

# Primary Electrical Distribution System Analysis Technical Report

for the

## 2011 Campus Master Plan

THE UNIVERSITY OF NORTH CAROLINA AT PEMBROKE



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## Table of Contents

**Executive Summary** page 1

### **Detailed Analysis**

Existing Primary Electrical System page 3

Future Electrical Distribution Plan page 4

Summary of Projected Future Loads page 5

Graph of Electrical System Load Projections page 6

### **Appendix**

#### **Detailed Electrical Load Projections**

Distribution System Load History Appendix A-1

Distribution System Load History Allocations Appendix A-2

Projected Electrical Demand Loads Appendix A-4

#### **Campus Maps**

Existing Primary Electrical Distribution System Map Appendix B-1

Master Plan - Electrical Map Appendix B-2

## **EXECUTIVE SUMMARY**

### **Existing Primary Electrical System**

The existing primary electrical distribution system consists of a single 12.47 kV, 3-phase delivery from Progress Energy. The power then leaves the substation to a network of underground circuits that serve most of the campus facilities. There are some facilities on campus that are served from Progress Energy.

The campus electrical system had major upgrades in 2005 and 2009 and is in good condition with the exception of four (4) 15 kV pad mounted switches and five (5) pad mounted transformers.

### **Future Electrical Distribution Plan**

The maximum recorded electrical demand load was in September of 2010 of 5,011 kW peak which is 44% of the capacity of the main campus distribution switchgear. The future electrical load projections are based on the 2011 Campus Master Plan.

New loads will be added to the campus distribution system when the proposed future buildings are placed into service. In addition, some of the facilities that are currently served from separate Progress Energy meters can be switched to the UNC Pembroke campus electrical distribution system to save operating energy cost. In order to serve the new projected and transferred loads, additional electrical distribution equipment will be required at the substation. This substation equipment is needed to support more campus circuits in the future. Additional underground circuits will be required along with new 15 kV pad mounted switches in strategic areas of the campus. See Appendix B for the proposed system additions.

The main University owned main switchgear has adequate capacity to provide power for the planned campus expansion including the transfer of some existing loads that are

currently served from Progress Energy. With the current plan the main switchgear is projected to be at 94% capacity in the future with the loads projected.

The main campus electrical infrastructure is in good condition with the exception of the few switches and transformers that were identified for replacement. The University has taken good steps to put this reliable and safe system in place.



Main UNC Pembroke Substation and Switchgear

## DETAILED ANALYSIS

### Existing Campus Distribution System

The existing primary electrical distribution system consists of a single 12.47 kV, 3-phase delivery from Progress Energy. The University owned substation equipment adjacent to the Progress Energy equipment is pad mounted fused switchgear rated at 600 amps operating at 12.47 kV, giving the substation a capacity of 12,959 kVA. The campus switchgear is comprised of four (4) fused distribution bays with 200 amp fuses serving underground circuits for the campus. See the Appendix for a campus map showing the circuits. The switchgear has provisions to add two (2) future fused distribution bays. The main switchgear is manufactured by S&C and was installed in 2005.

The main 12.47 kV switchgear feeds a series of 15 kV rated pad mounted fused switches via single conductor 15 kV cables that are installed underground concrete encased ductbanks. The pad mounted switches intern serve oil filled pad mounted transformers near each of the buildings on campus. The secondary voltages of the transformers are mixed between 208 volts, 3-phase; 480 volts, 3-phase and 240 volts, 1-phase. The 15 kV underground cables were installed in 2005 and 2009. There are five (5) transformers that were identified for replacement: School of Business, North Residence Hall, Belk Residence Hall, West Residence Hall and Jacobs Hall.

There are twenty-three (23) pad mounted switches rated at 15 kV located throughout the campus. Many of the pad mounted switches were replaced or repaired in 2005 and 2009. There are four (4) switches that were installed in 1973 that are at their end of life, in poor condition and need to be replaced.

S-7	D.F. Lowery	S&C Model PMH-13
S-9	Livermore Library	S&C Model PMH-9
S-12	West Residence Hall	S&C Model PMH-6
S-14	Givens Performing Arts	S&C Model PMH-6

## Future Electrical Distribution Plan

The future electrical load projections are based on the Campus Master Plan as presented within this report and outlined in the tables below. The projections are based on the campus historical data from Progress Energy. The maximum recorded electrical demand load was in September of 2010:

<u>Peak kW</u>	<u>Peak kVAR</u>	<u>kVA</u>	<u>Amps</u>	<u>PF</u>
5,011	2,704	5,694	264	0.88

*\*Main Substation Switchgear Rating = 600 Amps => 44% of capacity at max load*

With the projected future loads, there will need to be two fused switch bays added to the switch gear line up at some time based on the schedules of construction. Also new underground circuits will be required to support the future buildings. See the Appendix B for the proposed circuit locations as shown on the campus map. With the new buildings and load transfers, new 15 kV pad mounted switches will be required to serve the transformers for the respective facilities. Proposed future switches are indicated on the campus map included in the Appendix B. Where facilities are transferred from Progress Energy to the campus distribution system new transformers may be required or purchased from Progress Energy.

The main University owned switchgear has adequate capacity to provide power for the planned campus expansion including the transfer of some existing loads that are currently served from Progress Energy. With the current plan the main switchgear is projected to be at 94% capacity with the planned construction and transfer of the proposed Progress Energy Loads.

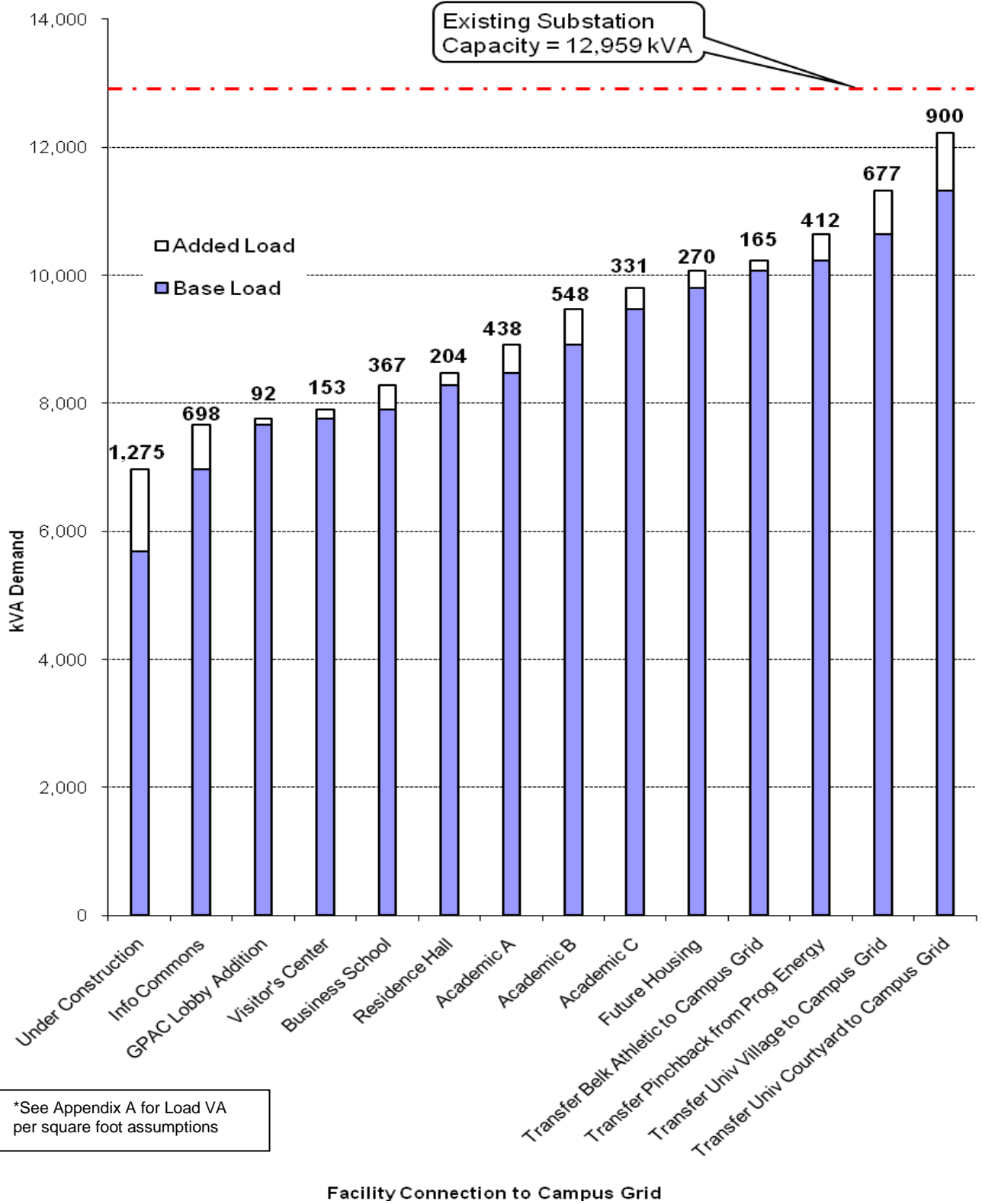
The main campus electrical infrastructure is in good condition with the exception of the few switches and transformers that were identified for replacement. The University has taken good steps to put this reliable and safe system in place.

**Summary of Projected Future Loads**

**Projected Electrical Demand for 12.47 kV Medium Voltage Distribution System**

Existing Demand Base Load (kVA) =	5,694	5,011 kW	* 12.47 kV	
<b>Future Facility</b>	<b>kVA Base Load</b>	<b>kVA Added Load</b>	<b>kVA Total Load</b>	<b>* Amps Total Load</b>
Under Construction	5,694	1,275	6,969	323
Info Commons	6,969	698	7,666	355
GPAC Lobby Addition	7,666	92	7,758	359
Visitor's Center	7,758	153	7,911	366
Business School	7,911	367	8,278	383
Residence Hall	8,278	204	8,483	393
Academic A	8,483	438	8,921	413
Academic B	8,921	548	9,469	438
Academic C	9,469	331	9,800	454
Future Housing	9,800	270	10,070	466
Transfer Belk Athletic to Campus Grid	10,070	165	10,236	474
Transfer Pinchback from Prog Energy	10,236	412	10,647	493
Transfer Univ Village to Campus Grid	10,647	677	11,324	524
Transfer Univ Courtyard to Campus Grid	11,324	900	12,224	566
<b>Substation Capacity</b>			<b>12,959</b>	<b>600</b>

### UNC Pembroke 12.47 kV Electrical System Load Projections





**APPENDIX A – DETAILED ELECTRICAL LOAD PROJECTIONS**

**UNC Pembroke Bulk Electrical Load Projections**

**12.47 kV Medium Voltage Distribution System Load History**

	Building SF	* KW <u>Demand</u>	Watts per SF	KVA <u>Demand</u>
<b>Existing Total System Loads</b>	1,115,921	5,011	4.49	5,694
(less buildings served from Progress Energy)				* Highest Progress Energy billing demand September 2010

	Peak KW	Peak KVAR	KVA	PF
Sep-2010	5,011	2,704	5,694	0.88

**Projected Future Campus Loads**

	Existing Demand +	20%		* Total
Projected Demand Load	Watts / SF	Watts / SF	Total Watts / SF	VA / SF
	4.49	0.898	=	6.12
			0.88	Power Factor *

**12.47 kV Medium Voltage Distribution System Load History Allocations**

<u>Bldg No.</u>	<u>Name</u>	<u>Size</u>	<u>% Contribution</u>	<u>Electrical Load Allocation (note 3)</u>	<u>kVA Load</u>
001	OLD MAIN	35,980	100%	35,980	184
002	MOORE HALL	24,112	100%	24,112	123
003	MUSIC ANNEX	2,720	100%	2,720	14
005	LOCKLEAR	21,108	100%	21,108	108
006	LIVERMORE LIBRARY	52,318	100%	52,318	267
007	OXENDINE SCIENCE BLD	92,673	100%	92,673	473
008	NURSING	3,409	100%	3,409	17
009	CHANCELLORS RES	6,418	75%	4,814	25
010	GUEST HOUSE	719	75%	539	3
011	WEST HALL	39,724	100%	39,724	203
017	D F LOWRY	20,803	100%	20,803	106
018	WELLONS HALL	18,560	100%	18,560	95
019	JACOBS HALL	24,584	100%	24,584	125
022	STUDENT HEALTH SVCS	5,523	100%	5,523	28
024	BUSINESS ADMIN	35,100	100%	35,100	179
025	BELK HALL	39,571	100%	39,571	202
026	NORTH HALL	39,571	100%	39,571	202
027	ENGLISH E. JONES BLD	125,531	100%	125,531	641
028	GIVENS PERF ARTS CTR	43,200	100%	43,200	220
029	EDUCATION BUILDING	33,500	100%	33,500	171
031	DIAL HUMANITIES	31,080	100%	31,080	159
034	JAMES CHAVIS CENTER	69,468	100%	69,468	354
043	LUMBEE HALL	49,166	100%	49,166	251
045	PINE HALL	82,500	100%	82,500	421
046	WEST OFFICE BLDG	1,680	0%	0	0
050	PINCBECK MAINT.	67,264	0%	0	0
051	REGIONAL CENTER	11,655	100%	11,655	59
051	BIOTECH ADDITION	4,635	100%	4,635	24
052	UNIV. VILLAGE I	21,555	0%	0	0
053	UNIV. VILLAGE II	21,555	0%	0	0
054	UNIV. VILLAGE III	21,555	0%	0	0

**12.47 kV Medium Voltage Distribution System Load History Allocations (continued)**

055	UNIV VILLAGE IV	21,555	0%	0	0
056	UNIV. VILLAGE V	21,555	0%	0	0
057	UNIV VILLAGE COMMONS	5,000	0%	0	0
058	SRMC	7,100	100%	7,100	36
059	INTERNATIONAL HOUSE	2,070	0%	0	0
059	INTERNATIONAL APT	880	0%	0	0
060	SIRIUS	1,904	0%	0	0
060	MIMOSA	1,904	0%	0	0
061	WELTON LOWRY LEASE	1,875	0%	0	0
063	AUXILARY SERVICES	48,017	100%	48,017	245
064	SAMPSON CLASSROOM	30,000	100%	30,000	153
066	CATON FIELD HOUSE	27,000	0%	0	0
067	OAK RESIDENCE HALL	89,078	100%	89,078	455
068	MAGNOLIA HOUSE	2,201	0%	0	0
069	CHAVIS ANNEX	17,618	100%	17,618	90
071	CARTER HALL	11,961	0%	0	0
072	FOOTBALL PRESSBOX	3,216	0%	0	0
073	DOGWOOD OFFICE BLDG	2,300	0%	0	0
074	MAX LOWRY LEASE	1,600	0%	0	0
075	CYPRESS HALL (note 2)	122,775	5%	6,139	31
076	ALLIED HEALTH (note 2)	87,500	7%	6,125	31

1,554,346	1,115,921	5,694 kVA
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Load /SF =	4.49	5.10	264 Amps
	W/sf	VA/sf	@ 12.47 kV

Notes:

- 1) 0% contribution indicates that load is not on campus system and is served by Progress Energy
- 2) Buildings under construction and power utilization is for construction
- 3) Building area allocation that is allocated for electrical load on campus grid

**Projected Electrical Demand for 12.47 kV Medium Voltage Distribution System**

	<u>SF</u>	<u>VA / SF Demand</u>	<u>kVA Demand</u>
<b><i>Under Construction</i></b>			
Cypress Hall	122,775	6.12	751
- less Cypress construction load			-6
Allied Health	87,500	6.12	536
- less Allied Health construction load			-6
			<b>1,275</b>
<b><i>Info Commons</i></b>			
	150,000	6.12	918
Demolish Wellons Residence Hall			-95
Demolish Jacobs Residence Hall			-125
			<b>698</b>
<b><i>GPAC Lobby Addition</i></b>			
	15,000	6.12	<b>92</b>
<b><i>Visitor's Center</i></b>			
	25,000	6.12	<b>153</b>
<b><i>Business School</i></b>			
	60,000	6.12	<b>367</b>
<b><i>Residence Hall</i></b>			
	66,500	6.12	407
Demolish West Residence Hall			-203
			<b>204</b>
<b><i>Academic A</i></b>			
	71,600	6.12	<b>438</b>
<b><i>Academic B</i></b>			
	89,600	6.12	<b>548</b>
<b><i>Academic C</i></b>			
	54,100	6.12	<b>331</b>
<b><i>Future Housing</i></b>			
	44,100	6.12	<b>270</b>

**Projected Electrical Demand for 12.47 kV Medium Voltage Distribution System (continued)**

**Transfer Belk Athletic to Campus Grid**

Caton Field House	27,000	6.12	165
Football Pressbox			Assume operation & Lighting is non coincident with peak
G.P. Johnson Stadium			Assume operation & Lighting is non coincident with peak

**Transfer Pinchbeck to Campus Grid**

Pinchbeck Maintenance Complex	67,264	6.12	412
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**Transfer Univ Village to Campus Grid**

UNIV. VILLAGE I	21,555	6.00	129
UNIV. VILLAGE II	21,555	6.00	129
UNIV. VILLAGE III	21,555	6.00	129
UNIV VILLAGE IV	21,555	6.00	129
UNIV. VILLAGE V	21,555	6.00	129
UNIV VILLAGE COMMONS	5,000	6.00	30
			<b>677</b>

**Transfer Univ Courtyard to Campus Grid**

University Courtyard Apartments (estimated area)	150,000	6.00	900
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<b>TOTAL FUTURE PROJECTION</b>	<b>1,143,214</b>	<b>SF</b>	<b>6,530</b>	<b>kVA</b>
			<b>302</b>	<b>AMPS</b>
			<b>@ 12.47 kV</b>	

# UNCP Primary Electrical Distribution 12,470 Volt System

## Existing Primary Electrical Circuits

- Circuit 4
- Circuit 3
- Progress Energy Substation
- Circuit 2
- Circuit 1



# Master Plan - Electrical

In Construction:

- A. Cypress Hall 122,775 gsf
- B. Allied Health 87,500 gsf

Future:

1. Info Commons
2. GPAC Lobby Addition
3. Visitor's Center
4. New Business School
5. Future Residence Hall
6. Long term Academic A
7. Long term Academic B
8. Long term Academic C
9. Future Housing

Transfer from Progress Energy to Campus System:

- a. Belk Athletic Complex & Playing Fields
- b. Pinchbeck Complex & Playing Field
- c. University Village Housing
- d. University Courtyard Housing

