Engineering Program

Haworth Hall Deferred Maintenance – Replace Electrical Distribution System

KU Project No. 104-9568

Date: March, 2012

Prepared by:

The University of Kansas, Lawrence Campus
Office of Design & Construction Management

Program Committee

Jim Modig, Director - Design & Const. Mngm't (DCM)

Joseph Heppert, Assoc. Vice Chancellor – Research & Graduate Studies

Vince Avila, Interim Director – Facilities Services

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Contents

Introduction

Original Construction

Haworth Hall was originally constructed in 1969 with a subsequent addition in 1986. The building houses the department of molecular biosciences (biochemistry; microbiology; molecular, cellular and developmental biology; neurobiology; and genetics); the department of ecology and evolutionary biology (programs in ecology and population biology, entomology, plant biology and systematics, macroevolution and biodiversity); and the undergraduate biology program. Haworth Hall houses a variety of high value research programs, collections and physical research.

Haworth houses the departments' administrative and staff offices; a greenhouse and electron microscope; laboratories, classrooms and an auditorium; the Genetics Program; and the Beach Center on Disability.

Haworth Hall has changed programs and occupancies multiple times since the original construction of the building. Over time, the usage has increased both in people occupancy and in equipment density. The increased usage has had an impact on the HVAC and electrical power systems. Currently, the building is operated on a 24/7 basis primarily due to the lab usage. Offices and classrooms are utilized primarily from 7am – 5pm.

Summary of Recent Utilities Master Plan Study

In the summer of 2011 an engineering study was commissioned with the goals of:

- Identifying the current HVAC and electrical issues in the building and determining if they are being addressed within a current project or identify the effort needed to resolve them in a separate project.
- Identifying any potential maintenance or life expectancy issues with the current equipment.
- Identifying and developing global and strategic solutions to keeping the building operational and viable for another 20 years.

Outcomes of the study included:

- Audits were completed that resulted in compilation of descriptions of the age, capacity and condition of existing HVAC and electrical equipment and controls.
- Current loads on the HVAC and electrical systems were determined by calculation and/or data gathering.
- Serviceability was assessed for these systems.
- Building occupants were polled, which resulted in compilation of description of causes for complaints in individual lab/research spaces (controls, capacity, maintenance, condition, HVAC matched to current heat loads, etc.)
- Recommendations for strategic improvements and respective cost estimates were developed.
- Recommendations for additional backup generator capacity were developed.
- Recommendations for loads that require a UPS support were developed.
- Cost estimates for any potential projects were developed.

Note: an electronic file of the entire 2011 study is available for consultant review.

Master Plan Study Findings, Recommendations, and Resulting Current Program Needs

The 2011 Study contained a number of findings and recommendations related to both the building HVAC and Electrical Systems. This section of the Program contains excerpts from the Report that detail study findings and recommendations.

The work envisioned by this program relates to the building electrical utility only and specifically to the 1967 power distribution system only. Other separately funded projects are anticipated, which will address additional HVAC and electrical utility deficiencies as funding is identified.

Power Distribution Findings

The original building electrical construction that was built in 1967 remains in service. This service consists of two indoor substations located on the first floor of the building. Primary service to the substations is 12,470 volts. One substation is 120/208 volt secondary, has an integral 1000 kva transformer and is loaded to about 30% capacity. One substation is 277/480 volt secondary, has an integral 1000 kva transformer and is loaded to about 66% capacity. The 277/480 volt switchboard feeds distribution panels located on each floor of the building. These panels primarily serve 277 volt fluorescent lights on each floor. The 120/208 substation feeds bus duct risers that provide 120/208 volt power to the floors. Each floor has a bus duct routed above the lab ceilings that provides the ability to access power in each space.

A third small substation was added adjacent to the two original substations. This substation is 277/480 volt secondary, has an integral 112.5 kva transformer and is loaded to about 75% capacity. This substation serves limited space in the original construction.

The west addition that was constructed in 1983 has separate electrical services. These are located in the basement of the addition in a separate main electric room. There are two indoor substations both with primary 12,470 volt service. One substation is 120/208 volt secondary, has an integral 500 kva transformer and is loaded to about 30% capacity. The other substation is 277/480 volt secondary, has an integral 1500 kva transformer and is loaded to about 30% capacity.

There are several current issues with the power distribution to address:

- The university is in the process of removing the indoor substations that are in many of the campus buildings. These substations are difficult to replace and many are at the end of their service life. These substations should be replaced with new padmount transformers that would be located outside the building.
- The 1967 switchgear is in very poor condition. A number of the breakers are labeled as “Do not use.” There is no ability to add loads to this switchgear. The switchgear is in a very confined location with very poor access. The switchgear manufacturer no longer is in business making replacement equipment very difficult to obtain.
- There is a significant amount of bus duct installed in the building. While this provides easy access to large amounts of power throughout the building, bus duct of this vintage requires regular inspections and tightening of the bolted connections that join sections of the duct. Given the extremely tight locations the duct has been installed much of it cannot be accessed.
- The electrical system for the building effectively consists of five electrical services that are all intermingled. The National Electrical Code permits this situation for different voltages and capacities so it does not appear to technically violate the NEC. However, a system like this is very hard

to maintain and small additions in electrical work to a space can result in a very complicated and potentially dangerous electrical system.

Generator Findings

The 1967 construction did not include a standby generator. The 1983 addition has a diesel-powered generator installed inside the basement. This generator is rated at 437.5 KVA and supplies emergency power to the entire building. The generator transfer system is a conventional "break before make" resulting in loss of power to the critical loads during testing and during transfer back to normal from emergency. There is not a comprehensive and complete list of loads served by the generator system making it impossible to determine if its capacity is being utilized properly.

There are several current issues with the generator to address:

- The capacity of the generator as shown by the load tests that have been performed shows a steady-state capacity of about 80% with intermittent peaks approaching 100%. Given this information additional loads should not be added to the generator.
- The indoor location of the generator is very hard to access for non-routine maintenance. Indoor conditions for generators present a severe environment for overheating that usually results in the generator being de-rated by 10%-20%. The visual observation of ventilation and radiator exhaust air shows that prolonged use of the generator during warm ambient conditions (summer) could result in quickly overheating.
- The conventional "break before make" transfer system caused needless intermittent downtime and outages which can cause premature equipment failure.
- A diesel generator does nothing to contribute to "clean" disturbance-free power.

Uninterruptable Power Supply/Reliable Power Findings

There are no significant UPS systems in the building. A few isolated locations have stand-alone UPS to serve a dedicated load. An occupant survey was conducted as part of this study to help identify the need for uninterruptible power in the building. It was noted that there are many pieces of equipment that do not automatically restart upon a power failure and do not alarm. In most cases, a short power outage is more of a nuisance than a catastrophic failure. Several spaces include high value specimens and the potential exists that these specimens can be lost if an outage were to occur and a piece of equipment not restart. Refer to the original 2011 Report for the occupant survey responses.

Power Quality Findings

The building does not have power conditioning or surge protection installed.

There are several methods of enhancing power quality utilized in various labs throughout the building that will automatically notify off-site personnel in the event of a power disturbance or failure.

There are several current issues with the power quality to address:

- There are widespread reports of power fluctuations throughout the facility. The disturbances are not localized to one area indicating a local problem within the buildings. These fluctuations reportedly will commonly cause equipment to shut down which does not automatically restart. Several labs have purchased line conditioners to put on individual equipment attempting to rectify the problem.

- The off-site personnel notification system is not reliable and does not sufficiently address all critical areas. It appears some personnel are notified of an event and are required to come into the building to restart equipment. Given the critical nature of ongoing experiments and years of study stored in freezers, timely and reliable notification is essential.

Power System Replacement Recommendations

The 2011 Study Report included descriptions and cost estimates for a total of five Report recommendations for work related to the building electrical distribution system are included in this section of the program. Of the five, only the recommendations titled *Replace 1967 Switchgear* & *Replace 1967 building electrical distribution system* are funded and are intended to be included in the scope of work of this project.

The Report also included descriptions and cost estimates for work to provide enhanced capacity and quality of reliable power to critical laboratory loads. These recommendations are not included in the scope of work described in this program.

The paragraphs that follow are directly transcribed from the 2011 Report, and are intended for the consultant's reference as an aid to understanding the University's expectations for a phased series of Haworth Hall electrical improvements projects.

Replace 1967 Switchgear –**Design Completed by KU**

The original building electrical substations should be replaced. The new equipment should consist of padmount transformer(s) located outside the building feeding new electrical equipment located inside the building. Since the existing electrical system has both a 480/277 volt and a 208/120 service it may be most effective to replace each with a new service; a padmount transformer at 277/480 volt and another padmount transformer at 120/208 volts. However, this is not a system that would normally be designed (separate services for separate voltages). More study may determine if one 480/277 volt service that then is transformed internally down for the 208/120 volt loads is preferable to two separate services. The new service equipment switchboard(s) should be located in dedicated spaces adequately sized for regular maintenance. This study recommendation cost estimates are based on a single service voltage at 277/480 volts and internal dry-type transformers that will step down to 120/208 volts. The location of the padmount transformer(s) is likely the service yard to the south of the building. A single transformer rated 2000 kva, 12470:277/480 volts in this location can provide the power source to both switchboards.

- Estimated Construction Cost (**currently funded**): $493,100

Replace 1983 Distribution System – Future

The 1983 electrical construction is not at the end of its service life and is in good condition. However, the indoor substation construction should be replaced with a padmount transformer(s) located outside on grade. Given the significant work associated with this scope it is also recommended to replace the 1983 switchgear at the same time. More study may determine if one 480/277 volt service that then is transformed internally down for the 208/120 volt loads is preferable to two separate services. The new service equipment switchboard(s) should be located in dedicated spaces adequately sized for regular maintenance. This study recommendation cost estimates are based on a single service voltage at 277/480 volts and internal dry-type transformers that will step down to 120/208 volts.

- Estimated Construction Cost (future funding): $411,000

Replace 1967 Distribution System – **This Program Scope**

The original building electrical equipment is approaching the end of its service life with decreasing reliability and diminished spare parts capacity. Maintaining power to occupied spaces

will make replacement of this equipment a very complex process. Periodic electrical shutdowns of the duration necessary for a "replace in place" process is likely not realistic. A new electrical distribution system is recommended to be entirely installed in the building while the existing system remains operational. Once the new system is installed individual spaces and equipment can be selectively transferred to the new system. It is not anticipated to replace individual branch circuits.

- Estimated Construction Cost (**currently funded**) :$1,362,600

Power Monitoring and Reporting System - Future

An important aspect of the reliability of the electrical systems for this building is the automatic notification of off-site personnel, mainly lab personnel, of a power event. This provides the actual user the knowledge to judge the significance of an event and take appropriate action. A power monitoring system should be installed that will monitor the power quality and power interruptions for each lab. This system will then automatically notify lab and maintenance personnel of the event.

- Estimated Construction Cost (future funding): $200,000

Generator Enhancements - Future

The generator is not near the end of its service life and reportedly provides reliable back-up power. It is now fully loaded and is not capable of supporting additional loads. Complete power loss at the facility is a relatively rare occurrence. This existing generator would be best utilized to serve "building loads" rather than "process" (inside the lab) loads. These critical loads should be served by a new emergency power system that can address both prolonged outages but also the far more common intermittent disturbance. Further discussion is below under "UPS/Reliable Power." Improvements to the quality of power delivered by the generator can be achieved by replacing the governor with an electronic governor. Replacing the automatic transfer switch with an Isolation Bypass Switch will allow the generator to be tested without a power disruption.

- Estimated Construction Cost (future funding): $200,000

UPS/Reliable Power - Future

The surveys that have been performed show that reliable power inside the lab is broadly divided into equipment that will automatically re-start after a power outage (consisting mainly of refrigeration) and equipment that will automatically re-start (consisting mainly of electronics) but that is also more sensitive to electrical quality disturbances. Improvements on both categories could improve the overall building electrical performance. Utilizing the existing generator to serve the refrigeration loads (along with appropriate reporting) and installing a reliable high-quality emergency system for the electronics is recommended.

There are three approaches to providing reliable power to the electronic equipment in the labs:

Individual "Spot" Power Conditioner/UPS Option. Provide individual spot power conditioners/ ups systems that would only serve the loads in an individual lab. Several of the labs are already utilizing this approach in an effort to overcome the existing systems shortcomings. These units are relatively short-lived as the small internal batteries need replacement every 3 to 5 years. These systems are most suited for small computer loads and are generally not large enough to support refrigeration loads. They have the advantage of being incrementally installed in individual labs as funds become available.

- Estimated Construction Cost for this Electronic Emergency Power Option (future funding): $137,585

Conventional Battery UPS Option. Provide a conventional Uninterruptible Power System that would have a battery back-up system that would provide continuous, clean power for a limited amount of time generally 5 – 15 minutes. The UPS would also have diesel powered generator backing it up that would then provide continuous power for extended power outages. These systems are very dependable and will provide excellent power quality. They are also quite costly and must be installed all at one time. The UPS portion of the system i.e. batteries require constant maintenance and regular and often replacement.

- Estimated Construction Cost for this Electronic Emergency Power Option (future funding): $703,289

Generator/Flywheel Option. Provide a diesel generator/flywheel system that will provide continuous, clean power indefinitely. These systems are an "on-line" system that will continually provide clean power not affected by intermittent disturbances on the utility service. They incorporate a flywheel that is constantly rotating that can take over short duration power interruptions of about 15 seconds. This flywheel allows the diesel generator to start and take over power supply without a disruption to the user. This system provides a similar level protection as a battery-based system without the batteries and with less maintenance.

- Estimated Construction Cost for this Electronic Emergency Power Option (future funding): $536,044

Program

Program Item - Replace 1967 Switchgear. **Confirm the preliminary switchgear/power center design and incorporate existing preliminary design documents into the program construction documents.**

- In order to compress the project schedule the University has completed the preliminary design for replacement of the original 1967 building substations. Once preliminary design is confirmed by the consultant and the design team, the University plans to pre-purchase two outdoor pad-mounted transformers, including one 12,470-V/150-kVA capacity unit intended for 208Y/120V secondary service and one 12,470-V/200-kVA capacity unit intended for 480Y/277V service. The consultant will incorporate the installation of these pre-purchased transformers into the construction documents for this project.
- Additionally, the University has completed preliminary designs for, and plans to pre-purchase for installation within the scope of this project, two new main distribution panelboards that are to replace existing 1967-vintage power centers. The preliminary designs include both specifications for the panelboards, as well as proposed locations. The proposed locations have been identified with the objective of allowing load transfers to be completed with the least possible outage time requirement.
- Electronic files of preliminary specifications sections and drawings are available as templates for the consultant's use. Copies of each are included as Appendix A of this program for reference.

Program Item - Replace 1967 Distribution System. **Provide a design to replace the existing I-line bus/bus plug power distribution system with a series of new circuit breaker type power distribution panelboards and branch-circuit panelboards.**

- The consultant is expected to identify and detail a functional, serviceable, and code-compliant location of new power distribution panelboards that will replace the existing I-line bus/bus plug equipment on each of the eight occupied floors of the building. Separate distributed services are required on each of the eight floors of the 1967 building for 120/208-V power and 208/480-V power. The consultant will determine the required total ampacity and circuit counts for each panelboard based on review of the data available in the 2011 Study Report and as confirmed by field investigation.
- The consultant is expected to identify and detail a functional, serviceable, and code-compliant location for new lighting and appliance branch-circuit panelboards. These panelboards will ultimately be put into service as replacements for 1967-vintage bus plug-fed panelboards which are currently located throughout the building in laboratories, classrooms, and other occupied spaces.
- The existing 120/208-V busway system will remain in place and in service until the replacement equipment has been installed and tested. The switchover of building loads from the existing busway system to the new panelboard system will require careful detailing within the construction documents and extensive coordination with the building occupants, and will likely require considerable off-hours work scheduling by the contractor.
- The existing 277/480-V panelboards, which are flush-mounted in central corrindors of each of the eight floors will remain in place and in service until the replacement equipment has been installed and tested. As with the 120/208-V distribution system, the work will require careful planning.
- Review the sketch included as Appendix B of this program for reference. The intent of the sketch is to inform consultants who are reviewing this program as to the configuration of the existing bus plug distribution system,

and to illustrate feasible locations for the anticipated replacement distribution panelboards.

Document University expectations for utility outages & work-arounds during construction periods

- Identify feasible solutions to the following critical logistical issues
  - Determine a mode of removal and a building exit pathway for removal of the existing air handling equipment that is code compliant, acceptable to the authority having jurisdiction (AHJ), and compatible with the ongoing functions of the building.
  - Evaluate the duration and consequences of, and areas affected by, the loss of ventilation/conditioning air supply during completion of the project; and, design compensating measures necessary to minimize the impact to ongoing functions of the building.
  - Identify an acceptable contractor staging area.

Hazardous Materials

The KU Environmental Health & Safety Office has performed tests of some, but not all, of the existing materials in the anticipated Haworth work areas. These tests have found ACM materials throughout the building, floor tile/mastic; linoleum; and pipe insulation

- A complete set of hazmat tests will be needed prior to construction to verify exact locations of remaining materials that will need to be abated.
- Estimated abatement costs are estimated to be approximately $20,000.
- KU policy is to remove all hazardous materials when undertaking major renovations of existing buildings.
- The University will separately contract for this work, using departmental funding that is separate from the proposed project funding.

Code Requirements

- Codes currently used on KU projects include the following:
  - International Building Codes, 2006 editions and local amendments.
  - Kansas Fire Prevention Code, KSFMO, current edition.
  - International Fire Code (IFC), 2006 edition.
  - Other codes as listed at the State of Kansas, Division of Facilities Management (DFM) website.
- Code Footprints of the existing buildings shall be prepared by DCM and shall be furnished to the architect on DCM's standard 11x17 code footprint sheets.
- The architect shall update these drawings to reflect all proposed work and submit them for approval to DFM through the KU-DCM office, immediately following approval of the Design Development phase.
- Electronic files of the approved code drawings shall be forwarded to DCM in both .PDF and .DWG formats.
- Construction Exiting: Where applicable, temporary fire-rated exit corridors shall be provided through the construction site, to direct occupants from all required exits in the existing buildings to a public way. They shall remain in-place at all times while construction work is underway.
- Fire alarm systems shall comply with current code and KU requirements for an intelligent addressable system.

Design Document Standards & Consultant Services

- The consultant team shall comply with the latest provisions of The University of Kansas *Design and Construction Standards*, as maintained by the Office of Design and Construction Management (DCM).

These standards are available at the DCM website: (http://www.dcm.ku.edu/standards/design/).

  - The consultant team shall also comply with supplemental updates to these standards which may be issued during the course of the project.
- The University's Project Representative will be a DCM staff person assigned to serve as KU's Project Manager, and who will be the primary point of contact for all communications between the Owner, A-E and Contractor.
- Special Consultants may be required on the A-E team, in addition to the usual architectural and engineering disciplines.
- Electronic Files: Consultants shall deliver to KU complete sets of electronic drawing and spec files for each project's bid sets and as-built sets, and shall include both PDF and AutoCAD .dwg files.

Deliverables

Major equipment pre-purchase packages

The consultant team will be expected to assist with finalizing specification information and review of subsequent submittal information for the following equipment, which the University expects to purchase directly and turn over to the successful bidding contractor for installation:

- Outdoor Pad-mount Transformers
- Main Distribution Panelboard Gear

Project construction bid document preparation

The consultant will be expected to prepare bid documents for award to the successful bidder. It is anticipated that the project will be awarded to a single successful bidding general contractor for installation of the replacement electrical service entrance and power distribution equipment described in this program. The consultant should prepare a consolidated set of construction drawings that encompasses all anticipated work. The anticipated bid process will be administered through the University Purchasing Services Department.

The anticipated design sequence will follow requirements of Chapter 12 of the State Office of Facilities and Property Management's (OFPM) Building Design and Construction Manual. At a minimum, the following milestones are anticipated:

- Schematic Design Review
- Design Development Review
- 100% Construction Document Review

Project construction administration

The consultant will be expected to provide construction administration (CA) services during the construction phase of the project. CA service requirements will follow requirements of Chapter 16 of the OFPM Building Design and Construction Manual.

Historic Preservation Reviews

The consultant team shall assist the University in developing the design in a manner consistent with the applicable historic preservation guidelines, and in presenting and reviewing it with applicable historic review agencies and committees.

Interior modifications and exterior maintenance work do not typically require an historic review. Exterior modifications or additions typically do require compliance with applicable guidelines and must follow review processes by the KU Campus Historic Preservation Board (CHPB) and the City of Lawrence Historic Resources Commission (LHRC). It is also subject to review by the City when the listed property is not on KU land, but a proposed KU project is within the listed property's 500' notification limits.

Annual Maintenance & Operating Costs

This project includes replacement of existing electrical service equipment with new. As such, both annual maintenance needs and equipment energy use and operating costs are expected to be reduced.

Space Standards & Utilization Analysis

No changes to current space assignments are anticipated as part of this work.

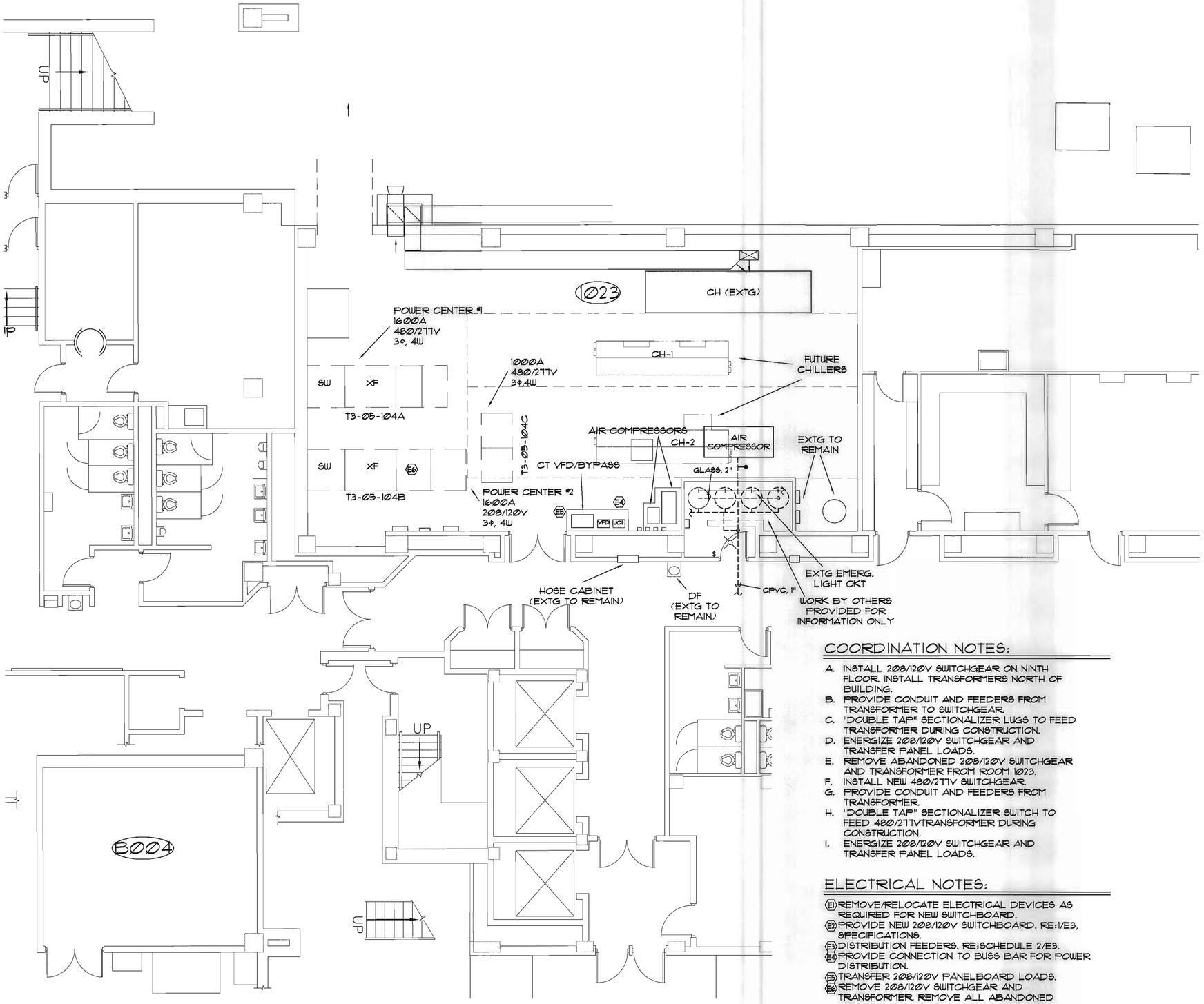
Project Budget

Construction Costs	
Purchase and Installation of Transformer(s) and Switchgear	386,460
Purchase and Installation of Distribution Equipment	1,081,410
Subtotal - Construction Costs	**$1,467,870**
Non-Contractor Construction Costs	
Allowance for University staff support and coordination for utilities systems outages	15,000
HazMat Abatement Work	20,000
Subtotal – Non-GC Costs	**$35,000**
Miscellaneous Costs	
Fees - Consultants & State/KU Agencies	370,000
Printing & Shipping of Bid Documents	1,200
Construction Testing and Commissioning	15,000
Bidding & Construction Contingency	150,000
Subtotal - Miscellaneous Costs	**$536,200**
Total Estimated Project Cost	**$2,039,070**

Project Schedule

Program Submission to Board of Regents	April 2012
Program & FY 2011 Funding Approval (BOR, Legislature)	April 2012
Advertise & Shortlist Consultants	May 2012
Interview & Select Consultants	May 2012
Negotiate Fees & Process Contracts	June 15, 2012
Program Review & Prelim. Design (6-wks.)	August 1, 2012
Design Development (1 mo.)	Sept. 1, 2012
Construction Documents (1 mo.)	Oct. 1, 2012
Bidding (1 mo.)	Nov. 1, 2012
Contract Award & Execution (1 mo.)	Dec. 1, 2012
Construction	Jan. 2013 – December 2013

Appendix A – Preliminary Electrical Design (Replace 1967 Switchgear)



DEMOLITION PLAN

SCALE: 3/16" = 1'-0"

COORDINATION NOTES:

A. INSTALL 208/120V SWITCHGEAR ON NINTH FLOOR. INSTALL TRANSFORMERS NORTH OF BUILDING.
B. PROVIDE CONDUIT AND FEEDERS FROM TRANSFORMER TO SWITCHGEAR.
C. "DOUBLE TAP" SECTIONALIZER LUGS TO FEED TRANSFORMER DURING CONSTRUCTION.
D. ENERGIZE 208/120V SWITCHGEAR AND TRANSFER PANEL LOADS.
E. REMOVE ABANDONED 208/120V SWITCHGEAR AND TRANSFORMER FROM ROOM 1023.
F. INSTALL NEW 480/277V SWITCHGEAR.
G. PROVIDE CONDUIT AND FEEDERS FROM TRANSFORMER.
H. "DOUBLE TAP" SECTIONALIZER SWITCH TO FEED 480/277VTRANSFORMER DURING CONSTRUCTION.
I. ENERGIZE 208/120V SWITCHGEAR AND TRANSFER PANEL LOADS.

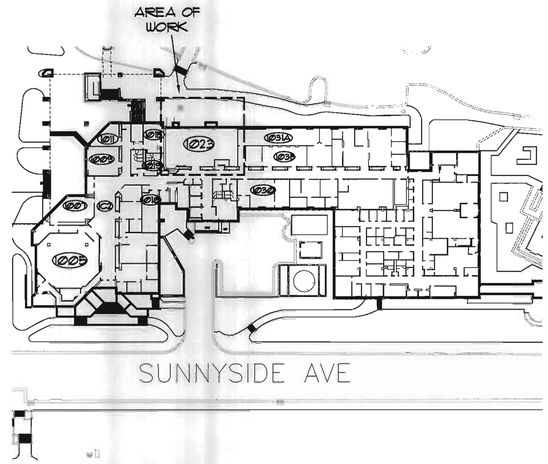
ELECTRICAL NOTES:

(E1) REMOVE/RELOCATE ELECTRICAL DEVICES AS REQUIRED FOR NEW SWITCHBOARD.
(E2) PROVIDE NEW 208/120V SWITCHBOARD. RE:1/E3, SPECIFICATIONS.
(E3) DISTRIBUTION FEEDERS. RE:SCHEDULE 2/E3.
(E4) PROVIDE CONNECTION TO BUSS BAR FOR POWER DISTRIBUTION.
(E5) TRANSFER 208/120V PANELBOARD LOADS.
(E6) REMOVE 208/120V SWITCHGEAR AND TRANSFORMER. REMOVE ALL ABANDONED CONDUITS AND CONDUCTORS.
(E7) PROVIDE NEW 480/277V SWITCHBOARD. RE:2/E3.
(E8) USE EXISTING TEMPORARY FEEDERS TO ENERGIZE 480/277V GEAR DURING REPLACEMENT.
(E9) NEW TRANSFORMER. RE: SCHEDULE

CONTRACTOR GENERAL NOTES:

G1 - DO NOT scale these drawings. Work from drawing dimensions.
G2 - These drawings and notes establish the minimum requirements for this project.
G3 - Coordinate all trades involved
G4 - Verify all conditions and dimensions on the site
G5 - This project has been reviewed by the office of Design & Construction Management. Any deviation from plans must be noted and reviewed by said office
G6 - One set of these drawings shall be kept on site during all phases of construction
G7 - All existing conditions or building materials damaged by construction shall be repaired or replaced to match original conditions
G8 - Before commencing work, coordinate with the office involved and affected by the project
G9 - One set of 'As-Built' drawings shall be delivered to the office of DCM upon completion of the project if items of work are going to be concealed which are not included in drawings
G10- Shop drawings for major purchased equipment / material system items shall be submitted to DCM for approval prior to installation. Items are identified on drawings
G11- Contact NTS, EHS and IDS to coordinate construction at commencement of project
G12- All materials used for this project shall be asbestos free. Contractor to submit M.S.D.S. to DCM at completion of the project.
G13- Contractors shall take into consideration the academic mission of the University and schedule work activities in a manner that minimizes disruptive noise between 7:30 a.m. and 5:30 p.m. Monday through Friday and 7:30 a.m. and 12:00 p.m. on Saturdays. If possible evening programs will be relocated or appropriate adjustments to the construction schedule will be required and approved. Disruptive noise is defined as noise generated by rotary hammer drills, core drills, concrete and masonry saws, jack hammers, grinders, heavy construction equipment, etc., that have the ability to resonate sound throughout the building. Therefore, contractors shall take into consideration scheduling all disruptive work activities after normal occupied hours at no additional cost to the bid submitted
G14- A sign-in sheet must be maintained on the project site. At the completion of construction a copy of these sheets shall be provided to DCM. DCM will provide the initial blank form. The contractor is responsible for maintaining the sign-in sheet
G15. All work considered here shall be governed by all relevant National and State Codes as follows -
1. International Building Code (IBC), 2006 Ed.
   a. Chapter 11, Accessibility is deleted. See ADA item below.
   b. Life Safety Code (NFPA 101, 2000 Ed.) is applicable on projects required to meet Federal requirements
2. International Building Fire Code (IFC), 2006 Ed.
3. International Residential Code (IRC), 2006 Ed.
4. International Mechanical Code (IMC), 2006 Ed.
5. International Plumbing Code (IPC), 2006 Ed.
6. National Electric Code (NEC), 2006 Ed.
7. International Fuel Gas Code (IFGC), 2006 Ed.
8. International Energy Conservation Code (IECC), 2006 Ed.
9. National Fire Protection Association (NFPA)
   a. National Fire Codes & Standards Items 1-7
   b. NFPA 13 & 13R, 2002 Ed.
   c. NFPA 70 - NEC, 2005 Ed.
   d. NFPA 101, 2000 Ed. - Life Safety Code shall only be applicable on projects required to meet Federal Requirements
   e. NFPA 70 - National Electric Code (NEC), 2005 Ed.
10. Kansas Fire Prevention Code
11. Americans with Disabilities Act Accessibility Guidelines for Buildings & Facilities (ADAAG), 1991 and/or Uniform Federal Accessibility Standard (UFAS)
12. Kansas Boiler Code (K.S.A. 44-913) & ASME Boiler Pressure Vessel Code

SHEET INDEX



LOCATION PLAN

SCALE: NTS

KU

DESIGN & CONSTRUCTION MANAGEMENT
THE UNIVERSITY OF KANSAS
1246 WEST CAMPUS ROAD #114
LAWRENCE, KANSAS 66045-7505
TELEPHONE (785) 864-3431

DCM PROJECT #
PPMR# 104/9547

PROJECT TYPE:
REMODEL

APPROVED BY:

DEPARTMENT OF ADMINISTRATION
DIVISION OF FACILITIES MANAGEMENT
900 SW JACKSON, SUITE 100
TOPEKA, KANSAS 66612-1220
TELE 785-296-8899
FAX 785-296-8898

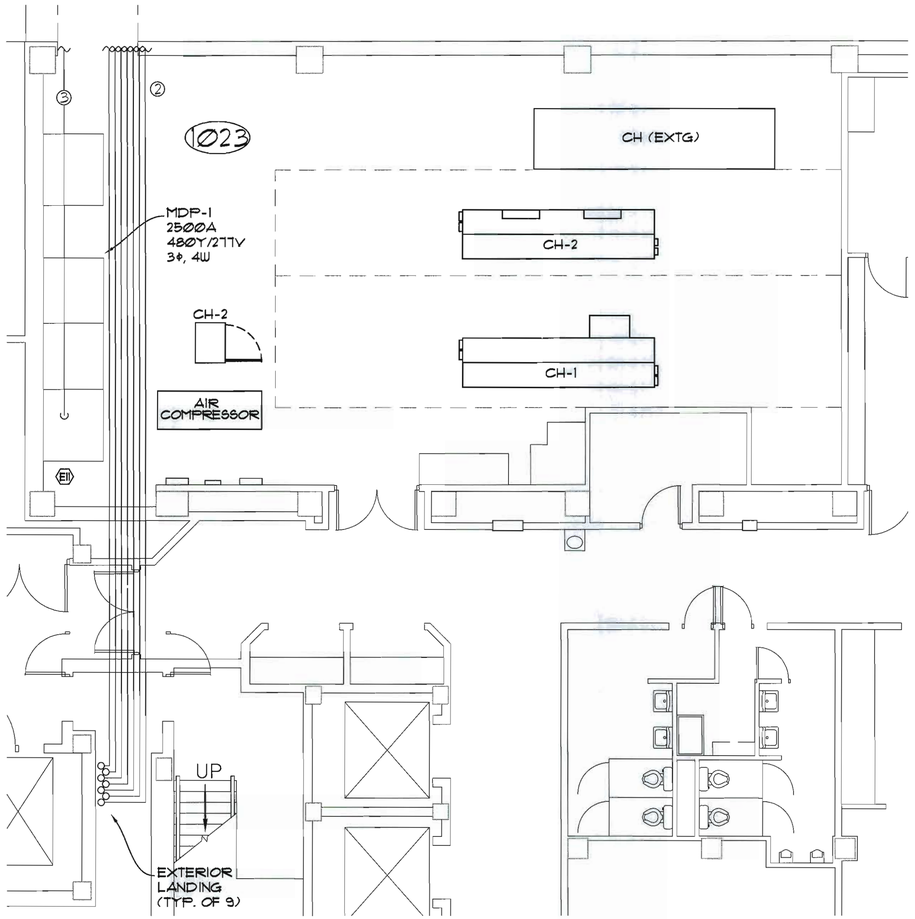
THE UNIVERSITY OF KANSAS
HAWORTH HALL
REPLACE ELECTRICAL SUBSTATION
BLDG# 68200-00104

DRAWN BY: RGZ
CHECKED BY: PJE
DATE: OCT 11
REV:

A-011909

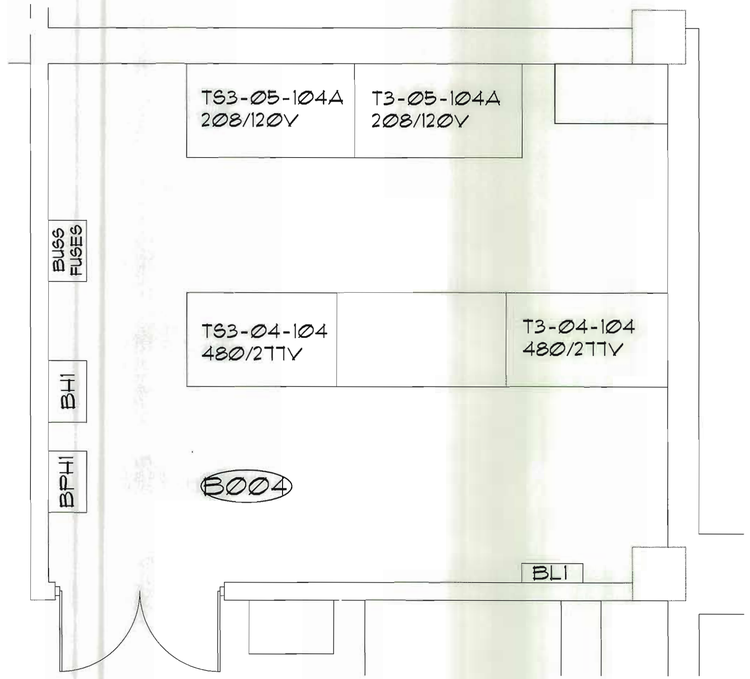
E100

ORIGINAL CONTRACT DOCUMENTS



ELECTRICAL PLAN (FIRST FLOOR)

SCALE: 3/16" = 1'-0"



ELECTRICAL PLAN (BASEMENT)

SCALE: 3/8" = 1'-0"

ELECTRICAL NOTES:

E1 REMOVE/RELOCATE ELECTRICAL DEVICES AS REQUIRED FOR NEW SWITCHBOARD.
E2 PROVIDE NEW 208/120V SWITCHBOARD. RE:1/E3, SPECIFICATIONS.
E3 DISTRIBUTION FEEDERS. RE:SCHEDULE 2/E3.
E4 PROVIDE CONNECTION TO BUSS BAR FOR POWER DISTRIBUTION.
E5 TRANSFER 208/120V PANELBOARD LOADS.
E6 REMOVE 208/120V SWITCHGEAR AND TRANSFORMER. REMOVE ALL ABANDONED CONDUITS AND CONDUCTORS.
E7 PROVIDE NEW 480/277V SWITCHBOARD. RE:2/E3.
E8 USE EXISTING TEMPORARY FEEDERS TO ENERGIZE 480/277V GEAR DURING REPLACEMENT.
E9 NEW TRANSFORMER RE: SCHEDULE

UTILITY SITE PLAN

SCALE: NTS

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DESIGN & CONSTRUCTION MANAGEMENT
THE UNIVERSITY OF KANSAS
1246 WEST CAMPUS ROAD #114
LAWRENCE, KANSAS 66045-7505
TELEPHONE (785) 864-3431

DCM PROJECT #
PPMR# 104/9547

PROJECT TYPE:
REMODEL

APPROVED BY:

DEPARTMENT OF ADMINISTRATION
DIVISION OF FACILITIES MANAGEMENT
900 SW JACKSON, SUITE 100
TOPEKA, KANSAS 66612-1220
TELE 785-296-8899
FAX 785-296-8898

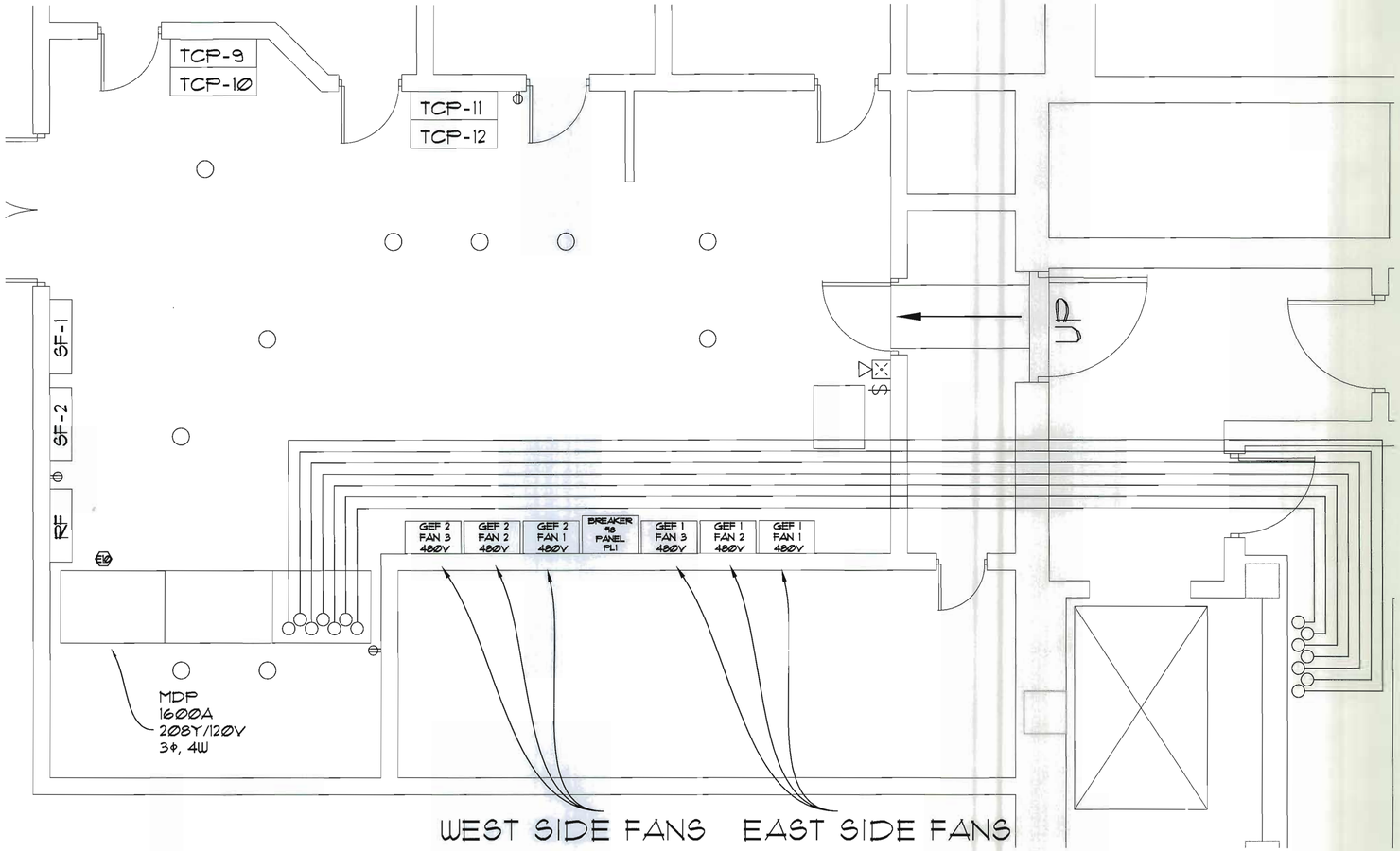
THE UNIVERSITY OF KANSAS
HAWORTH HALL
REPLACE ELECTRICAL SUBSTATION
BLDG# 68200-00104

DATE: OCT 11
DRAWN BY: RGZ
CHECKED BY: PJE
REV:

A-011909

E200

ORIGINAL CONTRACT DOCUMENTS



ELECTRICAL PLAN (NINTH FLOOR)

SCALE: 3/8" = 1'-0"

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LAWRENCE, KANSAS 66045-7505
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DCM PROJECT #
PPMR# 104/9547

PROJECT TYPE:
REMODEL

APPROVED BY:

DEPARTMENT OF ADMINISTRATION
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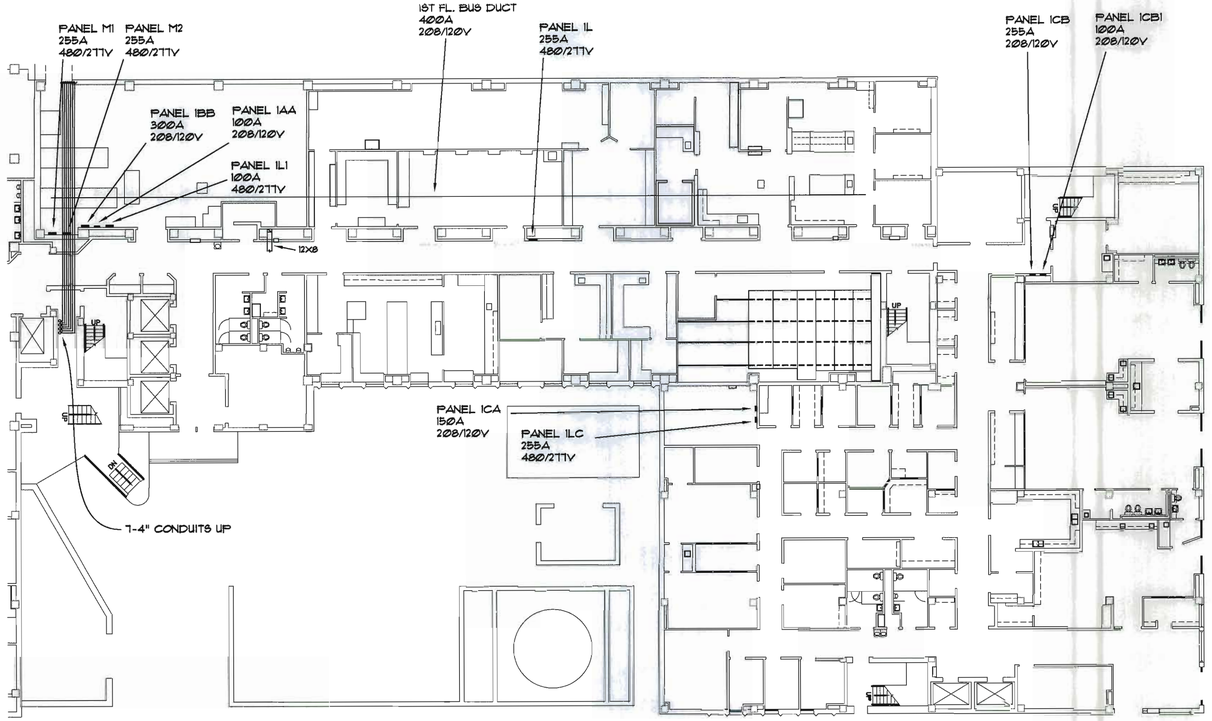
THE UNIVERSITY OF KANSAS
HAWORTH HALL
REPLACE ELECTRICAL SUBSTATION
BLDG# 68200-00104

DATE: JAN 12
DRAWN BY: RGZ
CHECKED BY: PJE
REV:

A-011909

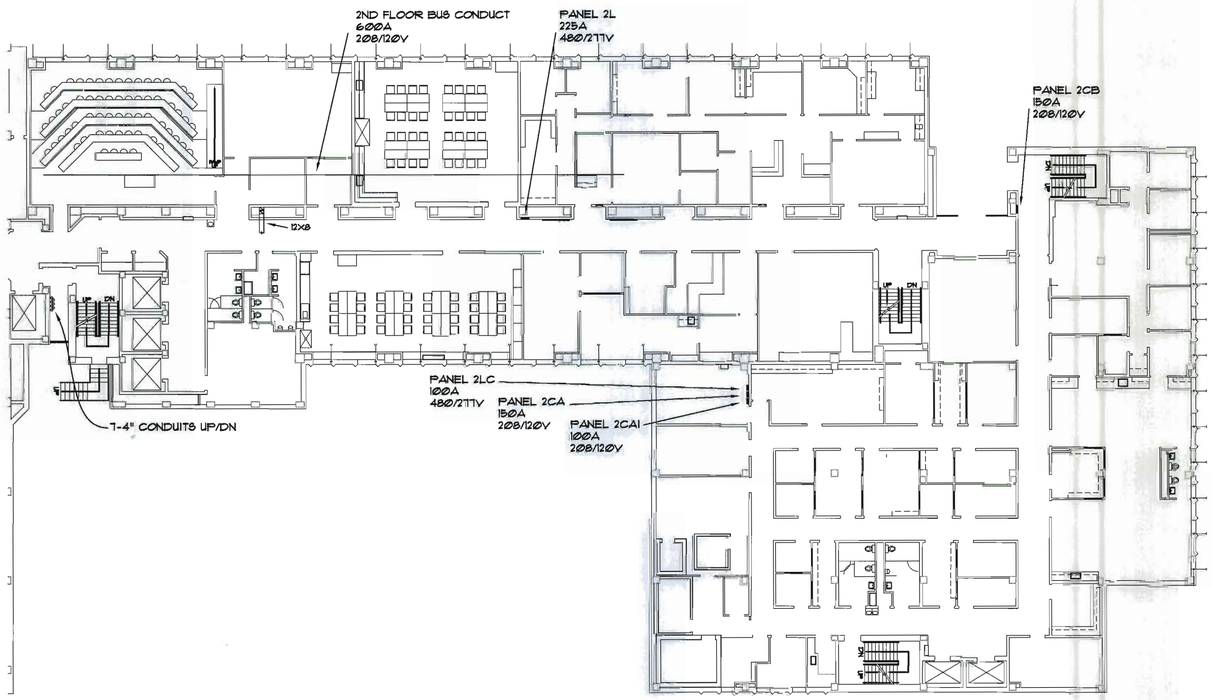
E201

ORIGINAL CONTRACT DOCUMENTS



PANEL LOCATION (1ST FLOOR)

SCALE: 1/16" = 1'-0"

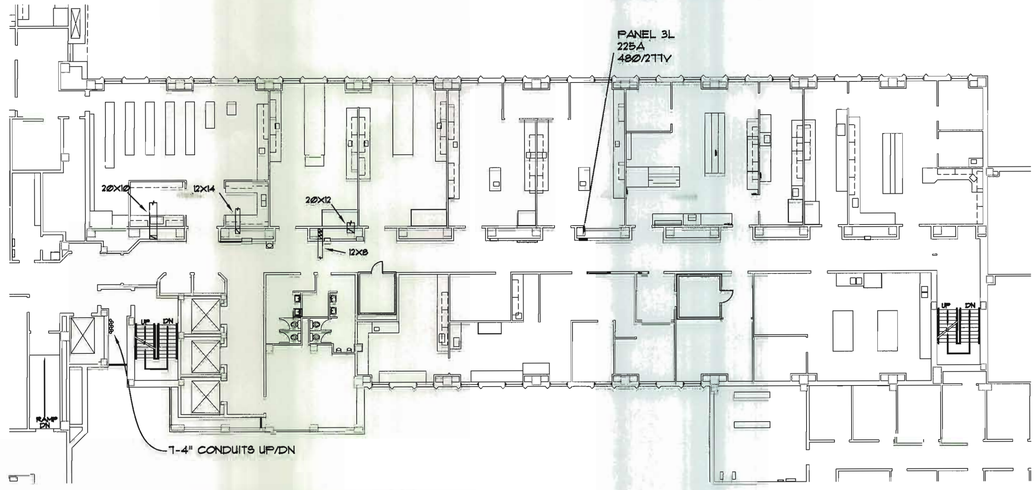


PANEL LOCATION (2ND FLOOR)

SCALE: 1/16" = 1'-0"

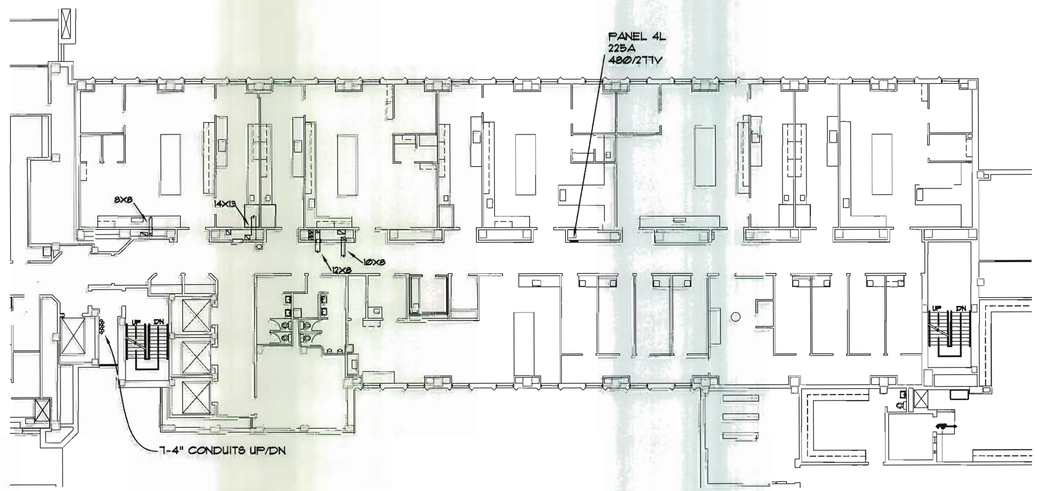
ELECTRICAL NOTES:

REFER TO NOTES ON SHEET E100



PANEL LOCATION (3RD FLOOR)

SCALE: 1/16" = 1'-0"



PANEL LOCATION (4TH FLOOR)

SCALE: 1/16" = 1'-0"

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DCM PROJECT #
PPMR# 104/9547

PROJECT TYPE:

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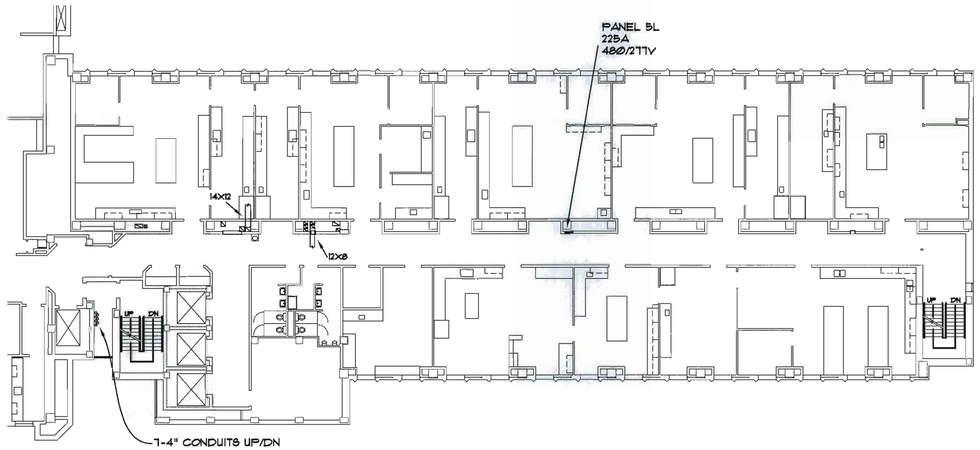
THE UNIVERSITY OF KANSAS
HAWORTH HALL
REPLACE ELECTRICAL SUBSTATION
BLDG# 68200-00104

DRAWN BY: RGZ
CHECKED BY: PJE
DATE: JAN 12
REV:

A-011909

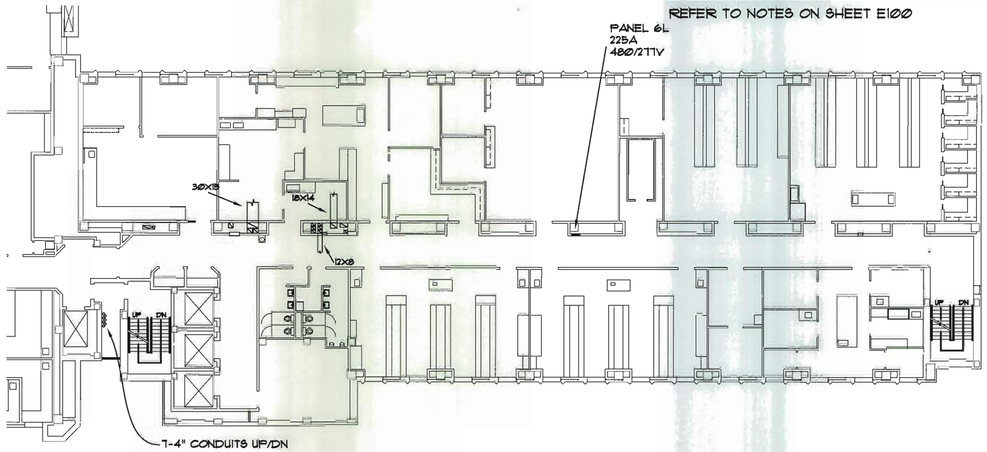
E202

ORIGINAL CONTRACT DOCUMENTS



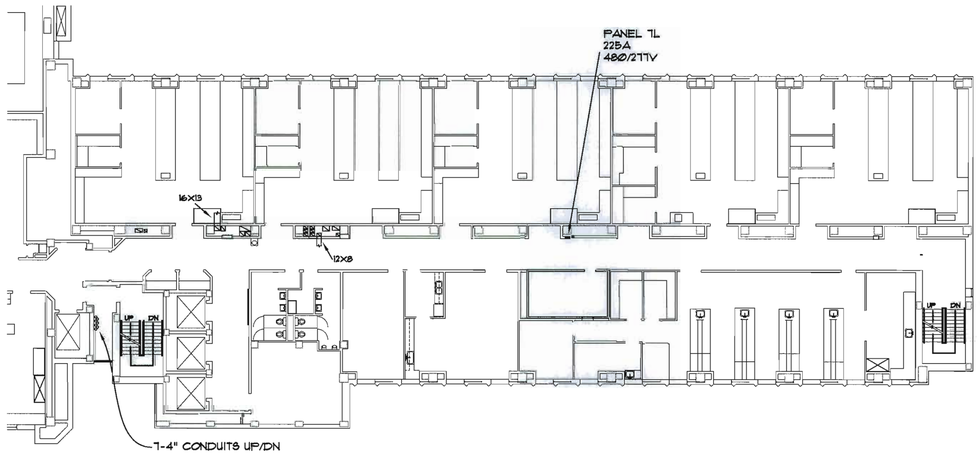
PANEL LOCATION (5TH FLOOR)

SCALE: 1/16" = 1'-0"



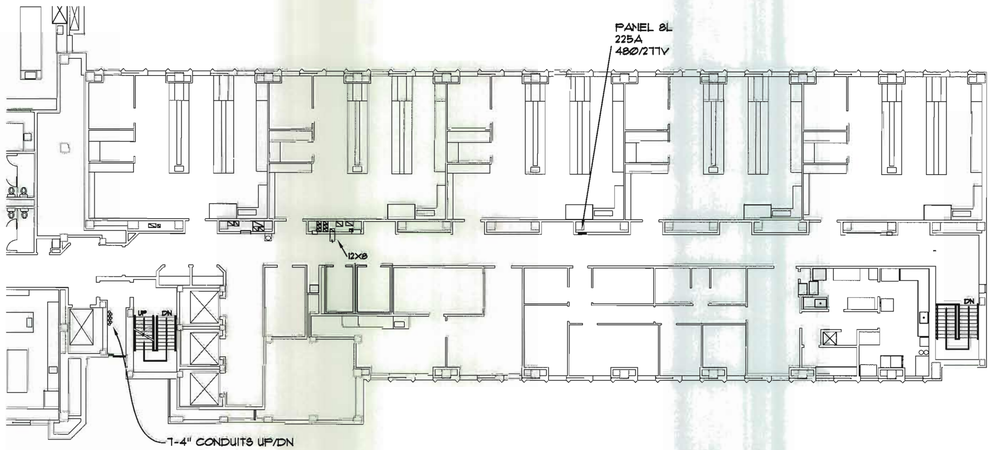
PANEL LOCATION (6TH FLOOR)

SCALE: 1/16" = 1'-0"



PANEL LOCATION (7TH FLOOR)

SCALE: 1/16" = 1'-0"



PANEL LOCATION (8TH FLOOR)

SCALE: 1/16" = 1'-0"

ELECTRICAL NOTES:

REFER TO NOTES ON SHEET E100

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DCM PROJECT #
PPMR# 104/9547

PROJECT TYPE:

APPROVED BY:

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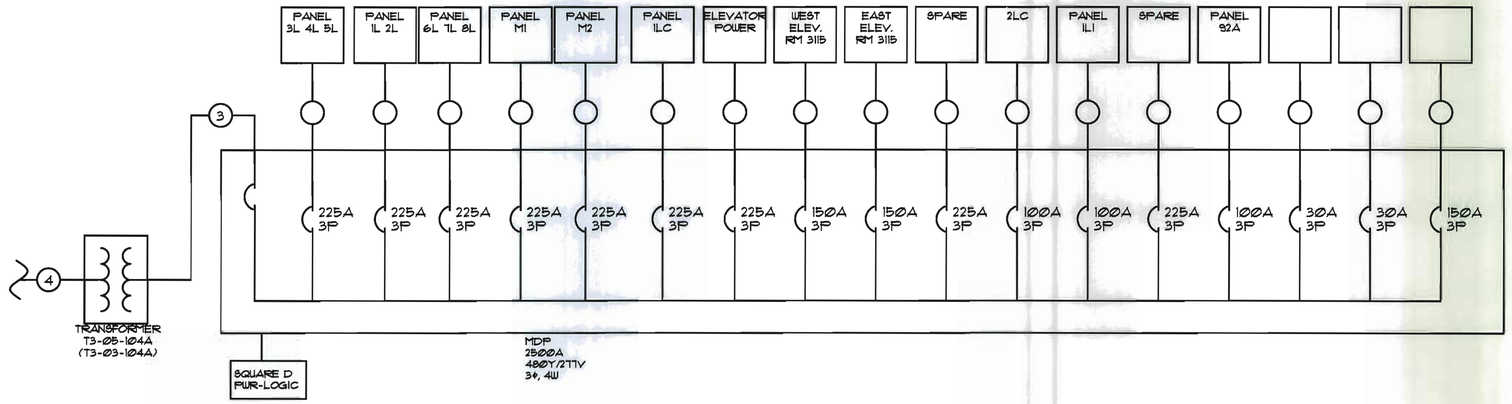
THE UNIVERSITY OF KANSAS
HAWORTH HALL
REPLACE ELECTRICAL SUBSTATION
BLDG# 68200-00104

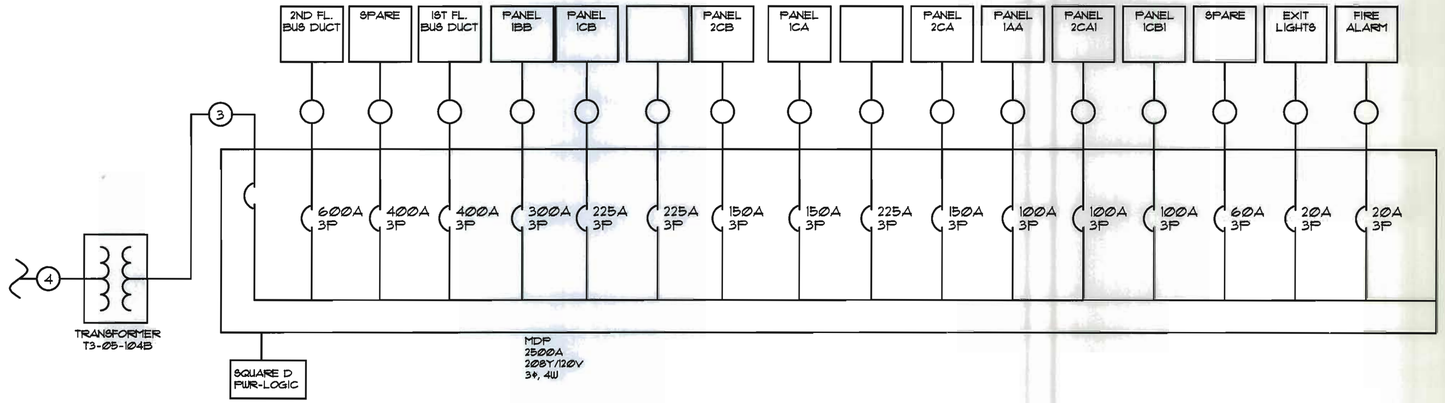
DRAWN BY: RGZ
CHECKED BY: PJE
DATE: JAN 12
REV:

E203

ORIGINAL CONTRACT DOCUMENTS



ONE-LINE ELECTRICAL DIAGRAM (480Y/277V) — 1 / E300



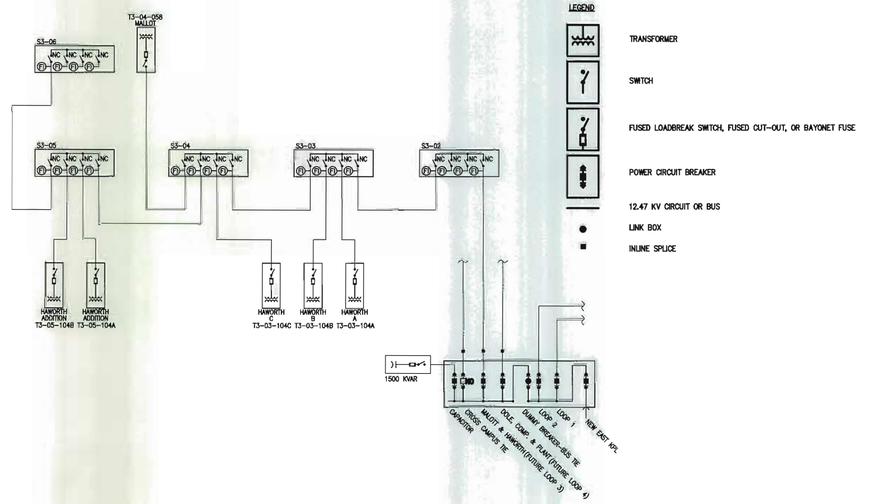
ONE-LINE ELECTRICAL DIAGRAM (208Y/120V) — 2 / E300

MARK	CONDUCTORS/CONDUIT
1	4-3/0, #6G IN 2"C.
2	(4) 3-500 MCM, #4/0 BARE COP G IN 4" C.
3	(1) 4-500 MCM, #4/0 BARE COP G IN 4" C.
4	EXTG
5	(3) 3-350 MCM, 2/0 G IN 3" C.
6	3-3/0, #6 G IN 2" C.
7	4#6, #10 G IN 1" C.
8	3#6, #10 G, IN ¾" C.
9	4#3, #8 G, IN 1-¼" C.
10	NOT USED
11	NOT USED

FEEDER SCHEDULE — 3 / E300

MARK	CAP	PRIMARY	SECONDARY
T3-03-104A	150 KVA	12470V	208Y/120V
T3-03-104B	200KVA	12470V	480Y/277V

TRANSFORMER SCHEDULE — 4 / E300



ONE-LINE ELECTRICAL DIAGRAM — 5 / E300

ELECTRICAL NOTES:

DESIGN & CONSTRUCTION MANAGEMENT
THE UNIVERSITY OF KANSAS
1246 WEST CAMPUS ROAD #114
LAWRENCE, KANSAS 66045-7505
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DEPARTMENT OF ADMINISTRATION
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TOPEKA, KANSAS 66612-1220
TEL# 785-296-8898
FAX 785-296-8898

DCM PROJECT #
PPMR# 104/9547

PROJECT TYPE:
REMODEL

APPROVED BY:

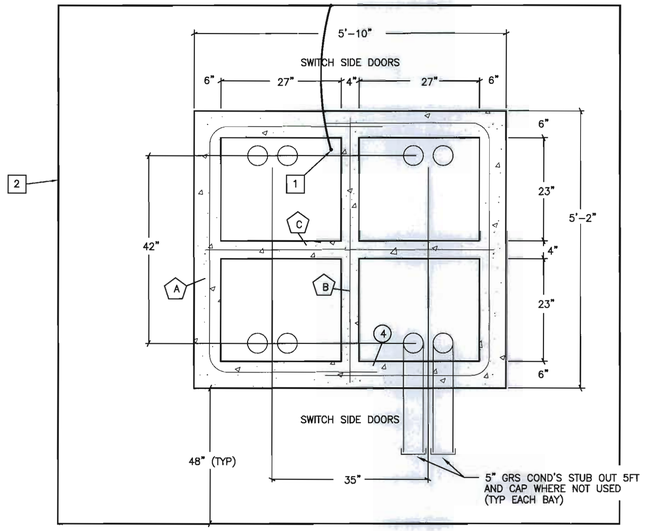
THE UNIVERSITY OF KANSAS
HAWORTH HALL
REPLACE ELECTRICAL SUBSTATION
BLDG# 68200-00104

DRAWN BY: RGZ
CHECKED BY: PJE
DATE: OCT 11
REV:

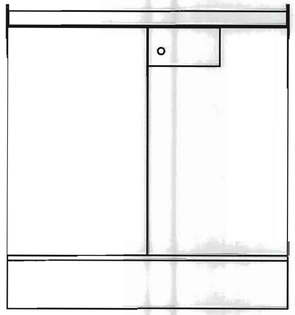
A-011909

E300

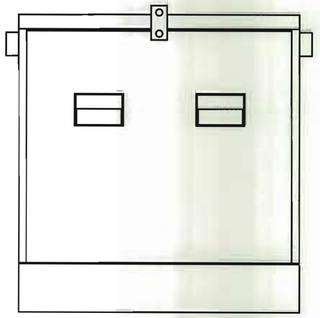
ORIGINAL CONTRACT DOCUMENTS



PLAN



FRONT VIEW



SIDE VIEW

NOTES:

1. SWITCHGEAR IS S&C PMH-10 WITH 12" BASE EXTENSION AND PROVISIONS FOR FAULT INDICATORS.
2. INSTALL FAULT INDICATORS ON INCOMING AND OUTGOING LOOP CIRCUITS
3. IDENTIFICATION SHALL CONSIST OF:
   -SWITCH NUMBER ON 2 SIDES.
   -EACH CIRCUIT TO SWITCH SHALL BE IDENTIFIED.

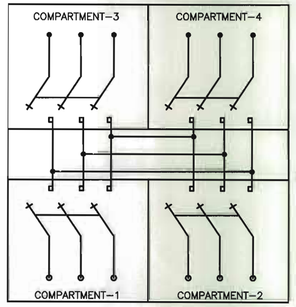
NOTES:

1. COORDINATE EXACT DIMENSIONS WITH SWITCHGEAR SUPPLIER.
2. BASE SHALL BE PRE-CAST CONCRETE, 5000PSI AT 28 DAYS. BARBOUR CONCRETE 6219C OR APPROVED EQUAL.

CONSTRUCTION NOTES:

1 GROUND ROD. BOND SWITCH ENCL. AND ALL CONDUITS.

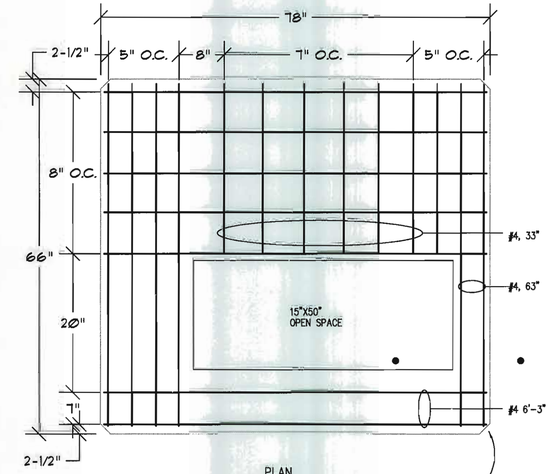
2 #4/0 AWG BARE COPPER GROUND RING (24"MIN BLW GRADE). CONNECT TO GROUND ROD.



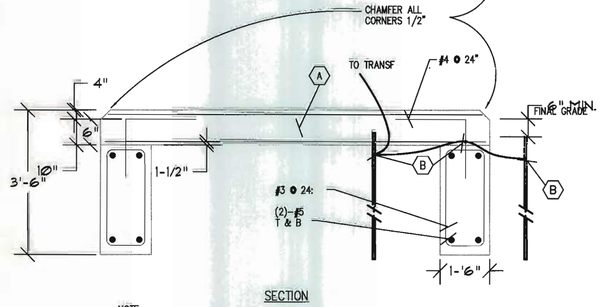
CONNECTION DIAGRAM

PAD-MOUNT SWITCHGEAR 2 E301

NOT TO SCALE



PLAN



SECTION

NOTE:

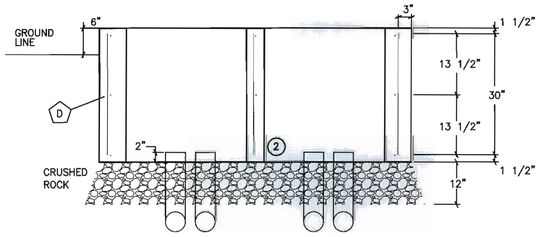
A. ALL CONCRETE SHALL BE AIR ENTRAINED AND TEST 3000 PSI(MIN.) IN 28 DAYS.

B. EXOTHERMIC WELD GROUND CONDUCTORS TO GROUND ROD AND REINFORCING STEEL (TYP). INSTALL GROUND RODS AND CONDUCTORS AS SHOWN ON THE PLANS.

TRANSFORMER PAD DETAIL 3 E301

NOT TO SCALE

MINIMUM REINFORCING		
BAR	QUAN.	SIZE
A	6	4
B	2	4
C	2	4
D	9	4

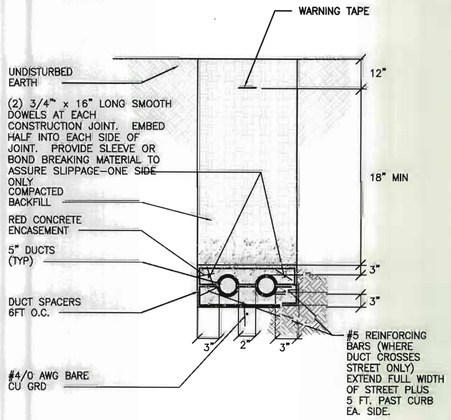


SECTION

SWITCH PAD DETAIL 1 E301

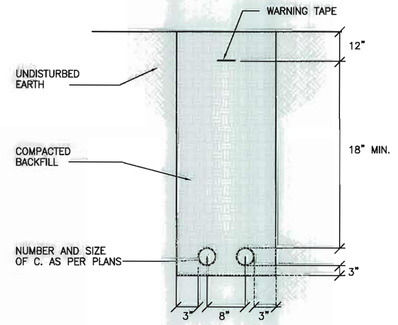
NOT TO SCALE

CONTRACTOR NOTE: WHERE ANY DUCT BACK DIES INTO A MANHOLE, (2) # 5 X 3'-0" LONG REBAR DOWELS SHALL BE DRILL AND EPOXY ANCHORED INTO THE CONCRETE MANHOLE WITH 4" MINIMUM CONCRETE EMBEDMENT AND CAST INTO THE DUCT BANK CONCRETE TO PREVENT DIFFERENTIAL SETTLEMENT BETWEEN THE MANHOLE AND THE DUCT BANK. THE LOCATIONS SHALL BE AT THE SAME LOCATIONS SHOWN BELOW FOR CONSTRUCTION JOINTS.



2x1 DUCT BANK 5 E301

NOT TO SCALE



UNDERGROUND SECONDARY SERVICE 4 E301

NOT TO SCALE

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LAWRENCE, KANSAS 66045-7505
TELEPHONE (785) 864-3431

DCM PROJECT # PPMR# 104/9547

PROJECT TYPE: ADDITION

APPROVED BY: MLR

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THE UNIVERSITY OF KANSAS
HAWORTH HALL
REPLACE ELECTRICAL SUBSTATION
BLDG# 68200-00104

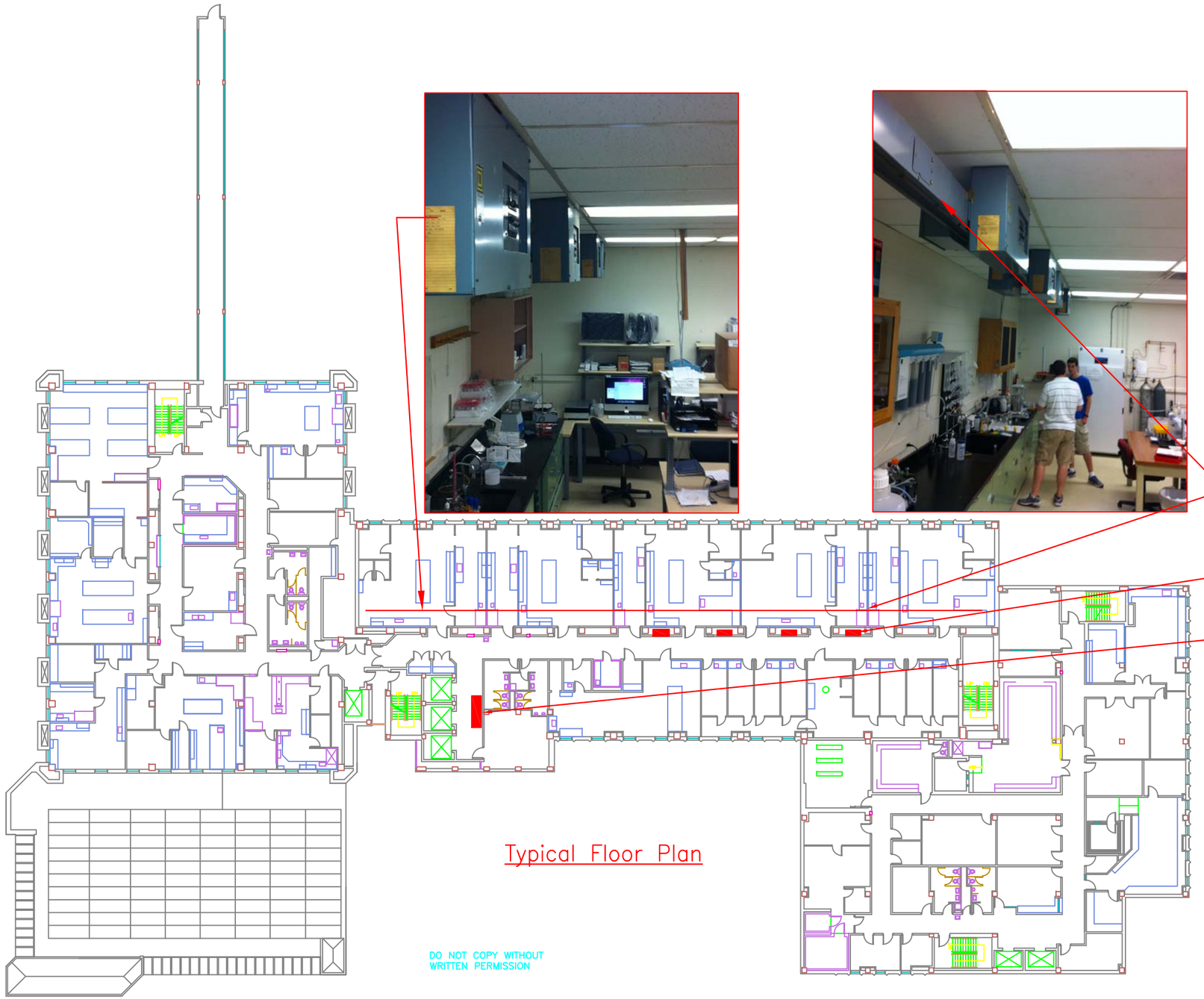
DRAWN BY: RDJ
CHECKED BY: PJE
DATE: 10.09.10
REV:

A-011909

E301

ORIGINAL CONTRACT DOCUMENTS

Appendix B – Reference Floor Plan



Typical Overhead Electrical Bus

Feasible Location for Branch Circuit Panelboards

Feasible Location for Power Distribution Panelboards

Typical Floor Plan

Reference Floor Plan
KU Project #104/9568
Haworth Hall Deferred Maintenance
Replace Electrical Distribution System
March 2012