.00	0.00
5-31	1,768.06	1,768.06	0.00	0.00	0.00
	63,680.82	63,680.82		0.00	0.00

Nicor Gas

Gas Transportation Customer Service Center P.O. Box 190 Aurora, IL 60507-0190 (630) 983-4040

SET #: 7322

ACCOUNT NUMBER 0934650000 3
Issue Date 6/03/14
Rate 74 TRANSPORT SVC HEAT

Customer GLENBROOK HOSPITAL
Meter Number 0325730

Service Address 2100 PFINGSTEN RD GLENVIEW

BILLING PERIOD 5/01/14 to 6/01/14, 31 Days

Total Current Bill due on 7/21/14 $ 8,224.04

Please see the enclosed calculation sheet(s) for a detailed description of your current charges.

ACCOUNT SUMMARY

	Total Current Bill	$	8,224.04
	Previous Account Balance	$	22,447.55
5/12/14	Payment Received, Thank you	$	-12,404.32
5/20/14	Payment Received, Thank you	$	-10,043.23
	Total Due	$	8,224.04

Your safety is important to us. Ask to see an employee ID when our field team is working in or around your premises. Also, verify your account information with customer service before making a transaction over the phone.

ENERGY PROFILE	This year
Average daily cost	$265.29
Average daily therms	2,054.22

QUESTIONS ABOUT YOUR GAS SERVICE?
Customer Service 630 983-4040
Your account number is: 0934650000 3 9

Detach and return this portion with payment

Nicor Gas™
An AGL Resources Company

ACCOUNT NO.
0934650000 3

Total Amount Due
$8,224.04

GLENBROOK HOSPITAL
111 MONUMENT CIR STE 2200
INDIANAPOLIS IN 46204-5112

BILL PAYMENT CENTER
Nicor Gas
P.O. BOX 5407
CAROL STREAM, IL 60197-5407

Please do not mark or write below this line

09 34 65 0000 3 0008224040 0008224040 9

EXHIBIT 2

Floorplans

Advanced Technologies Group, Inc.
FACILITY INFORMATION CONSULTANTS
377 East Butterfield Road, Suite 900 Lombard, IL 60148
atginc@atginc.com

FLOOR
BASEMENT
SECTION 1 OF 1

NORTHSHORE UNIVERSITY HEALTHSYSTEM GLENBROOK HOSPITAL

GLENBROOK, IL.

DATE: Nov 20, 2012 – 2:21:57 PM

PLAN
SPACE UTILIZATION

DRAWN BY	SHEET NUMBER
X.X.	SP–0B
CHECKED BY X.X.	

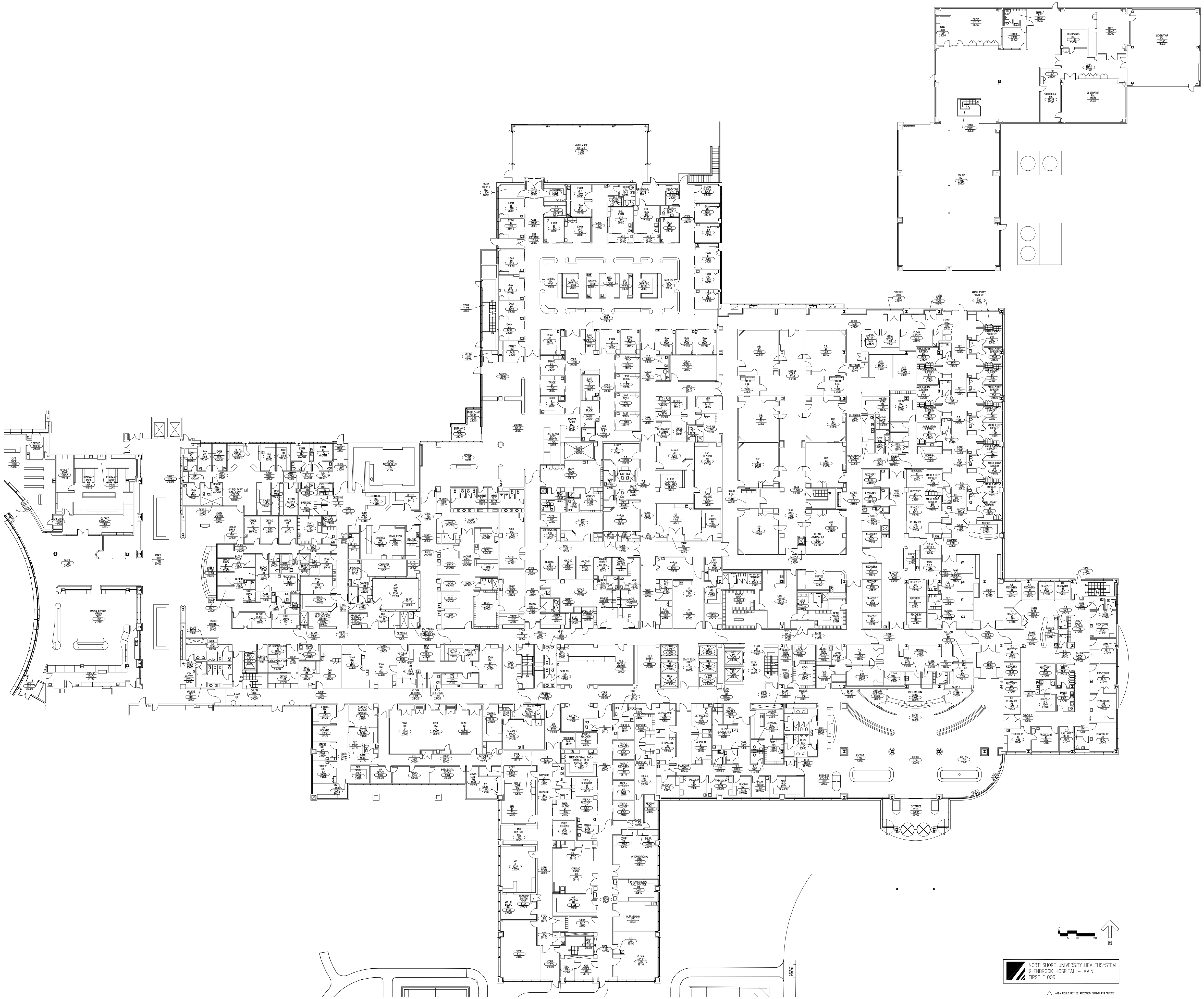
GENERAL NOTES

- △1 AREA COULD NOT BE ACCESSED BY ONE SURVEY MEMBER
- △2 AREA COULD NOT BE ACCESSED BY TWO SURVEY MEMBERS
- △3 AREA UNDER CONSTRUCTION

KEY PLAN

NORTHSHORE UNIVERSITY HEALTHSYSTEM
GLENBROOK HOSPITAL – MAIN
BASEMENT

△ AREA COULD NOT BE ACCESSED DURING ATG SURVEY



NORTHSHORE UNIVERSITY HEALTHSYSTEM
GLENBROOK HOSPITAL – MAIN
FIRST FLOOR

△ AREA COULD NOT BE ACCESSED DURING ATG SURVEY

Advanced Technologies Group, Inc.
FACILITY INFORMATION CONSULTANTS
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atginc@atginc.com

FLOOR
FIRST FLOOR
SECTION 1 OF 1

NORTHSHORE UNIVERSITY HEALTHSYSTEM
GLENBROOK HOSPITAL

GLENBROOK, IL.

DATE: Nov 20, 2012 – 2:19:59 PM

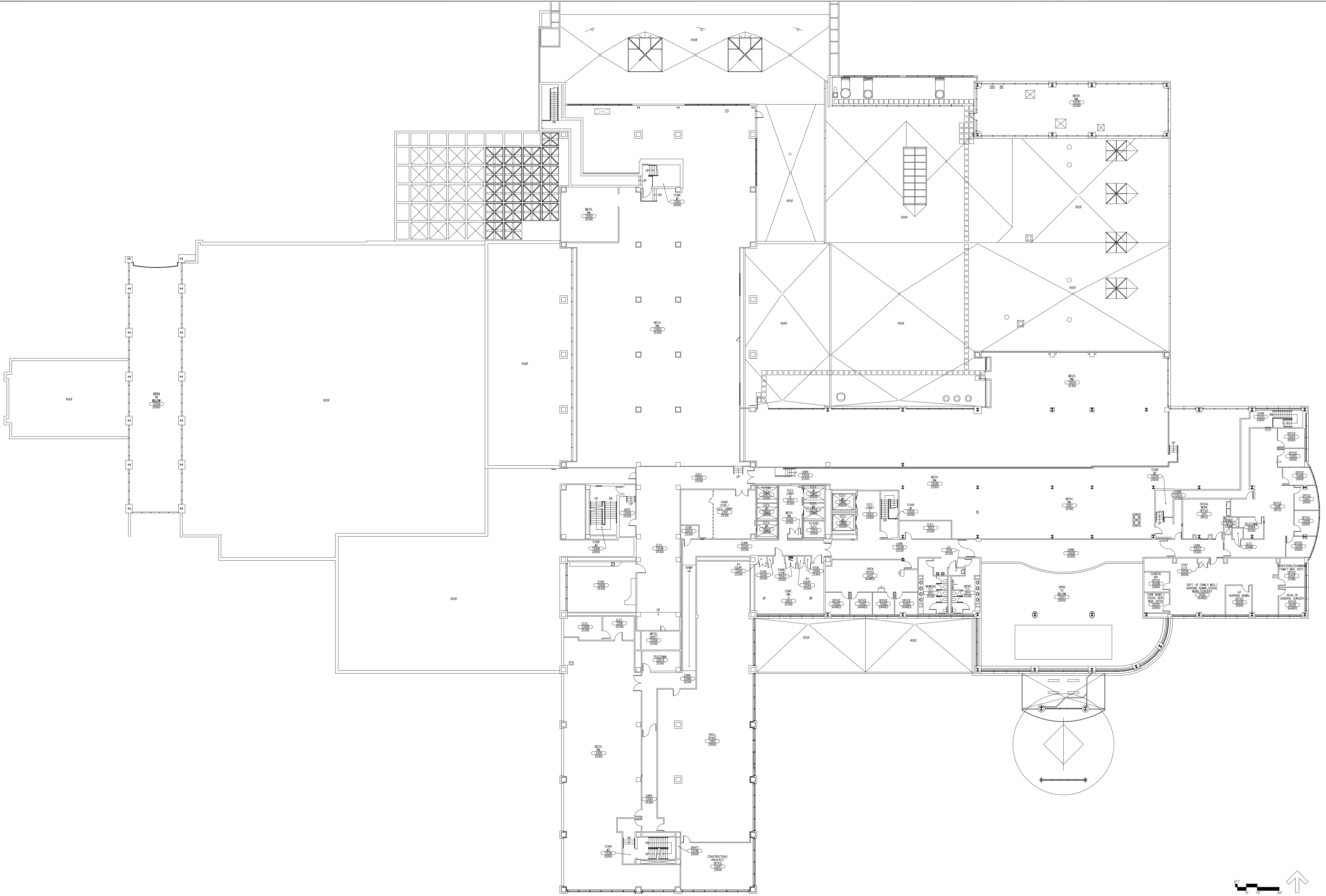
PLAN
SPACE UTILIZATION

DRAWN BY X.X.	SHEET NUMBER
CHECKED BY X.X.	SP–01

GENERAL NOTES

△ AREA COULD NOT BE ACCESSED DURING ATG SURVEY

KEY PLAN



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atginc@atginc.com

FLOOR
SECOND FLOOR
SECTION 1 OF 1

NORTHSHORE UNIVERSITY HEALTHSYSTEM
GLENBROOK HOSPITAL

GLENBROOK, IL.

DATE: Nov 20, 2012 – 2:08:19 PM

PLAN
SPACE UTILIZATION

DRAWN BY X.X.	SHEET NUMBER
CHECKED BY X.X.	SP–02

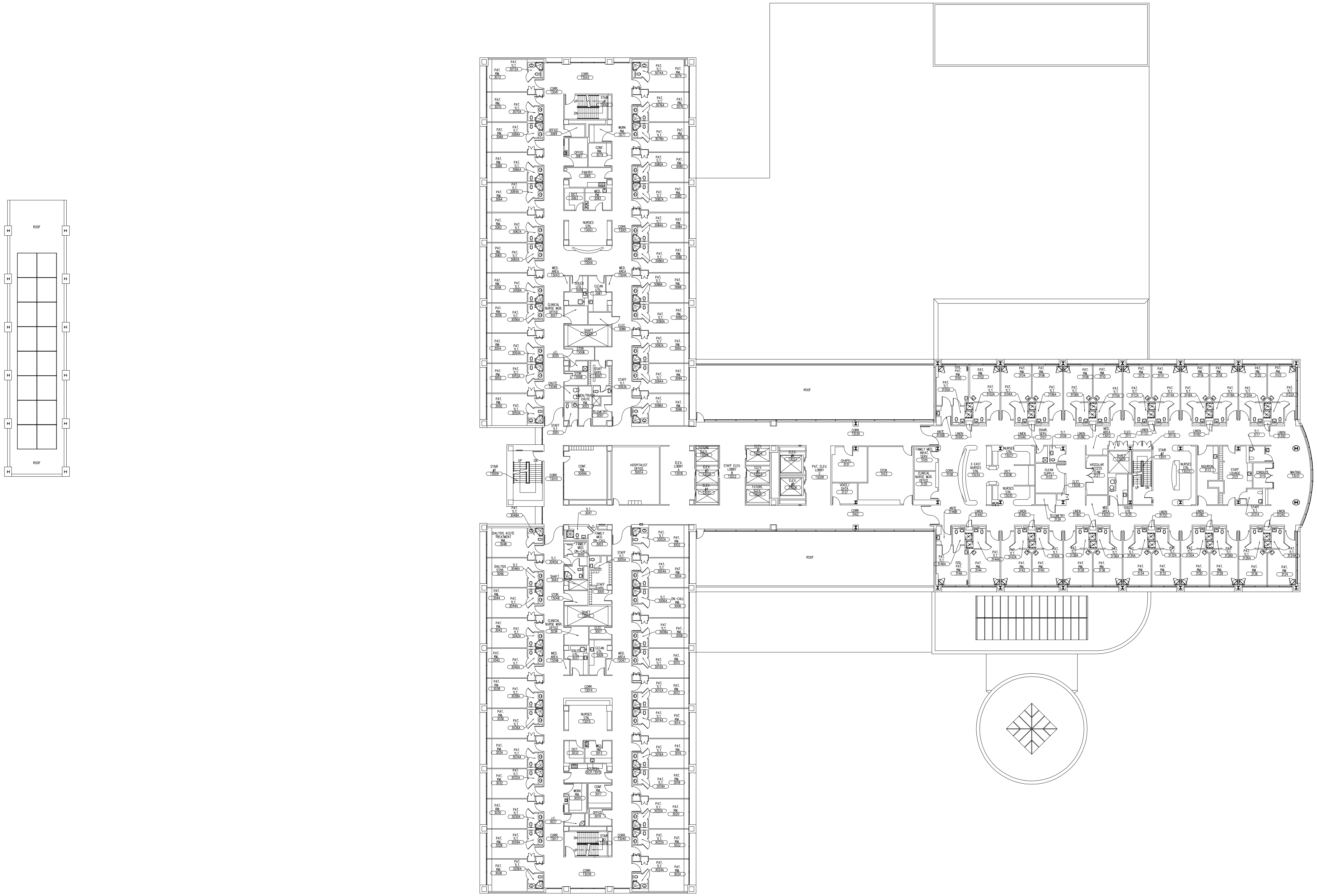
GENERAL NOTES

1. AREA COULD NOT BE ACCESSED BY ONE SURVEY MEMBER
2. AREA COULD NOT BE ACCESSED BY TWO SURVEY MEMBERS
3. AREA UNDER CONSTRUCTION

KEY PLAN

NORTHSHORE UNIVERSITY HEALTHSYSTEM
GLENBROOK HOSPITAL – MAIN
SECOND FLOOR

AREA COULD NOT BE ACCESSED DURING ATG SURVEY



Advanced Technologies Group, Inc.

FACILITY INFORMATION CONSULTANTS

377 East Butterfield Road, Suite 900 Lombard, IL 60148
atginc@atginc.com

FLOOR

THIRD FLOOR

SECTION 1 OF 1

NORTHSHORE UNIVERSITY HEALTH SYSTEM GLENBROOK HOSPITAL

GLENBROOK, IL.

DATE: Nov 20, 2012 - 2:09:14 PM

PLAN

SPACE UTILIZATION

DRAWN BY X.X.

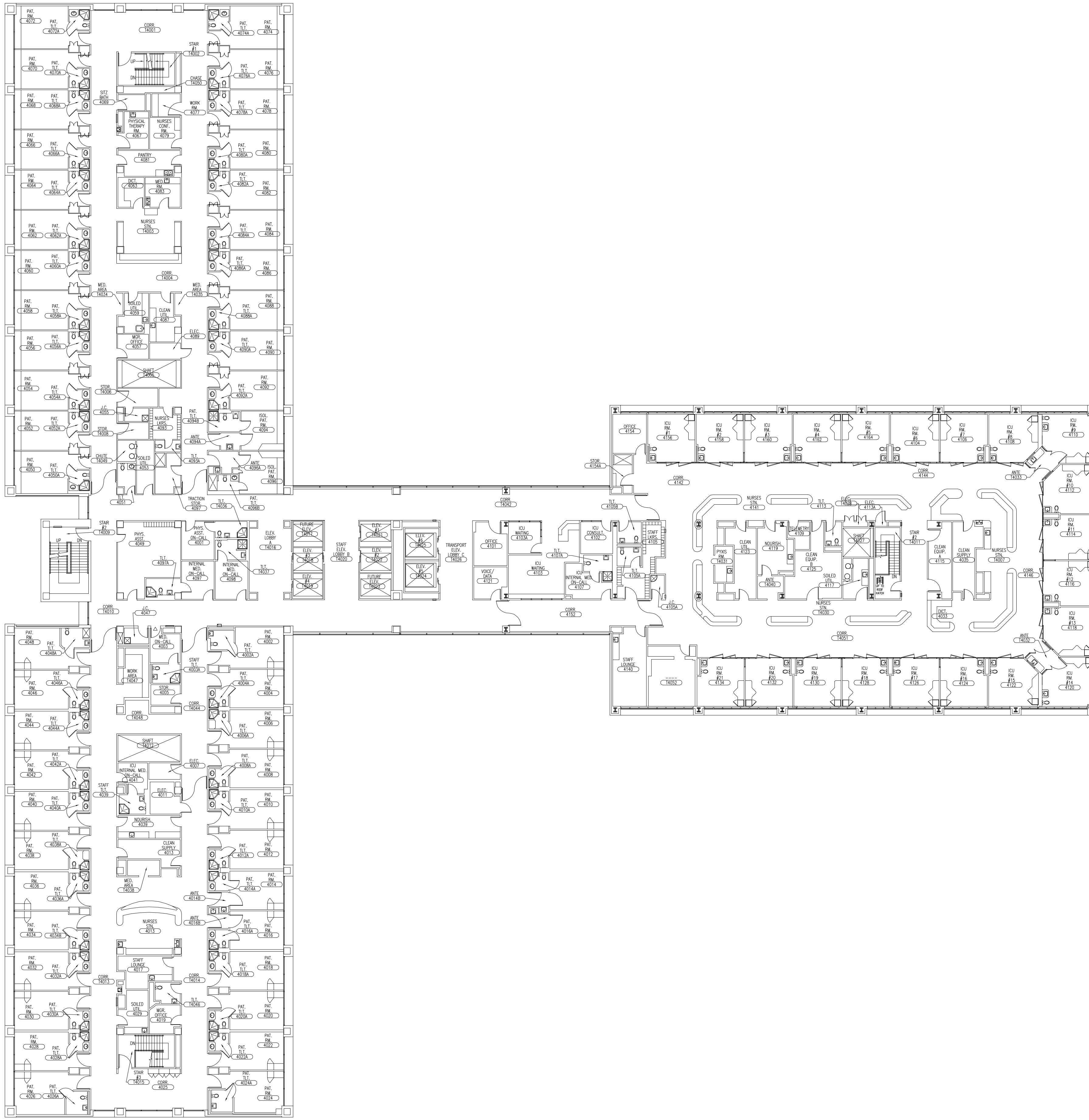
CHECKED BY X.X.

SHEET NUMBER SP-03

GENERAL NOTES

△ AREA COULD NOT BE ACCESSED ON ATG SURVEY

KEY PLAN



Advanced Technologies Group, Inc.
FACILITY INFORMATION CONSULTANTS

377 East Butterfield Road, Suite 900 Lombard, IL 60148
atginc@atginc.com

FLOOR
FOURTH FLOOR
SECTION 1 OF 1

NORTHSHORE UNIVERSITY HEALTH SYSTEM
GLENBROOK HOSPITAL

GLENBROOK, IL.

DATE: Nov 20, 2012 – 2:10:01 PM

PLAN
SPACE UTILIZATION

DRAWN BY
X.X.

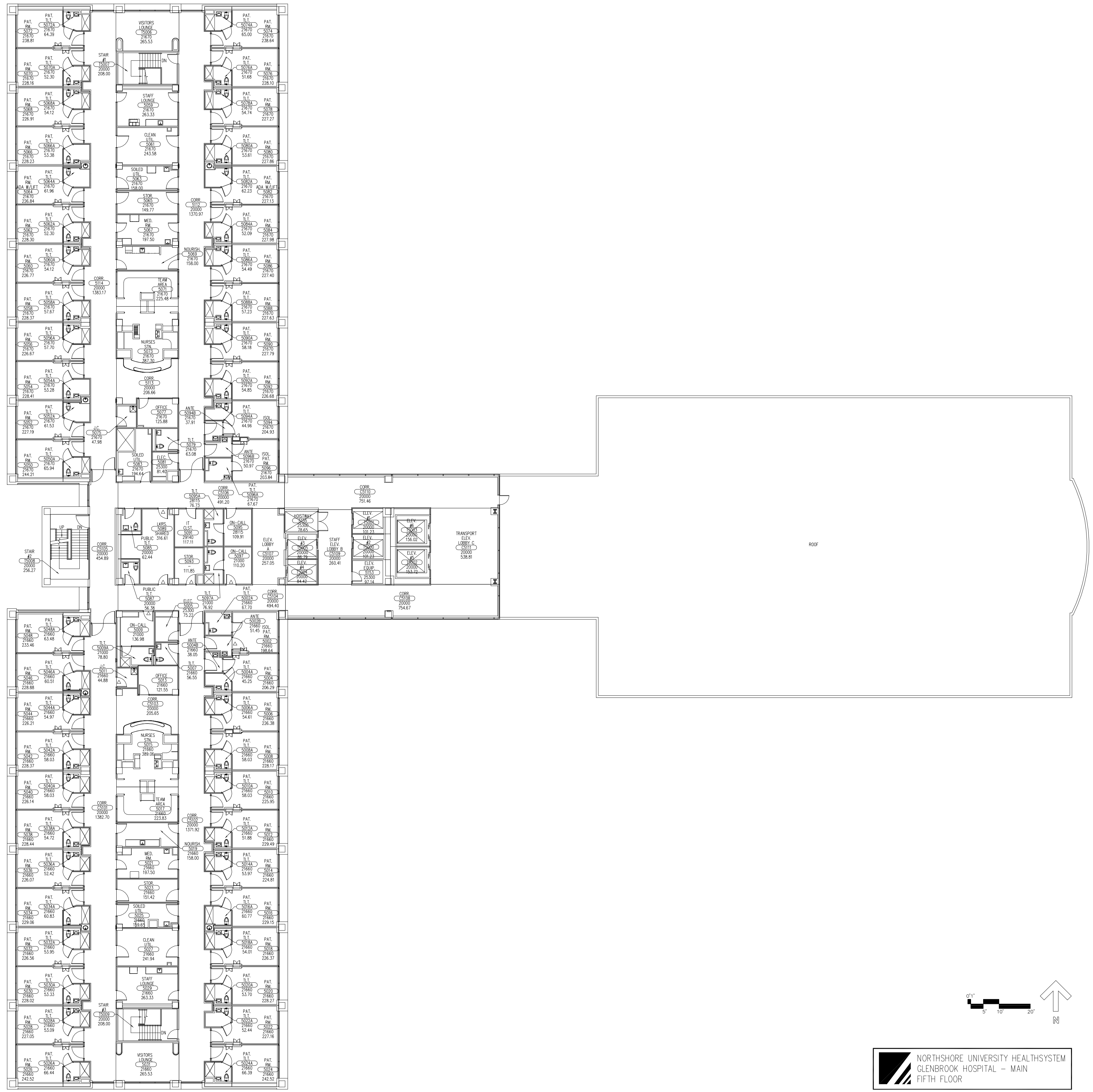
CHECKED BY
X.X.

SHEET NUMBER
SP–04

GENERAL NOTES

△ AREA COULD NOT BE ACCESSED ON ATG SURVEY

KEY PLAN



Advanced Technologies Group, Inc.
FACILITY INFORMATION CONSULTANTS
377 East Butterfield Road, Suite 900 Lombard, IL 60148
atginc@atginc.com

FLOOR
FIFTH FLOOR
SECTION 1 OF 1

NORTHSHORE UNIVERSITY HEALTH SYSTEM
GLENBROOK HOSPITAL

GLENBROOK, IL.

DATE: Nov 20, 2012 - 2:10:01 PM

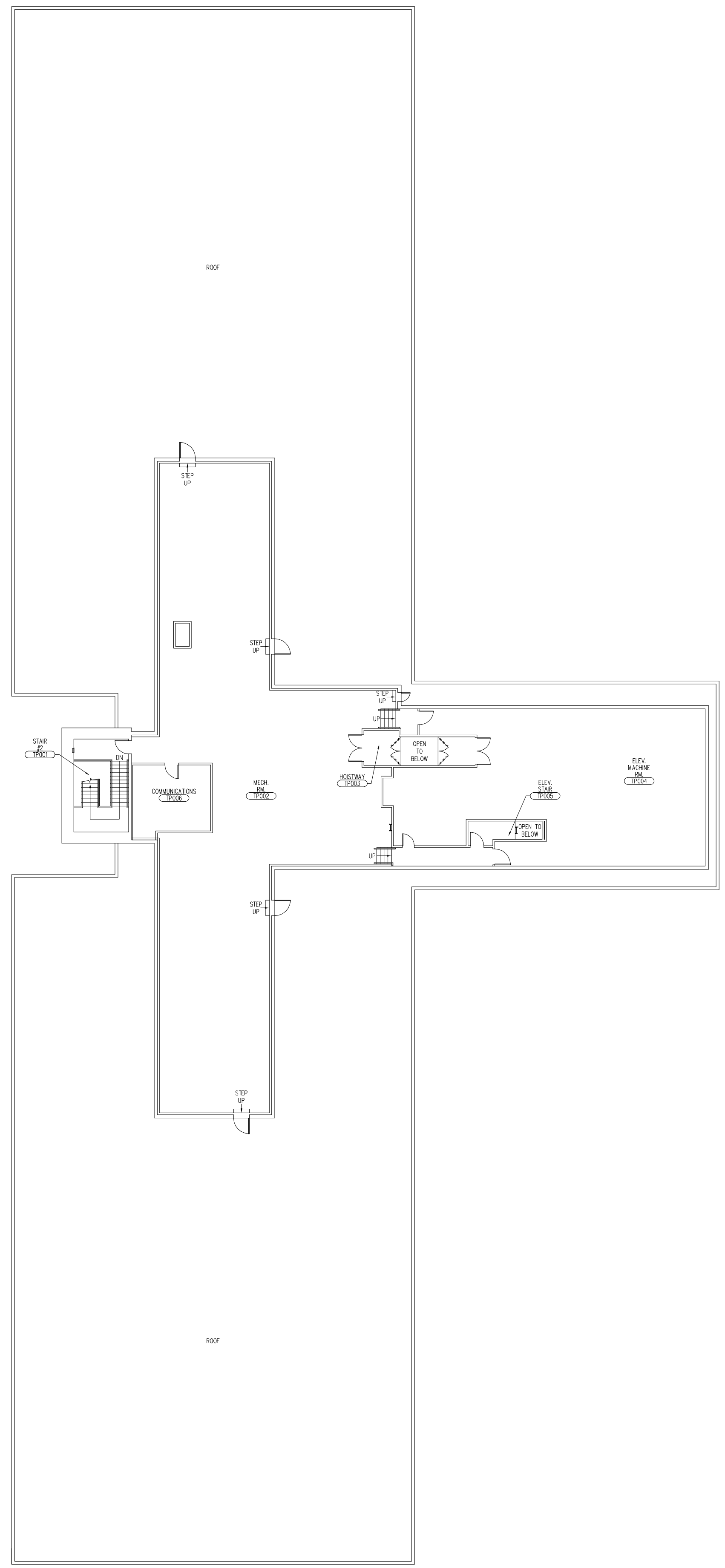
PLAN
SPACE UTILIZATION

DRAWN BY
X.X.
CHECKED BY
X.X.
SHEET NUMBER
SP-05

GENERAL NOTES
△ AREA COULD NOT BE ACCESSED ON ATG SURVEY

KEY PLAN

NORTHSHORE UNIVERSITY HEALTHSYSTEM
GLENBROOK HOSPITAL - MAIN
FIFTH FLOOR



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377 East Butterfield Road, Suite 900 Lombard, IL 60148
atginc@atginc.com

FLOOR
PENTHOUSE
SECTION 1 OF 1

NORTHSHORE UNIVERSITY HEALTH SYSTEM
GLENBROOK HOSPITAL

GLENBROOK, IL.

DATE: Nov 27, 2013 - 10:41:09 AM

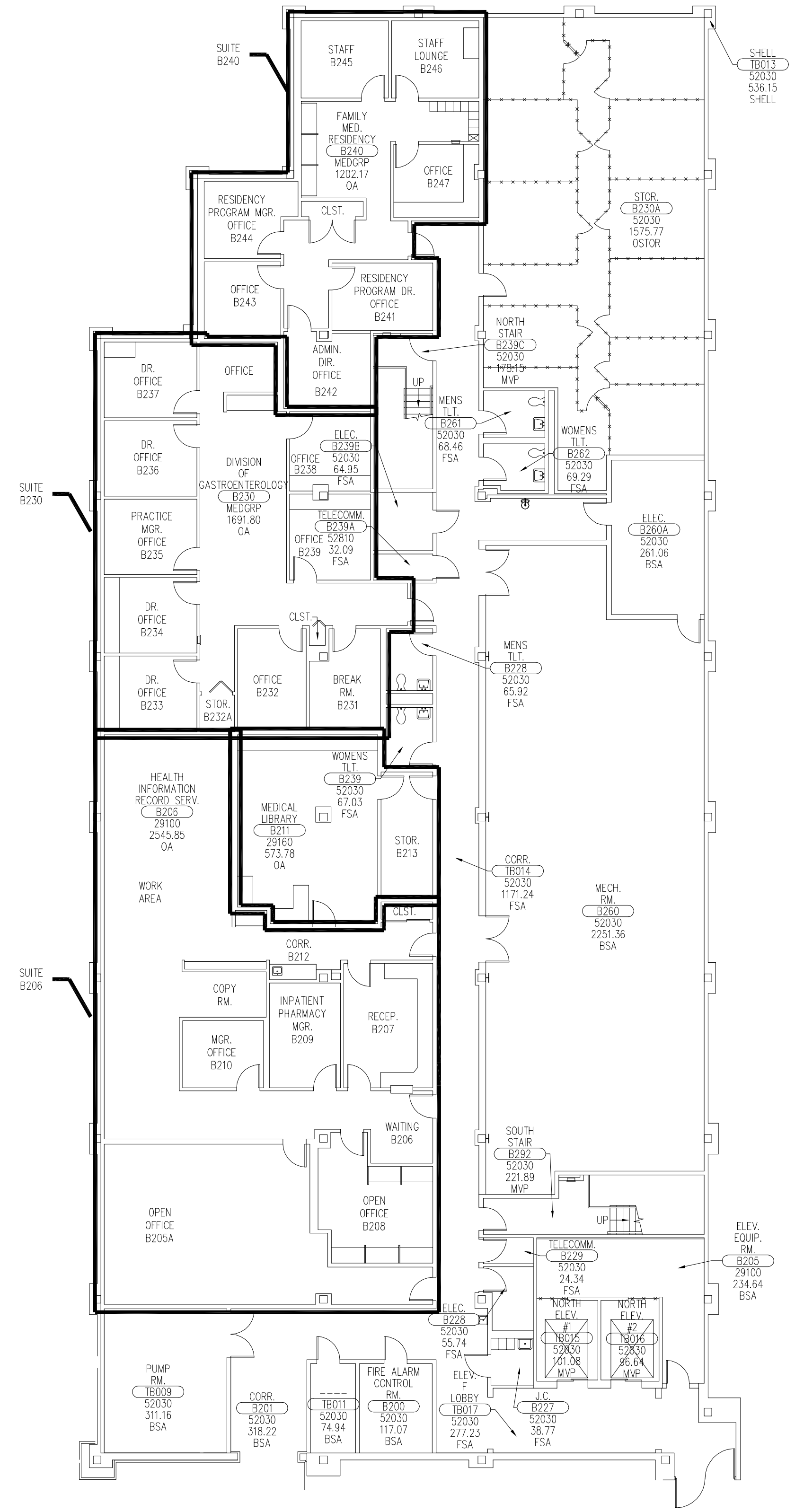
PLAN
SPACE UTILIZATION

DRAWN BY X.X.
CHECKED BY X.X.
SHEET NUMBER SP-PH

GENERAL NOTES

△ AREA COULD NOT BE ACCESSED ON ATG SURVEY

KEY PLAN



SPACE DEFINITION LEGEND	
MVP	MAJOR VERTICAL PENETRATION
OA	OCCUPANT AREA
OSTOR	OCCUPANT STORAGE
BAA	BUILDING AMENITY AREA
BSA	BUILDING SERVICE AREA
FAA	FLOOR AMENITY AREA
FSA	FLOOR SERVICE AREA
PARK	PARKING

NORTHSHORE UNIVERSITY HEALTHSYSTEM
GLENBROOK HOSPITAL – NORTH MOB
BASEMENT

△ AREA COULD NOT BE ACCESSED DURING ATG SURVEY

Advanced Technologies Group, Inc.
FACILITY INFORMATION CONSULTANTS
377 East Butterfield Road, Suite 900 Lombard, IL 60148
atginc@atginc.com

FLOOR
BASEMENT
SECTION 1 OF 1

EVANSTON NORTHWESTERN GLENBROOK HOSPITAL NORTH MOB

EVANSTON, ILLINOIS

DATE: Nov 20, 2012 – 1:22:59 PM

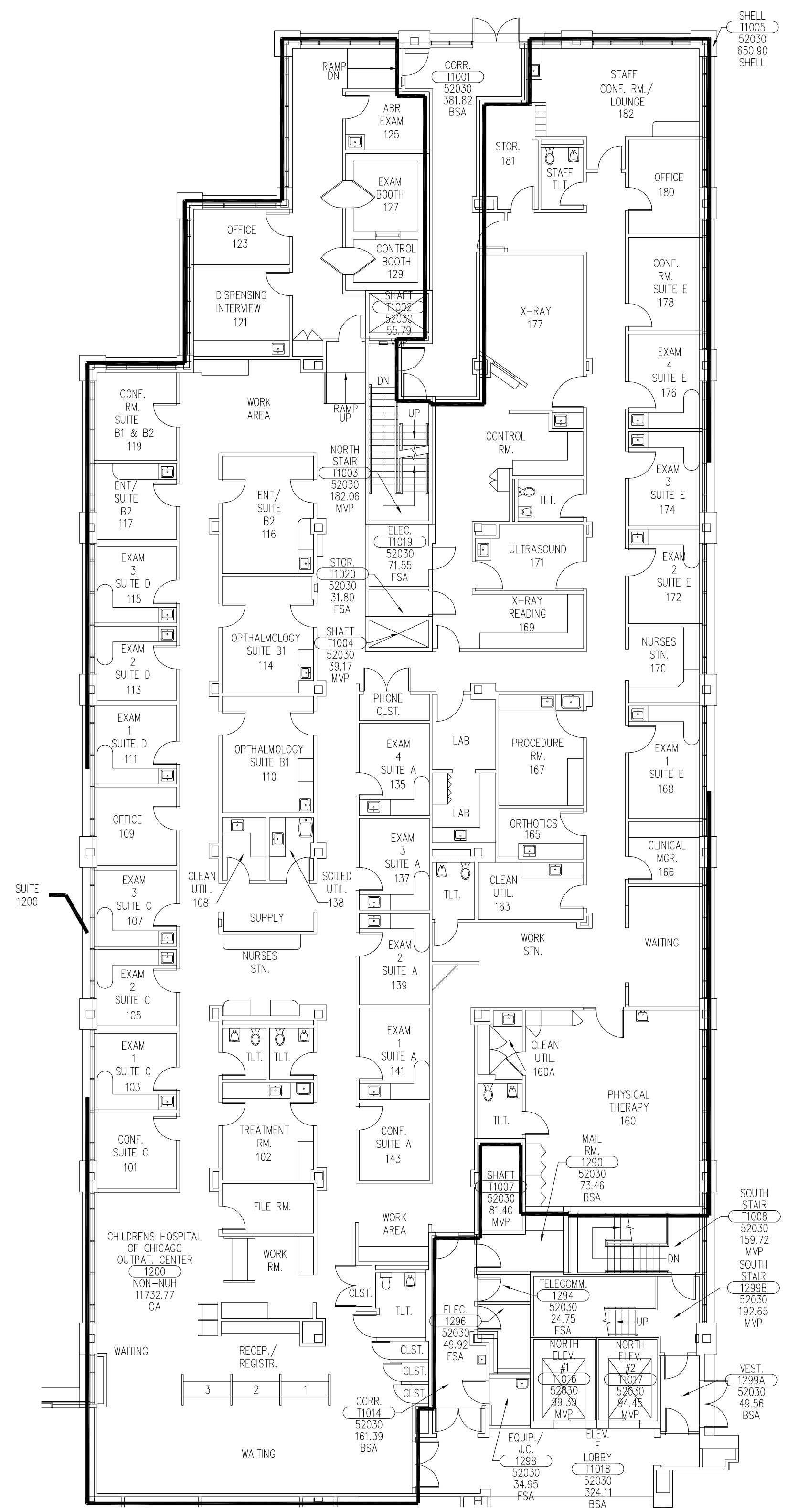
PLAN
SPACE UTILIZATION

DRAWN BY X.X.
CHECKED BY X.X.
SHEET NUMBER SP-0B

GENERAL NOTES

1. AREA COULD NOT BE ACCESSED BY ONE SURVEY MEMBER
2. AREA COULD NOT BE ACCESSED BY TWO SURVEY MEMBERS
3. AREA UNDER CONSTRUCTION

KEY PLAN



0'1' 5' 10' 20' N

SPACE DEFINITION LEGEND	
MVP	MAJOR VERTICAL PENETRATION
OA	OCCUPANT AREA
OSTOR	OCCUPANT STORAGE
BAA	BUILDING AMENITY AREA
BSA	BUILDING SERVICE AREA
FAA	FLOOR AMENITY AREA
FSA	FLOOR SERVICE AREA
PARK	PARKING

NORTHSHORE UNIVERSITY HEALTHSYSTEM
GLENBROOK HOSPITAL – NORTH MOB
FIRST FLOOR

AREA COULD NOT BE ACCESSED DURING ATG SURVEY

Advanced Technologies Group, Inc.
FACILITY INFORMATION CONSULTANTS
377 East Butterfield Road, Suite 900 Lombard, IL 60148
atginc@atginc.com

FLOOR
FIRST FLOOR
SECTION 1 OF 1

EVANSTON NORTHWESTERN
GLENBROOK HOSPITAL
NORTH MOB

EVANSTON, ILLINOIS

DATE: Apr 30, 2012 – 4:36:06 PM

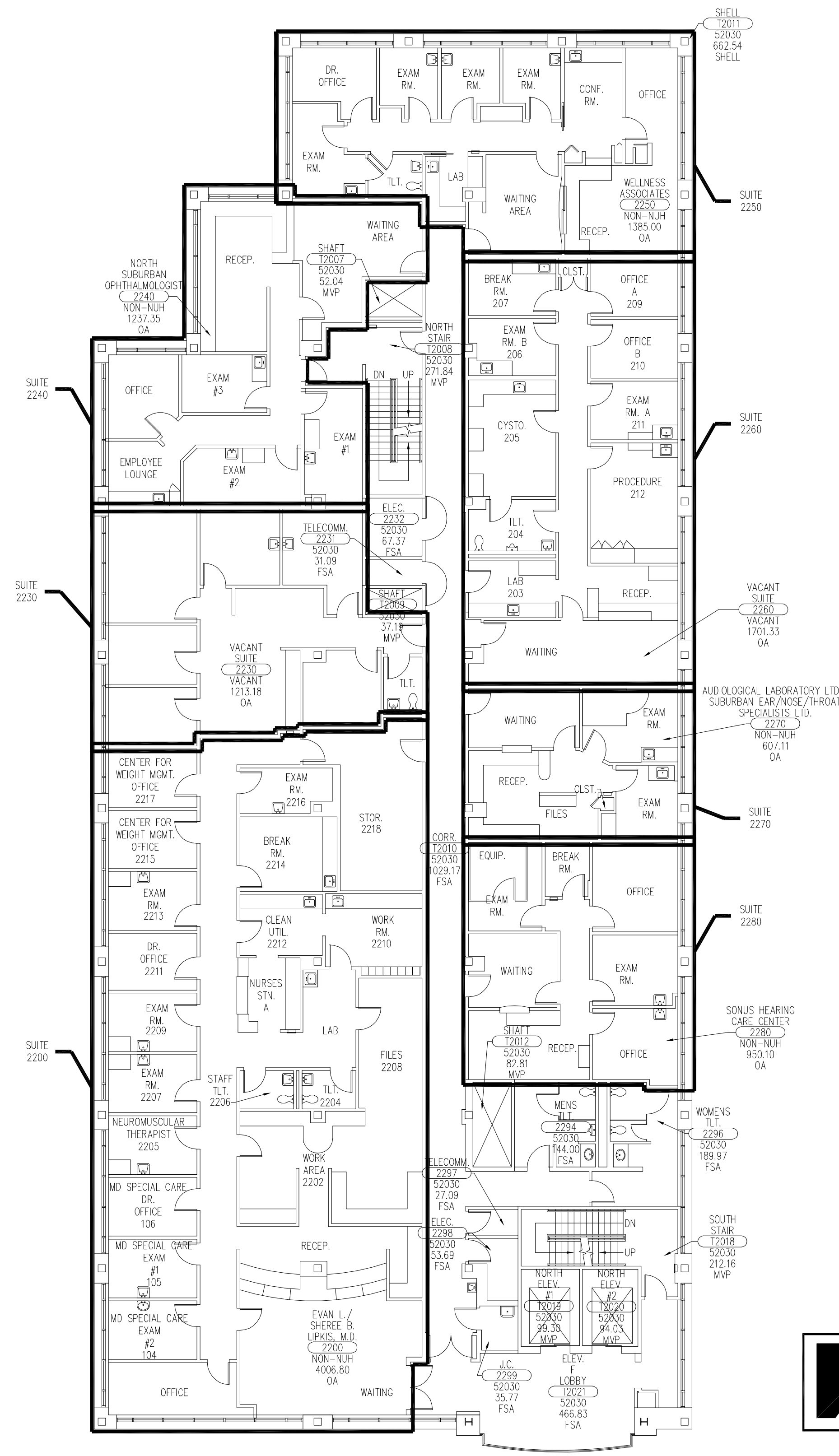
PLAN
SPACE UTILIZATION

DRAWN BY X.X.
CHECKED BY X.X.
SHEET NUMBER SP-01

GENERAL NOTES

1. AREA COULD NOT BE ACCESSED BY ONE SURVEY MEMBER
2. AREA COULD NOT BE ACCESSED BY TWO SURVEY MEMBERS
3. AREA UNDER CONSTRUCTION

KEY PLAN



SPACE DEFINITION LEGEND	
MVP	MAJOR VERTICAL PENETRATION
OA	OCCUPANT AREA
OSTOR	OCCUPANT STORAGE
BAA	BUILDING AMENITY AREA
BSA	BUILDING SERVICE AREA
FAA	FLOOR AMENITY AREA
FSA	FLOOR SERVICE AREA
PARK	PARKING

NORTHSHORE UNIVERSITY HEALTHSYSTEM
GLENBROOK HOSPITAL – NORTH MOB
SECOND FLOOR

△ AREA COULD NOT BE ACCESSED DURING ATG SURVEY

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atginc@atginc.com

FLOOR
SECOND FLOOR
SECTION 1 OF 1

EVANSTON NORTHWESTERN
GLENBROOK HOSPITAL
NORTH MOB

EVANSTON, ILLINOIS

DATE: Apr 30, 2012 – 4:36:27 PM

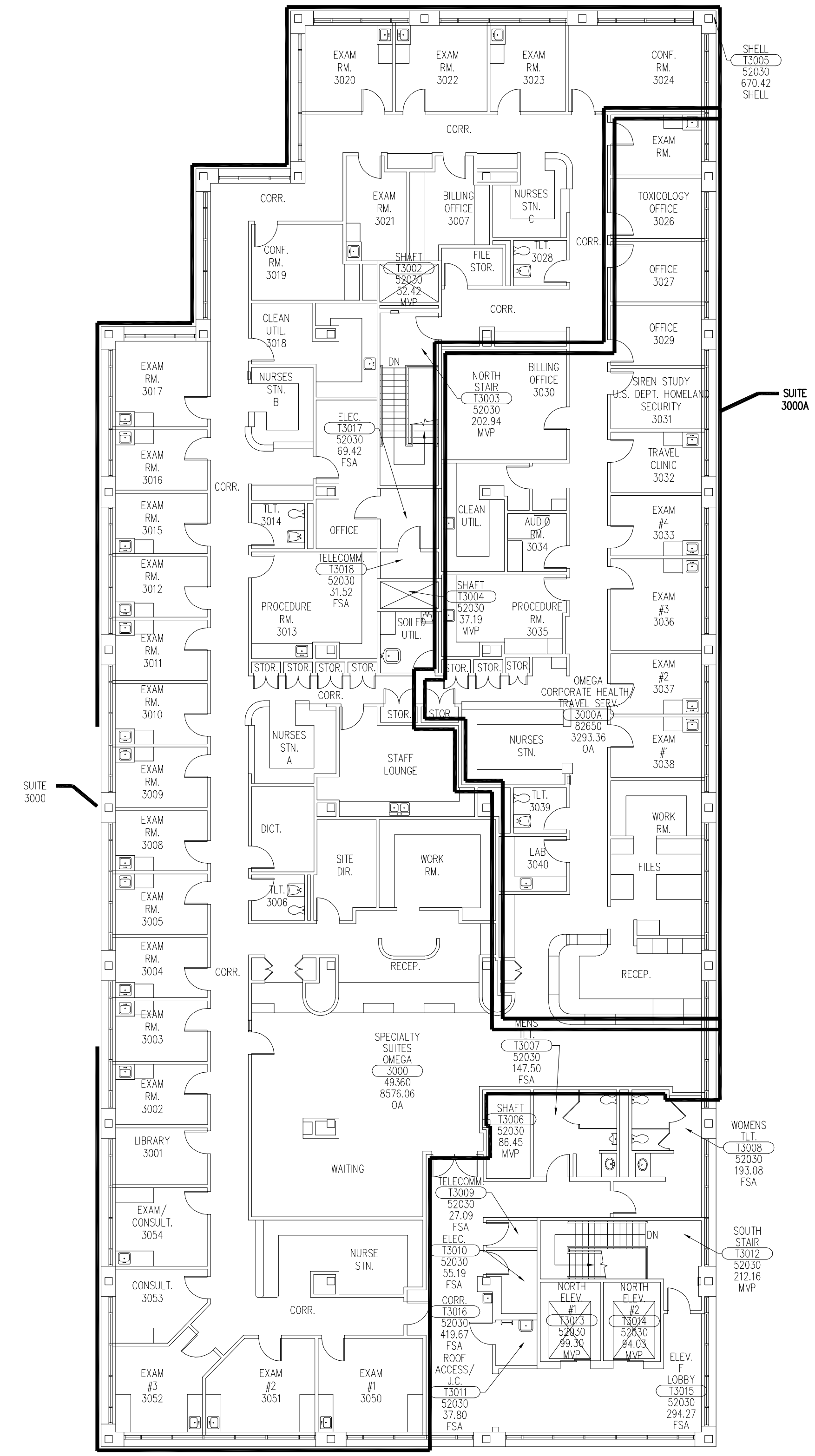
PLAN
SPACE UTILIZATION

DRAWN BY X.X.
CHECKED BY X.X.
SHEET NUMBER SP-02

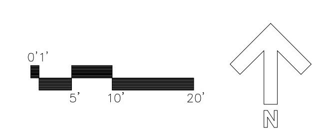
GENERAL NOTES

1. AREA COULD NOT BE ACCESSED BY ONE SURVEY MEMBER
2. AREA COULD NOT BE ACCESSED BY TWO SURVEY MEMBERS
3. AREA UNDER CONSTRUCTION

KEY PLAN



SPACE DEFINITION LEGEND	
MVP	MAJOR VERTICAL PENETRATION
OA	OCCUPANT AREA
OSTOR	OCCUPANT STORAGE
BAA	BUILDING AMENITY AREA
BSA	BUILDING SERVICE AREA
FAA	FLOOR AMENITY AREA
FSA	FLOOR SERVICE AREA
PARK	PARKING



NORTHSHORE UNIVERSITY HEALTHSYSTEM
GLENBROOK HOSPITAL – NORTH MOB
THIRD FLOOR

△ AREA COULD NOT BE ACCESSED DURING ATG SURVEY

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atginc@atginc.com

FLOOR
THIRD FLOOR
SECTION 1 OF 1

EVANSTON NORTHWESTERN
GLENBROOK HOSPITAL
NORTH MOB

EVANSTON, ILLINOIS

DATE: Apr 30, 2012 – 4:37:03 PM

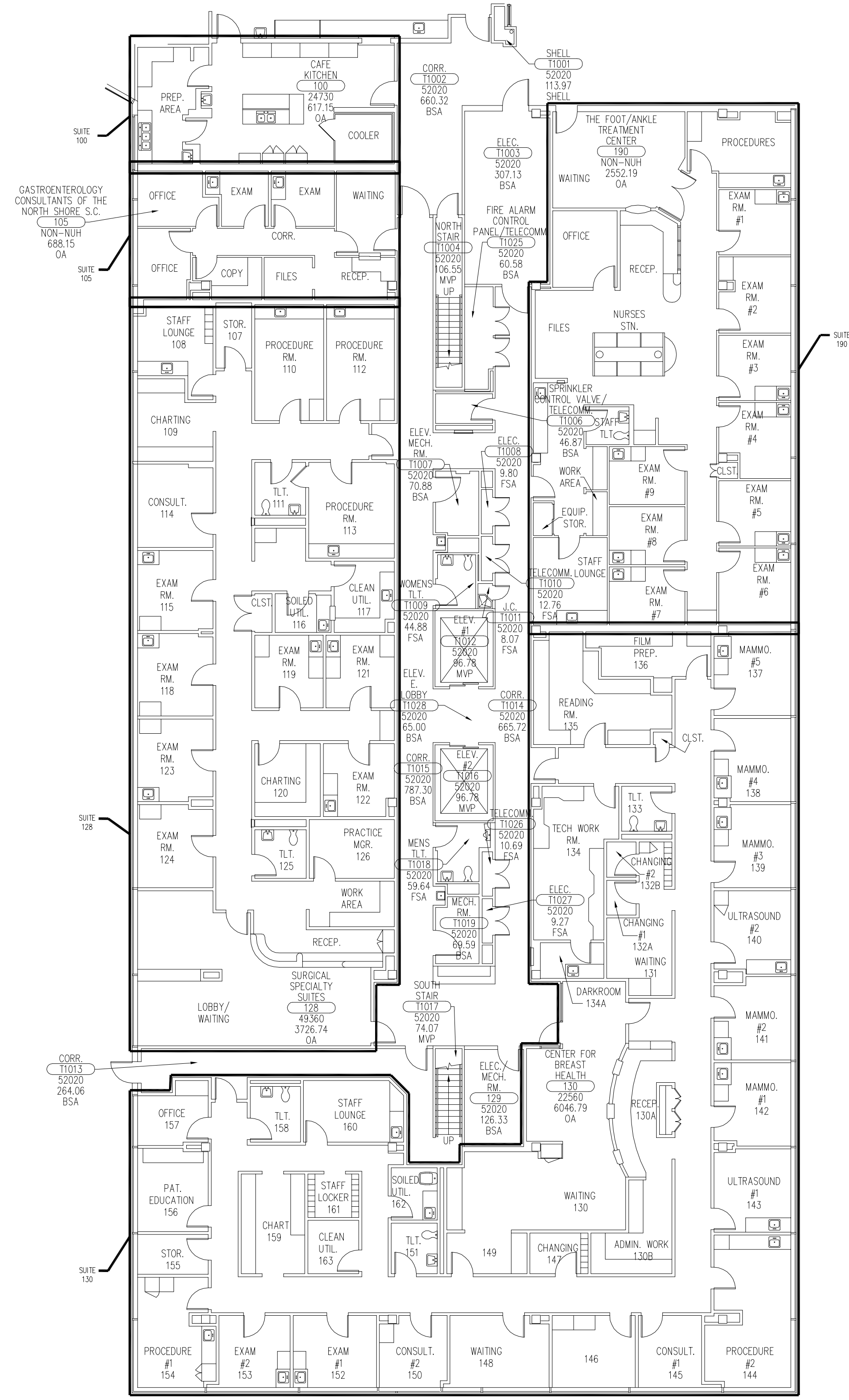
PLAN
SPACE UTILIZATION

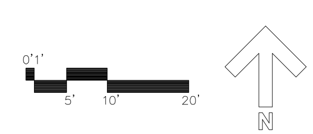
DRAWN BY X.X.
SHEET NUMBER SP-03
CHECKED BY X.X.

GENERAL NOTES

1. AREA COULD NOT BE ACCESSED BY ONE SURVEY MEMBER
2. AREA COULD NOT BE ACCESSED BY TWO SURVEY MEMBERS
3. AREA UNDER CONSTRUCTION

KEY PLAN





SPACE DEFINITION LEGEND	
MVP	MAJOR VERTICAL PENETRATION
OA	OCCUPANT AREA
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PARK	PARKING

Advanced Technologies Group, Inc.
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377 East Butterfield Road, Suite 900 Lombard, IL 60148
atginc@atginc.com

FLOOR
FIRST FLOOR
SECTION 1 OF 1

EVANSTON NORTHWESTERN GLENBROOK HOSPITAL SOUTH MOB
EVANSTON, ILLINOIS

DATE: Oct 22, 2008 – 2:08:42 PM

PLAN
SPACE UTILIZATION

DRAWN BY X.X.
CHECKED BY X.X.
SHEET NUMBER SP-01

GENERAL NOTES

1. AREA COULD NOT BE ACCESSED BY ONE SURVEY MEMBER
2. AREA COULD NOT BE ACCESSED BY TWO SURVEY MEMBERS
3. AREA UNDER CONSTRUCTION

KEY PLAN

Advanced Technologies Group, Inc.

FACILITY INFORMATION CONSULTANTS

377 East Butterfield Road, Suite 900 Lombard, IL 60148

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FLOOR

SECOND FLOOR

SECTION 1 OF 1

EVANSTON NORTHWESTERN
GLENBROOK HOSPITAL
SOUTH MOB

EVANSTON, ILLINOIS

DATE: Oct 22, 2008 - 2:16:27 PM

PLAN

SPACE UTILIZATION

DRAWN BY X.X.

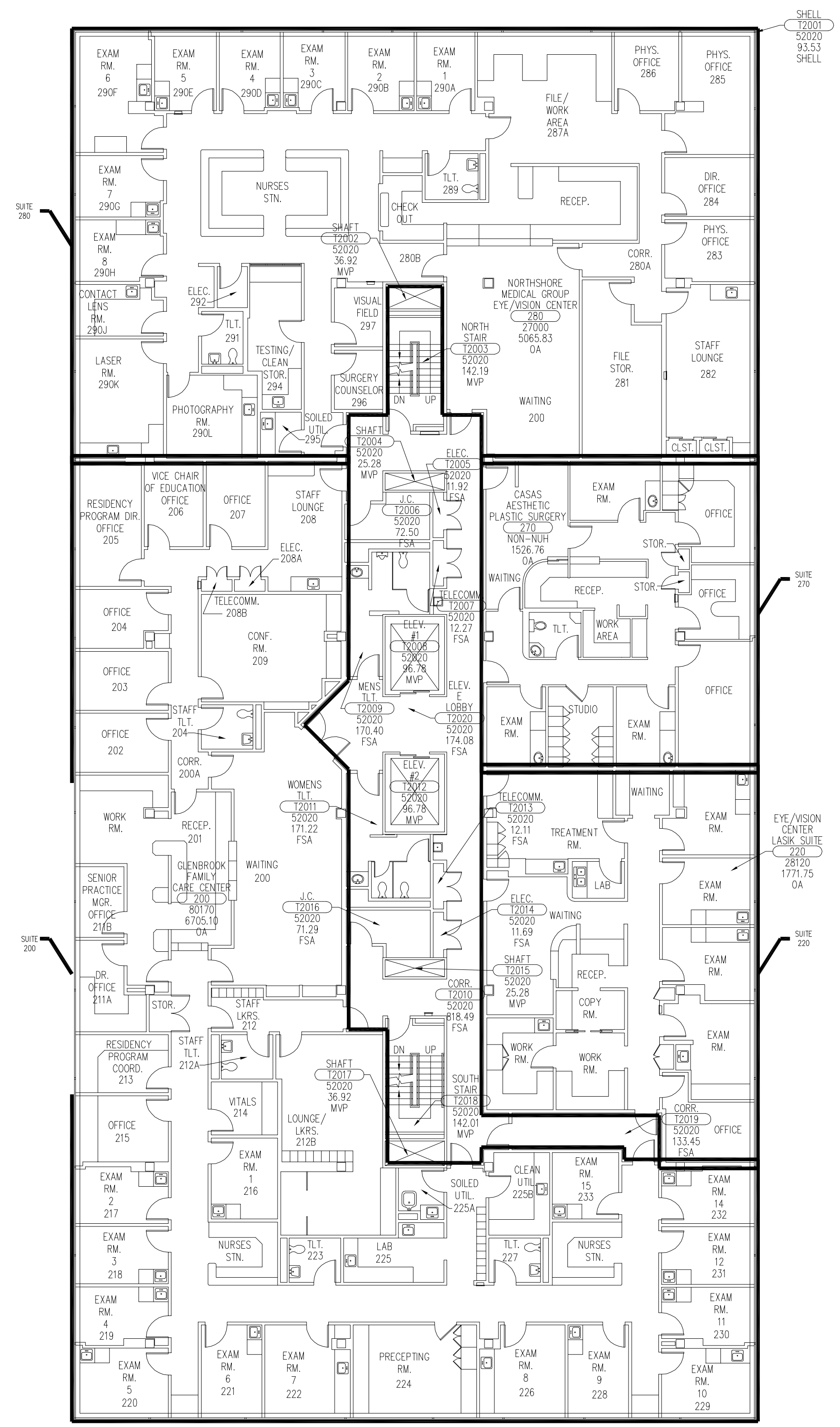
CHECKED BY X.X.

SHEET NUMBER SP-02

GENERAL NOTES

1. AREA COULD NOT BE ACCESSED BY ONE SURVEY MEMBER
2. AREA COULD NOT BE ACCESSED BY TWO SURVEY MEMBERS
3. AREA UNDER CONSTRUCTION

KEY PLAN



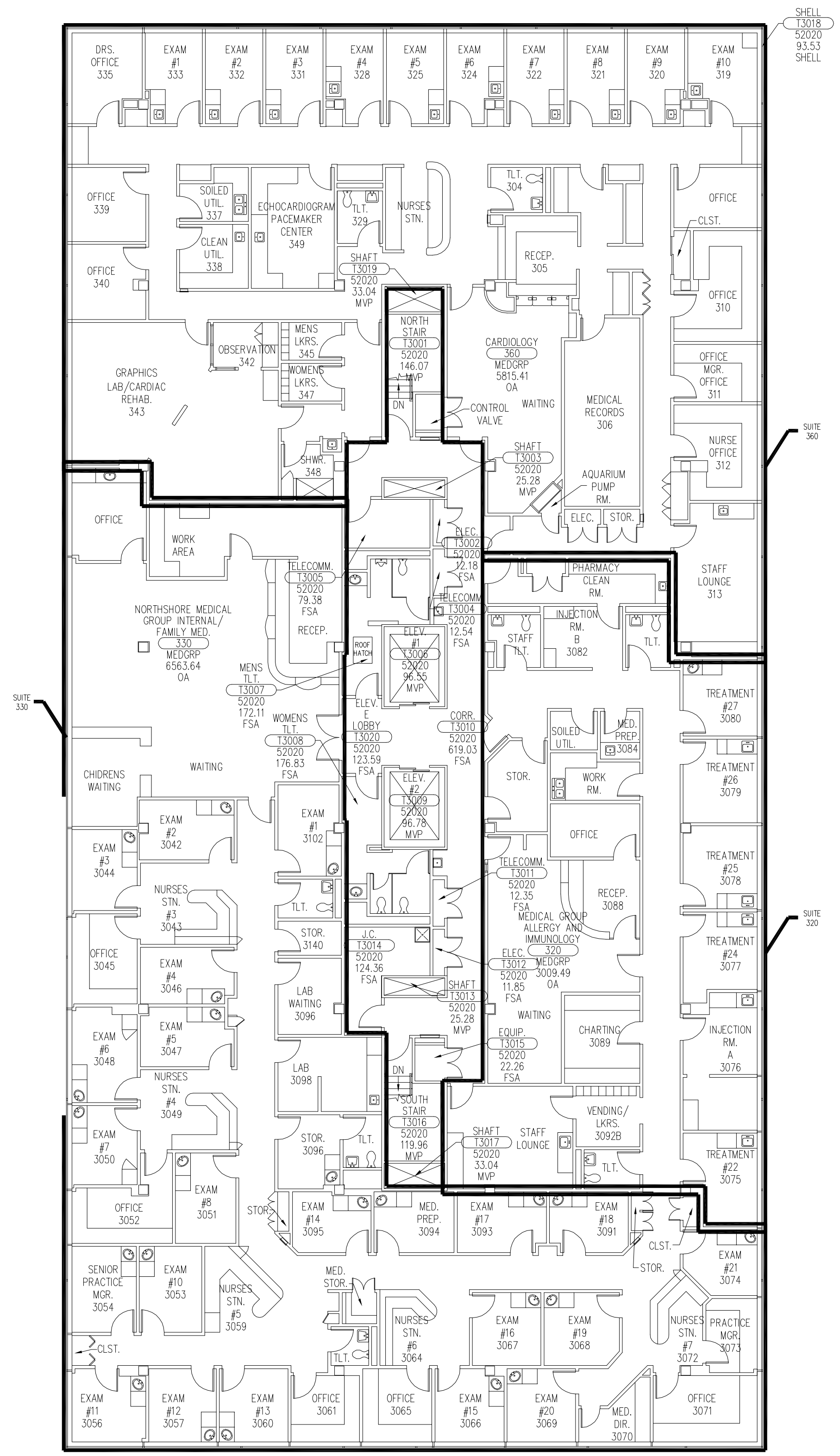
SPACE DEFINITION LEGEND

MVP	MAJOR VERTICAL PENETRATION
OA	OCCUPANT AREA
OSTOR	OCCUPANT STORAGE
BAA	BUILDING AMENITY AREA
BSA	BUILDING SERVICE AREA
FAA	FLOOR AMENITY AREA
FSA	FLOOR SERVICE AREA
PARK	PARKING

0'1" 5' 10' 20'

N

NORTHSHORE UNIVERSITY HEALTHSYSTEM



Advanced Technologies Group, Inc.

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atginc@atginc.com

FLOOR

THIRD FLOOR

SECTION 1 OF 1

EVANSTON NORTHWESTERN
GLENBROOK HOSPITAL
SOUTH MOB

EVANSTON, ILLINOIS

DATE: Oct 22, 2008 – 2:13:30 PM

PLAN

SPACE UTILIZATION

DRAWN BY X.X.	SHEET NUMBER
CHECKED BY X.X.	SP-03

GENERAL NOTES

1. AREA COULD NOT BE ACCESSED BY ONE SURVEY MEMBER
2. AREA COULD NOT BE ACCESSED BY TWO SURVEY MEMBERS
3. AREA UNDER CONSTRUCTION

ADVANCED TECHNOLOGIES GROUP, INC.(ATG) WARRANTS TO THE CLIENT THAT ALL SERVICES HAVE BEEN PERFORMED IN A WORKMANLIKE MANNER. IN THE EVENT OF ANY DISCREPANCIES OR DEFICIENCIES, THE CLIENT SHALL NOTIFY ATG WITHIN ONE (1) YEAR OF FINAL DELIVERY OF THE PROJECT. ATG WILL TAKE PROMPT ACTION TO REMEDY SUCH DISCREPANCY, DEFICIENCY, OR DEFECT, WITHOUT CHARGE TO THE CLIENT, UNLESS THE CLIENT HAS MADE MODIFICATIONS TO THE SPECIFICATIONS AGREED UPON, OR AS LIMITED HEREUNDER.

FAILURE TO GIVE NOTICE OF SUCH CLAIM WITHIN ONE (1) YEAR OF FINAL DELIVERY OF THE PROJECT TO THE CLIENT, SHALL CONSTITUTE A WAIVER BY THE CLIENT OF ALL CLAIMS WITH RESPECT TO THIS PROPOSAL. THE ABOVE REMEDY IS THE SOLE AND EXCLUSIVE REMEDY OF THE CLIENT, AND ANY RIGHT OF THE CLIENT FOR LOSS OF PROFITS, OR SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES WHATSOEVER, CAUSED BY ATG'S NEGLIGENCE, ERRORS, OMISSIONS, INACCURACIES, STRICT LIABILITY, BREACH OF CONTRACT OR BREACH OF WARRANTY, OR OTHER CAUSE OR CAUSES OF ACTION ARE HEREBY SPECIFICALLY EXCLUDED, WAIVED, AND DISCLAIMED BY THE CLIENT.

THE SERVICES PERFORMED BY ATG ARE NOT INTENDED OR REPRESENTED TO BE SUITABLE FOR REFERENCE, REUSE, OR RELIANCE BY THIRD PERSONS NOT A PARTY TO THIS PROPOSAL. ANY REFERENCE OR REUSE BY THE CLIENT, WILL BE AT THE CLIENT'S SOLE RISK AND WITHOUT LIABILITY TO OR RESPONSIBILITY OF ATG. THE CLIENT BY AUTHORIZING ATG TO PERFORM THE SERVICES HEREUNDER, HEREBY AGREES TO HOLD HARMLESS AND INDEMNIFY ATG FROM AND AGAINST ANY AND ALL THIRD PARTY ACTIONS AND CLAIMS ARISING OUT OF OR RELATING TO THIS PROJECT.

KEY PLAN

SPACE DEFINITION LEGEND	
MVP	MAJOR VERTICAL PENETRATION
OA	OCCUPANT AREA
OSTOR	OCCUPANT STORAGE
BAA	BUILDING AMENITY AREA
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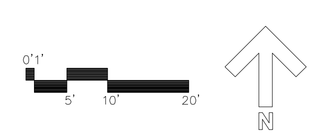


NORTHSHORE UNIVERSITY HEALTHSYSTEM

EXHIBIT 3

Parking Lot LED Fixtures

LUMERICA

L.E.D. PARKING LOT/AREA LIGHT

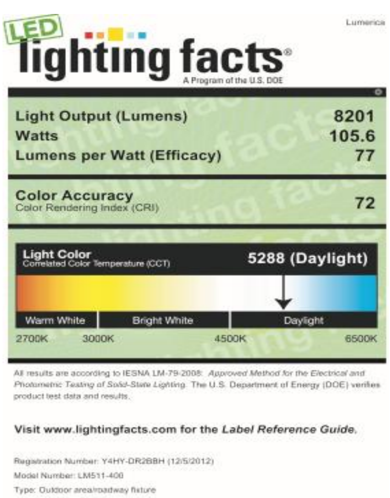
THE L.E.D. ADVANTAGE

- ENERGY SAVING
- LONG LIFE = REDUCED MAINTENANCE COSTS
- NO MERCURY OR CFCs
- MADE OF FULLY RECYCLABLE MATERIALS
- LONGER LIFE = LESS RECYCLING

Replaces High Pressure Sodium, Metal Halide and Mercury Vapor Fixtures

The Lumerica LED Parking Lot/Area Light outperforms other L.E.D. Parking Lot/Area Lights, and it does so at a significantly lower cost. In addition to energy savings, the Lumerica L.E.D. Parking Lot/Area Light also provides significant maintenance savings while promoting a cleaner environment.

- REPLACE HID FIXTURES
- HEAVY DUTY DIE-CAST HOUSINGS RATED FOR WET LOCATIONS
- HEAT AND IMPACT RESISTANT TEMPERED GLASS LENS
- PHOTO CELL AND MOTION SENSORS OPTIONAL
- IDEAL FOR PARKING AREAS, TENNIS COURTS, SHOPPING CENTERS, COMMERCIAL AND INDUSTRIAL COMPLEXES, PARKWAY LIGHTING



LED lighting facts
A Program of the U.S. DOE
Lumerica

Light Output (Lumens)	8201
Watts	105.6
Lumens per Watt (Efficacy)	77
Color Accuracy Color Rendering Index (CRI)	72
Light Color Correlated Color Temperature (CCT)	5288 (Daylight)

Warm White | Bright White | Daylight
2700K 3000K 4500K 6500K

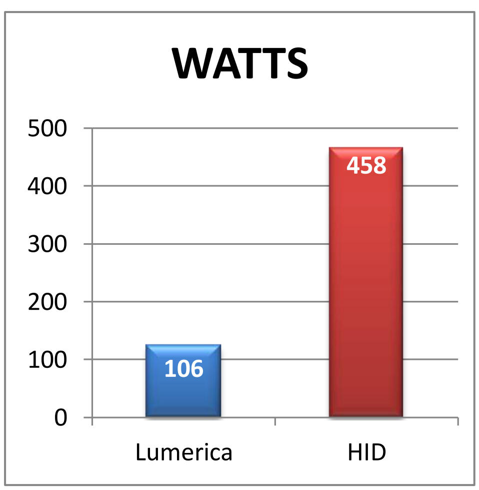
All results are according to IESNA LM-79-2008: *Approved Method for the Electrical and Photometric Testing of Solid-State Lighting*. The U.S. Department of Energy (DOE) verifies product test data and results.

Visit www.lightingfacts.com for the *Label Reference Guide*.

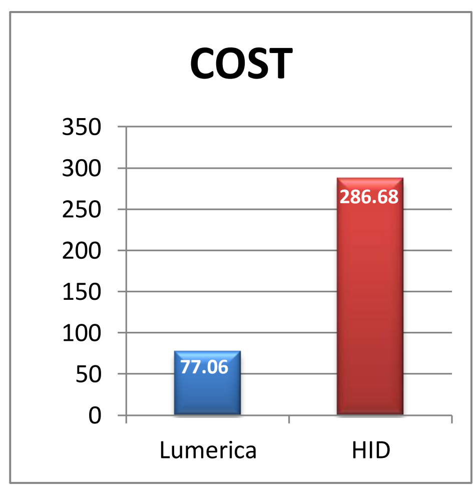
Registration Number: Y4HY-DR2BBH (12/5/2012)
Model Number: LM511-400
Type: Outdoor area/roadway fixture

SAVINGS

ANNUAL ENERGY USAGE AND ENERGY COST OF A 400W HID FIXTURE VS. LUMERICA 106W LED FIXTURE



Includes HID Lamp and Ballast



Based on $0.13 / kwh, 13 hrs/day , 365 days/yr

MADE IN USA

DESIGNLIGHTS CONSORTIUM®

LUMERICA

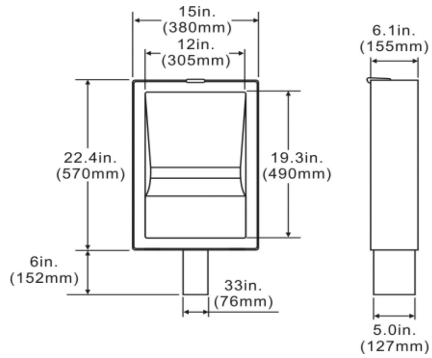
L.E.D. PARKING LOT/AREA LIGHT

PART NUMBERING, OPTICAL AND ELECTRICAL

Electrical
Input: 120-277 VAC
Input Current: .416 Amps
Power Factor: 91.5% @ 277VAC
CRI: 72
CCT: 5288 (Measured)
R9: -26
Input Voltage THD: 0.1%
Input Current THD: 8.0%
Off State Power: 0

Housing
Bronze powder coat standard, RAL and custom colors available

Environmental
Operating temperature is -40°C to +70°C



Mounting Options
Industry standard pole mount, trunnion, or slipfitter available

347 -480 VAC
Step-down transformer available

Other
Class "A" Sound Rating
10,000 and 20,000 amp surge protection available
EMI: Title 47 CFR Part 15 Class A

Warranty
5 Year limited system warranty for standard applications

For Standard Product; Custom configurations/color temps available

Part Number	Color Temp	Initial Lumens @ 25°C	LM-79 Lumens	Watts*	Lumens/Watt
LM511-400	5300K	11000	8201	105.6	77.66

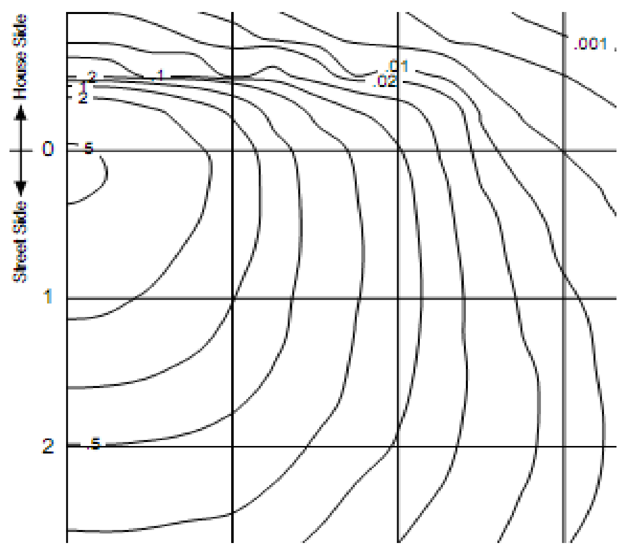
*@120VAC

PHOTOMETRIC DATA

Part No. LM 511-400

Pursuant to IES-LM 79

Mounting Height = 25 FT
Mounting Angle = Horizontal (90° from vertical)
Scale = 25FT
Measurements in Footcandles



Tests performed by Independent Testing Laboratories, Boulder, CO

The Lumerica LED Parking Lot/Area Light must be installed correctly. The contractor, owner, installer, purchaser and user is responsible for installing, maintaining, and operating the light fixture in compliance with all state and local laws, ordinances, regulations, and the American National Standards Institute (ANSI) Safety Code.

*The validity of the product warranty is subject to the correct storage, installation, operation, and maintenance of this product. Failing to comply with proper storage, installation, operation and maintenance routines will make the warranty invalid. More full warranty information, contact the company or click here.

Specification subject to change without notice.

LUMERICA

L.E.D. Wallpack

Replaces 150 to 250W Metal Halide and High Pressure Sodium Fixtures.

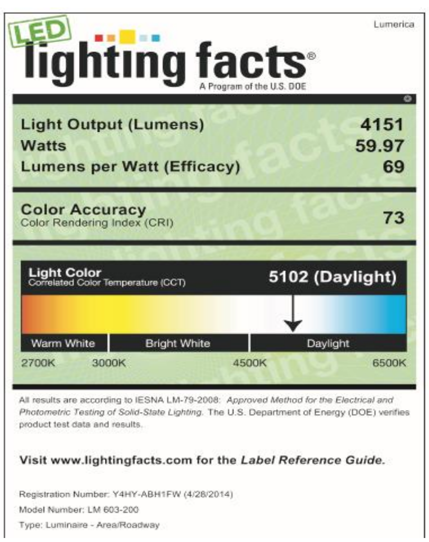
THE L.E.D. ADVANTAGE

- ENERGY SAVING
- LONG LIFE = REDUCED MAINTENANCE COSTS
- NO MERCURY OR CFCs
- MADE OF FULLY RECYCLABLE MATERIALS
- LONGER LIFE = LESS RECYCLING

- RUGGED ALUMINUM HOUSING
- GREAT EFFICACY
- CONVENIENT JUNCTION BOX MOUNTING (CONDUIT KNOCKOUT HOLES IN BOTH SIDES)
- NO FRAGILE GLASS OR TOXIC PHOSPHOR POWDERS
- MODULAR, REPLACEABLE LEDS AND POWER SUPPLIES
- PHOTOCELL OPTIONAL
- FULL CUTOFF VISOR AVAILABLE

SAVINGS

ANNUAL ENERGY USAGE AND ENERGY COST OF A 175W HID WALLPACK FIXTURE VS. LUMERICA 60W LED WALLPACK


LED lighting facts®
A Program of the U.S. DOE
Lumerica

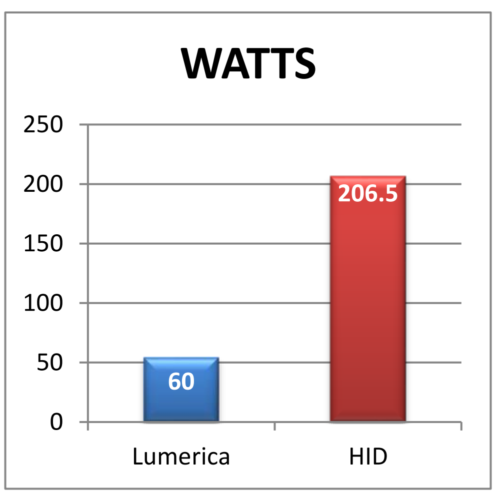
Light Output (Lumens)	4151
Watts	59.97
Lumens per Watt (Efficacy)	69
Color Accuracy Color Rendering Index (CRI)	73
Light Color Correlated Color Temperature (CCT)	5102 (Daylight)

Warm White | Bright White | Daylight
2700K 3000K 4500K 6500K

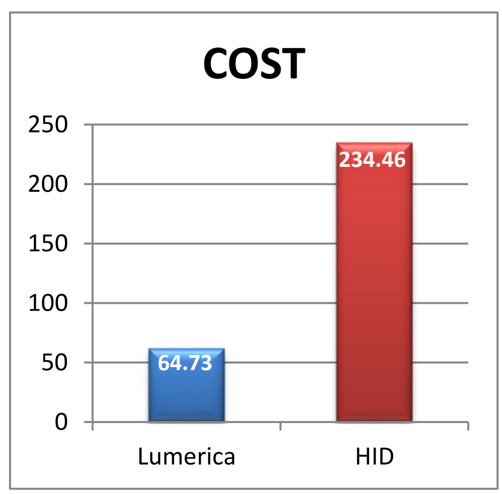
All results are according to IESNA LM-79-2008: *Approved Method for the Electrical and Photometric Testing of Solid-State Lighting.* The U.S. Department of Energy (DOE) verifies product test data and results.

Visit www.lightingfacts.com for the *Label Reference Guide.*

Registration Number: Y4HY-ABH1FW (4/28/2014)
Model Number: LM 603-200
Type: Luminaire - Area/Roadway



*Includes lamp and ballast



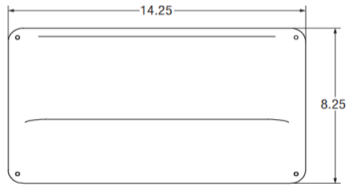
Based on $0.13 / kwh, 13hrs/day , 365 days/yr

Made in USA

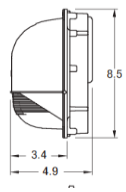
DESIGNLIGHTS® CONSORTIUM

LUMERICA
L.E.D Wallpack

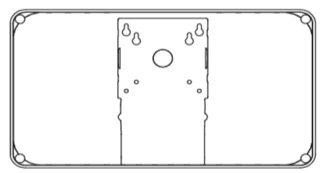
LM 603-200 SPECIFICATIONS



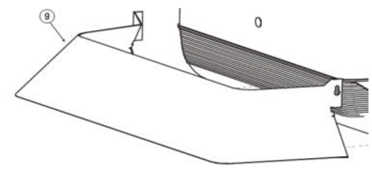
Front



Side



Back



Visor (optional) - Part No. LM 603-200FC

OPTICAL AND ELECTRICAL SPECIFICATIONS

Photometric
Lumens: 4151
Watts: 59.97
Lumens/Watt: 69.22
Color Temperature (CCT): 5102
CRI: 73

Electrical
Input: 120 To 277 VAC
Input Current: 0.583 Amps
Power Factor: 99.5%@120VAC; 91.5%@277 VAC
Input Frequency: 60 Hertz
A-THD: 4.81%@120VAC; 13.78%@277VAC

Environmental
Operating Temperature is -40°C to +60°C

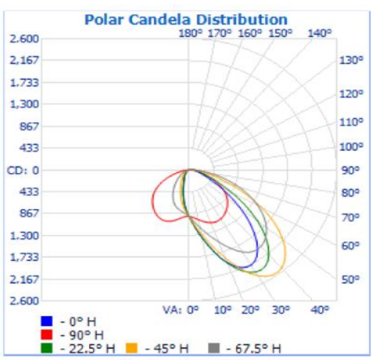
Housing
Dark Bronze powder coat standard; RAL and custom colors available

Warranty
5 year limited system warranty for standard applications

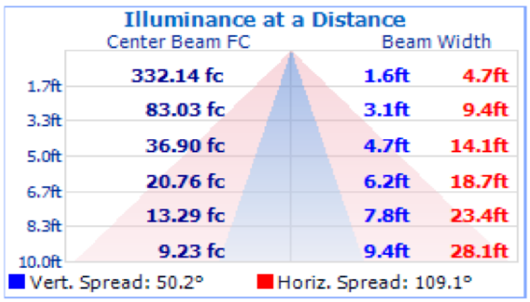
Photocell
Photocell optional, specify input voltage when ordering

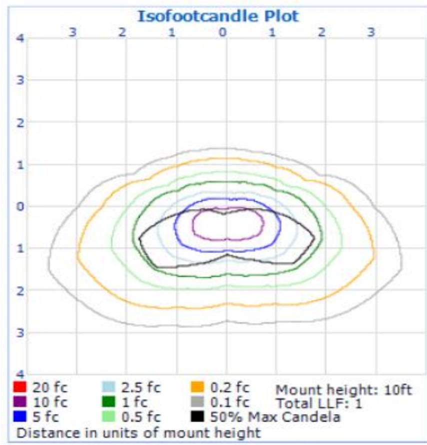
Other
Class "A" sound rating; EMI" Title 47 CFR Part 15 Class A
Additional surge protection available

ILLUMINANCE PLOTS



Polar Candela





Isofootcandle Plot

Photometric testing performed by TUV pursuant to IESNA LM79-2008

The Lumerica LED Wallpack must be installed correctly. The contractor, owner, installer, purchaser and user is responsible for installing, maintaining, and operating the light fixture in compliance with all state and local laws, ordinances, regulations, and the American National Standards Institute (ANSI) Safety Code.

*The validity of the product warranty is subject to the correct storage, installation, operation, and maintenance of this product. Failing to comply with proper storage, installation, operation and maintenance routines will make the warranty invalid. More full warranty information, contact the company or click here.

Specification subject to change without notice. The latest version of this specification will be posted on lumerica.com