FILE FOLDER

DESCRIPTION ON TAB:

82-462Ø Elec Distr Study, ~~Hadnot PT~~

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PROJECT LOG

PWD Proj. No. 82-4620

Title: Elec Distr System, ~~Hadnot Pt Substn~~ Basewide

DATE	REMARKS
8 Apr 82	Contract number asgd. hf

PUBLIC WORKS DEPARTMENT
BUILDING 1005, MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA 28542

In reply refer to

PWO:04:ELR:hf
82-B- 4620
In-House Design
8 April 1982

From: Public Works Officer
To: Base Accounting Officer

Subj: Assignment of Job Order Numbers

Ref: (a) BO P7000.1H

1. In accordance with the reference, it is requested that the following Job Order Numbers be established for FY-82, all having CAC 9120:

Job Order Number	Description
AM2 10 0230 4620 U (Engineering Design)	ELEC DISTR STUDY, ~~HADNOT PT SUBSTN~~ BASEWIDE
AM2 10 0235 " U (Reproduction)	"
AM2 10 0237 " U (Update Records & Drawings)	"
AM2 10 0241 " U (Post Award Efforts)	"
AM2 10 0245 " U (Rework)	"

this should be changed to camp Lejeune complex

2. Funds chargeable (if other than MCB): n/a

3. The following JON's are cancelled and no further time will be charged to them: n/a

E. L. ROUSE

By direction

Copy to:
Proj Folder
JON Book

OPNAV 5216/144 (REV. 6-70)
S/N 0107-LF-778-8099
DEPARTMENT OF THE NAVY

Memorandum

DATE: 8 April 1982

FROM Code 04

TO Code 02

SUBJ Assignment of Contract Number

1. Contract No. N62470-82-B-4620 has been assigned to the following project:

   Title: ELEC DISTR SYS, MADNOT PT SUBSTN

   Location: ______________________

2. Other numbers applicable to this project are:

   PWD No. ____________
   Project No. _______
   Program No. _______

E. L. ROUSE

POWER SYSTEM ANALYSIS
AND
PLANNING

AUGUST
1984

DRAFT

MARINE CORP BASE
CAMP LEJEUNE, NORTH CAROLINA

Prepared By:

J.W. KELLEY
Electrical Engineer

CONTENTS

SECTION 1

PURPOSE

This power system analysis and electrical system planning study for the Camp Lejeune complex is a comprehensive analysis used to evaluate the current electrical system for performance, adequacy, reliability, and to ascertain the effectiveness of alternate plans for system expansion and operation.

The analysis and planning is threefold.

First, it is used to develop a 10-15 year electrical utility master plan which is based on the military construction objectives.

Second, it is used to optimize utilization of capital within DOD funding constraints.

Third, it is used to develop a data base for future analysis, utilizing the Computer Assisted Power System Engineering Program (CAPSE).

SECTION 2

PROCEDURE

Field investigations were conducted to secure information in order to prepare bus-node diagrams of the electrical power system, compile existing load data, and determine circuit configurations and impedances. The existing circuit configuration and loads were entered into a digital computer in order to conduct fault current and loadflow analysis of the present system.

Based on the findings on Load flow Analysis L-83 and Fault Analysis F-83 other cases were developed and analyzed as required.

The fault current study is to be used in rating interrupting capacities of equipment and setting of protective devices.

Upon completion of using the CAPSE Program, the data for the computer runs were stored within the computer system. The stored data, which represents the electrical power system parameters and loading, can promptly be modified for future analysis.

SECTION 3

COMMERCIAL ELECTRICAL POWER SUPPLY

COMMERCIAL

Electrical power is purchased from the Carolina Power and Light Company at 12.47 KV. The Carolina Power and Light Company serves the Camp Lejeune complex from a 230 KV circuit through two transformers with a total of 50 MVA of capacity at 12.47 KV.

The total short circuit currents available at the point of service as calculated by Carolina Power and Light are as follows:

Three Phase = 13118 amps - symmetrical (283.3 MVA)
Line to ground = 13637 amps - symmetrical (294.5 MVA)

SECTION 4

EXISTING ELECTRICAL SYSTEM

The description of the existing system is reflected in Load Flow Analysis L-83 and Fault Current Analysis F-83.

The MCB CAMP LEJEUNE main switching station is served from an adjacent Carolina Power and Light Company Substation at 12,420/7,200 volts from two 25 MVA transformers. The CP&L substation is served from a 230 KV aerial line.

The interrupting capacities of the ten Main Substation Oil Circuit Breakers are 500 MVA. The present fault level from Carolina Power and Light is 295 MVA.

Distribution from the main switching station is accomplished by ten radial overhead circuits.

Sections of the existing overhead distribution system in the regimental areas are being converted to underground distribution as a result of the new construction in the area.

Air break switches on the overhead feeders allow for isolation of sections of the circuits for repair/maintenance as well as for providing a method to interconnect the feeders in order to provide alternate methods of service.

Presently, there are nine voltage regulators on five of the feeders to correct low voltage conditions.

Onslow Beach and portions of Paradise Point are served at 2.4 KV through step down transformers.

Midway Park and portions of Paradise Point have been converted to 12.47 KV.

The existing 2.4 KV distribution system at the old Naval Hospital site is scheduled for conversion to 12.47 KV as part of P808, Convert Hospital to Division HQ.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

SECTION 5

CAPSE FAULT STUDY

This program produces both three-phase, and single-line to ground fault current information. For each fault, the output data is based on the following:

a. Per-unit resistance and per-unit reactance to the point of fault on a 10 MVA base.

b. MVA at point of fault. Current (actual not per-unit) at point of fault at 12.47 KV.

Fault Analysis F1-83

Reference should be made to Bus-node diagram (Section 11) to correlate BUS location with calculated values listed in Table I.

TABLE I

	FAULT VALUES		3ϕ		ϕ-GND	
Bus #	Feeder	Location	MVA	AMPS	MVA	AMPS
2	Main Bus		283	13118	294	13637
29	Rifle Range	(BKR 44)	73	3370	53	2437
30	Rifle Range	(F.C. TAP)	47	2198	31	1439
31	Rifle Range	(R.R. 1)	33	1543	21	960
32	Rifle Range	(RR-2)	25	1145	15	692
33	Rifle Range	(Triangle Tap)	21	965	12	576
34	Rifle Range	(Triangle Load)	8	380	7	310
35	Rifle Range	(BKR 39)	20	933	12	555
37	Rifle Range	(BKR 43)	12	573	7	332
38	Rifle Range	(BKR 40)	8	378	5	216
39	Rifle Range	(End Load)	8	353	4	205
26	French Crk	(1500 KVA REG)	86	3970	64	2984
27	French Crk	(FTC Top)	72	3356	53	2441
28	French Crk	(FTC Load)	62	2885	44	2050
25	Industrial	(GUM ST)	101	4688	77	3572
23	Reg 2	(Gum St)	162	7517	141	6520
24	Reg 2	(BKR 37)	94	4372	72	3333
21	Reg 3	(Holcomb Cir)	113	5226	87	4019
22	Reg 3	(End Load)	80	3689	58	2674
18	Reg 1	(BKR 41)	145	6701	111	5166
19	Reg 1	(BKR 33-34-8)	131	6048	99	4584
20	Reg 1	(End Load)	101	4689	76	3511
11	Paradise Pt	(BKR 7)	112	5167	76	3529
16	Paradise Pt	(Hospital)	73	3353	45	2099
~~17~~	-					
12	Paradise Pt	(BKR 18)	59	2715	40	1857
14	Paradise Pt	(BKR 11)	42	1965	29	1331
3	Capehart	(SUB)	50	2310	33	1539
6	Montford Pt	(Midway)	41	1888	27	1241
5	Montford Pt	Alt Hospital	38	1738	29	1339
8	Hospital	New Hospital	46	2123	24	1097
9	Montford Pt	(BKR 31)	22	1016	15	684
10	Montford Pt	(Camp 2)	18	817	12	557

TABLE I

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10	Montford Pt	(Camp 2)	18	817	12	557

SECTION 6

STATION LOAD ANALYSIS

Existing Conditions

A peak load of 37,843 KW (40,650 KVA) with a power factor of 93 percent was recorded on August 22, 1983. The peak electrical demand has increased by approximately 20 percent since 1979. A graph of the monthly peak demand and kilowatt hour consumption for the years 1979 through 1983 are provided as Attachment A and B. Utilizing 1983 hourly, utility metering data a load duration curve and typical maximum, average and minimum daily load profiles were prepared for each month and are provided as Attachments C and D.

Future Requirements

Projected future loading for each radial circuit is as follows:

CIRCUIT BREAKER NUMBER	CIRCUIT	PROJECTED MVA LOAD/ RATED CKT CAPACITY	PERCENT OF RATED CAPACITY	
1	Midway/Monford Pt	5.0/11.4	43.9%	
2	Regimental #1	4.6/11.4	40.4%	
3	Rifle Range	3.8/6.6	57.6%	403 KVA
4	Paradise Point	4.2/10.3	40.8%	
5	French Creek	5.4/11.4	47.4%	
6	Capehart	6.6/11.4	57.9%	
7	Industrial	4.3/6.6	65.2%	
8	Regimental #2	7.8/10.3	75.7%	
9	Regimental #3	3.4/10.3	33.0%	
10	Hospital	3.8/11.4	33.3%	

Total Projected System Load 48,900 KVA

The future electrical load increase on the system was determined by considering the planned projects scheduled for construction and consideration of normal load growth. The load increase for the next five years is projected to continue to increase at the four percent average annual rate experienced during the past five years, resulting in a peak station load of 48,900 KVA.

The planned projects, listed by individual feeders, that were considered in projecting the increased electrical load are as follows:

Montford Point/Midway Park Feeder

HR3-81 (under construction) Repair Laham Housing (Midway Park)

P628 (FY-84) UEPH

P808 (FY-86) of 35 Mech School

P810 (FY-87) of 35 Mech School

P807 (FY-88) of 35 Driver Training Facility

Regimental #1 Feeder

P808 (FY-85) Division HQ

P527 (FY-86) Elec Comm Maintenance Shop

P525 (FY-87) Combat Vehicle Maintenance Facility

P643 (FY-87) Elec Comm Maintenance Shop

Rifle Range Feeder

F775 (FY-84) Onslow Beach Lodge

P346 (FY-84) Amphibious Vehicle Maintenance Shop

P784 (FY-84) Expand Utilities (water and sewage)

French Creek Feeder

P240 (FY-84) Combat Maintenance Shops

P054 (FY-85) Automotive Org Shop

P065 (FY-86) Gym

P517 (FY-86) Combat Vehicle Maintenance Shop

P031 (FY-87) BN SQDRN HQ

P057 (FY-87) Administrative Building

P167 (FY-87) Elec Comm Maintenance Shop

P257 (FY-87) Field Maintenance Shop

P803 (FY-87) Field Maintenance Shop

P679 (FY-88) Elec Comm Maintenance Shop

P804 (FY-88) Field Maintenance Shop

P805 (FY-88) Field Maintenance Shop

<u>Capehart Feeder</u>

F549 (FY-85) High School

<u>Industrial Feeder</u>

P786 (FY-88) Cold Storage Plant

<u>Regimental #2 Feeder</u>

P503 (under construction) Engr Btn Vehicle Maintenance Shop

P635 (under construction) UEPH

P624 (FY-85) UEPH

P631 (FY-86) UEPH

P806 (FY-86) Light Armored Vehicle Maintenance Shop

P627 (FY-87) UEPH

P229 (FY-88) Elec Comm Maintenance Shop

P568 (FY-88) Combat Vehicle Maintenance Shop

P626 (FY-88) UEPH

<u>Regimental #3</u>

P785 (FY-85) Water Treatment Facility Upgrade

P629 (FY-88) UEPH

SECTION 7

SYSTEM LOADFLOW ANALYSIS

Load Flow Case L-83 (Existing Sytem)

Reference should be made to the one-line diagram (Section 10) to correlate specific locations with the discussion. The analysis assumes regulators and capacitors shown on the one-line diagram are operational.

A peak station load of 37843 KW (40,650 KVA at 93% power factor) was recorded during August of 1983.

The load flow analysis was conducted to determine the capability of the system at rated cpacity, that is 50 MVA. The loads utilized for the ten radial feeders under this condition are as follows:

Feeder	MVA Load. Rated MVA	Percent of Rated capacity
1. Montford Point	4.0/11.4	35.0%
10. New Hospital	5.0/11.4	43.9%
7. Industrial	4.0/6.6	60.6%
6. Capehart	6.0/11.4	52.6%
4. Paradise Point	5.8/10.3	56.3%
2. Regimental 1	4.2/11.4	36.8%
8. Regimental 2	6.8/10.3	66.0%
9. Regimental 3	3.4/10.3	33.0%
5. French Creek	6.2/11.4	54.4%
3. Rifle Range	4.6/6.6	70.0%
	50 MVA	

- The load flow analysis indicates no problem areas when the feeders were operated with a total system load of 50 MVA.

LOAD FLOW ANALYSIS

Additional Load flow Analysis was conducted to detrmine the effects of interties between feeders during emergency cases.

Reference should be made to bus-node diagram and one-line diagram (Section 10) to correlate the node discussion with specific locations in the cases discussed below:

Industrial load on Regimental 2 Feeder

In the event that Main Breaker 7 is out of service, a switch can be closed between nodes 23-25 at Gum Street to connect the Industrial load to the Regimental 2 feeder. Computer calculations were obtained using a peak load of 5.8 MVA on the Regimental 2 feeder and a peak load of 3.9 MVA on the Industrial feeder. The critical points for this temporary arrangements are listed below:

a. Nodes 2-23, a load of 9.9 MVA can be expected on #4/0 Regimental 2 bottom circuit along Holcomb Boulevard which is rated at 10.3 MVA.

b. Additional construction in the Regimental Area will add new air conditioning load which will reduce the capability of the Regimental 2 feeder to serve the Industrial Area during peak load periods. Load shedding will be required on both feeders during these times in order to reduce load.

Rifle Range Load on French Creek Feeder

In the event that Main Breaker 3 is out of service, a switch can be closed between nodes 30-27 along the Main Service Road to connect the Rifle Range load to the French Creek feeder. A peak load of 6.2 MVA on French Creek feeder and peak load of 4.6 MVA on the Rifle Range feeder. The critical points for this temporary arrangement are listed below:

a. Nodes 2-26, a load of 10.8 MVA can be expected on the #336.4 ACSR French Creek feeder rated at 11.4 MVA.

b. At node 26, a load of 10.4 MVA can be expected on the 1500 KVA regulator rated at 15 MVA.

c. At node 27, a load of 8.7 MVA can be expected on #4/0 section of French Creek feeder along Main Service Road which is rated at 10.3 MVA.

d. The voltage regulator at Node 10 (French Creek Area) and the voltage regulators on the Rifle Range feeder are adequate to compensate for the expected voltage drop on both feeders.

French Creek Load on Regimental 2 Feeder

In the event that Main Breaker 5 is out of service, a switch can be closed between nodes 24-26 to connect the French Creek load to Regimental 2 feeder. Computer calculations were obtained using a peak load of 5.7 MVA on the French Creek feeder and a peak load of 5.6 MVA on Regimental 2 feeder. The crucial points for this temporary arrangement are listed below:

a. At node 23, a load of 11.3 MVA can be expected on #4/0 Regimental 2 bottom circuit along Holcomb Boulevard which is rated at 10.3 MVA. This represents a 10% overload.

b. At node 24, a 5% voltage drop can be expected at Regimental 2 area loads.

c. To reduce the possible overloading of the Regimental 2 feeder that may result from this method of operation it is recommended that a portion of the existing load on Regimental 2 and future projects in the area be served from the Regimental 3 feeder. This can be accomplished by closing Switch R-1 and opening OCB 35.

Regimental 2 Load on Regimental 3 Feeder

In the event that Main Breaker 8 is out of service, a switch can be closed between nodes 21-24 to connect Regimental 2 load to the Regimental 3 feeder. Computer calculations were obtained using a peak load of 6.0 MVA on the Regimental 2 feeder and 2.6 MVA on Regimental 3 feeder. The critical points for this temporary arrangement are listed below:

a. At node 21, a load of 8.6 MVA can be expected on #4/0 Regimental 3 top circuit along Holcomb Boulevard which is rated at 10.3 MVA.

b. A 5% voltage drop can be expected at the L Street load.

Regimental 3 Load on Regimental 1 Feeder

In the event that Main Breaker 9 is out of service, a switch can be closed between nodes 19-21 to connect Regimental 3 load to the Regimental 1 feeder. Computer calculations were obtained using a peak load of 3.6 MVA on Regimental 3 feeder and 4.7 MVA for Regimental 1 feeder. The critical point for this temporary arrangement is listed below:

a. At node 2-21, a load of 8.3 MVA can be expected on #336.4 ACSR bottom circuit of the 3 circuit armless construction span leading from the Main Substation to Breaker 41 which is rated at 11.4 MVA.

Regimental 1 Load on Regimental 3 Feeder

In the event that Main Breaker 2 is out of service, a switch can be closed between nodes 19-21 on Main Service Road near Holcomb Circle to connect the Regimental 1 load to the Regimental 3 feeder. Computer calculations were obtained using a peak load of 4.4 MVA on Regimental 1 feeder and 3.6 MVA for Regimental 3 feeder. The critical point for this temporary arrangement is listed below:

a. Nodes 2-21, a load of 8.3 MVA can be expected on #4/0 Regimental 3 top circuit along Holcomb Boulevard which is rated at 10.3 MVA.

Capehart Load on Montford Point Feeder

In the event that Main Breaker 6 is out of service, switches can be closed between nodes 4-14, 4-5 to connect the Capehart load to the Montford Point feeder. Computer calculations were obtained using a peak demand of 5.8 MVA for the Capehart feeder and 4.0 MVA for Montford feeder. The critical points are listed below:

a. At voltage regulator MM-1, the #4/0 run along Holcomb Boulevard to Brewster Avenue (rated at 10.3 MVA), and on the #336.4 ACSR section to the substation (rated at 11.4 MVA), a load of 9.8 MVA can be expected.

Paradise Point Load on Montford Point Feeder

In the event that Main Breaker 4 is out of service, switches can be closed between nodes 14-4 & 4-5, and a switche can be opened at Stone Street and Brewster Boulevard to connect the Paradise Point load on to Montford Point feeder. Computer calculations were obtained using a peak demand of 6.5 MVA for Paradise Point and 4.7 MVA for the Montford Point feeder. The crucial Points are listed below:

a. At nodes, a load of 11.2 MVA can be expected on #4/0 circuit along Holcomb Boulevard which is rated at 10.3 MVA. This represents an 8% overload.

b. At nodes 9, 6, and 12, low voltage condition would exist; approximately 11% voltage drop at Montford Point area, 8.5% voltage drop at Midway Park, and 17% voltage drop at Paradise Point area.

c. As indicated above the overloading of the conductor and the excessive voltage drop limits the load that can be served.

DRAFT

SECTION 8

GENERAL DISCUSSION AND RECOMMENDATIONS

EXISTING SYSTEM

The existing electrical distribution system is in good condition with no major operational problems. The system is well maintained for the most part. A contract, completed in 1982, provided for testing, inspection and calibration of circuit breakers, voltage regulator, major stepdown transformers and protective relays. The contract also identified equipment that required maintenance outside the scope of the contract.

Conversion of portions of the overhead distribution system in the Regimental Area to an underground system presents several potential problems that can be minimized by adequate system design. The existing overhead system can be easily examined for malfunction and repairs can be made in a timely manner. The underground system must provide for sectionalization of the system in such a manner as to minimize the area affected by the failure and where possible the provision of an alternate service. The purpose of this design is twofold; one, it permits sectionalization of the circuit to facilitate troubleshooting and, two, it allows a method of isolating the problem area allowing the unaffected portions to be served from alternate sources.

LOAD ANALYSIS

Analysis of the planned projects scheduled for construction indicates that the load growth for the next five years will continue to increase at the rate that was experienced during the past five years, approximately 4 percent per year. This projected load growth will approach the CP&L Substation transformer capacity by the early 1990's. Additional load growth above that projected will require additional transformer capacity from CP&L.

The individual distribution feeders, with the exception of the Rifle Range feeder, are capable of serving the anticipated load growth. Although the existing voltage regulators on the rifle range feeder are adequate for the existing load small increases in the load can be better served with the relocation of regulator RRZ in the main line between the Onslow Beach tap and the Camp Site #2 tap. It is recommended that future projects causing large electrical load increases on the Rifle Range feeder be delayed until modifications and circuit upgrade has been completed. Four voltage regulators and several capacitor banks (a total of 2,325 KVAC) are required to correct the low voltage conditions during periods of peak load. Due to the voltage drop on the feeder the capacity of the circuit (Rated 6.6 MW) is limited to approximately 4.5 MW. In order to provide the capability to serve loads in excess of 4.5 MW the following circuit modifications are proposed:

(a) Reconductor the Rifle Range feeder from the main switching station to the area of OCB 44 (near Lyman Road and Main Service Road) with 336.4 MCM Aluminum.

(b) Convert the 12.47 KV line to 34.5KV from OCB 44 to Courthouse Bay.

(c) Provide stepdown transformer to serve the Onslow Beach area and Triangle Outpost tap.

RELAY COORDINATION

A protective device coordination study was conducted to determine the proper setting for the relays and circuit reclosures. Recommended settings are provided in Section 9. It is recommended that a company specializing in relay testing and calibration be retained to test, calibrate and set the relays in accordance with the recommended settings.

SECTION 9

RELAY COORDINATION STUDY

PRESENT SYSTEM PROTECTION

The majority of the system protection consists of a combination of instantaneous and inverse time non-directional overcurrent type relays. circuit reclosers and fuses are used on branch circuits. System coordination can be achieved with the existing relays. Although on some circuits, relays of different time current characteristics result in higher settings of upstream devices than would be required if the relays had more compatitive characteristics. (As presently connected circuit breakers 8 and 8A can not be coordinated. It is recommended that circuit breaker 8A be connected as a tap off the Regimental #2 CIRCUIT IN LIEU OF THE LOAD SIDE OF CIRCUIT BREAKER 8.)

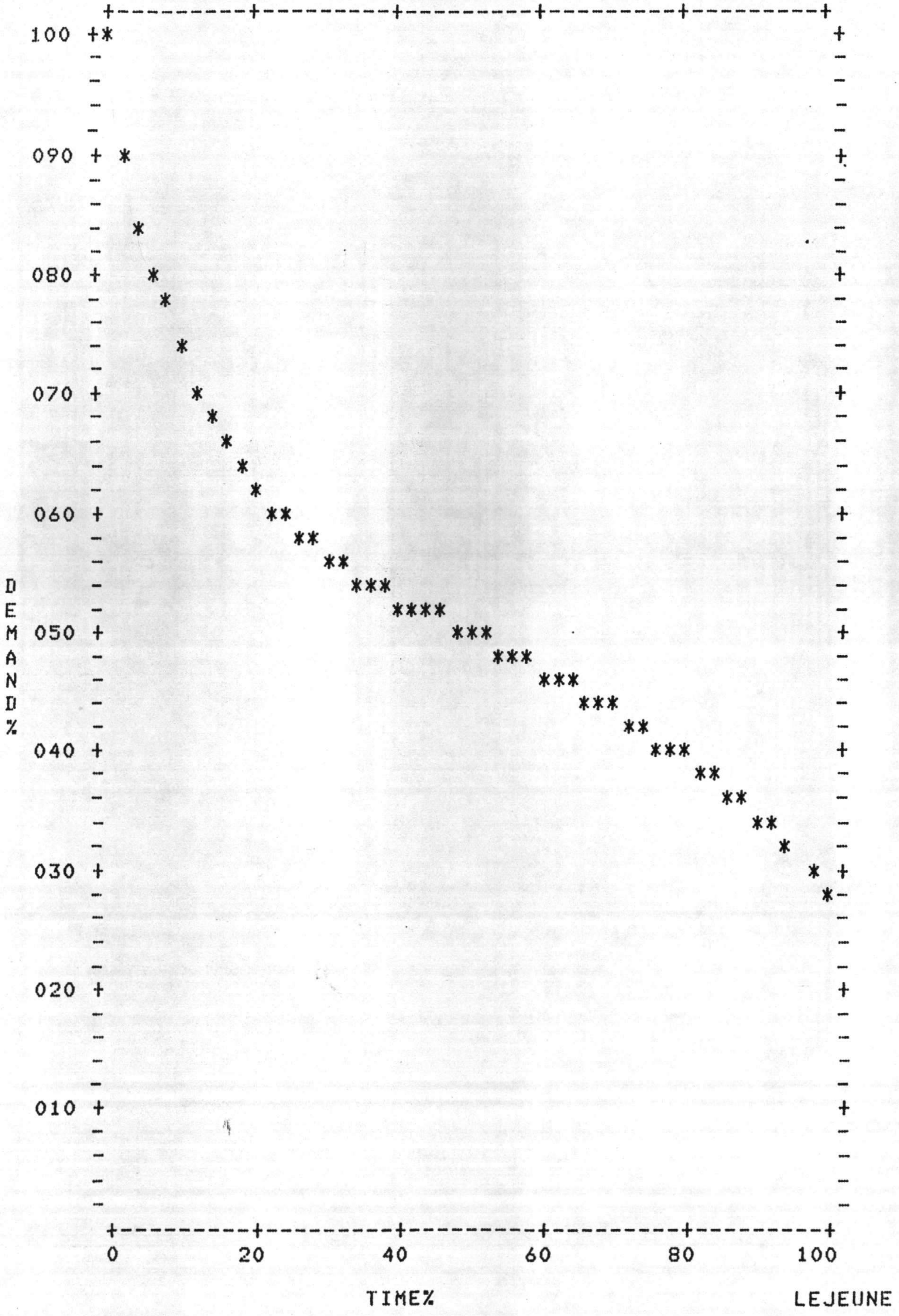
COORDINATION PROCEDURES

The primary objective of protective relaying is to constantly monitor the power system to assure maximum circuit and equipment protection consistant with assuring service continuity in the event of abnormal conditions such as short circuits of large overloads. Generally cordination is a complomise between the mutually desirable but somewhat inconsistent goals of maximum protection and maximum service continuity. The goal is to achieve a selective system in which the system problem will be isolated as quickly as possible while the remainder of the system remains in service. The settings recommended by this study, (Table I) are based on a judgement as to the best balance between the competing objectives.

LOAD DURATION CURVE

LOAD FACTOR=0.52 KILOWATT HOURS=170,036,800

DEMAND% VS TIME%



KILOWATT DEMAND	TIMES OF OCCURRENCE	NUMBER OF TIMES DEMAND WAS EXCEEDED OR EQUAL	KILOWATT DEMAND%	TIME%
37,100	1	1	99.99	0.01
37,000	3	4	99.73	0.04
36,800	1	5	99.19	0.05
36,700	4	9	98.92	0.10
36,600	4	13	98.65	0.14
36,500	3	16	98.38	0.18
36,400	15	31	98.11	0.35
36,300	6	37	97.84	0.42
36,200	19	56	97.57	0.63
36,100	8	64	97.30	0.73
36,000	12	76	97.03	0.86
35,900	9	85	96.76	0.97
35,800	14	99	96.49	1.13
35,700	9	108	96.22	1.23
35,600	5	113	95.95	1.29
35,500	12	125	95.68	1.42
35,400	4	129	95.41	1.47
35,300	5	134	95.14	1.52
35,200	2	136	94.87	1.55
35,100	4	140	94.60	1.59
35,000	3	143	94.33	1.63
34,900	9	152	94.07	1.73
34,800	4	156	93.80	1.78
34,700	4	160	93.53	1.82
34,600	7	167	93.26	1.90
34,500	4	171	92.99	1.95
34,400	6	177	92.72	2.02
34,300	3	180	92.45	2.05
34,200	11	191	92.18	2.18
34,100	5	196	91.91	2.23
34,000	5	201	91.64	2.29
33,900	4	205	91.37	2.34
33,800	7	212	91.10	2.42
33,700	9	221	90.83	2.52
33,600	12	233	90.56	2.66
33,500	11	244	90.29	2.78
33,400	4	248	90.02	2.83
33,300	11	259	89.75	2.95
33,200	6	265	89.48	3.02
33,100	12	277	89.21	3.16
33,000	2	279	88.94	3.18
32,900	17	296	88.67	3.37
32,800	6	302	88.40	3.44
32,700	12	314	88.14	3.58
32,600	3	317	87.87	3.61
32,500	16	333	87.60	3.80
32,400	16	349	87.33	3.98
32,300	2	351	87.06	4.00
32,200	8	359	86.79	4.09
32,100	5	364	86.52	4.15

LEJEUNE

KILOWATT DEMAND	TIMES OF OCCURRENCE	NUMBER OF TIMES DEMAND WAS EXCEEDED OR EQUAL	KILOWATT DEMAND%	TIME%
32,000	13	377	86.25	4.30
31,900	7	384	85.98	4.38
31,800	8	392	85.71	4.47
31,700	2	394	85.44	4.49
31,600	10	404	85.17	4.61
31,500	3	407	84.90	4.64
31,400	10	417	84.63	4.76
31,300	5	422	84.36	4.81
31,200	14	436	84.09	4.97
31,100	14	450	83.82	5.13
31,000	8	458	83.55	5.22
30,900	18	476	83.28	5.43
30,800	3	479	83.01	5.46
30,700	10	489	82.74	5.58
30,600	7	496	82.47	5.66
30,500	12	508	82.21	5.79
30,400	6	514	81.94	5.86
30,300	15	529	81.67	6.03
30,200	10	539	81.40	6.15
30,100	16	555	81.13	6.33
30,000	17	572	80.86	6.53
29,900	10	582	80.59	6.64
29,800	23	605	80.32	6.90
29,700	12	617	80.05	7.04
29,600	21	638	79.78	7.28
29,500	15	653	79.51	7.45
29,400	17	670	79.24	7.64
29,300	10	680	78.97	7.76
29,200	17	697	78.70	7.95
29,100	2	699	78.43	7.98
29,000	27	726	78.16	8.28
28,900	19	745	77.89	8.50
28,800	6	751	77.62	8.57
28,700	27	778	77.35	8.88
28,600	8	786	77.08	8.97
28,500	12	798	76.81	9.11
28,400	9	807	76.54	9.21
28,300	20	827	76.28	9.44
28,200	6	833	76.01	9.51
28,100	22	855	75.74	9.76
28,000	12	867	75.47	9.89
27,900	15	882	75.20	10.06
27,800	8	890	74.93	10.16
27,700	21	911	74.66	10.40
27,600	21	932	74.39	10.64
27,500	9	941	74.12	10.74
27,400	18	959	73.85	10.94
27,300	8	967	73.58	11.04
27,200	16	983	73.31	11.22
27,100	9	992	73.04	11.32

LEJEUNE

KILOWATT DEMAND	TIMES OF OCCURRENCE	NUMBER OF TIMES DEMAND WAS EXCEEDED OR EQUAL	KILOWATT DEMAND%	TIME%
27,000	17	1,009	72.77	11.51
26,900	8	1,017	72.50	11.61
26,800	26	1,043	72.23	11.90
26,700	12	1,055	71.96	12.04
26,600	20	1,075	71.69	12.27
26,500	21	1,096	71.42	12.51
26,400	15	1,111	71.15	12.68
26,300	27	1,138	70.88	12.99
26,200	10	1,148	70.61	13.10
26,100	18	1,166	70.35	13.31
26,000	12	1,178	70.08	13.44
25,900	18	1,196	69.81	13.65
25,800	9	1,205	69.54	13.75
25,700	23	1,228	69.27	14.01
25,600	9	1,237	69.00	14.12
25,500	22	1,259	68.73	14.37
25,400	33	1,292	68.46	14.75
25,300	8	1,300	68.19	14.84
25,200	21	1,321	67.92	15.08
25,100	11	1,332	67.65	15.20
25,000	27	1,359	67.38	15.51
24,900	27	1,386	67.11	15.82
24,800	21	1,407	66.84	16.06
24,700	9	1,416	66.57	16.16
24,600	32	1,448	66.30	16.53
24,500	17	1,465	66.03	16.72
24,400	32	1,497	65.76	17.09
24,300	31	1,528	65.49	17.44
24,200	16	1,544	65.22	17.62
24,100	30	1,574	64.95	17.97
24,000	15	1,589	64.69	18.14
23,900	53	1,642	64.42	18.74
23,800	19	1,661	64.15	18.96
23,700	28	1,689	63.88	19.28
23,600	23	1,712	63.61	19.54
23,500	36	1,748	63.34	19.95
23,400	7	1,755	63.07	20.03
23,300	40	1,795	62.80	20.49
23,200	18	1,813	62.53	20.69
23,100	30	1,843	62.26	21.04
23,000	37	1,880	61.99	21.46
22,900	27	1,907	61.72	21.77
22,800	39	1,946	61.45	22.21
22,700	14	1,960	61.18	22.37
22,600	52	2,012	60.91	22.97
22,500	30	2,042	60.64	23.31
22,400	42	2,084	60.37	23.79
22,300	15	2,099	60.10	23.96
22,200	38	2,137	59.83	24.39
22,100	21	2,158	59.56	24.63

KILOWATT DEMAND	TIMES OF OCCURRENCE	NUMBER OF TIMES DEMAND WAS EXCEEDED OR EQUAL	KILOWATT DEMAND%	TIME%
22,000	38	2,196	59.29	25.07
21,900	58	2,254	59.02	25.73
21,800	18	2,272	58.76	25.93
21,700	56	2,328	58.49	26.57
21,600	32	2,360	58.22	26.94
21,500	55	2,415	57.95	27.57
21,400	33	2,448	57.68	27.94
21,300	44	2,492	57.41	28.45
21,200	29	2,521	57.14	28.78
21,100	73	2,594	56.87	29.61
21,000	29	2,623	56.60	29.94
20,900	80	2,703	56.33	30.85
20,800	62	2,765	56.06	31.56
20,700	34	2,799	55.79	31.95
20,600	74	2,873	55.52	32.80
20,500	34	2,907	55.25	33.18
20,400	83	2,990	54.98	34.13
20,300	41	3,031	54.71	34.60
20,200	96	3,127	54.44	35.70
20,100	35	3,162	54.17	36.10
20,000	107	3,269	53.90	37.32
19,900	52	3,321	53.63	37.91
19,800	90	3,411	53.36	38.94
19,700	46	3,457	53.09	39.46
19,600	100	3,557	52.83	40.60
19,500	105	3,662	52.56	41.80
19,400	55	3,717	52.29	42.43
19,300	120	3,837	52.02	43.80
19,200	57	3,894	51.75	44.45
19,100	122	4,016	51.48	45.84
19,000	46	4,062	51.21	46.37
18,900	109	4,171	50.94	47.61
18,800	59	4,230	50.67	48.29
18,700	104	4,334	50.40	49.48
18,600	37	4,371	50.13	49.90
18,500	89	4,460	49.86	50.91
18,400	107	4,567	49.59	52.14
18,300	54	4,621	49.32	52.75
18,200	95	4,716	49.05	53.84
18,100	51	4,767	48.78	54.42
18,000	96	4,863	48.51	55.52
17,900	35	4,898	48.24	55.91
17,800	87	4,985	47.97	56.91
17,700	49	5,034	47.70	57.47
17,600	89	5,123	47.43	58.48
17,500	52	5,175	47.16	59.08
17,400	80	5,255	46.90	59.99
17,300	82	5,337	46.63	60.93
17,200	37	5,374	46.36	61.35
17,100	89	5,463	46.09	62.37

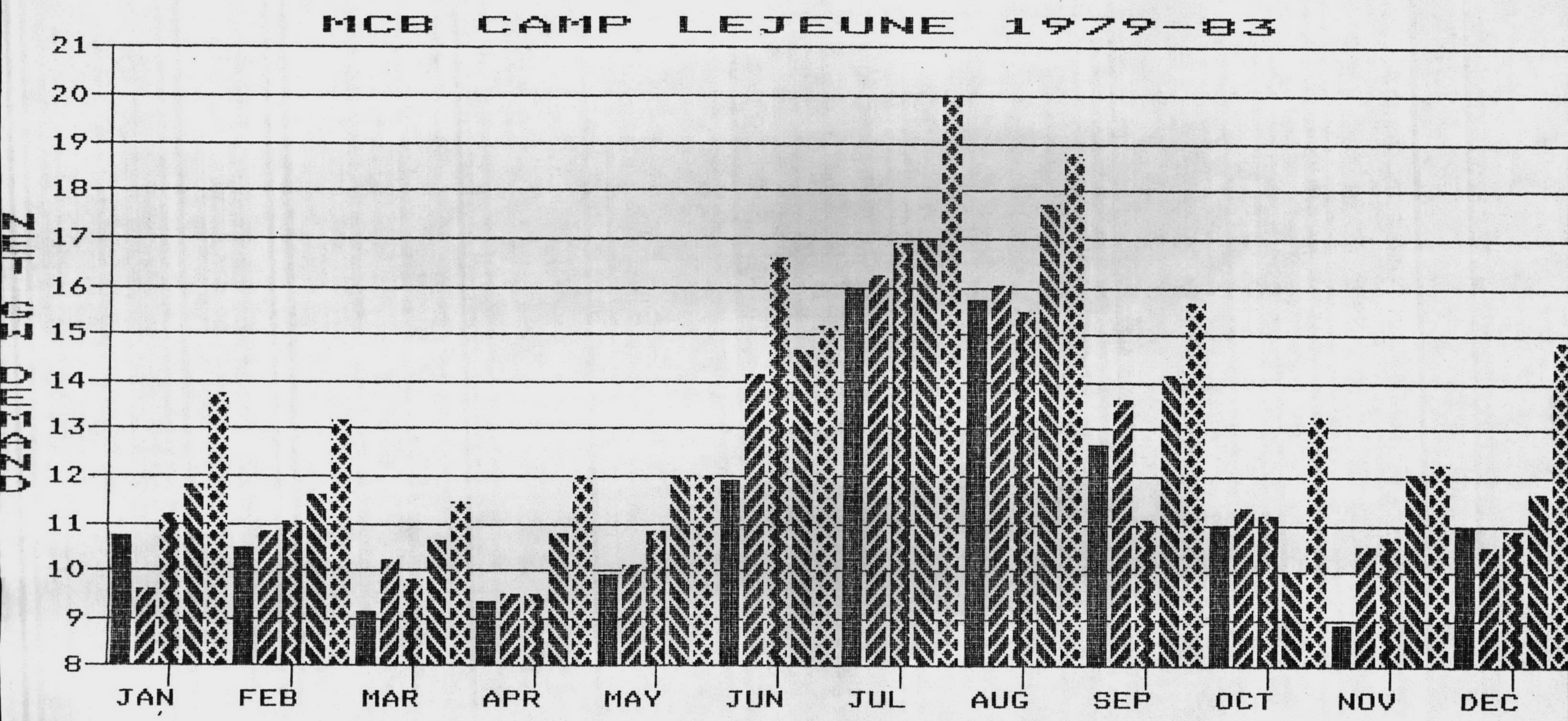
LEJEUNE

KILOWATT DEMAND	TIMES OF OCCURRENCE	NUMBER OF TIMES DEMAND WAS EXCEEDED OR EQUAL	KILOWATT DEMAND%	TIME%
17,000	46	5,509	45.82	62.89
16,900	75	5,584	45.55	63.75
16,800	49	5,633	45.28	64.31
16,700	63	5,696	45.01	65.03
16,600	57	5,753	44.74	65.68
16,500	107	5,860	44.47	66.90
16,400	50	5,910	44.20	67.47
16,300	87	5,997	43.93	68.46
16,200	85	6,082	43.66	69.43
16,100	45	6,127	43.39	69.95
16,000	81	6,208	43.12	70.87
15,900	45	6,253	42.85	71.38
15,800	82	6,335	42.58	72.32
15,700	34	6,369	42.31	72.71
15,600	74	6,443	42.04	73.55
15,500	50	6,493	41.77	74.12
15,400	81	6,574	41.50	75.05
15,300	36	6,610	41.23	75.46
15,200	82	6,692	40.97	76.40
15,100	43	6,735	40.70	76.89
15,000	84	6,819	40.43	77.85
14,900	71	6,890	40.16	78.66
14,800	38	6,928	39.89	79.09
14,700	71	6,999	39.62	79.90
14,600	37	7,036	39.35	80.32
14,500	65	7,101	39.08	81.07
14,400	30	7,131	38.81	81.41
14,300	63	7,194	38.54	82.13
14,200	52	7,246	38.27	82.72
14,100	56	7,302	38.00	83.36
14,000	38	7,340	37.73	83.79
13,900	71	7,411	37.46	84.61
13,800	63	7,474	37.19	85.32
13,700	26	7,500	36.92	85.62
13,600	62	7,562	36.65	86.33
13,500	25	7,587	36.38	86.61
13,400	50	7,637	36.11	87.19
13,300	33	7,670	35.84	87.56
13,200	47	7,717	35.57	88.10
13,100	26	7,743	35.30	88.40
13,000	76	7,819	35.04	89.26
12,900	33	7,852	34.77	89.64
12,800	65	7,917	34.50	90.38
12,700	80	7,997	34.23	91.30
12,600	26	8,023	33.96	91.59
12,500	63	8,086	33.69	92.31
12,400	34	8,120	33.42	92.70
12,300	76	8,196	33.15	93.57
12,200	26	8,222	32.88	93.86
12,100	58	8,280	32.61	94.53

LEJEUNE

KILOWATT DEMAND	TIMES OF OCCURRENCE	NUMBER OF TIMES DEMAND WAS EXCEEDED OR EQUAL	KILOWATT DEMAND%	TIME%
12,000	27	8,307	32.34	94.83
11,900	92	8,399	32.07	95.88
11,800	32	8,431	31.80	96.25
11,700	76	8,507	31.53	97.12
11,600	25	8,532	31.26	97.40
11,500	54	8,586	30.99	98.02
11,400	48	8,634	30.72	98.57
11,300	24	8,658	30.45	98.84
11,200	41	8,699	30.18	99.31
11,100	19	8,718	29.91	99.53
11,000	19	8,737	29.64	99.74
10,900	11	8,748	29.38	99.87
10,800	7	8,755	29.11	99.95
10,700	2	8,757	28.84	99.97
10,600	1	8,758	28.57	99.98
10,500	1	8,759	28.30	100.00

LEJEUNE



MCB CAMP LEJEUNE 1979-83
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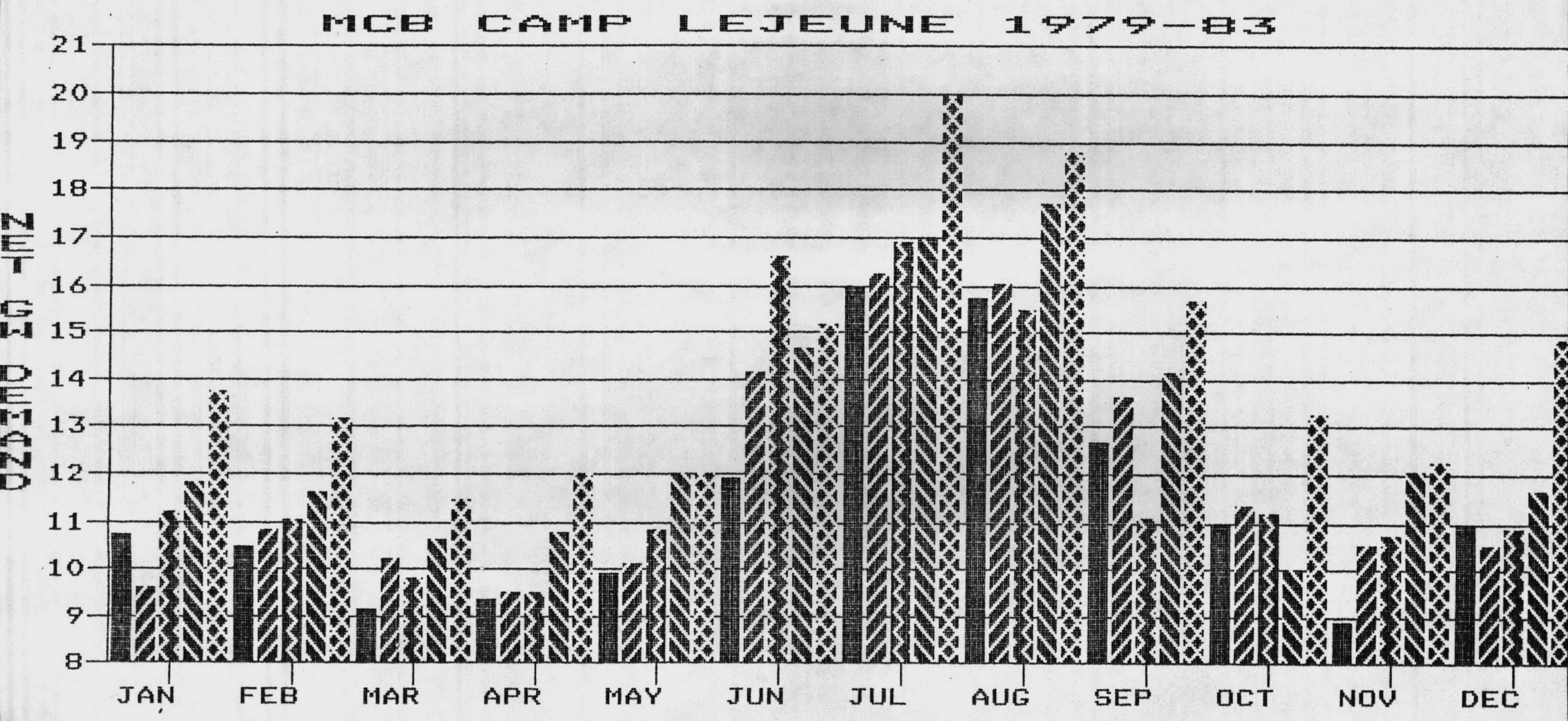
MCB CAMP LEJEUNE 1979-83
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GENERAL ELECTRIC

INSTALLATION AND SERVICE ENGINEERING DIVISION

GENERAL ELECTRIC COMPANY, 141 PROVIDENCE ROAD, P. O. BOX 30697
CHARLOTTE, NORTH CAROLINA 28230, Phone (704) 371-3300

April 13, 1982

Mr. Luther Norris
Public Works Design Division
Bldg. 1005
U.S. Marine Corps
Camp Lejeune, NC 28542

Subject: Power System Study (Scope)

Dear Luther:

This letter is to follow-up your phone conversation with Gene Weaver in regards to the subject.

Gene ask me to send you the scope covering the areas you and he discussed:

a) One-Line Diagram
b) Short Circuit Analysis
c) Short Circuit Calculations
d) Protective Devices Coordination
e) Load Flow

The attached scope is what we furnish in these areas. These are what we recommend and may go deeper than you want to go in the system. With that in mind, you may delete some of the scope.

We sure hope this is helpful and is what you need. We would like very much to do the study for you.

If we can be of further help, please give us a call.

Sincerely,

J. O. Crompton /psg

J. O. Crompton
Sales Engineer

psg

Attachment

cc: R. E. Weaver
C. F. Brown
J. B. Wise

Study Workscopes

One-Line Diagram

In meeting certain study input requirements, a composite one-line diagram of the power distribution system will be developed on one sheet, showing in detail all the power transformers, disconnect switches circuit breakers, fuses, protective relays, current transformers and power sources.

All circuits significant to the analyses will be included in the diagram using standard I.E.E.E. formats conducive to study work.

All motor loads will be shown individually or as lumped horsepower, depending upon size, quantity and function.

All substations, circuits, tie circuits, motor loads and the like will be identified and labeled on the diagram. Each power transformer will include the rating, voltage transformation, percent impedance, winding configuration, and grounding methods, if present. All circuit breakers and fuse disconnects will be labeled according to their ratings.

Conductor sizes and lengths pertinent to the analyses will be labeled on the drawing.

Short-Circuit Analysis

A short-circuit current study will be performed and documented in report form with all short-circuit current calculations made in accordance with the latest standards adopted by the American National Standards Institute. The following short-circuit calculating standards will be used where appropriate in the study:

- ANSI-C37.010 - 1979 - Standard Application Guide for AC High-Voltage Circuit Breakers.
- ANSI-C37.5 - 1969 - Calculation of Fault Currents for Application of Power Circuit Breakers Rated on a Total Current Basis.
- ANSI-C37.13 - 1980 - Low-voltage AC Power Circuit Breakers (600 Volt Insulation Class).

The short-circuit calculations will be accompanied by a bus-to-bus listing of all the system impedances referenced to the completed system one-line diagram. The short-circuit calculations will be made with the aid of a digital computer. A computer printout for each study condition will accompany the report for record purposes. The one-line diagram will be indexed to the computer printout for complete interpretation of short-circuit duties. Calculations will include all buses specifically identified for study on the one-line diagram.

An engineering discussion of the results of the short-circuit analyses will be included in the report.

In addition a tabulated comparison between the calculated short-circuit levels and the ratings of the circuit breakers and fuses encompassed in the study will be included in the report. Comments regarding the interrupting ratings of the tabulated devices and recommendations for replacing possible underrated equipment with specifications will be provided in each case.

To assure worst case conditions are covered, the calculations will be based on the system switching modes that will develop the maximum short-circuit currents.

Both the momentary and interrupting conditions will be calculated to check the ratings of the medium and low voltage circuit breakers and fuses.

Short-Circuit Analysis (cont'd)

The analysis will compare the calculated short-circuit currents with the interrupting ratings of all medium-voltage circuit breakers and fuses in the system.

The analysis will compare the calculated short-circuit currents with the interrupting ratings of all low-voltage protective devices of each load center sub-station in the system.

The analysis will compare the calculated short-circuit currents with the interrupting ratings of all low-voltage protective devices of each load center sub-station and motor control center/panel in the system.

The analysis will compare the calculated short-circuit currents with the interrupting ratings of all medium-voltage circuit breakers and fuses, along with all low-voltage protective devices of each load center substation in the system.

Short-Circuit Calculations

When protective devices in a power distribution system are to be coordinated, it is necessary to calculate the system short-circuit current magnitudes. The short-circuit current levels indicate how the protective devices are to be set relative to each other in achieving the desired selectivity throughout the system.

For protective device coordination purposes, short circuit calculations will be performed and documented in report form. All short-circuit current calculations will be made in accordance with the latest standards adopted by the American National Standards Institute. The following short-circuit calculating standards will be used where appropriate in the study:

ANSI - C37.010 - 1979 - Standard Application Guide for AC High Voltage Circuit Breakers.

ANSI - C37.5 - 1969 - Calculation of Fault Currents for Application of Power Circuit Breakers Rated on a Total Current Basis.

ANSI - C37.13 - 1980 - Low Voltage AC Power Current Breakers (600 Volt Insulation Class).

The short-circuit calculations will be accompanied by a bus-to-bus listing of all the system impedances referenced to the completed one-line diagram. The short-circuit calculations will be made with the aid of a digital computer. A computer printout for each study condition will accompany the report for record purposes. The one-line diagram will be indexed to the computer printout for complete interpretation of short-circuit duties.

Both the momentary and interrupting short-circuit currents will be calculated for protective device coordination purposes.

Protective Device Coordination Study

A complete protective device coordination study of the power system will be performed and documented for the purpose of prescribing settings for the system's protective devices. The prescribed settings will be determined based on a practical compromise between devices for downstream faults. The criteria for protection shall be in accordance with the latest requirements that are set forth by the National Electrical Code (NEC) and the American National Standards Institute (ANSI).

A tabulation of the recommended relay and circuit breaker settings will be included in the report. The listing will identify the devices by location and function number.

An engineering evaluation will be made of the protective devices in the system from an application standpoint. Where existing devices are inadequate to coordinate, the report will reflect these deficiencies and make recommendations for improvement.

Time-current coordination curve plots will be included in the report where necessary to display suggested settings for the system protective devices.

Revised 4/21/80
Replaces Original
Issued 4/23/79

[illegible] contamination [illegible]

[illegible]

[illegible] Code (1975) [illegible]

[illegible]

[illegible]

[illegible]

The study will begin "downstream" at the secondary main circuit breaker on each low-voltage substation. An analysis will be made of the setting for the main secondary circuit breakers based on the substation's highest set feeder circuit breaker. Where necessary, new settings will be prescribed for the secondary main circuit breakers and for all "upstream" medium-voltage applied adjustable relays in the system.

The study will begin at each low-voltage secondary feeder circuit breaker. An analysis will be made of the settings of each substation secondary feeder circuit breaker in providing the desired coordination with the largest downstream branch circuit protective device. Where necessary, new settings will be prescribed for the feeder circuit breakers to achieve this coordination. The study will continue through each substation secondary main circuit breaker, primary fuse (if applicable), medium-voltage feeder relay, main medium-voltage switchgear relays and then interface with the utility protective devices. New settings will be prescribed where necessary, to achieve the desired overall system coordination.

Where necessary, the study will prescribe new settings for all medium-voltage applied switchgear relays in the system. The settings will be prescribed based on existing settings for any downstream circuit breakers or fuses in the system.

The size and speed characteristics of the distribution fuses will be reviewed. Recommendations, where necessary, will be included to achieve the desired coordination.

Where necessary, the study will review and, if necessary, prescribe new settings for the protective relays such as bus, transformer, motor and generator differential relays, reverse power, loss of field, current unbalance, undervoltage, pilot wire and any other relays pertinent to the protection of the system.

Revised 4/21/80
Replaces Original
Issued 4/23/79
Revised 8/11/81 (2nd)

Load Flow Study

A load flow study will be performed for the purpose of investigating system loading conditions for the normal operating condition. Up to (Number of Cases) cases of alternative operating conditions will be studied. All system loads (watt and var components) and power sources (utility tieline & generators) will be included in the analyses.

The study will be processed on a digital computer and will determine bus voltage levels, amperes, power factor, and real and reactive flows at the (Voltage)-volt buses. The study report shall include the following:

The data base for the load flow analysis can be reliably established with existing ammeters and watt hour or var meters installed in the unit load center switchgear. If such devices are not available, an assumed power factor combined with connected loads and given diversity factors can be used with some reliability. On the other hand, if portable instrumentation is necessary to establish a more accurate data base, such field work is outside the scope of this proposal.

A separate one-line diagram showing real and reactive power quantities and direction, voltage levels, and power factor for each case studied will be included in the report. The one-line diagrams shall be accompanied with computer output sheets documenting the results of each case studied.

The study report will include a complete engineering analysis for each case studied. The engineering analysis will include recommendations for better system operating conditions involving suggestions for system redesign or operating conditions, if appropriate. The analysis will also include discussions on load shedding recommendations that would allow the system to continue functioning following the sudden loss of some supply power.

The study will review the system transformer tap positions. With the existing transformer tap ranges available, the study will include recommendations for new tap positions that will improve the voltage conditions in the system.

The study shall reflect steady-state loading conditions following automatic load shedding for emergency conditions.

The study will be used in conjunction with the stability study required as part of this specification.

Power System Analysis

BASE MAINTENANCE DIVISION
Marine Corps Base
Camp Lejeune, North Carolina 28542

ROUTING ORDER	INT
1 04	
2 404	
3 82-4420	
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5	
ORIG	INT

BMO/CL/dkm
4330
5 April 1982

From: Base Maintenance Officer
To: Public Works Officer

Subj: Request for Plans and Specifications

Ref: FONECON btwn L. Norris, PWD and F. Cone, BMO on 30 March 1982

1. As discussed during the reference, it is requested that plans and specifications be prepared to provide a coordination study for the electric distribution system served by the main Hadnot Point substation.

2. Base Maintenance personnel are available for consultation as required. Points of contact are F. Cone, Director, Utilities Branch, extension 5161 and H. Ireland, Supervisor, Electric Distribution Shop, extension 5256.

R.M. Dillon
R. M. DILLON
By direction

Copy to:
UtilBr
M&RBr
Shop 52

BMO/CL/dkm
4330
5 April 1982

From: Base Maintenance Officer
To: Public Works Officer

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