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Technical Report 2

TECHNICAL REPORT #2

Executive Summary

The purpose of this technical assignment is to give an introduction, overview and analysis of the existing electrical systems which service the RIT Gordon Fieldhouse. These systems are, in brief, the power distribution systems, the lighting systems, and the communications systems.

The report consists of brief narratives discussing the general and emergency power systems, overcurrent and protective devices, and the locations of the major components of the Electrical system. Also included is a summary of the lighting systems and compliance with ASHRAE and IESNA codes and standards, as well as design considerations which affected the final existing electrical design.

Additionally, Autocad documents and Excel spreadsheets have been attached to the narrative portion of this document to support and correlate to the stated information. These spreadsheets cover the building loads as well as check the size of the main switchgear and feeders leaving said equipment. Schedules of the electrical equipment, feeders, transformers, lamps and ballasts are also included in this report. A single line diagram has been created to display the distribution as well.

Furthermore, an overview of the available utility information is analyzed in another spreadsheet set. The data was provided in 15 minute intervals of the campus-fed service to the main transformer banks and was analyzed by creating graphs of the monthly real energy use of both the 208/120v and the 480/277v systems. Also an analysis was provided of the average current draw for both these systems as well.

Lastly, a narrative describing the key points of the telecommunications systems housed in the building is also attached. The telecommunications systems are comprised of a TV/Broadband video system, data service, telephone and fax capabilities, public address and annunciation equipment, fire alarm systems, and finally, security systems.

I. Power Distribution Systems

General Power System Information

The electrical distribution system type for the Gordon Fieldhouse is a simple radial distribution. The 12.47 KV campus feeder enters the Transformer Vault Room (Room 109) of the building from under the floor. Because this is a campus owned and operated building, the owner's service is the same as the "company's" service, but the equivalent point would be in the aforementioned Transformer Vault Room. From there, the power goes to 15KV medium voltage switchgear and then splits to 2 pad mounted power transformer banks which step down the voltage to service the 480/277v switchboard and the 208/120v switchboard. The transformer bank for the 480/277 service has (3) transformers of 750kva 1 phase each, with a primary voltage of 12.47KV and a secondary of 480/277v. This voltage system powers the lighting and mechanical loads (heating, air conditioning, pool pumps, etc). The other transformer bank which services the 208/120v switchboard has (3) transformers of 250 kva, 1 phase each, with a primary of 12.47 KVA and a secondary of 208/120v. This voltage system powers the wall receptacles and their loads (computers, desk lights, ect) and similar loads. In addition to the main transformer banks, there are 5 other transformers located in the fieldhouse. Please see attached spreadsheet for further details such as size, type, primary and secondary voltages, mounting, etc.

Emergency Power System Information

The Fieldhouse is equipped with an outdoor, 100KW, 480Y/277 Volt, Natural Gas, radiator cooled generator set located in a weatherproof enclosure on the roof to power the emergency power system. A dedicated automatic transfer switch (ATS) is provided for life safety loads. Life safety loads include egress lighting, exit lights, fire alarm, and exterior "blue phone" lights. A separate ATS is provided for other non-essential emergency loads including security, card access, telecom/data, selected 120v receptacles (for tools/lighting during power outages) selected exterior lighting, and minor mechanical equipment to prevent freezing.

Overcurrent and Protective Devices

There are several types of overcurrent protection devices incorporated into the Gordon Fieldhouse's electrical system. These devices include fuses, typical circuit breakers, and pullout circuit breakers. The fuses are located in the medium voltage switchgear, one pullout circuit breaker protects each of the main switchboards, and typical circuit breakers protect all of the branch circuits.

Locations

The medium voltage switchgear that services the building is located in room 109, the transformer vault. The main switchboards and many of the main panelboards are located in room 108, the main electrical room, which is adjacent to the transformer

vault. The emergency generator is located in room 228a, which is appropriately designated the generator room.

Lighting Systems Information

The lighting system for the basic interior spaces of the building utilizes fluorescent lamping fixtures. For the pool areas, special metal halide "tube light fixtures were chosen to uniformly illuminate the challenging spatial area of the competition pool. There are also some isolated cases of incandescent and tungsten halogen usage throughout the building, but the designer's emphasis on efficiency limited their use except where specifically necessary. The exit signage uses LED only, which is typical for buildings like the Fieldhouse. Contrarily, the exterior and site lighting systems use metal halide fixtures exclusively except for one fixture type (the step lights illuminating the main entrance steps to the entry lobby) which employs compact fluorescent lamping.

ASHRAE/IESNA 90.1 Requirements

Various shut-off devices are integrated in the lighting design to comply with ASHRAE/IESNA 90.1 shutoff requirements. These include multiple types of dimmers (incandescent as well as fluorescent), electronic timers, stand alone occupancy sensors, wide view range occupancy sensors, local view range occupancy sensors, narrow view range occupancy sensors, relay units, timeswitches, and photo-controllers.

Power Factor Correction

There are not any power factor corrective devices in the building.

Other Information

In the analysis of this building, it became apparent that there are definitely voltage drop considerations across the large expanse of the indoor fieldhouse area that were taken into account during the electrical design. The square footage of many of the spaces, as this is primarily an athletic facility and large open spaces like pools, basketball courts, tracks, tennis courts and other indoor sports fields, is quite large and the distance from one end to the other in many cases is a measurement that clearly needed to be taken into consideration when sizing and placing equipment and wires.

Attached are documents and various Excel spreadsheets denoting lamp and ballast information, mechanical and electrical equipment, load calculations, and data tables. Please refer to these references as appropriate.

*NEC loads were calculated by summing the total actual connected loads (data taken from panelboards) multiplying by specified demand factors (1.0 for lighting loads, 0.5 for receptacles, and 0.8 for motor and other loads) and adding for future growth.

Panel	Voltage	TCL (KW)	Demand I (A)	Req	Sized	OK?
1LEL1	208/120V	19.8	55	#6	1/0	✓
1PEH1	480/277V	39	48	#8	1/0	✓
1LSH3	480/277V	8.1	13	#14	1/0	✓
1LSH2	480/277V	9.6	16	#14	#6	✓
1LSH1	480/277V	21.4	36	#8	#6	✓
1LNL5	208/120V	58	109	#2	4/0	✓
1LNL4	208/120V	55.2	100	#3	4/0	✓
1LNL3	208/120V	96	170	2/0	4/0	✓
1LNL2	208/120V	86.3	153	2/0	4/0	✓
1L1L1	208/120V	88.8	227	4/0	4/0*	✓
1LNH3	480/277V	92.9	155	2/0	4/0	✓
1LNH2	480/277V	19.4	32	#8	4/0	✓
1LNH1	480/277V	42.2	71	#4	4/0	✓
RPNH3	480/277V	720	885	Parallel	350 KCMils**	✓
PRNH2	480/277V	666.9	820	Parallel	350 KCMils**	✓
RPNH1	480/277V	442.5	544	1000 KCMils	300 KCMils**	✓
2PSH1	480/277V	22.4	33	#8	1/0	✓
2PNL1	208/120V	113.5	223	4/0	3/0***	✓
2PNH1	480/277V	152.6	188	3/0	3/0***	✓
2PEH2	480/277V	43.5	53	#6	1/0	✓
2PEH1	480/277V	65.4	85	#3	1/0	✓
2LSL1	208/120V	2.5	6	#14	#8	✓
2LNL2	208/120V	3	5	#14	4/0	✓
2LNL1	208/120V	139	248	250 KCMils	4/0	✓
2LNH1	480/277V	50	84	#4	4/0	✓
2LEL1	208/120V	7.6	16	#14	#6	✓
1PNH2	480/277V	99.9	123	#1	4/0	✓
1PNH1	480/277V	160	197	3/0	3/0***	✓

General Note: ***Calculations include the following demand factors: Lighting = 1.0; Receptacles = 0.5; Motors/Other = 0.8. Additionally, 25% of each panel has been factored in for future growth.***

*** Note:** ***This panel has 2 sections and the sized cabling is for a fraction of the specified load. All sizings have been determined adequate.***

**** Note:** ***4 sets***

***** Note:** ***2 sets***

Panel	Voltage	TCL (KW)
1LEL1	208/120V	19.8
1LNL5	208/120V	58
1LNL4	208/120V	55.2
1LNL3	208/120V	96
1LNL2	208/120V	86.3
1L1L1	208/120V	88.8
2PNL1	208/120V	113.5
2LSL1	208/120V	2.5
2LNL2	208/120V	3
2LNL1	208/120V	139.7
2LEL1	208/120V	7.6
Total Connected Load:		669.7
Total Connected Amps:		1858.9

General Note: ***Calculations include the following demand factors: Lighting = 1.0; Receptacles = 0.5; Motors/Other = 0.8. Additionally, 25% of each panel has been factored in for future growth.***

P=1.7321 * I (line) * V (line)

1858.9 < 2500 ✓ OK

Panel	Voltage	TCL (KW)
1PEH1	480/277V	39
1LSH3	480/277V	8.1
1LSH2	480/277V	9.6
1LSH1	480/277V	21.4
1LNH3	480/277V	92.9
1LNH2	480/277V	19.4
1LNH1	480/277V	42.2
RPNH3	480/277V	720
PRNH2	480/277V	666.9
RPNH1	480/277V	442.5
2PSH1	480/277V	22.4
2PNH1	480/277V	152.6
2PEH2	480/277V	43.5
2PEH1	480/277V	65.4
2LNH1	480/277V	50
1PNH2	480/277V	99.9
1PNH1	480/277V	160
Total Connected Load:		2355.8
Total Connected Amps:		2833.6

2833.6 < 3000 ✓ OK

Please refer to http://www.arche.psu.edu/thesis/eportfolio/2007/portfolios/SJS345/tech-assign.htm or "P:\thesis\Tech 2 Supplement" for other schedules and calculations.

II. Communication Systems

A. The adjacent Student Life Center's infrastructure serves the new Fieldhouse's telecommunications. A raceway system was installed, consisting of trunk riser conduits, outlet boxes and cover plates, and conduit stubs. Additionally a center spline cable tray system, data racks, cabinets, and equipment backboards complete the system.
The various communication systems housed in the Gordon Fieldhouse are:

- TV/Broadband Video
  Television and video outlets are located in the main corridor of the building as well as in the fieldhouse, pools, fitness center and select other areas. Television and broadband video are utilized in the fitness center where six (6) banks of television sets are installed for entertainment purposes. Other applications of television are used in the security system as well as news feeds in the lobby and

- Data
  Data service provides many useful operations, one of the most important being internet access. Data outlets are located all over the building, but concentrated in the various offices, reception areas, the building's main corridor, the fieldhouse, pools, and fitness center.

- Telephone/Fax
  In and out lines as well as fax capabilities are needed in almost every space in the fieldhouse for means of communication. In offices, phone booths, the fieldhouse, pools, and reception areas, telephone equipment is installed.

- Public Address/Annunciation
  The public address system in the fieldhouse is an extension of the system in place in the adjacent Student Life Center. Supplementary amplifiers were installed at the existing equipment rack to accommodate the addition. Additional paging initiation locations were added throughout the building as the original initiation station from the adjoining building is at the equipment rack. Speakers are located in general public spaces such as corridors, lockers, and reception areas, and the paging system is also connection to the professional sound system installed in the pool areas, fitness center, and actual fieldhouse. Assisted listening systems are installed in areas of public assembly to comply with ADA code requirements. These systems are located in the main fieldhouse and competition pool area. Typical devices components that contribute to the public address system are microphones, preamplifiers, power amplifiers, racks, loudspeakers, loudspeaker horns, monitor panels, telephone paging adaptors, intercom stations, master station, volume control units (limiters/compressors, attenuators), battery back-up power unit/generator connections, and paging and system take-overs.

- Fire Alarm
  The fire alarm system in the fieldhouse is a continuation of the exsiting system in the adjacent Student Life Center building. A Simplex 4100 addressable fire alarm system

located in the mechanical room of the adjacent building serves the two buildings. A transponder panel accommodates the extension into the new building. The expanded system monitors all alarm and trouble signals at both the existing annunciator panel and a new annunciator panel located in the fieldhouse. The existing annunciator panel was upgraded to LCD type to match the new one. New and existing alarm and trouble signals continue to be monitored by campus security in a remote building. The control panels consist of multiple alarm zones. Many types of equipment comprise the fire alarm system, including: manual pull stations (high abuse and typical), strobe lights, speaker/horns, heat detectors, smoke detectors, duct smoke detectors, beam detectors (used in the fitness center), electromagnetic door holders, fire alarm control panel, field processing unit, fire alarm annunciator panel, and monitors.

- Security
  A raceway system for security wiring was installed to meet the needs of the fieldhouse. RIT was responsible for furnishing and installing all security devices, wiring, and equipment. Security equipment includes card readers at access points, door lock devices, pull/override stations throughout the site, security cameras and camera monitoring devices.