EAST CAROLINA UNIVERSITY

Health Sciences Campus

HSC Electrical Distribution

Utility Condition Assessment

September 16, 2016

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UTILITY CONDITION ASSESSMENT

SECTION 1

OVERVIEW

OVERVIEW

Introduction

This document addresses the assessment of the physical condition and estimated remaining reliable operating life for the electrical distribution equipment at the East Carolina University (ECU) Health Sciences Campus (HSC). Overall, the electrical distribution system is in good physical condition. The majority of the equipment has been well maintained and will outlast the ten-year scope of this analysis.

Primary electrical service is provided to ECU-HSC by two incoming transmission lines from the local utility (Greenville Utilities Commission) at 12.47 kV. The campus is supplied this medium voltage power through two point of delivery (POD) circuits and a series of underground duct banks and utility manholes. The two POD circuits are identified as MSG-1 and MSG-2, and each switchgear assembly has a maximum rating of 15 kV and 1,200 amps. Four loop circuits originating at MSG-1 and MSG-2 distribute electrical service. The following is a summary of the loops and the facilities they serve:

- Loop A – Brody School of Medicine, Leo Jenkins Cancer Center, MRI
- Loop B – Biotech Building, Heart Institute, Life Sciences Building, Health Sciences Building, Modular Office Building
- Loop C – Dental School, Family Medicine
- Loop D – Central Plant and Equipment, Clinical Skills Building, Lakeside Modular Units

The campus is also equipped with oil-filled transformers, pad-mounted selector and SF6 switches, fused and non-fused load interrupters and emergency power generators, various sizes of switchgear, vacuum circuit breakers, power circuit breakers, and switchboards. The condition of this equipment and any recommendations for repair, replacement, or upgrade are detailed within this report.

Costs Overview

Current Replacement Value

It is estimated that the current replacement value of the electrical distribution system is $11,080,500. This is an estimate of the cost in current dollars to replace the equipment. It is not a construction estimate or a detailed take-off but rather an estimate of replacement with like equipment.

Total Project Costs

The total recommended renewal costs are $6,055,857, with $1,855,791 being recurring costs, $49,193 corrective action, and $4,285,048 plant adaption. The majority of the recommendations for this system consist of replacing aging distribution cable, transformers, and switchgear equipment that make up Loop

A and POD2/MSG-2 circuits. Additional recommendations are to create redundancy and reliability and to provide new emergency power networks to facilities that currently share a generation source.

Methodology

This document is the result of the assessment of the physical condition and estimated remaining reliable operating life of the electrical distribution equipment at ECU-HSC. The estimates for remaining useful life consider safety, reliability, efficiency, and sustainability as the primary operational objectives for capital renewal. These estimates are based on actual equipment age, visual and nondestructive observations, performance data reviews, personnel interviews, maintenance practices, and operating history. Previous surveys, including the Campus Master Plan developed by RDK Engineers and Arc Flash Coordination Reports developed by Eaton Electrical Service & Systems, were reviewed. The goal was to produce a campuswide report with project and lifecycle renewal recommendations that have been incorporated into the ISES Asset Management System (AMS).

Approach to Lifecycle Calculation

The realization of expected equipment useful life preserves the original capital investment strategy, while accelerated depreciation results in premature expenditure of resources. These observations point out the importance of providing adequate, but not excessive, resources for utility system asset preservation. The table below shows typical estimated useful life projections for the majority of the medium voltage electrical equipment at ECU-HSC.

Table 1: Typical Average Equipment Expected Useful Life

COMPONENT	TYPE	USEFUL LIFE (YEARS)
Transformer	Oil-Filled	40
Transformer	Dry-Type	40
Circuit Breaker	Vacuum	25
Relay	Electro-mechanical	20
Switch	Air, fused	30
Switch	SF6	30
Switch	Air, nonfused	30
Cable	500 MCM	40
Switchgear	Metalclad, copper buss, stacked	50
Manhole	Cast-in-place concrete	75
Battery	12 aH, Ni-Cad	8
Battery Charger	DC	15

Source Data: ASHRAE, BOMA, IEEE, Hartford Ins. Co., ISES Database

ISES emphasizes that these expected useful life values are averaged forecasts based on equipment that is properly maintained and operated without frequent and/or severe operating excursions. There is ample evidence of equipment listed in this table operating well beyond its predicted useful life. Chronological equipment age is not the primary determinant of service life. This is why it is important to modify these values with actual equipment condition. This modification is based on service history, operating conditions, installation environment, and actual field performance.

In addition, equipment reaching the predicted endpoint of expected useful life does not necessarily cease to function. What does occur is a downward trend toward loss of service reliability and a potential increase in forced outages and maintenance cost requirements.

It is important to note that utility infrastructure assets normally encompass more than just a single piece of equipment and will, in most situations, represent a section or group of materials, i.e. linear footage of installed piping systems or electrical wiring. The majority of these systems will continue to operate reliably and safely beyond the ten-year planning horizon of this assessment. However, beyond the next ten years, it will be necessary to reinspect the systems to ensure that they continue to operate reliably. The items detailed in this report are areas and equipment that are deemed to be at risk for potential failure or deterioration within the next ten years.

Original Equipment Manufacturers (OEMs) provide periodic maintenance requirements for their equipment as part of the operating instructions. In most cases, these instructions are designed to retain warranty coverage and minimize warranty claims. They cover the most severe operating conditions, and they usually conflict with customer operational schedules by requiring periodic shutdowns, interfering with production or program schedules, or directly affecting demands for continuity of service. In the case of electrical equipment, these OEMs can help trend and predict problems prior to an occurrence. Transformer oil and gas and transformer turns ratio tests help technicians develop information detailing internal performance patterns of equipment not visible to a standard physical inspection. The removal, inspection, and operation of circuit breakers ensure proper operation at the time of fault, if any. Digital and electromechanical relays need testing to ensure that these safety devices operate when necessary to prevent costly damage to equipment and harm to personnel.

The trend in recent years toward planned obsolescence by manufacturers of certain plant systems and equipment alters the strategy for capital replacement as some systems become obsolete. Although the equipment may have many remaining years of safe, reliable, and efficient operation, manufacturers are phasing systems out and not supporting the equipment past a specific phase-out date. For example, digital electronic control systems have an estimated operating life of fifteen years, not because of failure to function but because of the planned lifecycle established by the OEM. One reason for this situation is technological advancements and product development. This also results in a requirement for continuous operator training as equipment is replaced. It is not unusual for newer equipment to have better efficiency and lower operating costs. However, this requires careful analysis by owners to actualize potential savings.

One method of providing consistency in methods of system/equipment operation is the implementation of Standard Operating Procedures (SOPs). These provide a reference guide for the operating staff for most of the expected operating conditions. They cannot, however, provide 100 percent guidance for all possible events. This is why operator training in the fundamentals of plant operation is so critical. The implementation of SOPs also provides a method of reminding operators about system equipment requirements in plants where there are few, if any, abnormal operating excursions. In this type of operation, skills that have not been exercised recently become difficult to recall under the pressure of rapidly developing events.

UTILITY CONDITION ASSESSMENT

SECTION 2

SYSTEM FINDINGS

SYSTEM FINDINGS

Main Switchgear and Switchboards

The main switchgear assemblies in the Central Utility Plant (CUP) Substation are identified as MSG-1 and MSG-2. Both are rated for 15 kV and 1,200 amps. MSG-1 was installed in 2005 and consists of Square D metalclad equipment with eight medium voltage circuit breakers. The breaker cabinet assemblies are each equipped with Square D SEPAM digital relays and Square D Powerlogic type PM800 digital monitoring and recordings devices. Overall, this section of switchgear has been well maintained and, with continued maintenance, operation, and testing, will continue to operate beyond the next ten years.

The second section (MSG-2) was installed in 1989 and consists of Westinghouse metalclad equipment with five vacuum circuit breakers.

Image 1: Metalclad Switchgear MSG2

The switchgear cabinets housing the breakers have been retrofitted with Square D SEPAM digital relays and Square D Powerlogic type PM800 digital monitoring and recordings devices. This section of switchgear will reach the end of its reliable statistical life within the next ten years and should be updated. It should also be noted that this section has been subject to very limited maintenance and operation. As a result, it is probable that the charging mechanisms within the breakers have seized, as have the contact points between the breakers and the bus.

Within the CUP are sections of switchgear and switchboards of various sizes that provide primary electrical service to local chillers, pumps, fans, heating equipment, and various electrical components in the CUP and the surrounding exterior site. An emergency power switchboard is installed in the emergency generator building located within the CUP substation. The older 2,000 amp Federal Pacific switchboard that is located in room 105 and the emergency power switchboard were included with the 2015 ISES Facility Condition Assessment for the CUP (asset designation UTIL).

Metalclad switchgear MSGA is rated for 1,200 amps, 4.16 kV and was installed in 2005. This Square D equipment is in proper working condition and will require only minimal maintenance to remain reliable beyond the scope of this analysis. Switchboards MSBA and MSBB are also in proper working condition and will require only routine maintenance to remain serviceable over the next ten years.

A main circuit breaker located at Allied Health Sciences was installed without a proper trip coil. A trip coil is a protective device that detects unusual electrical current and voltage within a circuit breaker and forces the equipment to open in order to protect the device from damage. A circuit breaker not opening during a fault event could cause severe equipment damage and potentially injure maintenance personnel. It is recommended that this breaker be retrofit with an aftermarket trip coil.

The DC control power for the switchgear at the CUP is generated from a standard battery charger set and battery bank. This battery bank is currently in proper working condition, but it should be anticipated that this equipment will reach the end of its statistical useful life within the next five years. It is recommended that the batteries be replaced at that time. The battery charger may still be serviceable beyond the next ten years, but funding has been allocated for its replacement.

Transformers

Located throughout the campus are approximately 20 oil-filled transformers of various ages and electrical capacities. This equipment undergoes oil and gas surveys every five years to determine if there is any evidence of winding or insulation deterioration resulting from excessive heat due to overload situations. The majority of this equipment will remain reliable beyond the next ten years.

However, eight transformers are recommended for replacement. The 1,500 kVA transformers TX-2 and TX-3 at the CUP were installed in 1980 and have reached the end of their reliable service life. They are also undersized for future growth and should be upgraded to 2,500 kVA when replaced.

Image 2: Transformers TX-4, TX-5, TX-6, and TX-7 at Brody

Outside of Brody are transformers TX-4, TX-5, TX-6, and TX-7. TX-4, TX-5 and TX-7 were installed in 1982 and have a rated capacity of 2,500 kVA. TX-6 was installed in 1984 and has a rated capacity of 750 kVA. These are currently in proper working condition but will reach the end of their reliable service life within the next ten years. Replacement is recommended at that time.

The transformer that serves the West Academic Building is currently operating well beyond the reliable, safe lifespan for an oil-filled transformer. It is recommended that this transformer be replaced in the near term to avoid the potential for an unscheduled forced outage due to an electrical failure.

The primary service feed to the Ross School of Dental Medicine is from an exterior oil-filled transformer rated for 2,000 kVA. This facility was originally designed to be equipped with multiple transformers, but limited funding and design space prevented the installation of the redundant service transformer. It is recommended that an additional 2,000 kVA transformer be installed to provide a redundant service feed. Additional project funding has been included for the redesign and renovation of the main electrical room 1182 if necessary.

The transformer identified as TX-10 located outside Warren Life Sciences has a small leak inside the unit. A fuse holder has developed a minor crack that needs to be further inspected. No recommendation for repair or replacement has been developed, as further inspection is required to determine the severity of the damage or deterioration.

Selector Switches and Load Interrupters

The electrical distribution system is equipped with pad-mounted selector switches, pad-mounted SF6 switches, and standard fused load interrupters of various ages, conditions, and capacities. The majority of this equipment has been installed or replaced since 2005. Five pad-mounted switches rated for 15 kV and 600 amps were inspected and found to be in proper working condition. An additional four pad-mounted SF6 switches were also in proper working condition. Outside of CUP are six fused load interrupters rated for 15 kV. With proper maintenance and operation, all of these switches will remain reliable beyond the scope of this assessment.

Distribution Cable and Duct Banks

The electrical conductor cable is installed throughout campus via approximately 10,800 LF of underground duct bank that is in good condition. The majority of this duct bank is presumed to be cast-in-place concrete, and there is no recommendation for replacement at this time.

It is estimated that there is approximately 11,500 LF (four wire per) of various feeder circuits and distribution cable installed throughout the system. The cable is distributed via four circuits or loops identified as A, B, C and D. The oldest loop is Circuit A, which dates to around 1980. It serves facilities located near the Brody School of Medicine. The conductor serving this loop will have almost 50 years of continuous service at the end of this ten-year planning horizon. Statistically, a typical 500 kcmil cable rated for 15 kV with very minimal fault experience will have a reliable service life of 40 years under normal conditions. Although the University has experienced very few forced outages, the A loop feeder cable reliability must be questioned. It is therefore recommended that the following cable feeds be replaced within the next ten years:

Table 2: Conductor Wire Material and Feeds to be Replaced

MATERIAL	FEEDER CIRCUIT
2/0 CABLE - 15 KV	HVSS6 – TX3
2/0 CABLE - 15 KV	HVSS2 – TX8
2/0 CABLE - 15 KV	HVSS1 – TX5
2/0 CABLE - 15 KV	HVSS1 – TX4
2/0 CABLE - 15 KV	HVSS2 – TX7
2/0 CABLE - 15 KV	HVSS2 – TX6
350 KCMIL CABLE - 15KV	MSG2 – HVSS1
500 KCMIL CABLE - 15KV	MSG1 – HVSS2

Utility Manholes

The electrical system is equipped with approximately 24 cast-in-place concrete utility vaults of various sizes. All of the vaults that were inspected had some level of standing water, which can lead to premature deterioration of cable splicing and ultimately to spalling of concrete floor and walls. Most 15 kV cable or wire installed in an underground distribution network is designed to be water resistant to an extent. Unless originally designed to be submerged in water, cable wrapping will prematurely deteriorate. To eliminate the possibility for this kind of failure, it is recommended that these vaults be equipped with small submersible sump pumps. This not only reduces the opportunity for water to cause an unscheduled forced outage, it reduces the cost of manually pumping out the vaults.

Image 3: 15 kV cable submerged in standing water within a utility vault

Approximately six manholes are recommended for refurbishment. Repair spalling concrete, reseal and waterproof the seams, joints, and cracks, and install a proper NEMA rated access ladder. This does not apply to any specific vault, as this recommendation is a placeholder for future capital expenditure.

Emergency Power

This campus does not have a central emergency power system. Individual emergency generators provide power to lighting, egress, and critical systems in individual buildings, although some share generation systems. The majority of the generators were included in the individual building FCA reports, and any recommendations for replacement can be found in those reports.

A 1,250 kW generator provides emergency power to not only the CUP but also to Allied Health Sciences and the Heart Institute. It is recommended that these two facilities be equipped with dedicated emergency generators. Install new generators, fuel-oil tanks, day tanks, battery chargers, and battery banks.

Miscellaneous

Due to the nature of the programs and ongoing research at this campus, it is very challenging for the facilities management department to schedule electrical shutdowns that allow for necessary equipment maintenance. This inability to perform standard, routine maintenance has led to the premature deterioration of the components within the main switchgear assembly MSG2. It should be anticipated that switchgear MSG1 will also be subject to this premature deterioration. To provide the University with continuous, reliable electrical service and also allow the facilities team to perform the OEM recommended annual maintenance, additional service feeds need to be installed. A project has been developed that would provide a budget for the development and installation of additional circuit breakers and switchgear expansion that could provide true N+1 redundancy. The theory of the N+1 redundancy practice states that in the event of a component failure, there will be at least one independent backup to take its place. The N+1 philosophy would eliminate premature expenditure of resources by allowing maintenance teams to greatly extend the reliable useful life of circuit breakers, relays, meters, and switchgear assemblies.

The four campus electrical loop feeds provide some level of redundant power but not enough to ensure a continuous service feed to all facilities in the event of an unscheduled forced outage. To ensure that these research facilities are equipped with a reliable power source, the installation of additional pad-mounted selector switches is recommended throughout campus, along with new feeder conductor and duct bank. These new installations would act as a bridge between the loops, creating multiple service feeds to each facility, and would contribute to extending the life of the existing equipment, as the facilities team would have the ability to perform maintenance on the conductor assets that are very rarely tested. Information from biannual or even three-to-five-year nondestructive testing of cables and duct bank would enable facilities management to track and trend cable deterioration, providing a greater understanding of the condition of these assets and helping develop a more realistic replacement schedule.

Campuswide coordination studies are recommended. The Brody and Allied Health buildings have been subject to this type of survey, and it is recommended that the remaining facilities and the distribution system undergo one as well. This campus has experienced new growth, and many of the original facilities have been subject to remodel and/or space reallocation, so the electrical system load demands have changed. This type of survey provides vital information that helps develop an accurate economical operating plan that is safe and efficient not only for employees but also for the mechanical and electrical equipment installed throughout campus.

SECTION 3

CONDITION ASSESSMENT DEFINITIONS

CONDITION ASSESSMENT DEFINITIONS

The following information is a clarification of the Asset Report using example definitions.

Material and Labor Cost Factors and Additional Markups

The database contains an R. S. Means City Cost Index for material and labor cost factors to adjust the project costs from the national averages to reflect conditions in Greenville. The percentage adjustment of the national average is shown below. Typical general contractor fees (which could include profit, overhead, bonds, and insurance) and professional fees (architect or engineer design fees and in-house design costs) are also included. However, most of the project costs were provided by University personnel, so no mark-ups have been applied.

GLOBAL MARKUP	%
Local Labor Index	51.3
Local Materials Index	100.7
General Contractor Markup	20.0
Professional Fees	16.0

Recurring and Nonrecurring Renewal Costs

Renewal costs are divided into two main categories – recurring and nonrecurring. Recurring costs are cyclical and consist primarily of major repairs to or replacement/rebuilding of systems and components. The tool for projecting the recurring renewal costs is the Lifecycle Component Inventory, which is explained in detail below. Nonrecurring costs typically consist of modifications or repairs necessary to comply with code requirements or to address isolated, nonrecurring deficiencies that could negatively affect the systems and components. For these nonrecurring costs, projects have been developed and include estimated material and labor costs.

Recurring Costs

Asset Component Inventory and Cost Projections

The Asset Component Inventory is a list of major systems and components and is based on industry standard lifecycle expectancies. Each indicated component has the following associated information:

CATEGORY	DEFINITION
Uniformat Code	The standard Uniformat Code that applies to the component
Component Description	This line item describes the individual component
Identifier	Unique identifying information entered for a component as necessary
Quantity	The quantity of the listed component
Units	The unit of measure associated with the quantity
Unit Cost	The cost to replace each individual component unit (this cost is in today's dollars)
Complexity Adjustment	A factor utilize to adjust component replacement costs accordingly when it is anticipated that the actual cost will deviate from the average for that component
Total Cost	Unit cost multiplied by quantity, in today's dollars. Note that this is a one-time renewal/replacement cost
Install Date	Year that the component was or is estimated to have been installed. When this data is not available, it defaults to the year the asset was constructed
Life Expectancy	Average life expectancy for each individual component
Life Expectancy Adjustment	Utilized to adjust the first lifecycle of the component and to express when the next replacement should occur

The component listing forms the basis of the Recurring Component Renewal Schedule, which provides a year-by-year list of projected recurring renewal costs over the next ten years. Each individual component is assigned a replacement year based on lifecycles, and the costs for each item are in future year dollars. For items that are already past the end of their lifecycle, the replacement year is shown as Deferred Renewal.

Recurring Cost Classifications

- Deferred Renewal
  Recurring repairs, generated by the Lifecycle Component Inventory, that are past due for completion but have not yet been accomplished as part of normal maintenance or capital repair efforts. Further deferral of such renewal could impair the proper functioning of the system. Costs estimated for Deferred Renewal should include compliance with applicable codes, even if such compliance requires expenditures beyond those essential to effect the needed repairs.

- Recurring Component Replacement
  Recurring renewal efforts, generated by the Lifecycle Component Inventory, that will be due within

the scope of the assessment. These costs represent regular or normal facility maintenance, repair, or renovation that should be planned in the near future.

Nonrecurring Costs

As previously mentioned, modifications or repairs necessary to comply with code requirements and those that address isolated, nonrecurring deficiencies that could negatively affect the systems and components are not included in the Lifecycle Component Inventory. For each such deficiency, a project with an estimated cost to rectify said deficiency is recommended. These projects each have a unique number and are categorized by system type, priority, and classification, which are defined below. The costs in these projects are also indexed to local conditions and markups applied as the situation dictates.

Project Number

Each project has a unique number consisting of three elements, the asset identification number, system code, and a sequential number assigned by the FCA software. For example, the fourth electrical project identified for asset 0001 would have a project number of 0001EL04:

Example: Project Number 0001EL04		
0001	-	Asset Identification Number
EL	-	System Code (EL represents Electrical)
04	-	The next sequential number for an Electrical project

Project Classification

- Plant Adaption
  Nonrecurring expenditures required to adapt the physical plant to the evolving needs of the institution and to changing codes or standards. These are expenditures beyond normal maintenance. Examples include compliance with changing codes and improvements occasioned by the adoption of modern technology (e.g., the use of personal computer networks).

- Corrective Action
  Nonrecurring expenditures for repairs needed to correct random and unpredictable deficiencies. Such projects are not related to aligning a building with codes or standards. Deficiencies classified as Corrective Action could have an effect on utility safety, or usability.

Priority Class

- Immediate

  Projects in this category require immediate action to:

  a. correct a cited safety hazard
  b. stop accelerated deterioration
  c. and/or return a facility to normal operation

- Critical

  Projects in this category include actions that must be addressed in the short-term:

  a. repairs to prevent further deterioration
  b. improvements to facilities associated with critical accessibility needs
  c. potential safety hazards

- Noncritical

  Projects in this category include:

  a. improvements to facilities associated with noncritical accessibility needs
  b. actions to bring a facility into compliance with current building codes
  c. actions to improve the usability of a facility following an occupancy or use change

Category Code

CATEGORY CODE*	SYSTEM DESCRIPTION
EL1A – EL8A	ELECTRICAL
HV1A – HV8B	HVAC
PL1A – PL5A	PLUMBING

**Refer to the Category Code Report starting on the following page.*

Example: Category Code = EL5A	
EL	System Description
5	Component Description
A	Element Description

Priority Sequence

A Priority Sequence number is automatically assigned to each project to rank the projects in order of relative criticality and show the recommended execution order. This number is calculated based on the Priority Class and identified system of each project.

Example:			
Priority Class	**Category Code**	**Project Number**	**Priority Sequence**
1	HV2C	0001HV04	01
2	PL1D	0001PL02	02
2	EL4C	0001EL03	03

CATEGORY CODE REPORT

ELECTRICAL			
CODE	**COMPONENT DESCRIPTION**	**ELEMENT DESCRIPTION**	**DEFINITION**
EL1A	Incoming Service	Transformer	Main building service transformer.
EL1B	Incoming Service	Disconnects	Main building disconnect and switchgear.
EL1C	Incoming Service	Feeders	Incoming service feeders. Complete incoming service upgrades, including transformers, feeders, and main distribution panels are catalogued here.
EL1D	Incoming Service	Metering	Installation of meters to record consumption and/or demand.
EL2A	Main Distribution Panels	Condition Upgrade	Main distribution upgrade due to deficiencies in condition.
EL2B	Main Distribution Panels	Capacity Upgrade	Main distribution upgrades due to inadequate capacity.
EL3A	Secondary Distribution	Step-Down Transformers	Secondary distribution step-down and isolation transformers.
EL3B	Secondary Distribution	Distribution Network	Includes conduit, conductors, sub-distribution panels, switches, outlets, etc. Complete interior rewiring of a facility is catalogued here.
EL3C	Secondary Distribution	Motor Controllers	Mechanical equipment motor starters and control centers.
EL4A	Devices and Fixtures	Exterior Lighting	Exterior building lighting fixtures, including supply conductors and conduit.
EL4B	Devices and Fixtures	Interior Lighting	Interior lighting fixtures (also system wide emergency lighting), including supply conductors and conduits.
EL4C	Devices and Fixtures	Lighting Controllers	Motion sensors, photocell controllers, lighting contactors, etc.
EL4D	Devices and Fixtures	GFCI Protection	Ground fault protection, including GFCI receptacles and breakers.
EL4E	Devices and Fixtures	Lightning Protection	Lightning arrestation systems including air terminals and grounding conductors.
EL5A	Emergency Power System	Generation/ Distribution	Includes generators, central battery banks, transfer switches, emergency power grid, etc.
EL6A	Systems	UPS/DC Power Supply	Uninterruptible power supply systems and DC motor-generator sets and distribution systems.
EL7A	Infrastructure	Above Ground Transmission	Includes poles, towers, conductors, insulators, fuses, disconnects, etc.
EL7B	Infrastructure	Underground Transmission	Includes direct-buried feeders, duct banks, conduit, manholes, feeders, switches, disconnects, etc.
EL7C	Infrastructure	Substations	Includes incoming feeders, breakers, buses, switchgear, meters, CTs, PTs, battery systems, capacitor banks, and all associated auxiliary equipment.
EL7D	Infrastructure	Distribution Switchgear	Stand-alone sectionalizing switches, distribution switchboards, etc.
EL7F	Infrastructure	Area and Street Lighting	Area and street lighting systems, including stanchions, fixtures, feeders, etc.
EL8A	General	Other	Electrical system components not catalogued elsewhere.

HVAC			
CODE	**COMPONENT DESCRIPTION**	**ELEMENT DESCRIPTION**	**DEFINITION**
HV1A	Heating	Boilers/Stacks/ Controls	Boilers for heating purposes, including their related stacks, flues, and controls.
HV1B	Heating	Radiators/ Convectors	Including cast-iron radiators, fin tube radiators, baseboard radiators, etc.
HV1C	Heating	Furnace	Furnaces and their related controls, flues, etc.

CODE	COMPONENT DESCRIPTION	ELEMENT DESCRIPTION	DEFINITION
HV1D	Heating	Fuel Supply/Storage	Storage and/or distribution of fuel for heating purposes, including tanks and piping networks and related leak detection/monitoring.
HV2A	Cooling	Chillers/ Controls	Chiller units for production of chilled water for cooling purposes, related controls (not including mods for CFC compliance).
HV2B	Cooling	Heat Rejection	Repair/replacement of cooling towers, dry coolers, air-cooling, and heat rejection. Includes connection of once-through system to cooling tower.
HV3A	Heating/Cooling	System Retrofit/ Replace	Replacement or major retrofit of HVAC systems.
HV3B	Heating/Cooling	Water Treatment	Treatment of hot water, chilled water, steam, condenser water, etc.
HV3C	Heating/Cooling	Package/Self-Contained Units	Repair/replacement of self-contained/package type units, including stand-up units, rooftop units, window units, etc; both air conditioners and heat pumps.
HV3D	Heating/Cooling	Conventional Split Systems	Repair, installation, or replacement of conventional split systems, both air conditioners and heat pumps, including independent component replacements of compressors and condensers.
HV4A	Air Moving/ Ventilation	Air Handlers/ Fan Units	Includes air handlers and coils, fan coil units, unit ventilators, filtration upgrades, etc., not including package/self-contained units, split systems, or other specifically categorized systems.
HV4B	Air Moving/ Ventilation	Exhaust Fans	Exhaust fan systems, including fans, range and fume hoods, controls, and related ductwork.
HV4C	Air Moving/ Ventilation	Other Fans	Supply, return, or any other fans not incorporated into a component categorized elsewhere.
HV4D	Air Moving/ Ventilation	Air Distribution Network	Repair, replacement, or cleaning of air distribution network, including ductwork, terminal reheat/cool, VAV units, induction units, power induction units, insulation, dampers, linkages, etc.
HV5A	Steam/Hydronic Distribution	Piping Network	Repair/replacement of piping networks for heating and cooling systems, including pipe, fittings, insulation, related components, etc.
HV5B	Steam/Hydronic Distribution	Pumps	Repair or replacement of pumps used in heating and cooling systems, related control components, etc.
HV5C	Steam/Hydronic Distribution	Heat Exchangers	Including shell-and-tube heat exchangers and plate heat exchangers for heating and cooling.
HV6A	Controls	Complete System Upgrade	Replacement of HVAC control systems.
HV6B	Controls	Modifications/ Repairs	Repair or modification of HVAC control system.
HV6C	Controls	Air Compressors/ Dryers	Repair or modification of control air compressors and dryers.
HV7A	Infrastructure	Steam/Hot Water Generation	Generation of central steam and/or hot water, including boilers and related components.
HV7B	Infrastructure	Steam/Hot Water Distribution	Distribution system for central hot water and/or steam.
HV7C	Infrastructure	Chilled Water Generation	Generation of central chilled water, including chillers and related components.
HV7D	Infrastructure	Chilled Water Distribution	Distribution system for central chilled water.
HV7E	Infrastructure	Tunnels/ Manholes/ Trenches	Repairs, installation, or replacement of utility system access chambers.
HV7F	Infrastructure	Other	HVAC infrastructure issues not specifically categorized elsewhere.
HV8A	General	CFC Compliance	Chiller conversions/replacements for CFC regulatory compliance, monitoring, etc.
HV8B	General	Other	HVAC issues not catalogued elsewhere.

PLUMBING

CODE	COMPONENT DESCRIPTION	ELEMENT DESCRIPTION	DEFINITION
PL1A	Domestic Water	Piping Network	Repair or replacement of domestic water supply piping network, insulation, hangers, etc.

CODE	COMPONENT DESCRIPTION	ELEMENT DESCRIPTION	DEFINITION
PL1B	Domestic Water	Pumps	Domestic water booster pumps, circulating pumps, related controls, etc.
PL1C	Domestic Water	Storage/ Treatment	Equipment or vessels for storage or treatment of domestic water.
PL1D	Domestic Water	Metering	Installation, repair, or replacement of water meters.
PL1E	Domestic Water	Heating	Domestic water heaters, including gas, oil, and electric water heaters, shell-and-tube heat exchangers, tank type, and instantaneous.
PL1F	Domestic Water	Cooling	Central systems for cooling and distributing drinking water.
PL1G	Domestic Water	Fixtures	Plumbing fixtures, including sinks, drinking fountains, water closets, urinals, etc.
PL1H	Domestic Water	Conservation	Alternations made to the water distribution system to conserve water.
PL1I	Domestic Water	Backflow Protection	Backflow protection devices, including backflow preventers, vacuum breakers, etc.
PL2A	Wastewater	Piping Network	Repair or replacement of building wastewater piping network.
PL2B	Wastewater	Pumps	Pump systems used to lift wastewater, including sewage ejectors and other sump systems.
PL3A	Special Systems	Process Gas/Fluids	Generation and/or distribution of process steam, compressed air, natural and LP gas, process water, vacuum, etc.
PL4A	Infrastructure	Potable Water Storage/ Treatment	Storage and treatment of potable water for distribution.
PL4B	Infrastructure	Industrial Water Distribution/ Treatment	Storage and treatment of industrial water for distribution.
PL4C	Infrastructure	Sanitary Water Collection	Sanitary water collection systems and sanitary sewer systems, including combined systems.
PL4D	Infrastructure	Stormwater Collection	Stormwater collection systems and storm sewer systems; storm water only.
PL4E	Infrastructure	Potable Water Distribution	Potable water distribution network.
PL4F	Infrastructure	Wastewater Treatment	Wastewater treatment plants, associated equipment, etc.
PL5A	General	Other	Plumbing issues not categorized elsewhere.

SECTION 4

COST SUMMARIES AND TOTALS

RENEWAL COSTS MATRIX

All dollars shown as Present Value

CATEGORY	NON-RECURRING PROJECT NEEDS			RECURRING COMPONENT REPLACEMENT NEEDS											
	Immediate	Critical	Non-Critical	Deferred Renewal	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	TOTAL
ACCESSIBILITY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0
EXTERIOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0
INTERIOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0
PLUMBING	0	0	199,868	0	0	0	0	0	0	0	0	0	0	0	$199,868
HVAC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0
FIRE/LIFE SAFETY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0
ELECTRICAL	3,449	733,733	3,397,191	62,933	0	0	0	66,033	334,437	16,344	921,919	0	454,124	0	$5,990,164
SITE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0
VERT. TRANS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0
HEALTH/EQUIP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0
SUBTOTAL	$3,449	$733,733	$3,597,059	$62,933	$0	$0	$0	$66,033	$334,437	$16,344	$921,919	$0	$454,124	$0	$6,190,032
TOTAL NON-RECURRING PROJECT NEEDS			$4,334,241	TOTAL RECURRING COMPONENT REPLACEMENT NEEDS										$1,855,791	

CURRENT REPLACEMENT VALUE	$11,080,500
FACILITY CONDITION NEEDS INDEX	0.56
FACILITY CONDITION INDEX	0.01

GSF	TOTAL 10-YEAR FACILITY RENEWAL NEEDS	10-YEAR NEEDS/SF
NA	$6,190,032	NA

FACILITIES RENEWAL PLAN

NON-RECURRING PROJECT COST

All costs shown as Present Value

PROJECT NUMBER	PROJECT TITLE	UNI-FORMAT	PRIORITY CLASS	PROJECT CLASSIFICATION	PROJECT COST
HSELEL08	INSTALL TRIP COIL AT ALLIED HEALTH		1	Corrective Action	3,449
HSELEL02	PERFORM CAMPUS-WIDE COORDINATION STUDY		2	Plant Adaption	380,457
HSELEL05	INSTALL EMERGENCY GENERATOR AT ALLIED HEALTH SCIENCES		2	Plant Adaption	176,638
HSELEL06	INSTALL EMERGENCY GENERATOR AT HEART INSTITUTE		2	Plant Adaption	176,638
HSELPL01	INSTALL SUMP PUMPS IN ELECTRICAL MANHOLES		3	Plant Adaption	199,868
HSELEL01	INTERCONNECT LOOPS TO CREATE ADDITIONAL REDUNDANCY		3	Plant Adaption	1,256,676
HSELEL03	REFURBISH PHYSICAL STRUCTURE OF ELECTRICAL MANHOLES		3	Corrective Action	45,744
HSELEL04	INSTALL ADDITIONAL TRANSFORMER AT ROSS		3	Plant Adaption	175,823
HSELEL07	MODIFY AND INSTALL EQUIPMENT TO PROVIDE N+1 REDUNDANCY		3	Plant Adaption	1,918,948
				TOTAL	**$4,334,241**

FACILITIES RENEWAL PLAN

RECURRING COMPONENT REPLACEMENT COSTS

All costs shown as Present Value

ASSET CODE	COMP CODE	COMPONENT	IDENTIFIER	UNI-FORMAT	REPLACEMENT YEAR	REPLACEMENT COST
HSEL	TX17	TRANSFORMER - OIL-FILLED, 3PH, 5-15KV PRIMARY (300-500 KVA)	WEST ACAD BLDG	D5010	Deferred Renewal	62,933
HSEL	TX18	TRANSFORMER - OIL-FILLED, 3PH, 5-15KV PRIMARY (500-750 KVA)	TX6 MRI/LJCC	D5010	2019	66,033
HSEL	TX21	TRANSFORMER - OIL-FILLED, 3PH, 5-15KV PRIMARY (1500-2000 KVA)	TX2 CUP-TURBO	D5010	2020	167,219
HSEL	TX21	TRANSFORMER - OIL-FILLED, 3PH, 5-15KV PRIMARY (1500-2000 KVA)	TX3 CUP-MSBA	D5010	2020	167,219
HSEL	SG27	SWGR STATION BATTERY AND CHARGER SYSTEM	CUP-MSGA	D5010	2021	16,344
HSEL	ED13	2/0 CABLE - 15 KV	HVSS6 - TX3	D5010	2022	2,828
HSEL	ED13	2/0 CABLE - 15 KV	HVSS2 - TX8	D5010	2022	8,484
HSEL	ED13	2/0 CABLE - 15 KV	HVSS1 - TX5	D5010	2022	14,140
HSEL	ED13	2/0 CABLE - 15 KV	HVSS1 - TX4	D5010	2022	14,140
HSEL	ED13	2/0 CABLE - 15 KV	HVSS2 - TX7	D5010	2022	14,140
HSEL	ED17	350 KCMIL CABLE - 15KV	MSG2 - HVSS1	D5010	2022	196,555
HSEL	ED18	500 KCMIL CABLE - 15KV	MSG1 - HVSS2	D5010	2022	259,685
HSEL	TX22	TRANSFORMER - OIL-FILLED, 3PH, 5-15KV PRIMARY (>2000 KVA)	TX4 BROD-SSA	D5010	2022	137,316
HSEL	TX22	TRANSFORMER - OIL-FILLED, 3PH, 5-15KV PRIMARY (>2000 KVA)	TX5 BROD-SSB	D5010	2022	137,316
HSEL	TX22	TRANSFORMER - OIL-FILLED, 3PH, 5-15KV PRIMARY (>2000 KVA)	TX7 BROD-SSB	D5010	2022	137,316
HSEL	ED13	2/0 CABLE - 15 KV	HVSS2 - TX6	D5010	2024	11,312
HSEL	SG12	MC SWGR BREAKER - FME Adjustable (800-1600 AMP)	MSG2 SPARE CAB #8	D5010	2024	49,601
HSEL	SG12	MC SWGR BREAKER - FME Adjustable (800-1600 AMP)	MSG2 SPARE CAB #9	D5010	2024	49,601
HSEL	SG12	MC SWGR BREAKER - FME Adjustable (800-1600 AMP)	MSG2 HVSS10 FEEDER	D5010	2024	49,601
HSEL	SG12	MC SWGR BREAKER - FME Adjustable (800-1600 AMP)	MSG2 HVSS6 FEEDER	D5010	2024	49,601
HSEL	SG12	MC SWGR BREAKER - FME Adjustable (800-1600 AMP)	MSG2 EDWARD NELSON	D5010	2024	49,601
HSEL	SG12	MC SWGR BREAKER - FME Adjustable (800-1600 AMP)	MSG2 BRODY	D5010	2024	49,601
HSEL	SG23	MC SWGR INCOMING PWR CONNECT (CABLE/CONDUIT)	MSG2 POD	D5010	2024	145,204

FACILITIES RENEWAL PLAN

RECURRING COMPONENT REPLACEMENT COSTS

All costs shown as Present Value

ASSET CODE COMP CODE	COMPONENT	IDENTIFIER	UNI- FORMAT	REPLACEMENT YEAR	REPLACEMENT COST
				TOTAL	**$1,855,791**

UTILITY CONDITION ASSESSMENT

SECTION 5

PROJECT DETAILS

All costs shown as Present Value

INSTALL TRIP COIL AT ALLIED HEALTH

Project Number:	HSELEL08	**Category Code:**	EL7D
Priority Sequence:	1		
Priority Class:	Immediate	**System:**	ELECTRICAL
Project Class:	Corrective Action	**Component:**	INFRASTRUCTURE
Date Basis:	8/29/2016	**Element:**	DISTRIBUTION SWITCHGEAR

Code Application:	**Subclass/Savings:**	**Project Location:**
Not Applicable	Not Applicable	Item Only: Floor(s) S

Description

A main circuit breaker located at Allied Health Sciences was installed without a proper trip coil. A trip coil is a protective device that detects unusual electrical current and voltage within a circuit breaker and forces the equipment to open in order to protect the device from damage. A circuit breaker not opening during a fault event could cause severe equipment damage and potentially injure maintenance personnel. It is recommended that this breaker be retrofit with an aftermarket trip coil.

All costs shown as Present Value

Project Cost Estimate

Task Description	Unit	Qnty	Material Unit Cost	Total Material Cost	Labor Unit Cost	Total Labor Cost	Total Cost
Install circuit breaker trip coil, including testing and operation	EA	1	$1,792	$1,792	$1,500	$1,500	$3,292
Base Material/Labor Costs				**$1,792**		**$1,500**	
Indexed Material/Labor Costs				**$1,804**		**$1,070**	**$2,874**
General Contractor Mark Up at 20.0%							**$575**
Original Construction Cost							**$3,449**
Date of Original Estimate: 8/29/2016 — **Inflation**							**$0**
Current Year Construction Cost							**$3,449**
No Professional Fees Required							**$0**
TOTAL PROJECT COST							**$3,449**

All costs shown as Present Value

PERFORM CAMPUS-WIDE COORDINATION STUDY

Project Number:	HSELEL02
Priority Sequence:	2
Priority Class:	Critical
Project Class:	Plant Adaption
Date Basis:	8/31/2016

Category Code: EL7B

System:	ELECTRICAL
Component:	INFRASTRUCTURE
Element:	UNDERGROUND TRANSMISSION

Code Application:	Subclass/Savings:	Project Location:
Not Applicable	Not Applicable	Campus-wide: Floor(s) S

Description

This project recommends that coordination studies be performed on the campus grid switches, transformers, switchgear, and the following facilities: Leo Jenkins Cancer Center, MRI, Warren Life Sciences, Biotechnology, School of Dental Medicine, School of Nursing, and the Heart Institute. These overcurrent studies are necessary to predict future load capacities and availabilities. They could also provide statistics regarding the minimum safe approach standards for all installed equipment.

All costs shown as Present Value

Project Cost Estimate

Task Description	Unit	Qnty	Material Unit Cost	Total Material Cost	Labor Unit Cost	Total Labor Cost	Total Cost
Perform coordination study on distribution equipment	EA	1	$0.00	$0	$75,000	$75,000	$75,000
Perform coordination study at campus buildings	EA	7	$0.00	$0	$55,000	$385,000	$385,000
Base Material/Labor Costs				**$0**		**$460,000**	
Indexed Material/Labor Costs				**$0**		**$327,980**	**$327,980**
No GCM Required							**$0**
Original Construction Cost							**$327,980**
Date of Original Estimate: 8/31/2016 — **Inflation**							**$0**
Current Year Construction Cost							**$327,980**
Professional Fees at 16.0%							**$52,477**
TOTAL PROJECT COST							**$380,457**

All costs shown as Present Value

INSTALL EMERGENCY GENERATOR AT ALLIED HEALTH SCIENCES

Project Number:	HSELEL05
Priority Sequence:	3
Priority Class:	Critical
Project Class:	Plant Adaption
Date Basis:	8/29/2016

Category Code: EL5A

System:	ELECTRICAL
Component:	EMERGENCY POWER SYSTEM
Element:	GENERATION/DISTRIBUTION

Code Application:		Subclass/Savings:	Project Location:
NEC	700, 701, 702	Not Applicable	Building-wide: Floor(s) S

Description

This facility is currently served by an emergency generator located at the Central Utility Plant. It is recommended that a stand-alone emergency generator and associated fuel tank and day tank be installed. The facility is already equipped with a dedicated emergency power network and associated transfer switches.

All costs shown as Present Value

Project Cost Estimate

Task Description	Unit	Qnty	Material Unit Cost	Total Material Cost	Labor Unit Cost	Total Labor Cost	Total Cost
Diesel generator set, including fuel tank, day tank, battery and charger	KW	500	$218	$108,790	$48.65	$24,325	$133,115
Base Material/Labor Costs				**$108,790**		**$24,325**	
Indexed Material/Labor Costs				**$109,552**		**$17,344**	**$126,895**
General Contractor Mark Up at 20.0%							**$25,379**
Original Construction Cost							**$152,274**
Date of Original Estimate: 8/29/2016 **Inflation**							**$0**
Current Year Construction Cost							**$152,274**
Professional Fees at 16.0%							**$24,364**
TOTAL PROJECT COST							**$176,638**

All costs shown as Present Value

INSTALL EMERGENCY GENERATOR AT HEART INSTITUTE

Project Number:	HSELEL06
Priority Sequence:	4
Priority Class:	Critical
Project Class:	Plant Adaption
Date Basis:	8/29/2016

Category Code: EL5A

System:	ELECTRICAL
Component:	EMERGENCY POWER SYSTEM
Element:	GENERATION/DISTRIBUTION

Code Application:		Subclass/Savings:	Project Location:
NEC	700, 701, 702	Not Applicable	Item Only: Floor(s) S

Description

This facility is currently served by an emergency generator located at the Central Utility Plant. It is recommended that a stand-alone emergency generator and associated fuel tank and day tank be installed at the Heart Institute. The facility is already equipped with a dedicated emergency power network and associated transfer switches.

All costs shown as Present Value

Project Cost Estimate

Task Description	Unit	Qnty	Material Unit Cost	Total Material Cost	Labor Unit Cost	Total Labor Cost	Total Cost
Diesel generator set, including fuel tank, day tank, battery and charger	KW	500	$218	$108,790	$48.65	$24,325	$133,115
Base Material/Labor Costs				**$108,790**		**$24,325**	
Indexed Material/Labor Costs				**$109,552**		**$17,344**	**$126,895**
General Contractor Mark Up at 20.0%							**$25,379**
Original Construction Cost							**$152,274**
Date of Original Estimate: 8/29/2016						**Inflation**	**$0**
Current Year Construction Cost							**$152,274**
Professional Fees at 16.0%							**$24,364**
TOTAL PROJECT COST							**$176,638**

All costs shown as Present Value

INTERCONNECT LOOPS TO CREATE ADDITIONAL REDUNDANCY

Project Number:	HSELEL01	**Category Code:**	EL7B
Priority Sequence:	5		
Priority Class:	Non-Critical	**System:**	ELECTRICAL
Project Class:	Plant Adaption	**Component:**	INFRASTRUCTURE
Date Basis:	8/31/2016	**Element:**	UNDERGROUND TRANSMISSION

Code Application:		**Subclass/Savings:**	**Project Location:**
ANSI	C84.1-2011	Not Applicable	Campus-wide: Floor(s) S
NFPA	70		
NFPA	70E		

Description

It is recommended that new switches and underground distribution cable be installed to interconnect the loop feeds. This would provide the electrical distribution system with additional service feeds that could improve load factor and increase load diversity, provide an easier means of performing preventative maintenance on existing equipment, and provide redundancy by allowing the system to shed load or transfer load to campus facilities in the event of an unplanned forced outage. Professional fees have been included for the engineering and design of this recommendation.

All costs shown as Present Value

Project Cost Estimate

Task Description	Unit	Qnty	Material Unit Cost	Total Material Cost	Labor Unit Cost	Total Labor Cost	Total Cost
Install new pad-mounted 15 kV switches	EA	4	$46,622	$186,486	$4,514	$18,057	$204,544
Install new underground duct bank	LF	3,000	$47.00	$141,000	$21.15	$63,450	$204,450
Install new 15 kV cable (3 phase and ground)	LF	9,000	$51.58	$464,220	$7.39	$66,510	$530,730
			Base Material/Labor Costs	**$791,706**		**$148,017**	
			Indexed Material/Labor Costs	**$797,248**		**$105,536**	**$902,785**
						General Contractor Mark Up at 20.0%	**$180,557**
						Original Construction Cost	**$1,083,342**
Date of Original Estimate:	8/31/2016					**Inflation**	**$0**
						Current Year Construction Cost	**$1,083,342**
						Professional Fees at 16.0%	**$173,335**
						TOTAL PROJECT COST	**$1,256,676**

All costs shown as Present Value

REFURBISH PHYSICAL STRUCTURE OF ELECTRICAL MANHOLES

Project Number:	HSELEL03
Priority Sequence:	6
Priority Class:	Non-Critical
Project Class:	Corrective Action
Date Basis:	8/30/2016

Category Code: EL7B

System:	ELECTRICAL
Component:	INFRASTRUCTURE
Element:	UNDERGROUND TRANSMISSION

Code Application:	Subclass/Savings:	Project Location:
Not Applicable	Not Applicable	Item Only: Floor(s) S

Description

The electrical vaults have started to deteriorate due to time and water intrusion. The deterioration includes spalling concrete walls, floors, and roofs. This does not apply to any specific vault, as this recommendation is a placeholder for future capital expenditure. Repair spalling concrete, and install a dedicated access ladder.

All costs shown as Present Value

Project Cost Estimate

Task Description	Unit	Qnty	Material Unit Cost	Total Material Cost	Labor Unit Cost	Total Labor Cost	Total Cost
Repair spalling concrete	EA	6	$2,750	$16,500	$3,500	$21,000	$37,500
Install NEMA rated ladder	EA	6	$550	$3,300	$750	$4,500	$7,800
			Base Material/Labor Costs	**$19,800**		**$25,500**	
			Indexed Material/Labor Costs	**$19,939**		**$18,182**	**$38,120**
						General Contractor Mark Up at 20.0%	**$7,624**
						Original Construction Cost	**$45,744**
Date of Original Estimate:	8/30/2016					**Inflation**	**$0**
						Current Year Construction Cost	**$45,744**
						No Professional Fees Required	**$0**
						TOTAL PROJECT COST	**$45,744**

All costs shown as Present Value

INSTALL ADDITIONAL TRANSFORMER AT ROSS

Project Number:	HSELEL04	**Category Code:**	EL1A
Priority Sequence:	7		
Priority Class:	Non-Critical	**System:**	ELECTRICAL
Project Class:	Plant Adaption	**Component:**	INCOMING SERVICE
Date Basis:	8/29/2016	**Element:**	TRANSFORMER

Code Application:		**Subclass/Savings:**	**Project Location:**
NEC	230, 450	Not Applicable	Item Only: Floor(s) S

Description

It is recommended that an additional 2,000 kVA transformer be installed at Ross School of Dental Medicine. The facility is already equipped with concrete pad, and conduit is in place. This installation will provide the facility with a redundant power source in the event of a loss of power within the other circuit and transformer.

All costs shown as Present Value

Project Cost Estimate

Task Description	Unit	Qnty	Material Unit Cost	Total Material Cost	Labor Unit Cost	Total Labor Cost	Total Cost
Install new 2,000 kVA transformer, termination and commissioning	KVA	2,000	$41.62	$83,240	$5.89	$11,780	$95,020
Additional design service fee and materials	EA	1	$25,000	$25,000	$12,500	$12,500	$37,500
			Base Material/Labor Costs	**$108,240**		**$24,280**	
			Indexed Material/Labor Costs	**$108,998**		**$17,312**	**$126,309**
						General Contractor Mark Up at 20.0%	**$25,262**
						Original Construction Cost	**$151,571**
Date of Original Estimate:	8/29/2016					**Inflation**	**$0**
						Current Year Construction Cost	**$151,571**
						Professional Fees at 16.0%	**$24,251**
						TOTAL PROJECT COST	**$175,823**

All costs shown as Present Value

MODIFY AND INSTALL EQUIPMENT TO PROVIDE N+1 REDUNDANCY

Project Number:	HSELEL07	**Category Code:**	EL7D
Priority Sequence:	8		
Priority Class:	Non-Critical	**System:**	ELECTRICAL
Project Class:	Plant Adaption	**Component:**	INFRASTRUCTURE
Date Basis:	8/29/2016	**Element:**	DISTRIBUTION SWITCHGEAR

Code Application:		**Subclass/Savings:**	**Project Location:**
NFPA	70, 70E	Not Applicable	Undefined: Floor(s) S
OSHA	1910		

Description

To provide the University with continuous, reliable electrical service and also allow the facilities team to perform the OEM recommended annual maintenance, additional service feeds need to be installed. This project has been developed to provide a budget for the development and installation of additional circuit breakers and/or switchgear expansion that could provide true N+1 redundancy.

All costs shown as Present Value

Project Cost Estimate

Task Description	Unit	Qnty	Material Unit Cost	Total Material Cost	Labor Unit Cost	Total Labor Cost	Total Cost
Install additional switchgear cabinets and conductor	EA	12	$21,250	$255,000	$6,785	$81,420	$336,420
Install additional circuit breakers, relays, meters	EA	12	$79,604	$955,252	$11,896	$142,747	$1,097,999
			Base Material/Labor Costs	**$1,210,252**		**$224,167**	
			Indexed Material/Labor Costs	**$1,218,724**		**$159,831**	**$1,378,555**
						General Contractor Mark Up at 20.0%	**$275,711**
						Original Construction Cost	**$1,654,266**
Date of Original Estimate:	8/29/2016					**Inflation**	**$0**
						Current Year Construction Cost	**$1,654,266**
						Professional Fees at 16.0%	**$264,683**
						TOTAL PROJECT COST	**$1,918,948**

All costs shown as Present Value

INSTALL SUMP PUMPS IN ELECTRICAL MANHOLES

Project Number:	HSELPL01	**Category Code:**	PL2B
Priority Sequence:	9		
Priority Class:	Non-Critical	**System:**	PLUMBING
Project Class:	Plant Adaption	**Component:**	WASTEWATER
Date Basis:	9/1/2016	**Element:**	PUMPS

Code Application:		**Subclass/Savings:**	**Project Location:**
IPC	P712	Not Applicable	Campus-wide: Floor(s) S

Description

Install sump pump systems, including pit, pumps, alternating controls, alarms, piping, and electrical connections, in the campus electrical vaults.

All costs shown as Present Value

Project Cost Estimate

Task Description	Unit	Qnty	Material Unit Cost	Total Material Cost	Labor Unit Cost	Total Labor Cost	Total Cost
Sump pump system, including pit, pumps, controls, connections	SYS	24	$4,440	$106,560	$2,120	$50,880	$157,440
Base Material/Labor Costs				**$106,560**		**$50,880**	
Indexed Material/Labor Costs				**$107,306**		**$36,277**	**$143,583**
General Contractor Mark Up at 20.0%							**$28,717**
Original Construction Cost							**$172,300**
Date of Original Estimate: 9/1/2016 — **Inflation**							**$0**
Current Year Construction Cost							**$172,300**
Professional Fees at 16.0%							**$27,568**
TOTAL PROJECT COST							**$199,868**

UTILITY CONDITION ASSESSMENT

SECTION 6

SYSTEM PHOTOLOGS

HSEL001e 4/21/2016

Electrical GUC POD #2

Main substation

HSEL002e 4/21/2016

1,200 amp vacuum circuit breaker - SPARE

GUC POD #2

HSEL003e 4/21/2016

POD #2 switchgear

GUC POD #2

HSEL004e 4/21/2016

Electrical GUC POD #1

Main substation

HSEL005e 4/21/2016

POD #1 switchgear

GUC POD #1

HSEL006e 4/21/2016

1,200 amp vacuum circuit breaker

GUC POD #1

HSEL007e 4/21/2016

Battery charger

GUC POD #1

HSEL008e 4/21/2016

Battery bank

GUC POD #1

HSEL009e 4/21/2016

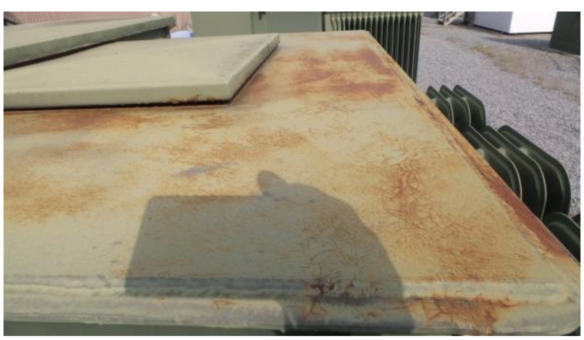
Selector switch HVSS3 and transformers

Main substation

HSEL010e 4/21/2016

Concrete transformer pad

Main substation



HSEL011e 4/21/2016

Slight frame deterioration on transformer

Main substation

HSEL012e 4/21/2016

Exterior bus access to POD #1 and POD #2

Main substation

HSEL013e 4/21/2016
Oil-filled transformer #2
Main substation

HSEL014e 4/21/2016
Oil-filled transformer #1
Main substation

HSEL015e 4/21/2016
Utility system load interrupter switches
Main substation

HSEL016e 4/21/2016
Utility system emergency generator building
Main substation

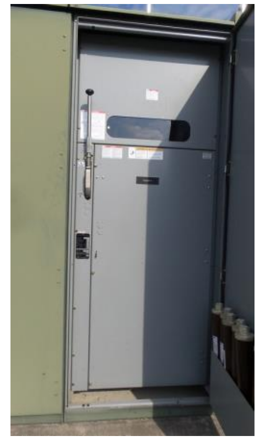
HSEL017e 4/21/2016
CUP emergency generator building
Main substation

HSEL018e 4/21/2016
1,250 kW CUP emergency generator
Main substation

HSEL019e 4/21/2016

Oil-filled transformers and load interrupters

CUP exterior



HSEL020e 4/21/2016

Feeder 4 fused load interrupter

CUP exterior

HSEL021e 4/21/2016

Five-way switch HVSS7

Warren Life Sciences exterior

HSEL022e 4/21/2016

Transformer TX-10

Warren Life Sciences exterior

HSEL023e 4/21/2016

Damaged and repaired concrete slab

Warren Life Sciences exterior

HSEL024e 4/21/2016

Damaged and repaired concrete slab

Warren Life Sciences exterior

HSEL025e 4/21/2016
Transformer TX-10A
Warren Life Sciences exterior

HSEL026e 4/21/2016
Selector switch HVSS8
New Student Union exterior

HSEL027e 4/21/2016
Selector switch HVSS5
Allied Health exterior

HSEL028e 4/21/2016
Transformers TX15 and TX16
Allied Health exterior

HSEL029e 4/21/2016
Transformer concrete slab settlement
Allied Health exterior

HSEL030e 4/21/2016
Transformer TX17
Ross Hall exterior

HSEL031e 4/21/2016
3,000 amp, 480 volt normal service switchgear
Ross Hall, room 1182

HSEL032e 4/21/2016
Installed conduit for second transformer and feeder circuit
Ross Hall, room 1182

HSEL033e 4/21/2016
750 kW emergency generator building
Ross Hall exterior

HSEL034e 4/21/2016
Selector switch HVSS10
Between Allied and Ross

HSEL035e 4/21/2016
Selector switch HVSS9
Between Family Medicine and Union

HSEL036e 4/21/2016
Oil-filled transformer TX-14
Family Medicine exterior

HSEL037e 4/21/2016
250 kW emergency generator housing
Family Medicine exterior

HSEL038e 4/21/2016
Four oil-filled transformers
Brody exterior

HSEL039e 4/21/2016
Oil-filled transformer TX-9
Biotech exterior

HSEL040e 4/21/2016
Electrical vault/manhole cover
Between Brody and Life Sciences

HSEL041e 4/21/2016
Standing water in manhole
Between Brody and Life Sciences

HSEL042e 4/21/2016
Standing water in manhole
Between Brody and Life Sciences

HSEL043e 4/21/2016
15 kV cable submerged in standing water
Between Brody and Life Sciences