CONTRACT N40085-19-0079
NAVFAC SPECIFICATION
NO. 05-19-0079

REPAIR MEDIUM VOLTAGE DISTRIBUTION SYSTEM, VARIOUS LOCATIONS

AT THE

MARINE CORPS BASE, CAMP LEJEUNE, NORTH CAROLINA

DESIGN BY:

KYLE BROWN
PUBLIC WORKS DESIGN DIVISION
CAMP LEJEUNE, NC

SPECIFICATION PREPARED BY:

KIM SAMPLE
DATE: MARCH 07, 2019

SPECIFICATION APPROVED BY:

T.H. BURTON, P.E., DIRECTOR
DESIGN BRANCH, PUBLIC WORKS DIVISION

J.M. ROCHE, COMMANDER, CEC, U.S. NAVY
FOR COMMANDER, NAVAL FACILITIES ENGINEERING COMMAND

05190079

SUBMITTAL REGISTER

CONTRACT NO. (Enter Contract No. Here)

TITLE AND LOCATION (Enter Contract Title and Locaiton Here)

CONTRACTOR (Enter Contractor Name Here)

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH NO	CLASSIFICATION	GOVT OR A/E REVIEW	Contractor Schedule Dates: SUBMIT	Contractor Schedule Dates: APPROVAL NEEDED BY	Contractor Schedule Dates: MATERIAL NEEDED BY	Contractor Action: ACTION CODE	Contractor Action: DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	Approving Authority: DATE FWD TO OTHER REVIEWER	Approving Authority: DATE RCD FROM OTH REVIEWER	Approving Authority: ACTION CODE	Approving Authority: DATE OF ACTION	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 20 00	SD-01 PRECONSTRUCTION SUBMITTALS														
			Schedule of Prices	1.3													
		01 30 00	SD-01 PRECONSTRUCTION SUBMITTALS														
			List of Contact Personnel	1.4.1													
		01 31 50	SD-11 CLOSEOUT SUBMITTALS														
			Interim DD1354, Transfer & Acceptance	1.2													
			of Military Real Property (If Applicable)														
		01 32 16	SD-01 PRECONSTRUCTION SUBMITTALS														
			Construction Schedule	1.2													
			Equipment Delivery Schedule	1.3													
		01 33 00	SD-11 CLOSEOUT SUBMITTALS														
			Submittal Register	1.4.1													
			Complete Submittal Package	1.6.1													
		01 35 29	SD-01 PRECONSTRUCTION SUBMITTALS														
			Accident Prevention Plan (APP)	1.9													
			Activity Hazard Analysis (AHA)	1.10													
			Crane Critical Lift Plan (If Applicable)	1.9.1													
			Crane Work Plan (If Applicable)	1.9.1													
			Crane Operators (If Applicable)	1.7.1.4													
			SD-06 TEST REPORTS														
			Reports	1.14													
			Accident Reports	1.14.1													
			Monthly Exposure Reports	1.14.3													
			Regulatory Citations and Violations	1.14.4													
			Crane Reports	1.14.5													
			SD-07 CERTIFICATES														
			Confined Space Entry Permit	1.11													

			Certificate of Compliance	1.14.6													
			Third Party Certification of Barge-	1.14.7													
			Mounted Movile Cranes														
		01 45 10	SD-11 CLOSEOUT SUBMITTALS														
			Qaulity Control Plan (QC Plan)	1.6													
		01 50 00	SD-01 PRECONSTRUCTION SUBMITTALS														
			Traffic Control Plan (If Applicable)	1.6.2.1													
			SD-03 PRODUCT DATA														
			Diesel Generator	26.32													
			Padmount Transformer	26.12													
			Automatic Transfer Switch	26.28/36													
			Meters	26.27/33.12													
			Medium Voltage Cable	26.05													
			SD-06 TEST REPORTS														
			Backflow Preventer Tests (If Applicable)	3.1													
			SD-07 CERTIFICATES														
			Backflow Tester Certification (If Applicable)	1.3													
			Backflow Preventers Certificate (If Applicable														
		01 57 19	SD-01 PRECONSTRUCTION SUBMITTALS														
			Environmental Protection Plan	1.6.1													
			Preconstruction Survey	1.6.4													
			MSDS for Class I ODS Waivered Product	1.7.2													
			Permit for Storm Water Discharge (If applicab	1.7													
			Notice of Intent (If applicable)	1.7													

CAMP LEJEUNE - PAD MOUNTED TRANSFORMER SUMMARY REPORT

HVS SHT #	AREA	BLDG #	NP DATE	KVA	PRI VOLT (KV)	SEC VOLT (V)	IMP %	MTR ON PMT?	MTR#	MAP QUAD	REPLACE PAD	EST. PRIMARY CABLE SIZE	EST. PRIMARY CABLE DIST
2	HADNOT	89	N/A	500	12470	208/120	4.75	YES	300689447	F8	Y	1/O CU	150
4	HADNOT	342	N/A	112.5	12470	208/120	3.9	NO	N/A	G7	Y	#2 CU	338
4	HADNOT	416	N/A	150	12470	208/120	3.3	NO	303715371	G7	Y	#2 CU	N/A
4	HADNOT	425	N/A	500	12470	208/120	4.5	NO	300689410	G8	Y	#2 CU	122
4	HADNOT	HP435	N/A	300	12470	208/120	5	YES	300689125	G7	Y	#2 CU	N/A
3	HADNOT	510	N/A	500	12470	208/120	5.26	YES	300689303	G8	Y	3/0 CU	92
4	HADNOT	514	N/A	300	12470	208/120	4.36	Yes	300689219	G8	Y	#2 CU	136
4	HADNOT	519	Jan-90	300	12470	208/120	4.36	YES	300689366	G8	Y	#2 CU	130
4	HADNOT	523	Jul-90	300	12470	208/120	4.36	Yes	300389387	G8	Y	#2 CU	80
4	HADNOT	527	Jan-90	300	12470	208/120	4.36	Yes	300689285	G8	Y	#2 CU	42
4	HADNOT	575	N/A	500	12470	480/277	4.75	Yes	300689308	G8	Y	#2 CU	N/A
2	HADNOT	895-1	N/A	225	12470	208/120	2.05	Yes	300689323	F8	Y	#2 cu	50
3	HADNOT - industrial	~~901A/~~ 1860	N/A	112.5	12470	480/277	7.7	Yes	303715212	G8	Y	#2 CU	354
3	HADNOT - industrial	~~901B~~/ 901-1	N/A	N/A	12470	208/120	3.1	Yes	303715237	F8	Y	#2 CU	354
3	HADNOT - industrial	1057	N/A	225	12470	208/120	4.2	Yes	303715362	F8	Y	#2 CU	300
3	HADNOT	1202B	N/A	112.5	12470	208/120	3.17	Yes	39287037 - no info	F8	N	#2 CU	160
3	HADNOT - industrial	1445	May-92	750	12470	480/277	5.65	Yes	303715178	F8	Y	#2 CU	245

CAMP LEJEUNE - PAD MOUNTED TRANSFORMER SUMMARY REPORT

HVS SHT #	AREA	BLDG #	NP DATE	KVA	PRI VOLT (KV)	SEC VOLT (V)	IMP %	MTR ON PMT?	MTR#	MAP QUAD	REPLACE PAD	EST. PRIMARY CABLE SIZE	EST. PRIMARY CABLE DIST
3	HADNOT - industrial	1450	N/A	150	12470	208/120	1.9	Yes	303715179	F8	Y	#2 CU	456
4	HADNOT - industrial	1770	N/A	225	12470	208/120	3.3	Yes	303715230	G8	Y	#2 CU	100
4	HADNOT - industrial	1771	N/A	300	12470	208/120	3.1	Yes	300689283	G8	Y	#2 CU	140
4	HADNOT - industrial	1780	Mar-89	225	12470	208/120	3.28	Yes	303715188	G8	Y	#2 CU	170
4	HADNOT - industrial	1880	N/A	300	12470	480/277	5.8	Yes	303715199	G8	Y	#2 CU	125
5	FC	FC40	N/A	112.5	12470	208/120	4.2	Yes	300689402	G9	Y	#2 CU	290
5	FC - Industrial	989	N/A	225	12470	480/277	3.4	Yes	300689458	G9	Y	#2 CU	N/A
5	FC	FC100	N/A	300	12470	208/120	7.7	Yes	303715250	G9	Y	#2 CU	250
5	FC	FC120	N/A	225	12470	208/120	7.3	Yes	303715428	G9	Y	#2CU	135
5	FC	FC190	N/A	225	12470	208/120	3.43	NO	N/A	G9	Y	#2CU	76
5	FC	FC200	N/A	225	12470	208/120	6	Yes	300689403	G9	Y	#2CU	45
5	FC	FC241	N/A	112.5	12470	208/120	1.9	Yes	303715 377	G9	Y	#2CU	455
5	FC	FC253	N/A	225	12470	208/120	3.43	NO	N/A	G9	Y	#2CU	200
5	FC	FC270	N/A	300	12470	208/120	4.2	Yes	300689287	G9	Y	#2CU	400
1	HOSP PT	H17~~N~~	N/A	500	12470	120/208	4.73	Yes	300689332	F6	Y	2/0 CU	125
2	HADNOT	HP51	N/A	225	12470	208/120	5	Yes	300689173	F7	Y	#2 CU	250
2	HADNOT	HP53	N/A	225	12470	208/120	6	Yes	300689184	F7	Y	#2 cu	171

CAMP LEJEUNE - PAD MOUNTED TRANSFORMER SUMMARY REPORT

HVS SHT #	AREA	BLDG #	NP DATE	KVA	PRI VOLT (KV)	SEC VOLT (V)	IMP %	MTR ON PMT?	MTR#	MAP QUAD	REPLACE PAD	EST. PRIMARY CABLE SIZE	EST. PRIMARY CABLE DIST
2	HADNOT	88	N/A	112.5	12470	208/120	1.8	NO	303715357	F7	Y	#2CU	280
2	HADNOT	HP100	1983	225	12470	208/120	6.4	Yes	300689389	F7	Y	#2 CU	256
2	HADNOT	HP104	N/A	300	12470	480/277	3.67	Yes	300689329	F7	Y	#2 CU	205
3	HADNOT	HP127	N/A	300	12470	480/277	3.8	Yes	303715400	F7	Y	2/0 CU	40
4	HADNOT	HP225	N/A	150	12470	208/120	5	Yes	300689353	F7	Y	#2CU	110
4	HADNOT	HP237	Apr-92	500	12470	480/277	5.41	Yes	300689350	F7	Y	4/0 CU	450
2	HADNOT	HP250	N/A	500	12470	480/277	4.875	Yes	300689445	F7	Y	1/0 CU	246
2	HADNOT	HP275	N/A	150	12470	208/120	5	Yes	300689449	F7	Y	1/0 CU	81
2	HADNOT	HP285	N/A	150	12470	208/120	5	Yes	300689384	F7	Y	1/0 CU	115
4	HADNOT	HP305	N/A	750	12470	480/277	5.75	Yes	303715385	F7	Y	4/0 CU	450
4	HADNOT	HP476	N/A	500	12470	480/277	5.07	Yes	303715266	G7	Y	2/0 CU	N/A
4	HADNOT	~~HP503~~ - HP504	N/A	300	12470	208/120	3.63	Yes	300689263	G8	Y	2/0 CU	N/A
4	HADNOT	HP512	N/A	300	12470	208/120	5.27	Yes	300689160	G8	Y	3/0 CU	60
4	HADNOT	~~HP514~~ - HP513	N/A	500	12470	208/120	5.26	Yes	300689159	G8	Y	3/0 CU	305
4	HADNOT	HP550	N/A	300	12470	208/120	2.16	Yes	300689316	G8	Y	3/0 CU	732
4	HADNOT	HP560	N/A	300	12470	208/120	2.16	Yes	300689317	G8	Y	3/0 CU	285
38	NR AS	AS205	N/A	225	12470	208/120	6	Yes	N/A	C2	Y	#2 CU	55

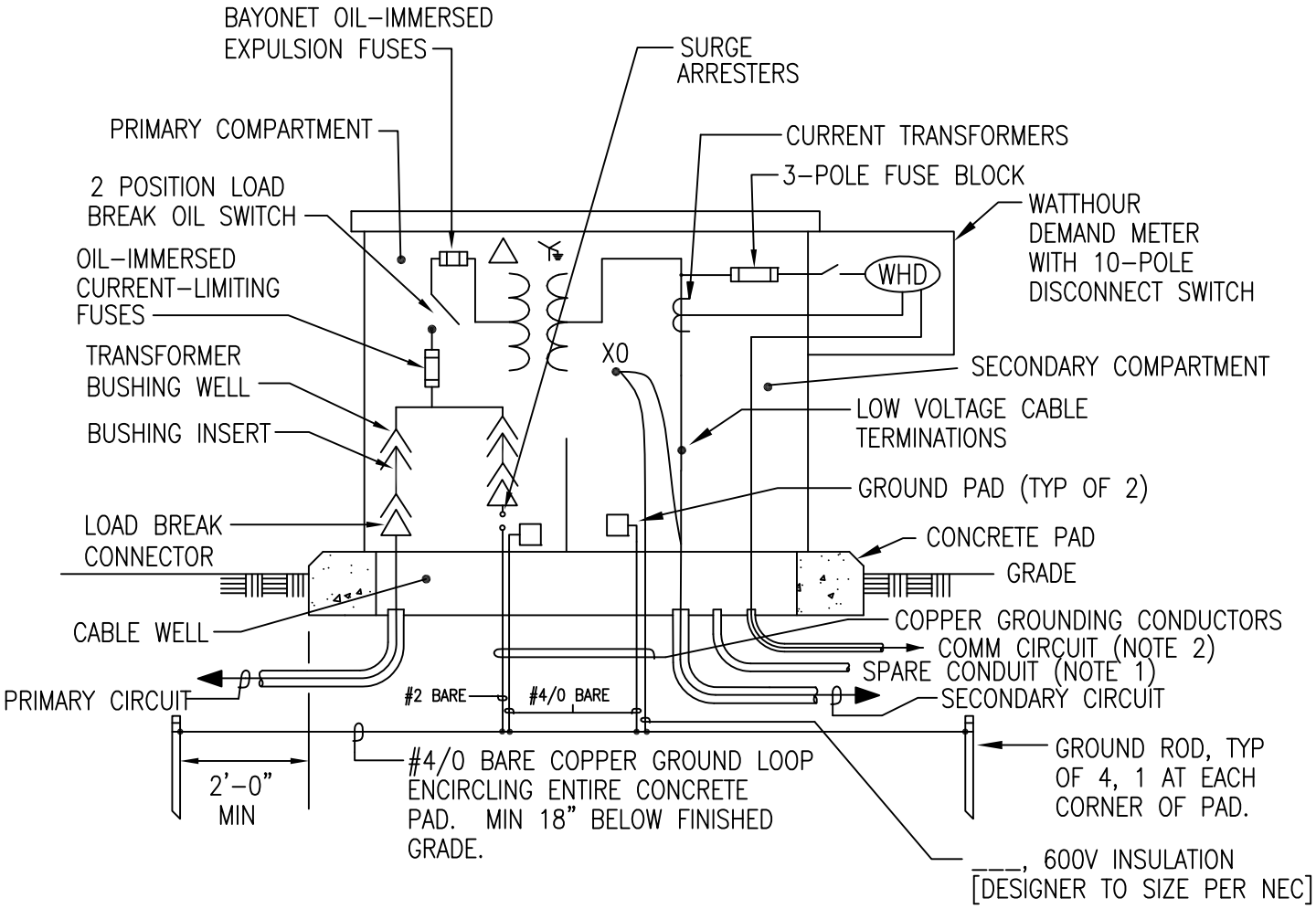
CAMP LEJEUNE - PAD MOUNTED TRANSFORMER SUMMARY REPORT

HVS SHT #	AREA	BLDG #	NP DATE	KVA	PRI VOLT (KV)	SEC VOLT (V)	IMP %	MTR ON PMT?	MTR#	MAP QUAD	REPLACE PAD	EST. PRIMARY CABLE SIZE	EST. PRIMARY CABLE DIST
40	NR AS	AS4035	N/A	500	12470	208/120	4.7	Yes	300689198	C2	Y	#2 CU	135
38	NR AS	AS4038	Oct-89	500	12470	208/120	5	Yes	300689180	C2	Y	#2 CU	275
38	NR AS	AS4040	N/A	500	12470	480/277	4	Yes	300689224	C2	Y	#2 CU	75
40	NR AS	AS4120	N/A	150	12470	480/277	N/A	Yes	300689208	C2	Y	#2CU	200
40	NR AS	AS4122	N/A	150	12470	208/120	4.17	Yes	303715364	C2	Y	#2 CU	230
40	NR AS	AS4141	N/A	750	12470	208/120	10	Yes	303715129	C2	N	#2 CU	60
40	NR AS	AS4171	N/A	150	12470	208/120	3.9	Yes	300689172	C2	Y	#2 CU	300
40	NR AS	AS4200	Jan-88	750	12470	208/120	6.65	Yes	300689121	C2	Y	1/0 CU	710
52	CB	BB118	N/A	300	12470	208/120	5	Yes	303715216	M7	Y	1/0 CU	235
5	FC	FC134	Jan-92	112.5	12470	208/120	4.07	Yes	303715335	G9	Y	#2 CU	275
5	FC	FC280	N/A	750	12470	408/277	5.8	NO	N/A - 303715243	G9	Y	2/0 CU	N/A
5	FC	FC285	N/A	750	12470	480/277	5.75	Yes	300689274	G9	Y	2/0 CU	N/A
6	FC	FC308	N/A	300	12470	208/120	4	YES	311186825	G9	Y	#2 CU	65
6	FC	FC330	N/A	500	12470	208/120	5.5	Yes	300689240	G9	Y	#2 CU	355
6	FC	FC332	Apr-88	225	12470	208/120	4.7	Yes	300689407	G9	Y	#2 CU	220
6	FC	FC420	N/A	750	12470	480/277	6.5	Yes	303715252	G9	Y	#2 AL	190
6	FC	FC500	N/A	300	12470	480/277	5.16	Yes	300?????? 300316894	G8	Y	#2 CU	N/A

CAMP LEJEUNE - PAD MOUNTED TRANSFORMER SUMMARY REPORT

HVS SHT #	AREA	BLDG #	NP DATE	KVA	PRI VOLT (KV)	SEC VOLT (V)	IMP %	MTR ON PMT?	MTR#	MAP QUAD	REPLACE PAD	EST. PRIMARY CABLE SIZE	EST. PRIMARY CABLE DIST
6	FC	FC515	N/A	300	12470	208/120	2.16	Yes	300689133	G8	Y	#2 CU	390
6	FC	FC555	N/A	300	12470	208/120	N/A	Yes	300689142	G8	Y	#2 CU	180
6	FC	FC565	N/A	300	12470	208/120	2.16	Yes	300689152	G8	Y	#2 CU	445
6	GEIGER	G-526	N/A	225	12470	480/277	4.6	Yes	300689144	B2	Y	#2 CU	N/A

Generator Replacement List			
Facility	**Existing**	**Map Location**	**Notes:**
FC442	750KW	H9	Install new generator to match existing.
FC443	750KW	H9	Install new generator to match existing.
FC445	900KW	H8	Install new generator to match existing.
H1	Kohler 400kW	F6	Install new generator to match existing; Existing generator to be turned over government.
H1-4		F6	Install new ATS to match existing (Note: location under AC Room)
M455-1	Onan 1250kW	A4	Remove existing fuel tank and provide new to match.
AS518	Onan 60kW	C2	Install new generator and ATS to match existing.
SAS888	Onan 60kW	C3	Install new generator and ATS to match existing.
SAS3503 (fed by generator from SAS3542)	Kohler 26kW	D3	Install new generator and ATS to match existing.
AS4147	Kohler 10kW	C2	Install new generator and ATS to match existing.
AS4192	Kohler 81kW	C2	Install new ATS to match existing.
G770	Olympian 20kW	A2	Install new generator and ATS to match existing.
411		G7	Install new ATS to match existing.
TT99	Kohler 350kW	A6	Install new ATS to match existing.
M107	Kohler 10kW	B4	Install new generator and ATS to match existing.
TT39	Kohler 265kW	A6	Install new generator and ATS to match existing.
AS3625-1	Onan 50kW	D2	Install new generator and ATS to match existing.
SAS3526	Olympian 30kW	D3	Install new generator and ATS to match existing.
AS426	Olympian 20kW	C3	Install new generator and ATS to match existing.
AS4041	Kohler 15kW	C2	Install new generator and ATS to match existing.
AS4145	Kohler 10kW	C2	Install new generator and ATS to match existing.
1023		F8	Install new ATS to match existing.
BA145	Generac 60kW	N11	Install new generator and ATS to match existing.
BA164	Kohler 26kW	N12	Install new generator and ATS to match existing.
BA129	Kohler 60kW	P11	Install new generator and ATS to match existing.
SBB225	Olympian 20kW	N7	Install new generator and ATS to match existing.
STT30	Generac 50kW	A6	Install new generator and ATS to match existing.
STT48	Generac 30kW	A7	Install new generator and ATS to match existing.



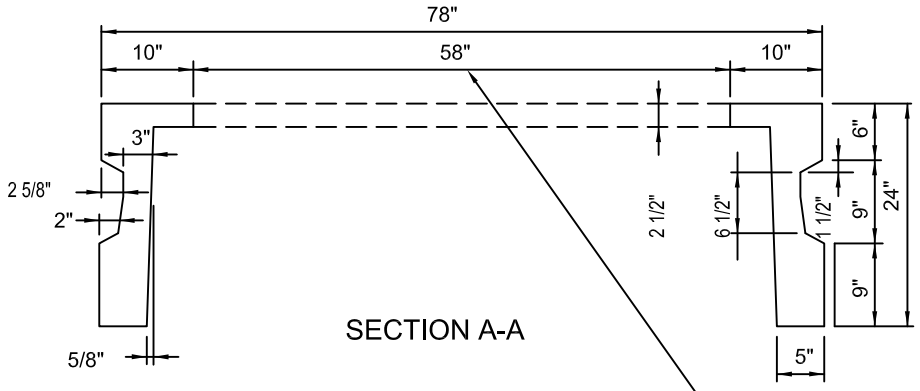
NOTE 1: PROVIDE ONE 1-INCH SPARE CONDUIT STUBBED-OUT FIVE FEET FROM PAD. COORDINATE WITH ACTIVITY FOR ADDITIONAL METERING INPUT (GAS, STEAM OR WATER SYSTEMS).

NOTE 2: PROVIDE THE COMM CIRCUIT TO THE MECHANICAL/ELECTRICAL EQUIPMENT ROOM. COORDINATE WITH ACTIVITY.

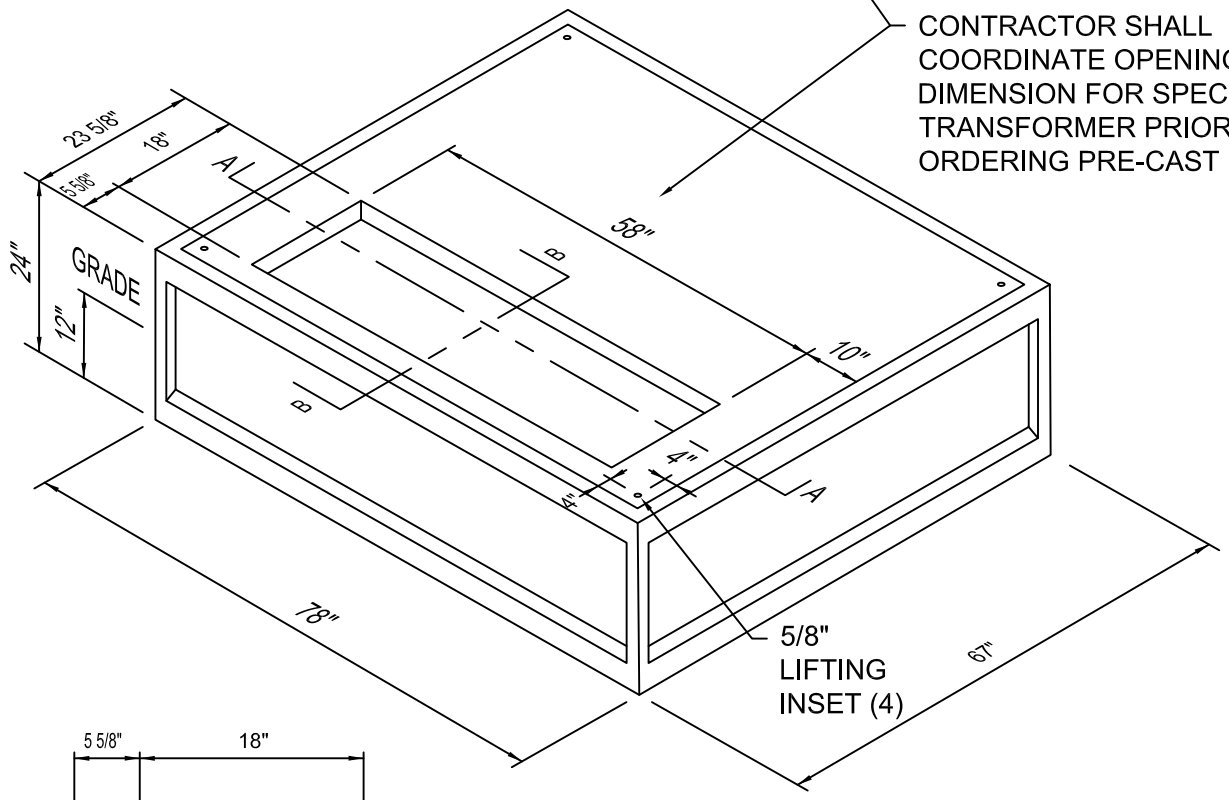
PAD-MOUNTED TRANSFORMER DETAIL

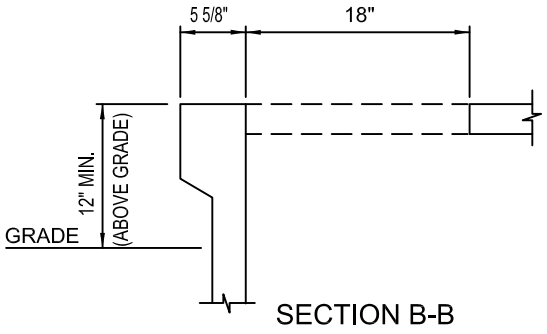
NOT TO SCALE

[UNGROUNDED OR SINGLE GROUNDED PRIMARY SYSTEM - WITH SURGE ARRESTERS]



CONTRACTOR SHALL COORDINATE OPENING & ALL DIMENSION FOR SPECIFIED TRANSFORMER PRIOR TO ORDERING PRE-CAST PAD



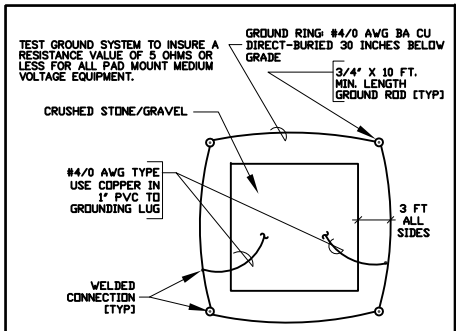


TRANSFORMER BOX PAD BASIS OF DESIGN: PARKER BUMPER COMPANY. ITEM NO. 7624-24

PRECAST TRANSFORMER PAD DETAIL

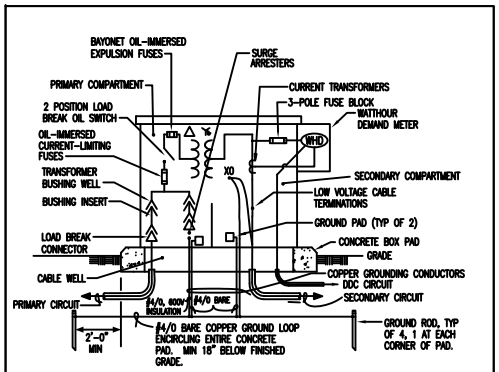
SKETCH DATE	APRIL 2015	STYLE

GROUNDING DETAILS



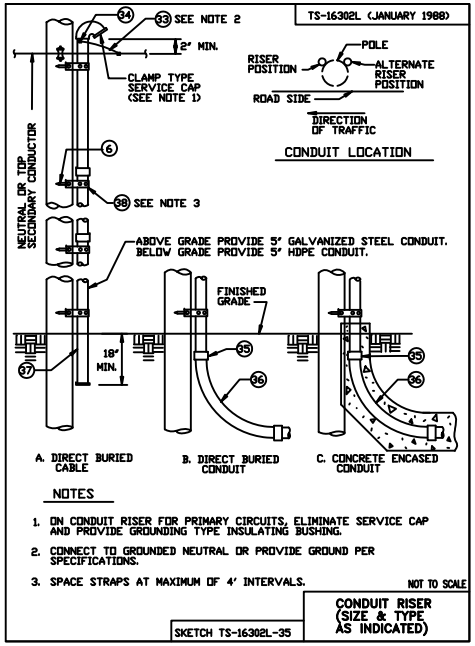
GROUNDING PLAN FOR PAD-MOUNTED EQUIPMENT (TYPICAL)

NOT TO SCALE



PAD-MOUNTED TRANSFORMER DETAIL

NOT TO SCALE



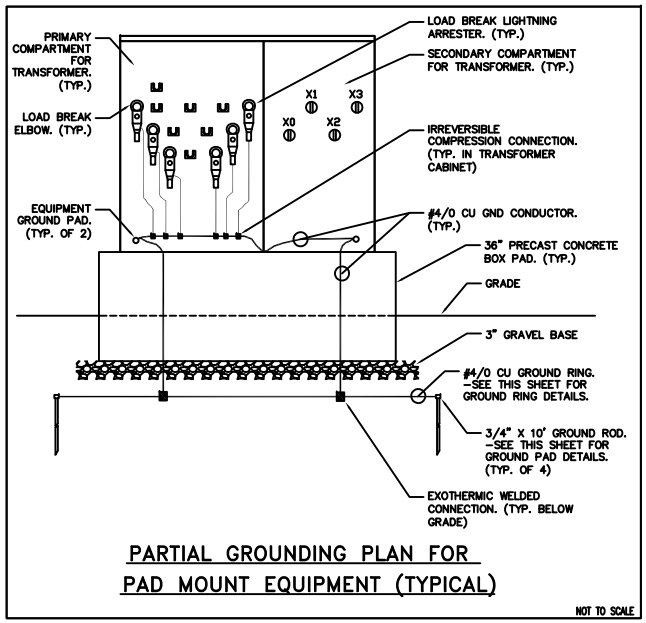
POLE LINE MATERIAL LIST

TS-16302L (JANUARY 1988)

1. FLAT STEEL BRACE (TWO PIECES)
2. MACHINE BOLT, 3/8" X LENGTH NEEDED WITH WASHER, NUT AND LOCKWASHER
3. 8' WOOD CROSSARM
4. MACHINE BOLT, 5/8" X LENGTH NEEDED WITH WASHER, NUT AND LOCKWASHER
5. TIMBER CONNECTOR
6. LAGSCREW, 1/2" X 4"
7. ANGLE STEEL BRACE (TWO PIECES)
8. MACHINE BOLT, 1/2" X LENGTH NEEDED, WITH WASHER, NUT & LOCKWASHER
9. DEADEND BOX
10. STEEL PIN
11. PIN INSULATOR
12. GRID GAIN, USED ONLY WHEN THERE IS NO POLE GAIN
13. ANGLE STEEL BRACE (ONE PIECE)
14. 10' WOOD CROSSARM
15. 5/8" EYE NUT
16. 5/8" EYE BOLT, LENGTH AS NEEDED, WITH WASHER, NUT & LOCKWASHER
17. EXTENSION LINK
18. BELL TYPE SUSPENSION INSULATOR WITH CONNECTING HARDWARE
19. STRAIN CLAMP
20. STEEL ANGLE PIN
21. CLUSTER MOUNTING BRACKET, STEEL
22. TRANSFORMER GROUNDING CONNECTION
23. STIRRUP
24. SECONDARY LEAD SUPPORT BRACKET
25. ADAPTER PLATE FOR CLUSTER MOUNTING
26. CLEVIS BRACKET FOR SPOOL INSULATOR
27. SPOOL INSULATOR
28. U BOLT CLAMP
29. PREFORMED GUY GRIP
30. GUY HOOK
31. GUY STRAIN INSULATOR
32. GUY WIRE, SIZE AS SPECIFIED
33. #4 WP CU. SOFT DRAWN GROUND WIRE
34. GROUND CLAMP
35. CONDUIT COUPLING
36. CONDUIT BEND
37. INSULATED BUSHING
38. PERFORATED STRAPPING, 1-1/2" WIDE
39. HOT LINE CLAMP
40. FUSED CUTOUT, 200A
41. SURGE ARRESTER, 10KV
42. POLE TOP PIN (RIDGE PIN) - 24 INCHES LONG
43. CROSSARM ANGLE PIN
44. ANGLE POLE TOP PIN
45. SOFT DRAWN WIRE-SIZE
    (a) TO MATCH OR EXCEED AMPACITY OF CONNECTING CABLE, OR
    (b) AT 125% OF TRANSFORMER FULL LOAD CURRENT, BUT NOT LESS THAN NO. 4A.W.G.

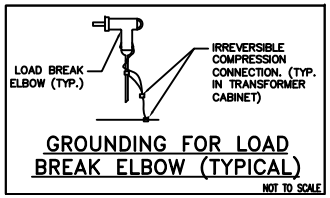
SKETCH TS-16302L-1.5

POLE LINE MATERIAL LIST



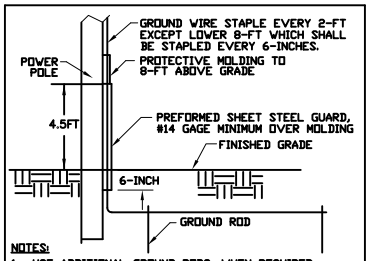
PARTIAL GROUNDING PLAN FOR PAD MOUNT EQUIPMENT (TYPICAL)

NOT TO SCALE



GROUNDING FOR LOAD BREAK ELBOW (TYPICAL)

NOT TO SCALE

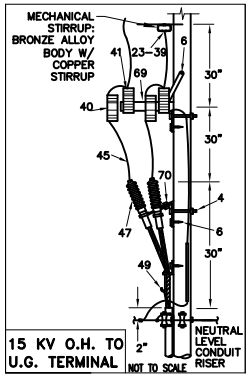


NOTES:

1. USE ADDITIONAL GROUND RODS, WHEN REQUIRED, TO OBTAIN RESISTANCE VALUE.
2. MAKE GROUNDING CONNECTIONS TO ALL EQUIPMENT ON POLE AS REQUIRED.

NOT TO SCALE

GROUND



15 KV O.H. TO U.G. TERMINAL

NOT TO SCALE

POLE LINE MATERIAL LIST

TS-16302L (JANUARY 1988)

46. TRI-MOUNT BRACKET
47. TERMINATOR
48. MOUNTED BRACKET
49. CABLE GRIP HANGER
50. HOSE CLAMP
51. STUD, 3/4" X 1-3/4"
52. LINE POST INSULATOR
53. TRIPLE INSULATOR BRACKET
54. ANGLE CLAMP
55. INSULATOR, LINE POST CLAMP
56. 4' CROSSARM
57. CROSSARM GAIN BRACKET
58. PULLEY BRACKET
59. WEDGE CLAMP
60. MIDSPAN SERVICE CLAMP
61. STUD, 7"
62. SADDLE, ANGLE
63. SADDLE CROSSARM
64. FITTING, POLE TOP
65. CONNECTOR
66. SUSPENSION CLAMP
67. TIE, SERVICE CABLE
68. 54" FIBERGLASS STRAIN
69. EQUIPMENT MOUNT, 3Ø, 48" WIDTH
70. EQUIPMENT MOUNT, 3Ø, 35" WIDTH

SKETCH TS-16302L-1.5A

POLE LINE MATERIAL LIST

MCB Camp Lejeune, North Carolina
Public Works Division, Design Branch

Electrical Policies & Criteria

March 7, 2018

1 Preface

The purpose of this document is to provide key design guidance for electrical systems installed at MCB Camp Lejeune, North Carolina. All electrical design shall be coordinated with the Unified Facilities Criteria (UFC) requirements. The UFC is a planning, design, construction, sustainment, restoration, and modernization criteria that applies to all DoD activities. Compliance with the UFC is mandatory for the design of electrical systems at all facilities and bases. Designs shall incorporate customer requirements, local past practices, and unified facilities criteria to deliver a fully functional, safe, code compliant, and effective project. UFC shall be employed to the maximum extent practicable in each design. Policies in this document are supplemental local directives to be applied in conjunction with the UFC requirements under engineering judgement. Design deviation requests from the UFC shall be submitted in writing via electronic mail. Requests for deviation shall be sent to the electrical design branch and include the project title, contract number, designer name, drawings, UFC reference, and reason for deviation.

2 Key Design Criteria & Codes

1. NFPA 70 National Electrical Code
2. NFPA 72 National Fire Alarm Code
3. NFPA 101 Life Safety Code
4. UFC 3-501-01 Electrical Engineering
5. UFC 3-520-01 Interior Electrical Systems
6. UFC 3-530-01AN Design: Interior and Exterior Lighting and Controls
7. UFC 3-550-03FA Design: Electric Power Suppy and Distribution
8. UFC 4-010-01 DoD Minimum Antiterrorism Standards for Buildings
9. UFC 1-200-01 Design: General Building Requirements
10. Unified Facility Guide Specifications (26 00 Series)
11. IESNA Illuminating Engineering Society of North America
12. IEEE C2 National Electrical Safety Code
13. MIL HDBK 1190 Military Handbook for Facility Planning and Design Guide
14. MIL HDBK 1191 Military Handbook for Medical and Dental Treatment Facilities
15. TM 5-811-3 Electrical Design: Lightning and Static Electricity Protection
16. TI 800-01 Design Guide
17. TI 800-03 Design Build Instructions
18. TM 5-811-1 Electrical Power Supply and Distribution
19. TM 5-811-3 Electrical Design Lightning and Static Electricity Protection
20. TI 811-16 Lighting Design Guide
21. International Building Code
22. ASHRAE 90.1

3 Design Requirements

1. Include electrical calculations with each design. Full load analysis and short circuit calculation summaries shall be provided for all projects and displayed on drawings. Provide calculation summaries, where applicable, for:

   - Protective device time-current coordination
   - Arc flash analysis
   - Voltage drop
   - Lighting
   - Lightning Protection
   - ASHRAE 90.1

2. Apply the demand factors to load analysis to determine transformer size. Do not exceed a transformer size greater than 12 VA/SF of facility gross floor area or 70% of the total connected load on installations served by tranformer 300 kVA or greater.

3. Design the electrical system such that any fault in the system will be preferentially isolated by the selective operation of the overcurrent protective device closest to the faulted condition.

4. The designer of record is responsible for the selective coordination of overcurrent protective devices, including protective relays and medium voltage protective devices, primary transformer protection, main secondary breakers, and secondary feeder protective devices. Ensure coordination between the new equipment and the existing distribution system.

5. Select system voltage based on projected building loads:

   - Three phase four wire 208Y/120V systems shall be selected for loads less than 150kVA.
   - Three phase four wire 480Y/277V systems shall be selected for loads greater than 150kVA.
   - 208Y/120V systems can be selected for loads exceeding 150 kVA if a full life cycle cost analysis has be completed and found to be more cost effective. Submit life cycle cost analysis as part of project documentation.

6. Evaluate each design for the energy savings possible by installing conductors of one size larger than required by the NEC. Increasing the wire size often generates a short payback. Increasing the wire size to one size larger than required by the NEC can produce the following benefits:

- Energy savings will be realized due to lower heating losses in the larger conductors.
- Less heat will be generated by the wiring system.
- The conductors will have smaller voltage drop.
- The system can better accommodate the adverse effects of nonlinear loads.

See the Tri-Service Electrical Working Group (TSWEG) TP-1 for calculation methods and further discussion on potential savings that can be realized.

7. The designer of record is responsible for providing to the contractor settings for relays, main secondary breakers, and related protective devices in the circuit.

8. Size service and feeder conductors for a maximum voltage drop of 2% at the circuits rated capacity. Branch circuits can be sized for a maximum 3% voltage drop at the circuits rated capacity.

9. Provide pad mounted transformers rather than pole mounted transformers for new three phase installations larger than 75kVA. Three phase pole mounted installations are limited to (3)-25 kVA and single phase pole mounted to (1)-75 kVA pole mounted transformer.

10. Provide two pad mounted transformers in lieu of one 480Y/277V service if the required 208Y/120V load exceeds 40% of the 480 volt service transformer capability.

11. The designer of record shall complete a detailed lightning risk assessment under NFPA 780 Annex L. The lightning risk assessment shall be considered when making determinations for lightning protection measures. The lightning risk assessment summary shall be included in the drawings or as a individual document in the project package.

4 Medium Voltage Electrical Distribution

1. Specify narrow profile construction for pole top electrical distribution. Provide steel crossarms for deadends and where required.

2. Specify 394.5 all aluminium alloy conductor (AAAC) for overhead primary conductors.

3. Specify ethylene propylene rubber (EPR) insulated cable for medium voltage underground distribution work.

4. Specify above ground junction boxes or above ground sectionalizers for medium voltage underground distribution work. Equipment shall utilize dead front construction with minimum 200 amp, 15kV load break elbow connectors.

5. Manholes or handholes are not permitted for use with medium voltage underground distribution work unless as specifically permitted by the UFC.

6. Specify #6 copper grounding conductors for power poles. Specify #4 copper grounding conductors for power poles with transformers, gang operated air break switches, reclosers, or guys attached.

7. Specify pressure treated pine class 3 power poles as a minimum. Larger class pole shall be used as required.

8. Pad mounted medium voltage distribution transformers shall be delta primary wye secondary configuration. Pad mounted medium voltage distribution transformers shall utilize dead front construction with minimum 200 amp, 15kV load break connectors. Insulating fluid shall flammable retardant biodegradable type. Surge arresters shall be rated minimum 10kV type with tap changer 2 2 .5% taps above and below rated voltage. Locate pad mounted transformers at least 25 ft. from building and not adjacent to egress paths from building.

9. Pole mounted medium voltage distribution transformers shall be connected delta primary wye secondary configuration. Insulating fluid shall be flame retardant biodegradable type. Surge arrester shall be rated minimum 10kV. Fused cutouts shall be 100 amp rated with fuses sized as required based upon transformer rating.

10. At Onslow Beach complex specify 33 kV Class insulators with RG glazing and bushings, and copper conductors for 12.47 kV primary overhead distribution system and for secondary service drops. At Onslow Beach complex specify stainless steel enclosures for overhead distribution transformers and exterior switchgear. Locate medium voltage equipment above surge tide level.

11. All medium voltage work shall include right-of-way clearing on existing distribution circuit. Utility right-of-way shall be a minimum 30 ft. on each side of the utility pole line creating a 60 ft width right-of-way. Right-of-way shall be cleared of limbs, trees, and vegetation from earth to sky. Trees or limbs extending into the sky area of the right-of-way shall be side trimmed to achieve the 30ft. distance requirements from centerline. Support guys and other equipment that extend into the utility right-of-way shall be cleared to maintain 10ft. clearance on all sides.

12. Underground distribution shall be copper conductors only.

13. Minimum copper ground rod size is 10 ft. x 3/4" inch diameter.

14. Notify the project manager whenever trees are to be disturbed in the electric right-of-way prior to performing work.

15. Electrical contractors must possess a valid North Carolina Public Utility Electrical, contractors license and be insured to do such work in the State of North Carolina.

5 Interior Electrical

1. Provide a minimum 15% spare and space capacity for all panelboards. Provide extra spare conduits extended above ceilings and below floors as necessary to accomodate potential use.

2. Specify metal clad switchgear for service entrance equipment when the service is 1200A or larger and all the branch feeder circuits are large such as 600A or 800A each.

3. Specify switchboards when service entrance is 1200A or larger and have combined feeder sizes between 20A and 800A.

4. Specify panelboards when service entrance equipment is less than 1200A.

5. Provide arc-fault circuit interrupter protection for branch circuits in dwelling units, dormitory units, guest rooms, guest suites as required by 210.12 of NFPA 70.

6. Provide surge protective device (SPD) on service equipment on buildings with high concentration of electronic equipment.

7. Branch circuit conductor minimum size shall be 12 AWG copper with THHN or THWN insulation.

8. Minimum breaker size is 20A. Smaller breakers are acceptable when required by a specific application such as fractional horsepower motor circuits.

9. Provide weatherproof GFCI duplex receptacle outlet within 25 feet of exterior H-VAC equipment.

10. Specify LED illuminated exit signs with 90 minutes of battery backup capabilities to meet requirements of exit identification in accordance with NFPA 101.

11. Combination exit/emergency luminaires shall be used in accordance with NFPA 101 standards.

12. Specify stand alone wall or ceiling mounted emergency luminaires with 90 minutes of battery backup capabilities to meet requirements of egress illumination in accordance with NFPA 101.

13. General area luminaires with emergency battery backup are not authorized for use where stand-alone type emergency wall packs are sufficient in providing egress illumination.

14. Specify exterior egress path emergency illumination in accordance with NFPA 101.

15. Connect exit sign and emergency luminaire ahead of the switch to the normal lighting circuit that is located in the area or room that exit/emergency luminaires are serving.

16. Electric Motors: Multi-voltage electric motors are acceptable. Well pump motor controllers shall be provided with soft starters. Motors shall be Premium efficiency.

17. Electrical Raceways: Use painted surface metal raceways on existing finished surface in administration spaces in lieu of exposed conduit. Provide (3) 3/4 inch and (2) 1-inch empty conduits where panelboards are flush-mounted. Run concealed in walls to above accessible ceiling and terminate to all flush-mounted panelboards; cap these conduits.

18. Specify LED or T-5 HO fluorescent high bay luminaires for high bay applications in lieu of conventional HID luminaires. The use of conventional HID fixtures are not authorized for use.

19. Dual technology occupancy sensor switches (i.e. passive infrared and ultrasonic) shall be utilized when required. Occupancy sensor switches shall be permitted in sleeping rooms only if a manual bypass OFF switch is incorporated.

20. Street and parking area lights are required to be architectural or cobrahead style LED type. LED luminaires shall meet the outdoor pole mounted area and roadway LED luminaire specification.

21. No multi-wire branch circuits allowed. Each circuit requiring a neutral conductor shall have its own separate dedicated neutral conductor. This does not apply to a circuit that feeds a single piece of equipment such as a cooking range or clothes dryer.

22. LED street lights shall have a color temperature between 5000k-6500k.

23. LED and drivers shall be rated for a minimum of 70,000 hours and entire fixture shall be warranted for at least five years for parts and labor.

24. Interior solid state lighting efficiencies are surpassing the efficiencies of linear fluorescent systems. Per UFC, perform a life cycle cost comparison to LED technology for applications where LED is a viable option. Exclude maintenance costs in all retrofit life cycle cost analysis that cannot be verified. See UFC 3-530 for full lighting requirements. Specify LED technology to the maximum extent practicable when cost effective to do so.

25. All fixtures shall be tested by an independent third party laboratory. Supplier shall submit LM-79-08 test results along with LM-80-08 results.

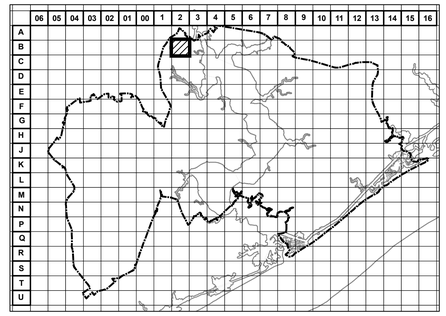
6 Generators

1. Provide NEMA 3R 3-pole double throw electrical switch with solid neutral connection, concrete pad, equipment mounting rack, and automatic transfer switch for load bank testing. Bus bar lugs shall be bronze or tin plated copper (Aluminum is not acceptable). Double throw switch to have lockable functionality between generator to ATS operation or generator to load bank testing operation. Mark phase rotation on electrical equipment.

2. Provide Generators with engine block heaters, alternator anti-condensation heater and battery charger. Each device shall be fed from dedicated branch circuit from building generator serves.

3. Provide generator platforms for all generators where generator base tank exceeds 30 inches in height above finished grade. Platforms shall be 6 inches below generator housing doors. Platform shall be wide enough to accommodate 180 degree door opening radius but shall not be less than 36 inches wide. Platform shall encompass generator 360 degrees. Platform shall not obstruct fuel fill port, fuel vent port, or any other generator equipment. Platform shall be constructed with hot dipped galvanized steel to include flooring, rails and stairs. Provide stairs with a rise and run in accordance with local building code. Ground and bond all platform material in accordance with NFPA 70 and UFC guidance.

4. Provide factory installed Cam Lock connection mounted into exterior of switch enclosure with NEMA 3R cam lock covers. Connect to load bank side of double throw electrical switch.



WARNING: **Plan Ahead & Call TWO business days before you plan to dig**

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3rd Party Utility locates call **811** or **1-800-632-4949**
MCB Camp Lejeune and MCAS New River Utility locates call **910-451-3001**
MCB Camp Lejeune and MCAS New River Telecomm locates call **910-451-3100** (during normal business hours) or **910-451-1019** (after business hours or in emergency situations)

NOTE: Contractors must provide locating services for utilities and will accept full responsibility at all times.

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Published: 4 June 2018

EDITION **005** SERIES **U0043S** SHEET **12**

Electrical Legend

Transformers
- Pole Mounted
- Pad Mounted

Conductors
- Primary OH
- Primary UG
- Secondary OH
- Secondary UG

- Voltage Regulator
- Electric Meter
- Manhole
- Generator
- Substation

Infrastructure Legend

- Fence
- Gate
- Wall
- Railroad
- Recreation Trail
- Road Centerline
- Other Roads
- Base Boundary
- Building Label Zone
- Building
- Structures
- Open Storage
- Recreation Area
- Athletic field
- Pavilion
- Golf Course
- Bridge
- Paved Surface
- Unpaved Surface
- Water Feature

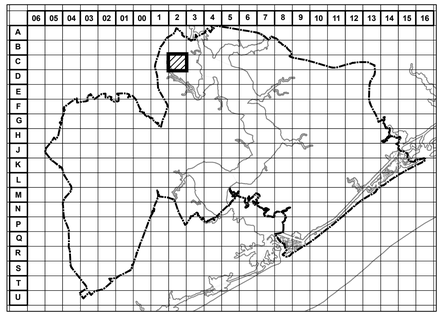
N W E S

Feet
0 200 400 600 800 1,000

North Carolina State Plane Coordinate System (NAD83, US Feet)

EXISTING CONDITIONS ELECTRICAL DISTRIBUTION

Grid **B2**



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Published: 4 June 2018

EDITION **005** SERIES **U0043S** SHEET **26**

Electrical Legend

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- Pad Mounted

Conductors
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- Secondary UG

- Voltage Regulator
- Electric Meter
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- Unpaved Surface
- Water Feature

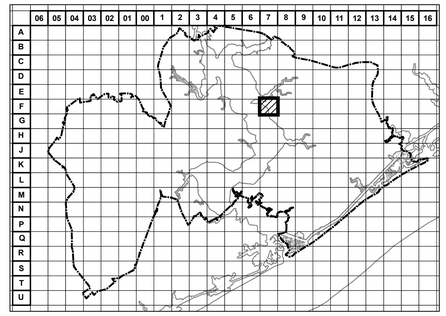
N W E S

Feet
0 200 400 600 800 1,000

North Carolina State Plane Coordinate System (NAD83, US Feet)

EXISTING CONDITIONS ELECTRICAL DISTRIBUTION

Grid **C2**



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Electrical Legend

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- Unpaved Surface
- Water Feature

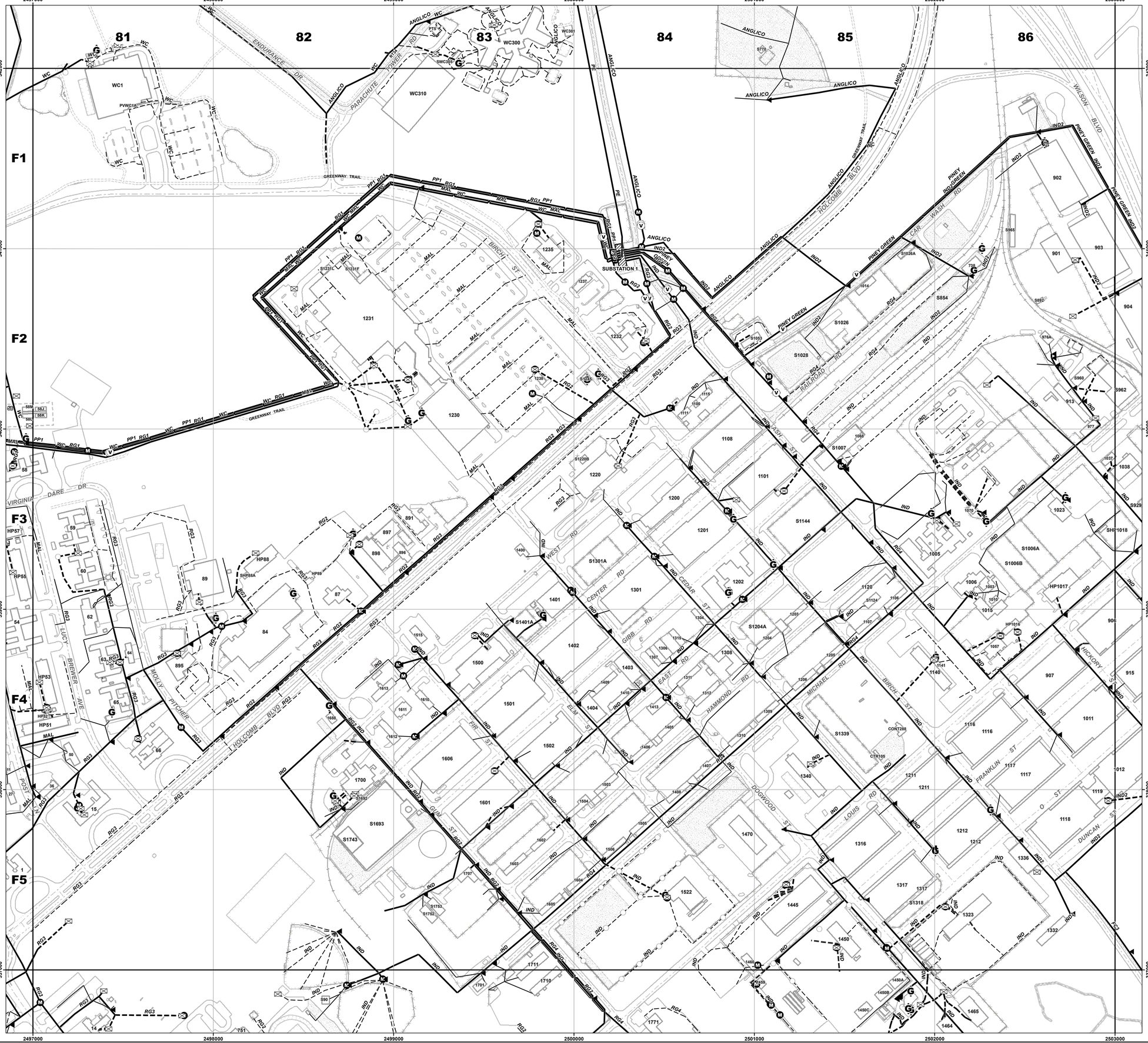
N W E S

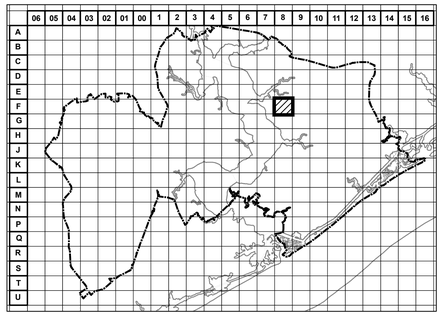
0 200 400 600 800 1,000
Feet

North Carolina State Plane Coordinate System (NAD83, US Feet)

EXISTING CONDITIONS
ELECTRICAL DISTRIBUTION

Grid **F7**





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EDITION **005** SERIES **U0043S** SHEET **62**

Electrical Legend

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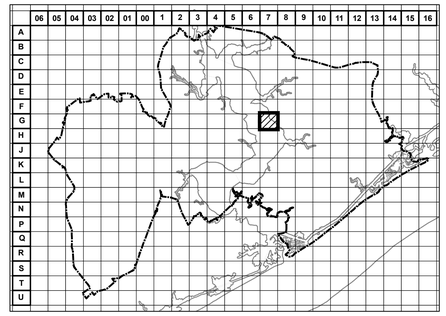
N W E S

Feet
0 200 400 600 800 1,000

North Carolina State Plane Coordinate System (NAD83, US Feet)

EXISTING CONDITIONS ELECTRICAL DISTRIBUTION

Grid **F8**



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EDITION **005** SERIES **U0043S** SHEET **73**

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- Bridge
- Paved Surface
- Unpaved Surface
- Water Feature

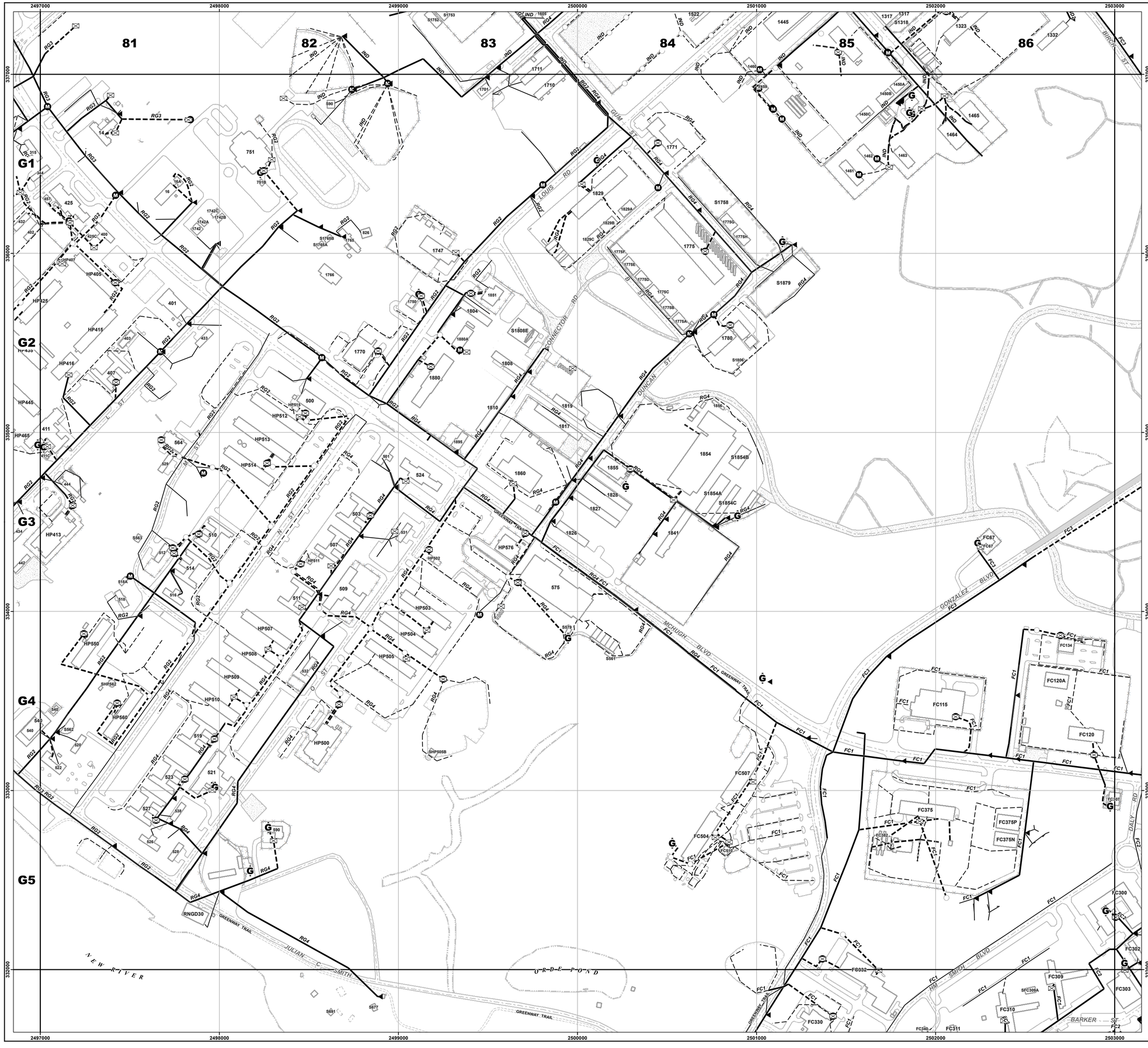
N W E S

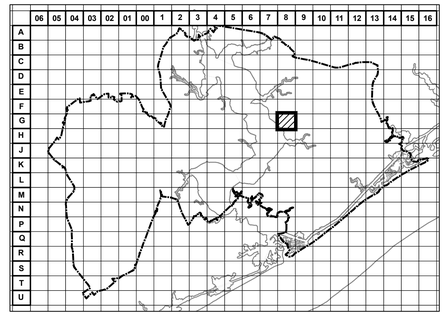
Feet
0 200 400 600 800 1,000

North Carolina State Plane Coordinate System (NAD83, US Feet)

EXISTING CONDITIONS ELECTRICAL DISTRIBUTION

Grid **G7**





WARNING: Plan Ahead & Call TWO business days before you plan to dig

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3rd Party Utility locates call **811** or **1-800-632-4949**
MCB Camp Lejeune and MCAS New River Utility locates call **910-451-3001**
MCB Camp Lejeune and MCAS New River Telecomm locates call **910-451-3100** (during normal business hours) or **910-451-1019** (after business hours or in emergency situations)

NOTE: Contractors must provide locating services for utilities and will accept full responsibility at all times.

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Questions regarding map content should be directed to the
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Published: 4 June 2018

EDITION **005** SERIES **U0043S** SHEET **74**

Electrical Legend

Transformers
- Pole Mounted
- Pad Mounted

Conductors
- Primary OH
- Primary UG
- Secondary OH
- Secondary UG

- Voltage Regulator
- Electric Meter
- Manhole
- Generator
- Substation

Infrastructure Legend

- Fence
- Gate
- Wall
- Railroad
- Recreation Trail
- Road Centerline
- Other Roads
- Base Boundary
- Building Label Zone
- Building
- Structures
- Open Storage
- Recreation Area
- Athletic field
- Pavilion
- Golf Course
- Bridge
- Paved Surface
- Unpaved Surface
- Water Feature

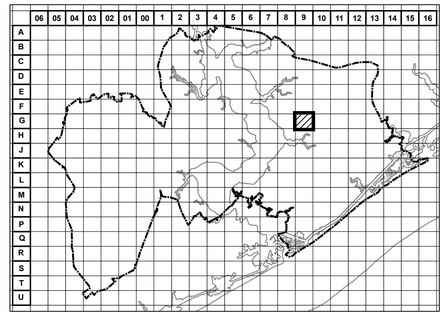
N W E S

0 200 400 600 800 1,000
Feet

North Carolina State Plane Coordinate System (NAD83, US Feet)

EXISTING CONDITIONS ELECTRICAL DISTRIBUTION

Grid **G8**



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Published: 4 June 2018

EDITION **005** SERIES **U0043S** SHEET **75**

Electrical Legend

Transformers
- Pole Mounted
- Pad Mounted

Conductors
- Primary OH
- Primary UG
- Secondary OH
- Secondary UG

- Voltage Regulator
- Electric Meter
- Manhole
- Generator
- Substation

Infrastructure Legend

- Fence
- Gate
- Wall
- Railroad
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- Road Centerline
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- Paved Surface
- Unpaved Surface
- Water Feature

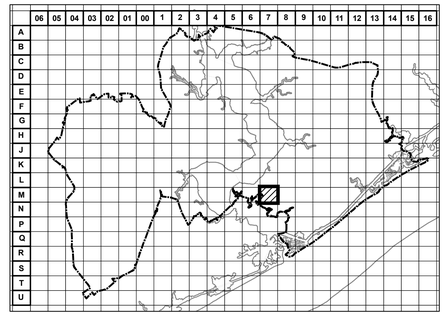
N W E S

Feet
0 200 400 600 800 1,000

North Carolina State Plane Coordinate System (NAD83, US Feet)

EXISTING CONDITIONS ELECTRICAL DISTRIBUTION

Grid **G9**



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Published: 4 June 2018

EDITION **005** SERIES **U0043S** SHEET **127**

Electrical Legend

Transformers
- Pole Mounted
- Pad Mounted

Conductors
- Primary OH
- Primary UG
- Secondary OH
- Secondary UG

- Voltage Regulator
- Electric Meter
- Manhole
- Generator
- Substation

Infrastructure Legend

- Fence
- Gate
- Wall
- Railroad
- Recreation Trail
- Road Centerline
- Other Roads
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N W E S

Feet
0 200 400 600 800 1,000

North Carolina State Plane Coordinate System (NAD83, US Feet)

EXISTING CONDITIONS ELECTRICAL DISTRIBUTION

Grid **M7**

[redacted]

Sample Padmount Transfomer Product Sheet

Description:

kVA	300 kVA 3 Phase Pad-Mounted Transformer
Temperature Rise	65 degree average winding rise
Cooling Class	KNAN
Frequency	60 Hz.
Insulating fluid	Envirotemp FR3
Elevation	Designed for operation at 1000 m (3300 ft) above sea level
Sound Level	NEMA TR1 Standard
Efficiency Standard	DOE 2010, 10 CFR Part 431
Primary Voltage	12470 Delta
BIL	95 kV
kV Class	15 kV
Primary Configuration	Dead Front
Primary Configuration	Loop Feed
Taps	2 - 2.5% taps above and 2 - 2.5% taps below nominal
Tap Changer	100 Amp 5-position tap changer
Primary Bushings	200 amp [redacted] bushing well(s) (Qty: 6)
Inserts	15 kV, 95 kV BIL [redacted] load-break inserts (Qty: 6)
Load-break Switching	630A four position T-blade switch
Arresters	None
Expulsion fuses	Bayonet fuses (Qty: 3)
Bayonet Holder	Copper Bayonet Fuse Holder (Qty: 3)
Secondary Voltage	208Y/120
BIL	30 kV
Secondary kV Class	1.2 kV
Secondary Bushings	1" copper stud with 4-hole screw-on spade bushing(s) (Qty: 4)
Cabinet	20in deep cabinet
Cabinet hardware	Penta-head cabinet door bolts
ANSI K-Dimension	Loop feed per ANSI C57.12.34 Figure 2 minimum dimensions
Coatings	Munsell Green (Munsell 7GY 3.29/1.5) topcoat

[redacted]

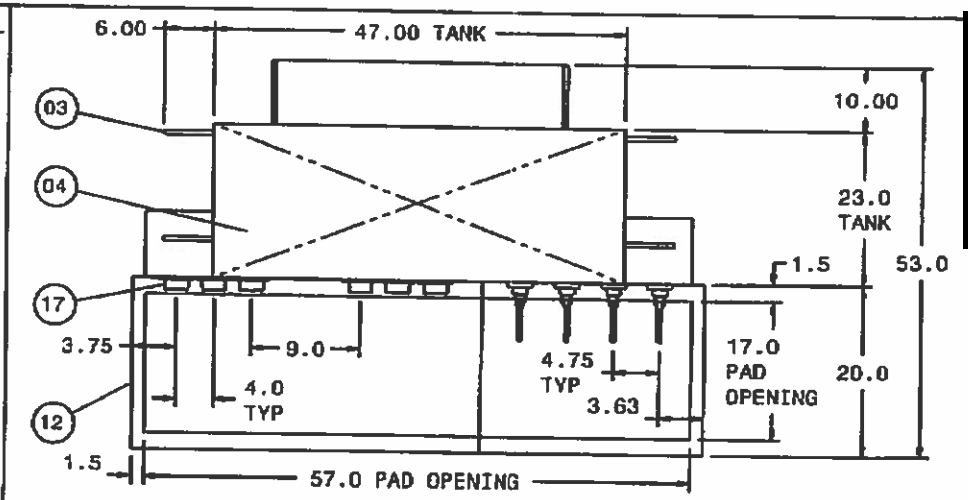
[redacted]

Notifications	Mr. Ouch Decal assembly–English
Notifications	Stainless Steel Nameplate
Gauges & Fittings	Liquid level gauge
Gauges & Fittings	Thermometer, dial-type
Gauges & Fittings	Schrader valve
Gauges & Fittings	Pressure relief device, 50 SCFM
Gauges & Fittings	Drain valve with sampler in LV Compartment (1")
Tank accessories	IEEE standard one-hole ground pads (Qty: 3)
Tank accessories	Nitrogen Blanket
Packaging	Pallet
Cover	Bolted cover
Load-break Switch	Under Oil On-Off Load-break Switch

PERFORMANCE DATA:	
Fluid Weight (lbs)	1252
Total Weight (lbs)	3812
Fluid Volume (Gallons)	163
Primary Conductor Material	Copper
Secondary Conductor Material	Copper

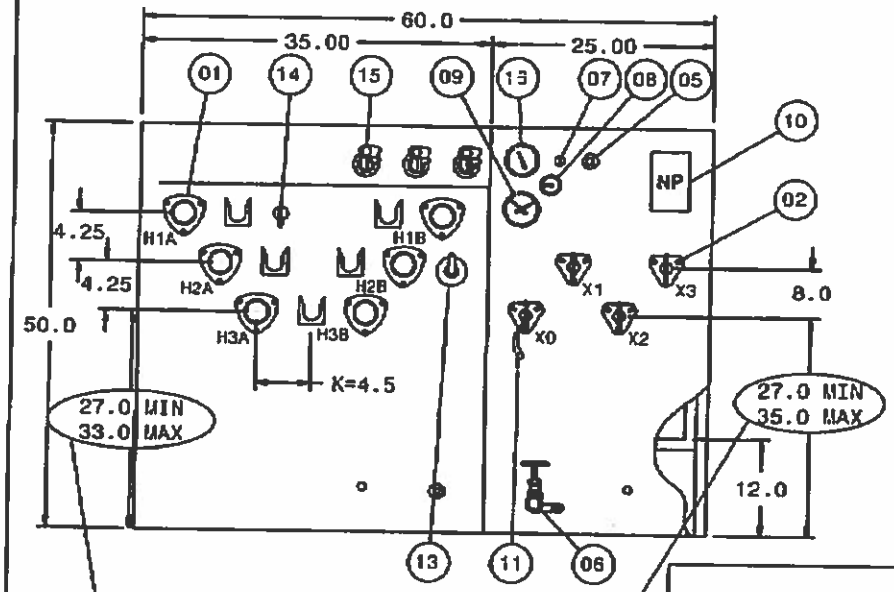
[redacted]

	STANDARD FEATURES
1	CPS 200 amp wells
2	835 A 1 inch CU stud 4-h spade
3	Lifting lugs (4)
4	Bolted cover (small kVA) (std)
5	1.0 in upper fill plug
6	Drain valve w/sampler
7	Pressure relief valve
8	Liquid level gauge
9	Therm dial-type
10	Laser-scribed anodized nameplate
11	One-hole ground pads
12	Penta-head cabinet door bolts
13	Taps: 100 Amp 5-position
14	Loadbreak Switches: 15kV 630A 4pos T-blade
15	Fuse: Bayonet
16	Gauges
17	Inserts: Standard
*	A-20in deep cabinet

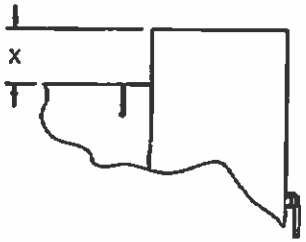


[redacted]

Phase:	Three-phase
Frequency:	60
Cooling:	KNAN
Fluid:	Envirotemp
BIL:	95 kV BIL
Temp Rise:	65
Primary:	12470 Delta
Taps:	2 above 2 below
Secondary:	208Y/120
Impedance:	ANSI Standard
Pri Wind:	Cu



SIDE VIEW DETAIL
X=2.0 FOR STANDARD CABINET
X=9.0 WHEN BAYONET FUSES REQUIRED



PLEASE NOTE: VARIABLE BUSHING HEIGHTS

DRAWING IS FOR REFERENCE ONLY, NOT FOR CONSTRUCTION OR FOR APPROVAL. CONTACT CPS FOR 'AS BUILT', APPROVAL, OR CONSTRUCTION DRAWINGS.
ONLY PAD OPENINGS ARE AS BUILT

(CONFIDENTIAL) MUST NOT BE USED IN ANY WAY DETRIMENTAL TO COOPER POWER SYSTEMS

[redacted]

[redacted]

Product Lead-time (X): 12-14 weeks ex-factory
Optional Approval Drawing Lead-time (Y): 2-4 weeks plus time for customer review.

Description:

kVA	300 kVA 3 Phase Pad-Mounted Transformer
Temperature Rise	65 degree average winding rise
Cooling Class	KNAN
Frequency	60
Insulating fluid	Envirotemp FR3
Elevation	Designed for operation at 1000 m (3300 ft) above sea level
Efficiency Standard	DOE 2010, 10 CFR Part 431
Sound Level	NEMA TR1 Standard
Primary Voltage	12470 Delta
BIL	95 kV
kV Class	15 kV
Primary Configuration	Dead Front, Loop Feed
Taps	2 - 2.5% taps above and 2 - 2.5% taps below nominal
Tap Changer	100 Amp 5-position tap changer
Primary Bushings	200 amp [redacted] bushing wells with removable studs (Qty: 6)
Inserts	15 kV, 95 kV BIL [redacted] load-break inserts (Qty: 6)
Load-break Switching	15 kV, 630A 4-Position T-blade
Arresters	None
Overcurrent Protection	Bayonet fuse in series with Partial-Range Current-Limiting Fuses (Qty: 3)
Expulsion fuses	Bayonet fuses (Qty: 3)
Bayonet Holder	Copper Bayonet Fuse Holder (Qty: 3)
Secondary Voltage	208Y/120
BIL	30 kV
Secondary kV Class	1.2 kV
Secondary Bushings	1" copper stud with 4-hole screw-on spade bushing(s) (Qty: 4)
Cabinet	20in deep cabinet
Cabinet hardware	Penta-head cabinet door bolts
IEEE K-Dimension	Loop feed per IEEE C57.12.34-2009 Figure 11 minimum dimensions (without bails)
Coatings	Munsell Green (Munsell 7GY 3.29/1.5) topcoat
Gauges & Fittings	Liquid level gauge
Gauges & Fittings	Thermometer, dial-type
Gauges & Fittings	Drain valve with sampler in LV Compartment (1")
Gauges & Fittings	Schrader valve
Gauges & Fittings	Pressure relief device, 50 SCFM
Gauges & Fittings	Fill valve (1")

[redacted]

[redacted]

Tank accessories	IEEE standard one-hole ground pads (Qty: 3)
Tank accessories	Nitrogen Blanket
Packaging	Pallet
Cover	Bolted cover with handhole

PERFORMANCE DATA:	.
Design Impedance	3.93
Fluid Weight (lbs)	1173.
Total Weight (lbs)	3618.
Fluid Volume (Gallons)	153.
Primary Conductor Material	CU
Secondary Conductor Material	CU

[redacted]

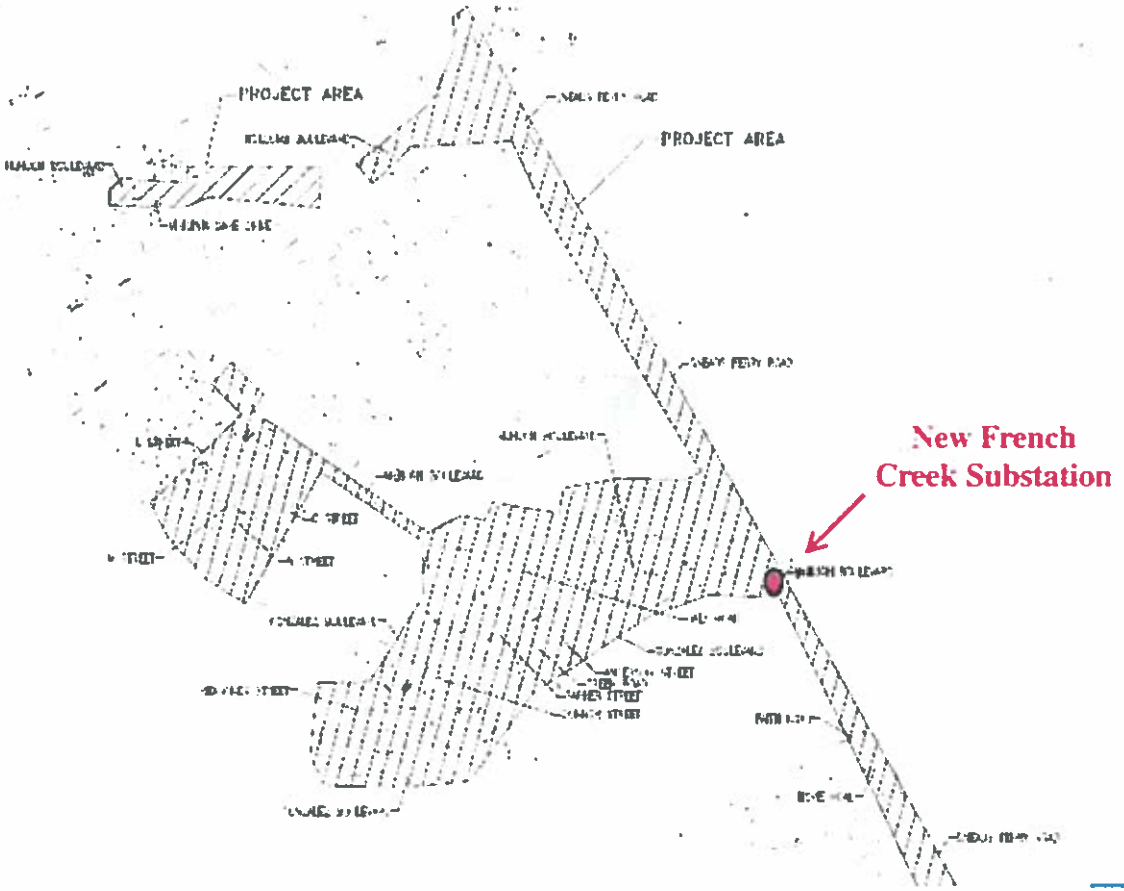
5/31/13 Completion

SAMPLE ENERGIZED WORK PERMIT/BRIEF

NAVFAC
Naval Facilities Engineering Command

Energized Permit Review Brief P1264 HP & P1265 FC Electrical Supply

18 May 2012



P1264 & 1265, Utilities and Road Upgrades
Hadnot Point and French Creek

Project Data:

- Contract: N40085-11-4030
- Prime: St. Wooten Corp.
- Award Date: 26 Sep 11
- Original CCD: 22 Oct 13
- Current CCD: 22 Oct 13
- Award Value: $65, 787,840.00
- Current Value: $65, 787,840.00

Description:

Design-Bid-Build contract to expand and upgrade the steam, water and electrical utility systems, roadway networks, and communication systems in the Hadnot Point and French Creek areas. Electrical system upgrades include expansion and relocation of overhead transmission and primary distribution lines.

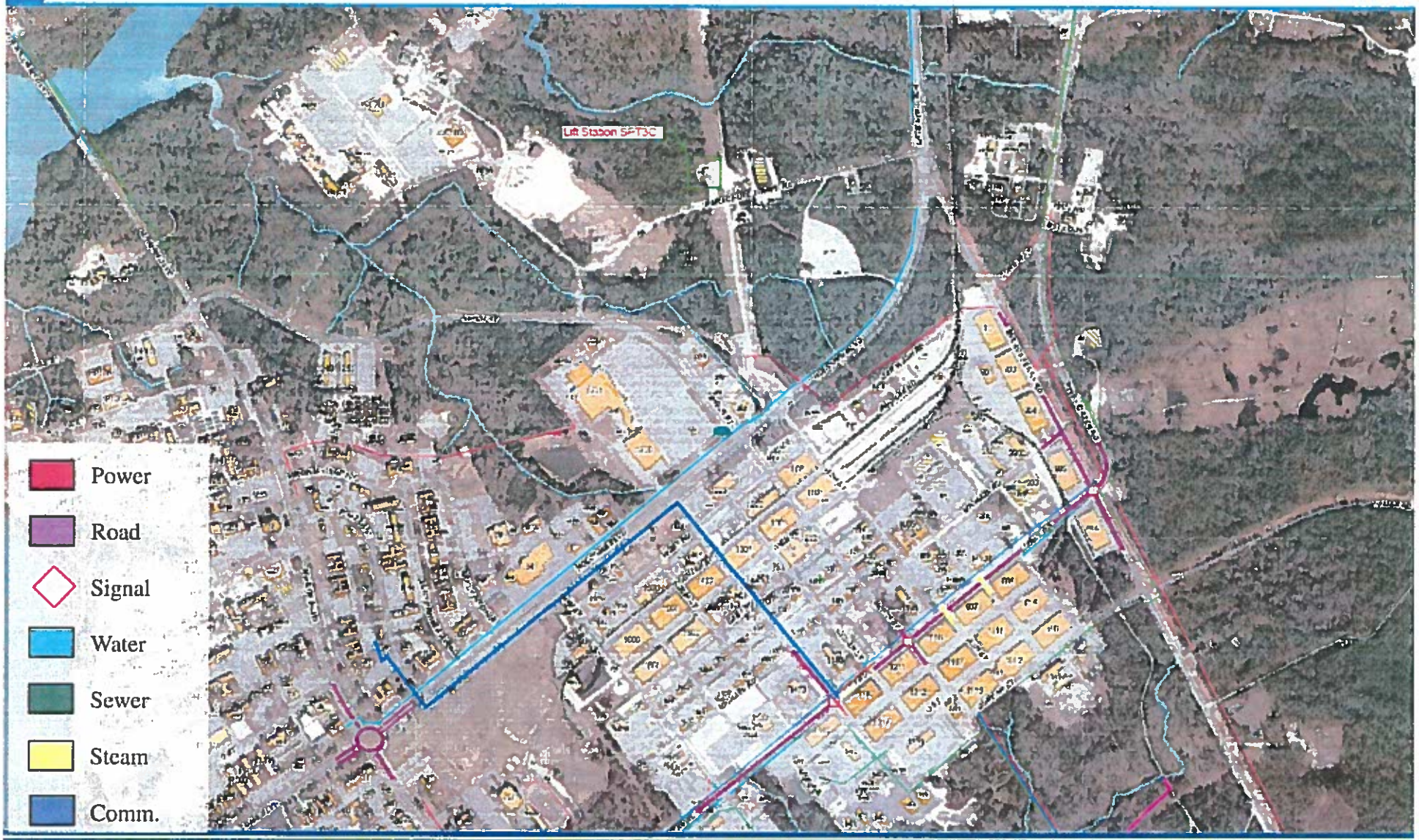
Status:

- Complete Baseline Schedule has been submitted.
- De-energized work is under way. This effort includes setting new poles and hardware and installing lines .
- New poles and hardware are being assembled and staged in anticipation of energized work.

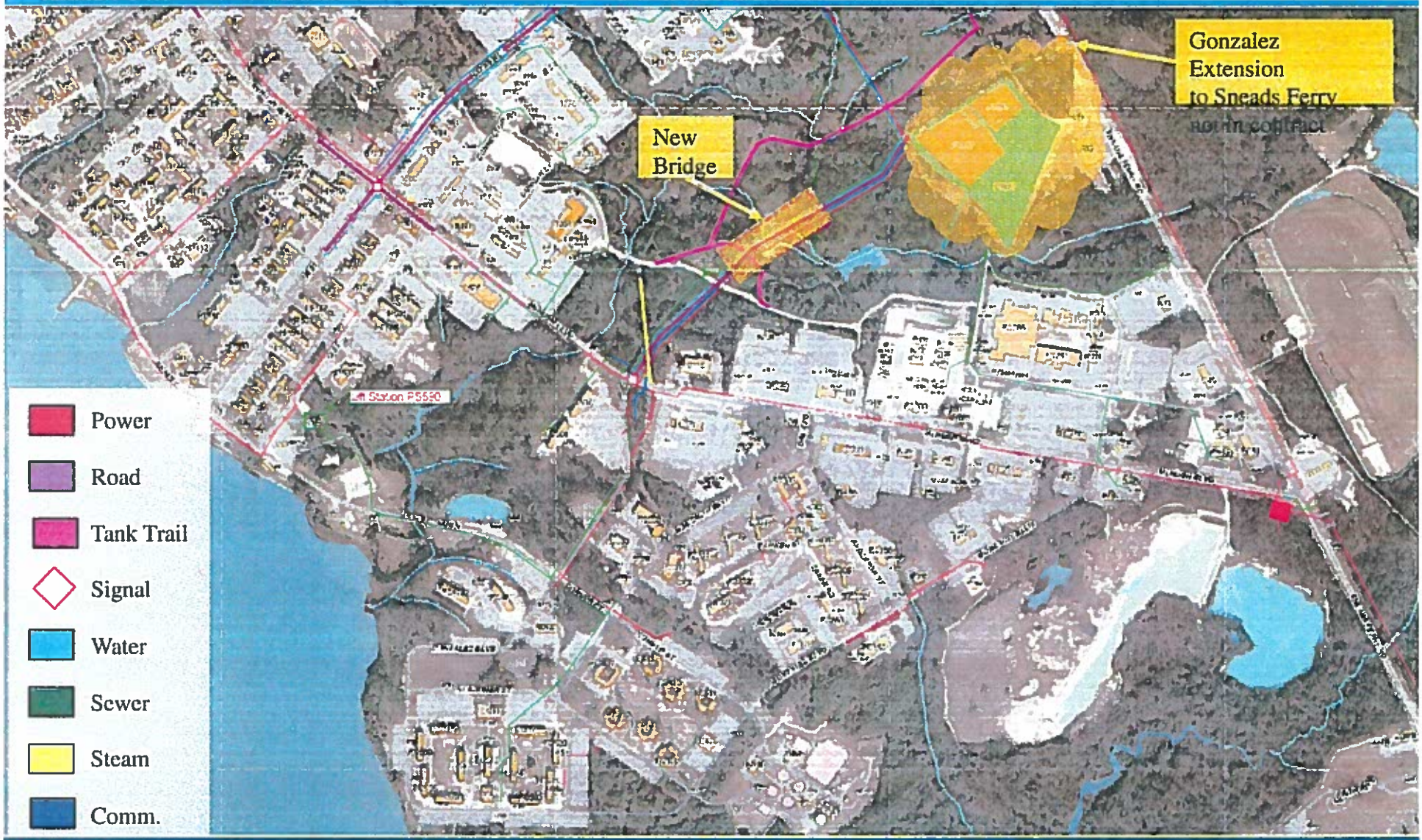
Discussion:

This project rewires the base core electrical distribution system to greatly improve power reliability, back feed areas from other circuits, isolate areas to reduce outage impacts and reduce need for future energized work.

Hadnot Point Map



French Creek Map



Purpose & Overall Work Scope

- Camp Lejeune electrical distribution system relies on two substations to power the base. Substation #1 is a 50 MVA (Megavolt Ampere) station and substation #2 is a 25 MVA station. This project provides a new 40 MVA substation at French Creek increasing the capacity by over 50%.

- Three of the feeder circuits in substation #1 will transfer to the new 40MVA substation at French Creek which will be built on the corner of McHugh Blvd. and Sneads Ferry Road. In addition two new circuits will be fed from this new substation. A total of five feeders will be pulled out of the new substation.

- Progress Energy to construct new 230 KV transmission line to feed the French Creek Substation.

- Multiple Gang Operated Air Break Switches (GOABS) will be installed in locations in the French Creek and Hadnot Point areas which will facilitate many new ties, bypasses and isolation points between Substation #1 and the new French Creek Substation to minimize future outages.

- Primary metering will be installed on 8 feeders near Substation # 1 and a remote control breaker operating system will be installed inside Substation # 1.

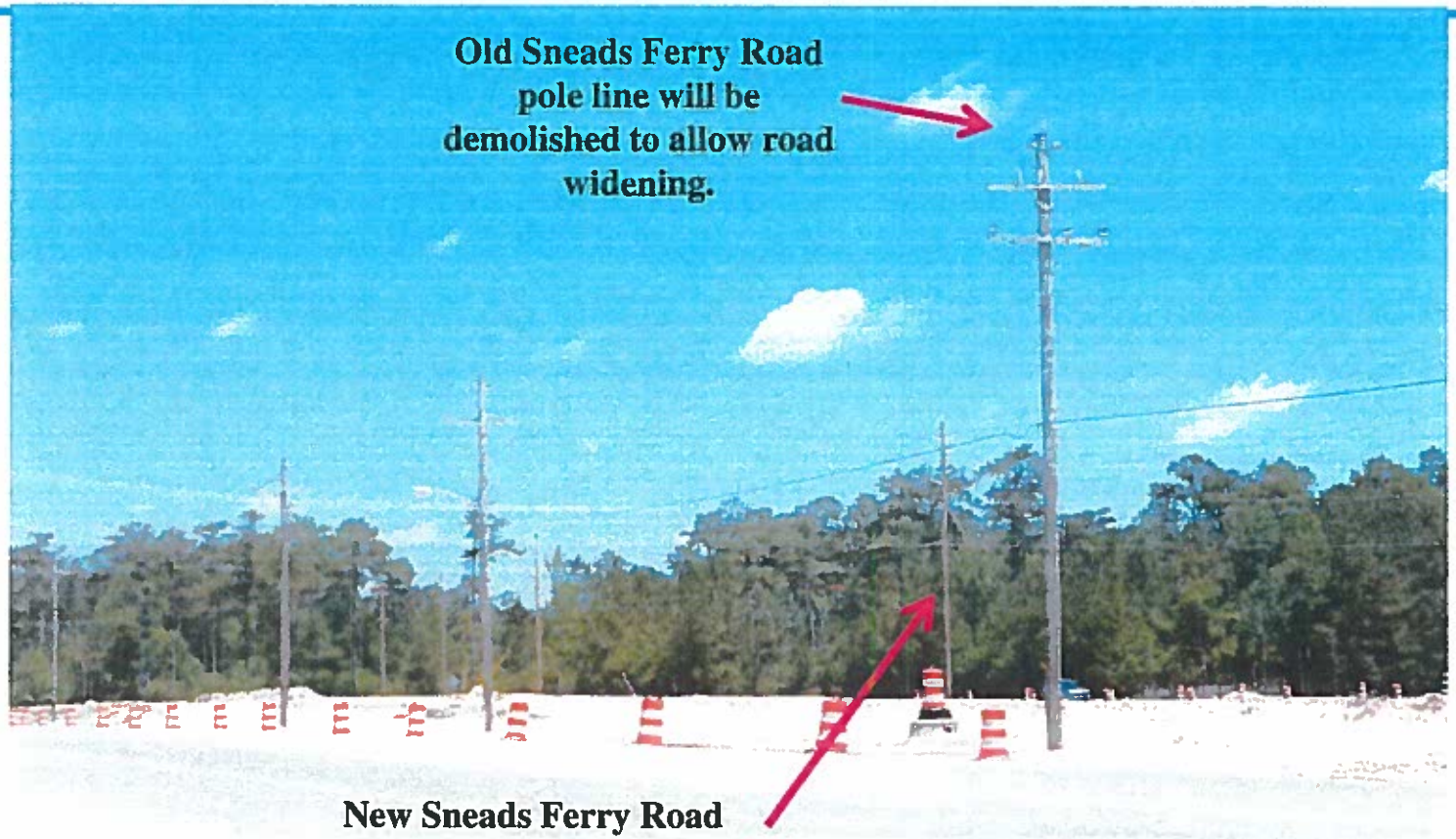
- Work has been separated into 6 phases by feeder for the purpose of requesting electrical outages (all have been denied by the base).

Phased Work Scope

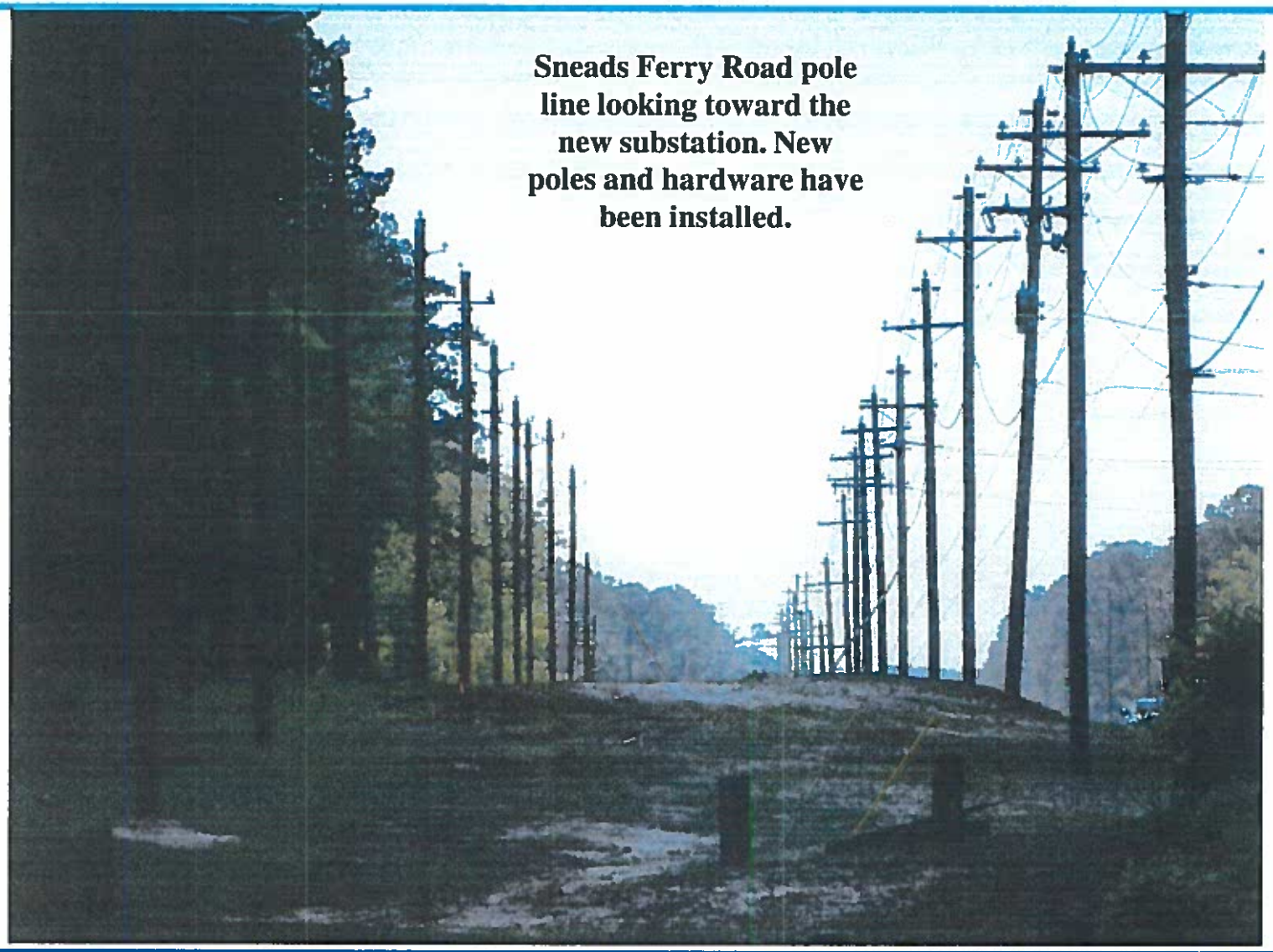
- **Phase 1** (CHB Feeder)
  - Work
    - Install new double circuit from Cone Way to McHugh Blvd. (new FC SS) along Sneads Ferry Road.
  - Outage Requested and Denied
    - Power outage for 30 working days
  - Outage Impact
    - All of CHB
    - Onslow Beach
    - Hwy 172 from Sneads Ferry Gate to Triangle Outpost Gate
    - Boat basin
  - Duration of energized work is 30-35 days.

Phase 1 Aerial View of Work Area

Sneads Ferry Road



Sneads Ferry Road



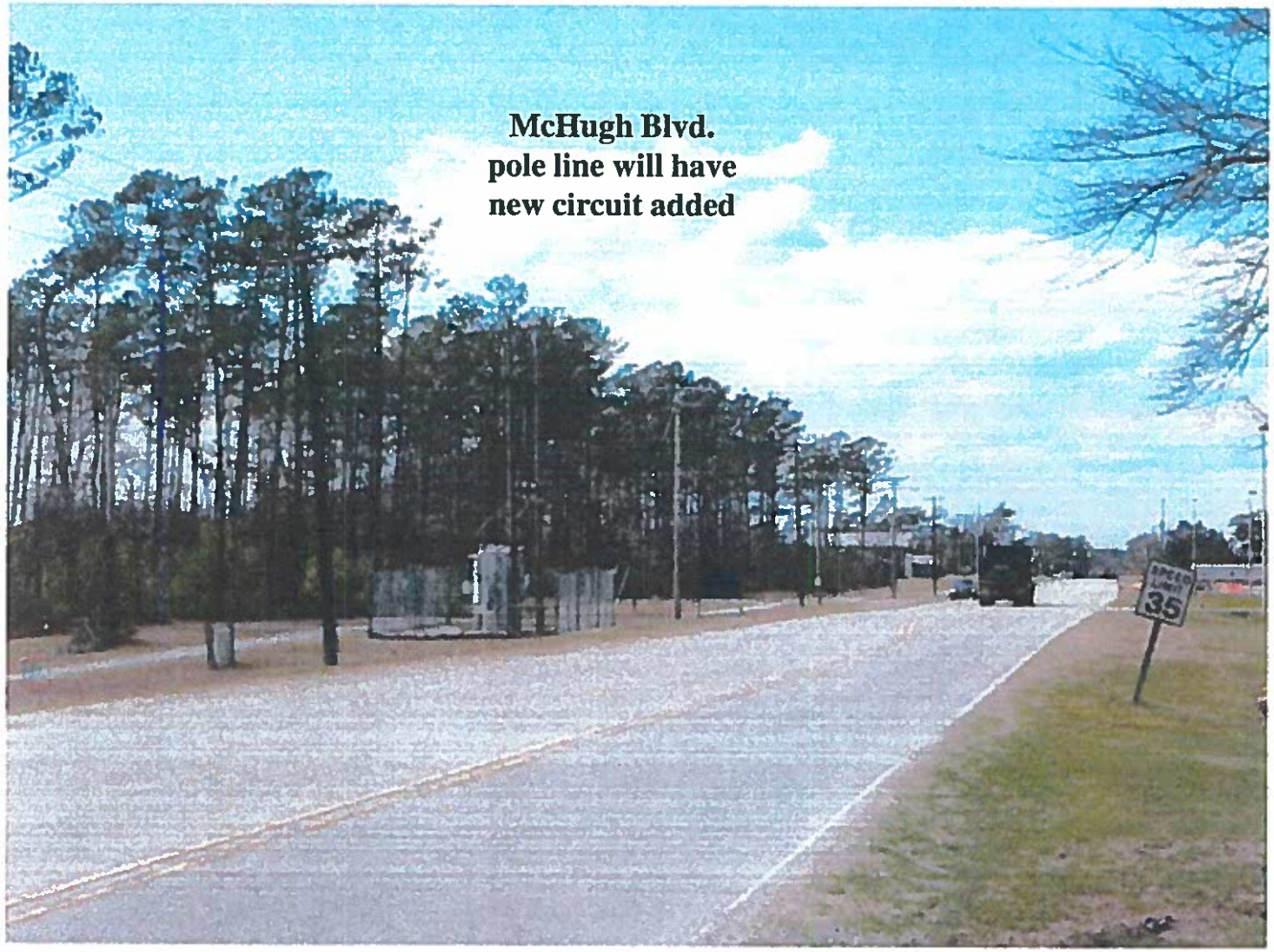
Sneads Ferry Road pole line looking toward the new substation. New poles and hardware have been installed.

Phased Work Scope

- **Phase 2** Exchange & Commissary (Mall Feeder), Central Area and Substation Work
  - Work
    - Construct new 12.47 KV feeder Exchange area to Central area.
    - New line will double circuit at McHugh Blvd (runs with REG#1)
    - Install primary metering on 8 of 11 circuits exiting SS#1
    - Cut in double dead ends on 2 of the circuits
    - Replace 2 spans with 600 amp conductors
    - Install duct bank at SS#1 from breakers to new control panel and connect
  - Outage Requested and Denied
    - All of Exchange & Commissary complex.
    - All of Central area.
    - All of the Regimental area (base theater to Cross St).
    - FC#2, REG#1, REG#2, REG#3, Wallace Creek area, Exchange/Central area, Cape Hart #1 area and PP area.
    - Total impact 18 working days
  - Duration of energized work is 18-25 days.

Phase 2 Aerial View of Work Area

McHugh Boulevard View



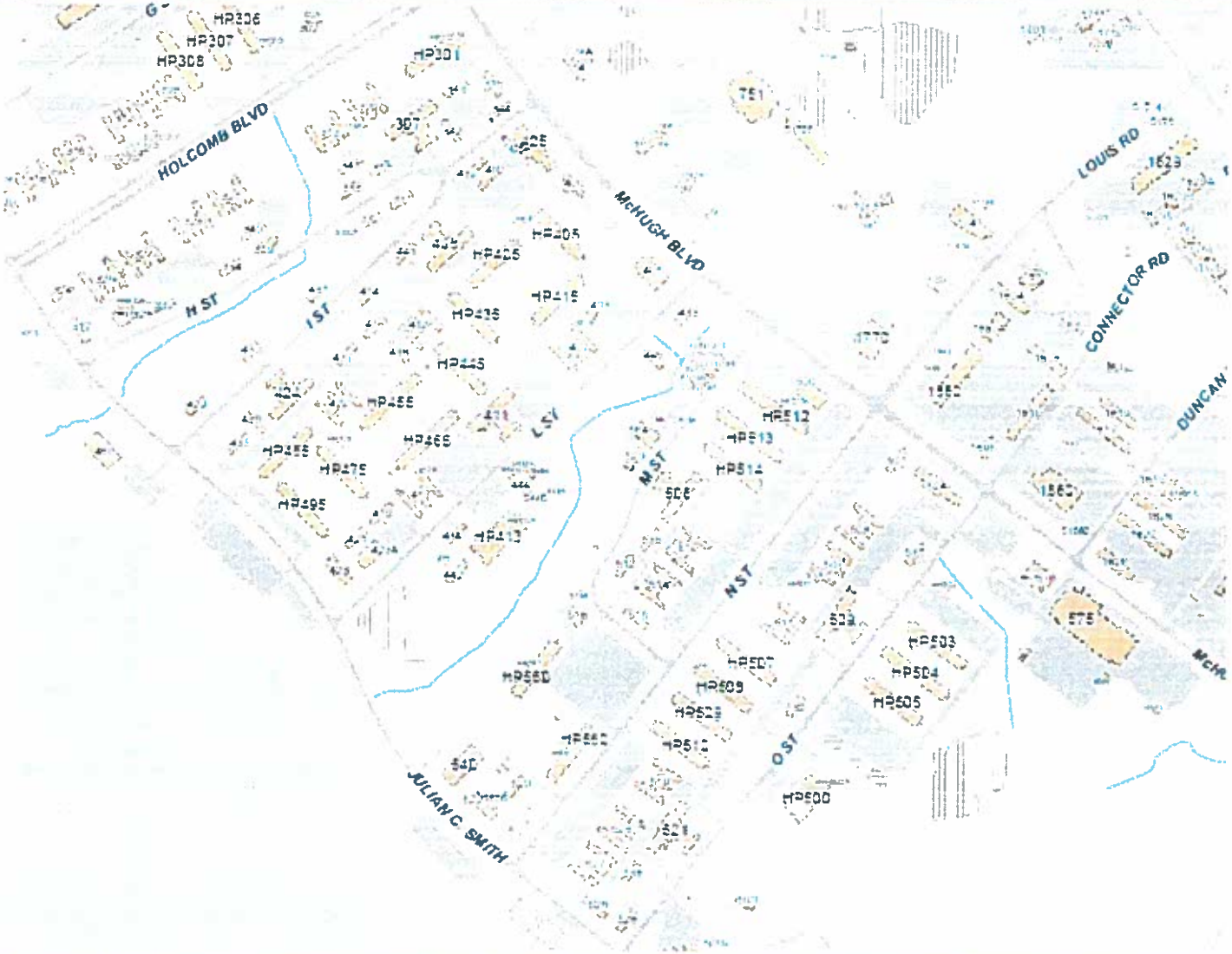
New French Creek Substation

New French Creek Substation

Phased Work Scope

- **Phase 3** (400, 500, 1700 & 1800 areas)
  - Work
    - Construct new circuit down O St. from McHugh Blvd. to Julian C Smith
    - Install 7 gang switches to allow feeders to be back fed from other sources or isolate when power outages are required.
  - Outage Requested and Denied
    - 60 working days.
  - Outage Impact
    - Regimental 400 and 500 areas
    - 1700 and 1800 areas
  - Duration of energized work is 60-65 days.

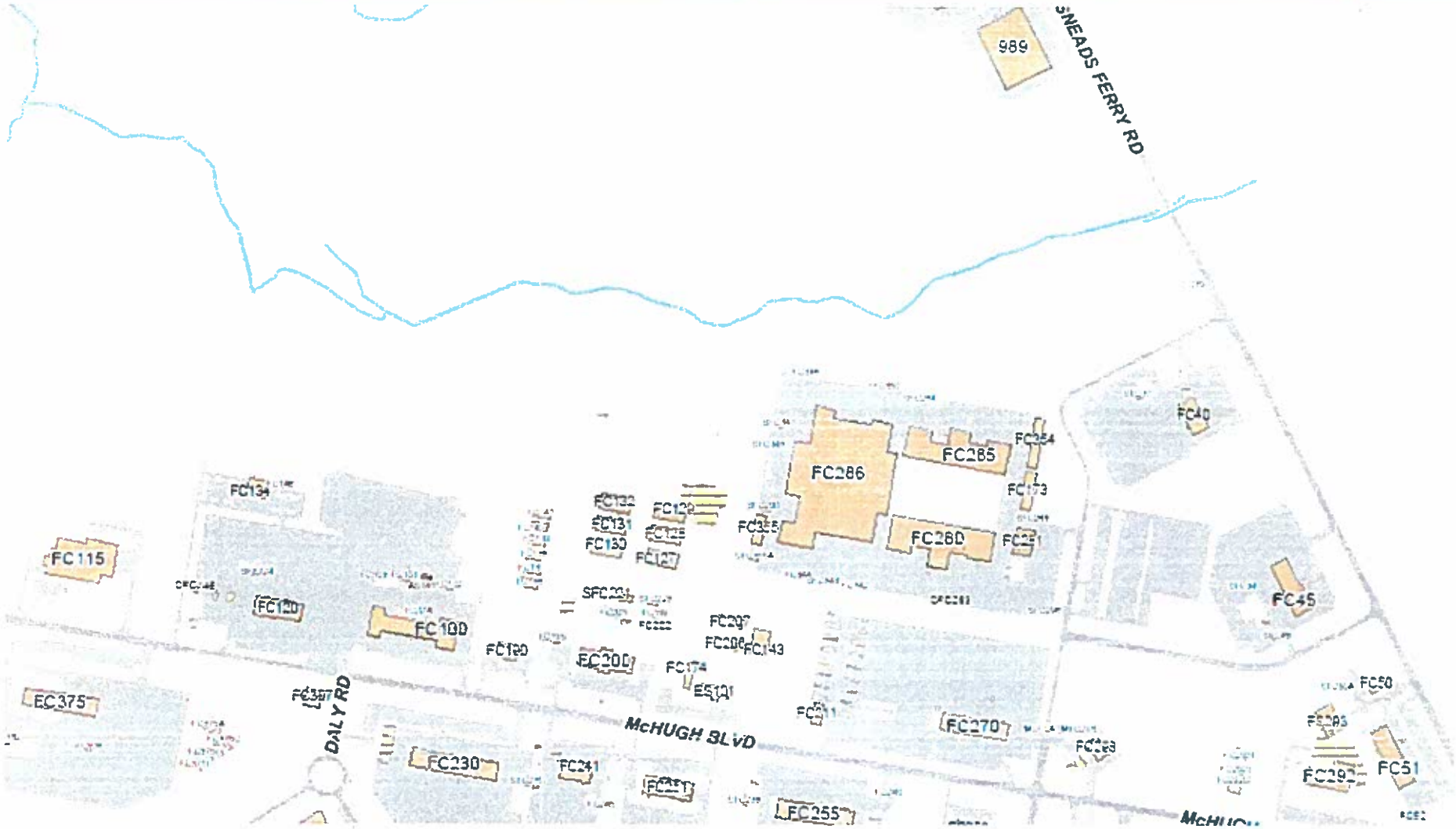
Phase 3 Aerial View of Work Area



Phased Work Scope

- **Phase 4: French Creek North**
  - Work
    - Construct new double circuit from new FC SS to Daly Rd
    - Install 4 gang switches to allow feeders to be back fed from other sources or isolated when power outages are required.
  - Outage Requested and Denied
    - 50 working days
  - Outage Impact
    - Main Sewage Plant FC,
    - All buildings on Gonzalez (sewage plant to Sneads Ferry Rd)
    - All buildings on Sneads Ferry Rd from Holcomb to McHugh
    - All of French Creek area
    - All buildings along Piney Green and Sawmill Rd
  - Duration of energized work is 50-60 days.

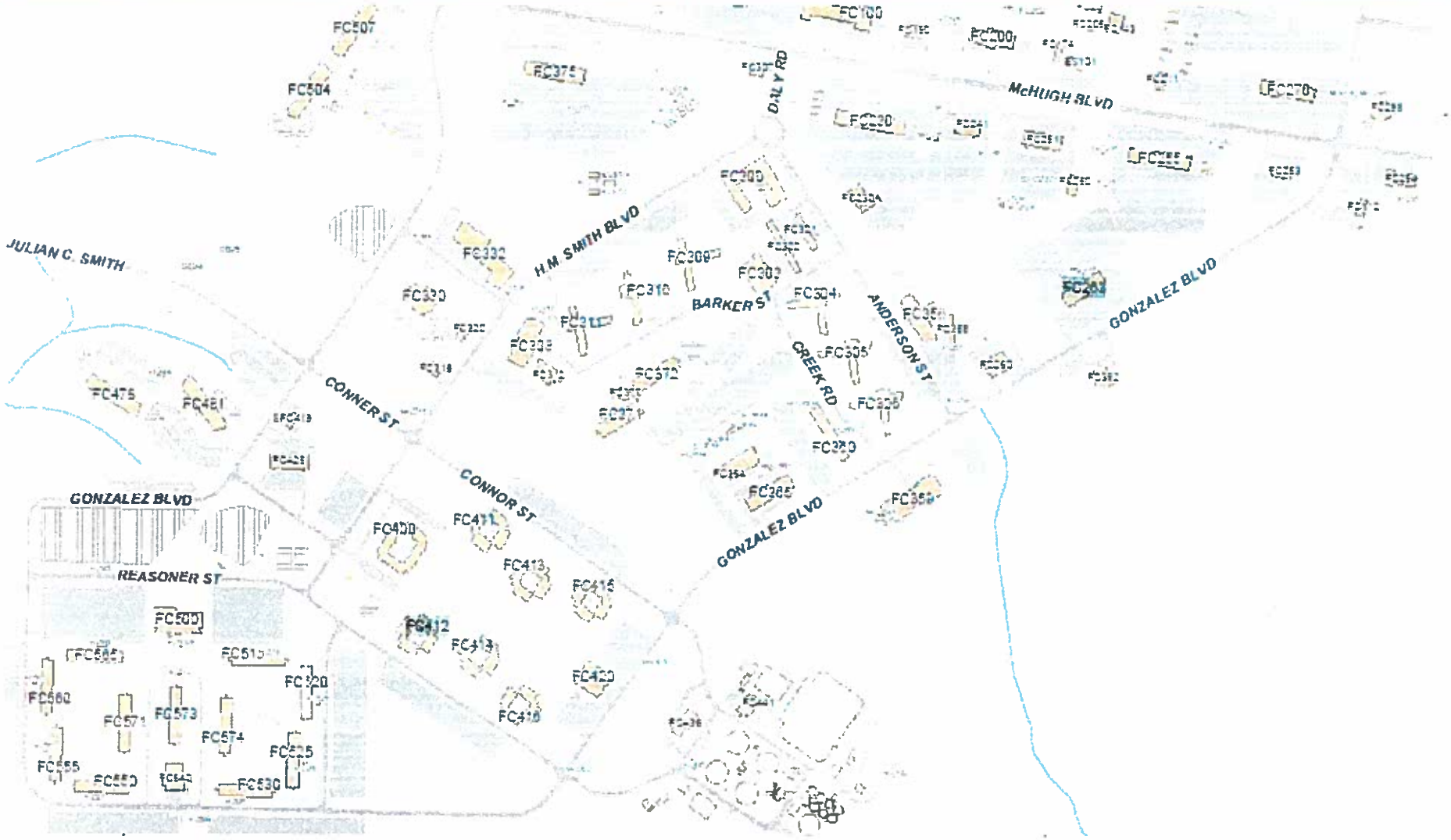
Phase 4 Aerial View of Work Area



Phased Work Scope

- **Phase 5: French Creek South**
  - Work
    - Construct new tie circuits on Conner St and Gonzalez and down Reasoner St. including new gang switches.
    - Upgrade all circuits in French Creek area to 600 amp and change out all poles and hardware.
  - Outage Requested and Denied
    - 70 working days
  - Outage Impact
    - Main Sewage Plant FC,
    - All buildings on Gonzalez (sewage plant to Sneads Ferry Rd
    - All buildings on Sneads Ferry from Holcomb to McHugh
    - All of French creek area
    - All building along Piney Green and sawmill Rd
  - Duration of energized work is 70-75 days.

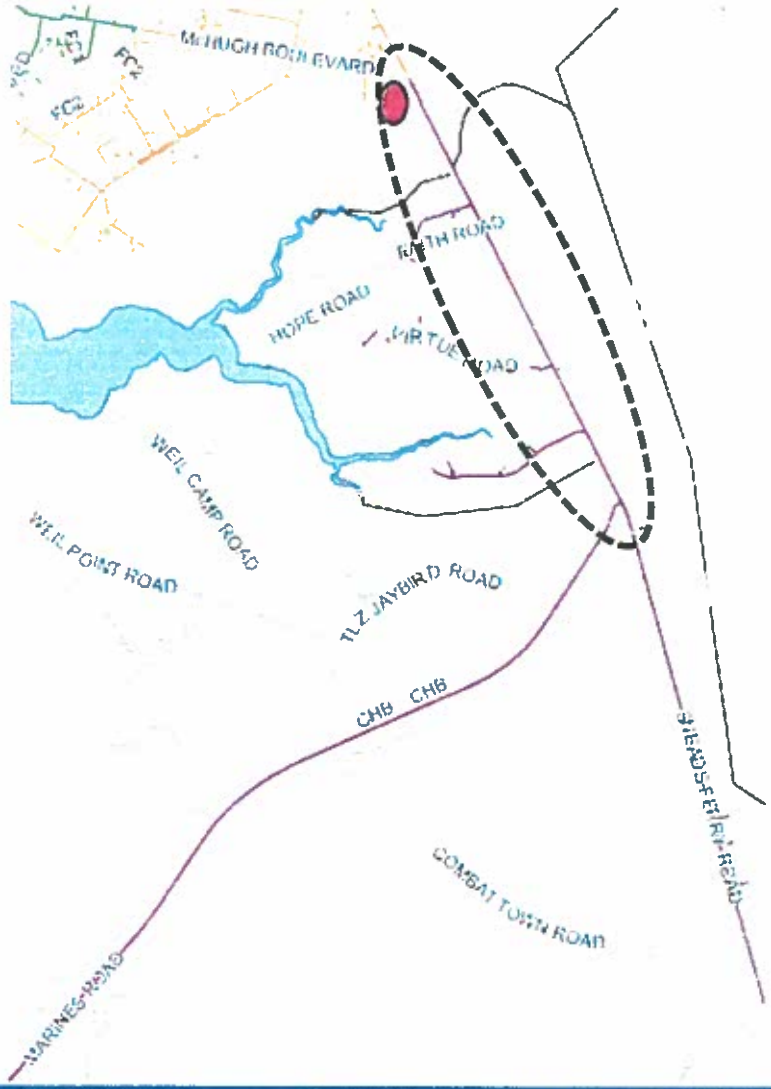
Phase 5 Aerial View of Work Area

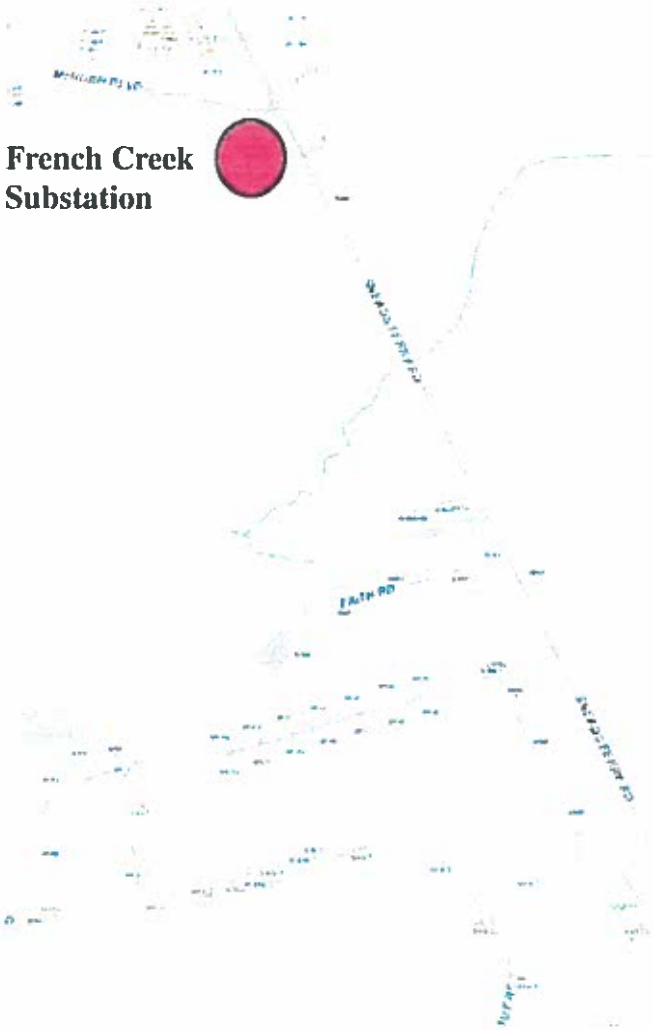


Phased Work Scope

- **Phase 6 (CHB Feeder)**
  - Work
    - Construct new 12.47 KV double circuit in the existing line from McHugh Blvd. (FC SS) to Marines Rd.
    - Circuits will become the Onslow Beach feeder and Courthouse Bay feeder both fed from the new FC SS.
  - Outage Requested and Denied
    - Power outage for 60 working days.
  - Outage Impact
    - All of CHB
    - Onslow Beach
    - Amphibious area
    - Hwy 172 from Sneads Ferry Gate to Triangle Outpost Gate
  - Duration of energized work is 60-70 days.

Phase 6 Aerial View of Work Area





Background

- **Non-energized work is utilized to maximum extent possible**
  - Ground will be cleared, footings placed, equipment mounted de-energized to maximum extent
  - Short acceptable outages will be requested when feasible as project moves forward
  - Poles with hardware will be staged or installed wherever possible
  - Demolition of poles and lines performed de-energized
- **Alternatives considered to reduce/eliminate energized effort**
  - Back feed: Not feasible as circuits are dead ended
  - Electrical outage requests: Six (6) outage requests have been denied by the base
  - Coordinate with PW Scheduled Outage: No outage planned
  - Portable/Permanent generation: Not feasible due to excessive scope/demand and limited portable capacity
  - Off shift work does not apply
  - Relocation of functions affected is not possible

Go/No-Go Process

- Assemble components (to maximum extent feasible) and stage materials in the work area.
- Go/No-Go Inspection Criteria
  - Visually inspect the work area and surroundings.
    - Ensure adequate clearance exists to perform the work safely.
  - Look for evidence of, or potential for, problems with the installation effort.
    - Frayed or broken wiring, discolored or burnt insulation.
    - Tree limbs, obstacles and weather/site conditions (rain, snow, wind, mud).
    - Other work conditions not expected which may present safety issues (brittle conductors, excessive traffic, odd equipment sounds or odors, etc.
  - Remain vigilant of safety issues throughout the effort and stop work as needed.
- OICC High Voltage ET's – Lindy Southerland and Jamie Lawrence
- Daily Go/No-Go Procedure
  - OICC ET will review the daily Job Briefing /Log with the contractors team.
  - OICC ET will ensure all workers are qualified and properly trained.
  - Contractor competent supervisor will inspect all energized work areas from the ground before any work is performed.
  - Competent lineman in bucket truck will re-inspect each work site, report findings to his supervisor who will then confer with OICC ET to obtain final go/no-go decision. These actions will repeat each day for the planned work scope.
  - OICC ET will remain engaged with the effort until energized work is complete.
  - OICC ET will ensure energized work area is secured at the end of each work day.

Safety Plan

- Re-closer(s) will be placed in non-reclose/fastest acting position and tagged. The pole will be flagged to indicate it is under OICC/contractor control (OICC ET and contractor name and cell numbers will be listed).
- All workers CPR certified and trained in First Aid.
- Personal Protection Equipment exceeds requirements.
  - Workers will wear PPE rated for 8 cal/cm2, Hazard/Risk Category 2, exceeding the worst case arc flash analysis result of 0.6 cal/cm2 which is Hazard/Risk Category 0.
- All workers trained and experienced in live work procedures.
- Contractor Safety Manual for energized work meets or exceeds requirements of NFPA 70E [2009].
- Naval Hospital is 3 to 8 miles from the various work locations. 911 operator will route the nearest EMT services.

Summary

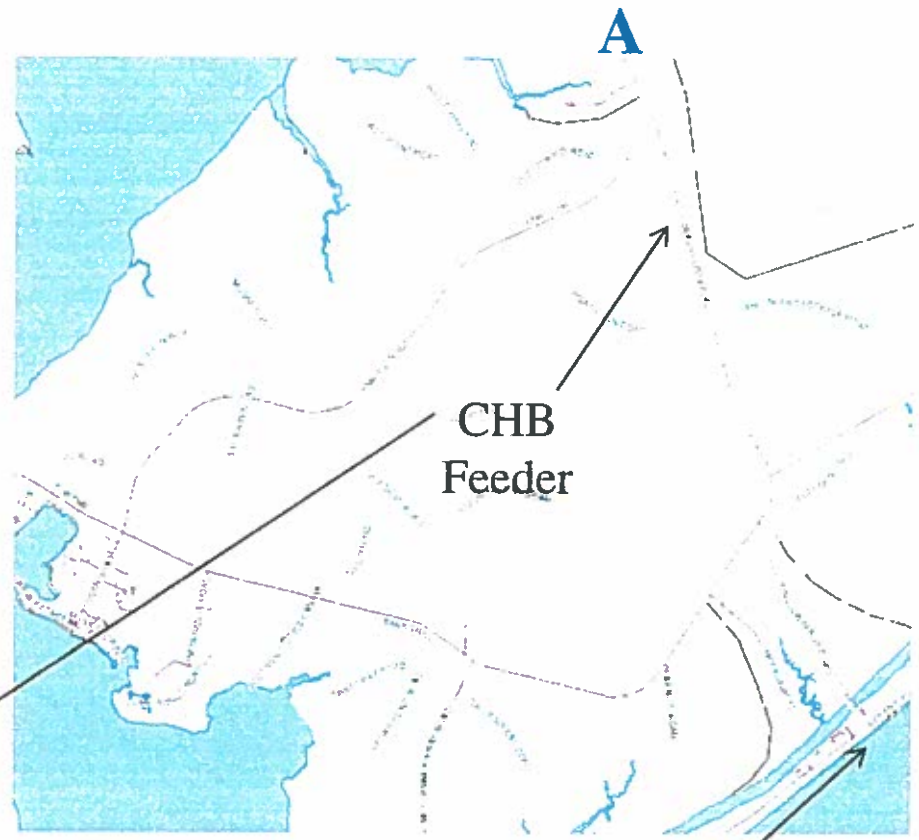
- Request CO Midlant approve energized work permit.
- Reasonable alternatives to energized work do not exist.
- Every effort has been made to limit the duration of energized work without sacrificing safety or expertise of subcontractors and OICC HV ET staff.
  - Install, pre-assemble and stage components while de-energized, to maximum extent possible.
- Qualified Personnel and Safety Plans for energized work are in place.
- Contractor safety representative will monitor all energized work.
- OICC HV ET's are fully empowered to secure work at any point they feel it is warranted and will lead/participate in weekly planning and coordination meeting and toolbox discussions with the prime contractor and their subs.

Backup Slide - General

- **Backup Information**
  - Prime contractor is Walbridge Aldinger Company
  - T&D Solutions, Inc. (formerly E&R, Inc.) is the subcontractor who will perform the energized work
    - NFPA 70E (2009) based Safety Manual, full time craft trainer, documented employee training
    - Safety representative will be on job site full time
    - Extensive energized work at Camp Lejeune over last 25 years
  - PPE worn will be based on 8 cal/cm2 and hazard risk category 2, exceeding the requirement
  - All analysis is per NFPA 70E (2009)

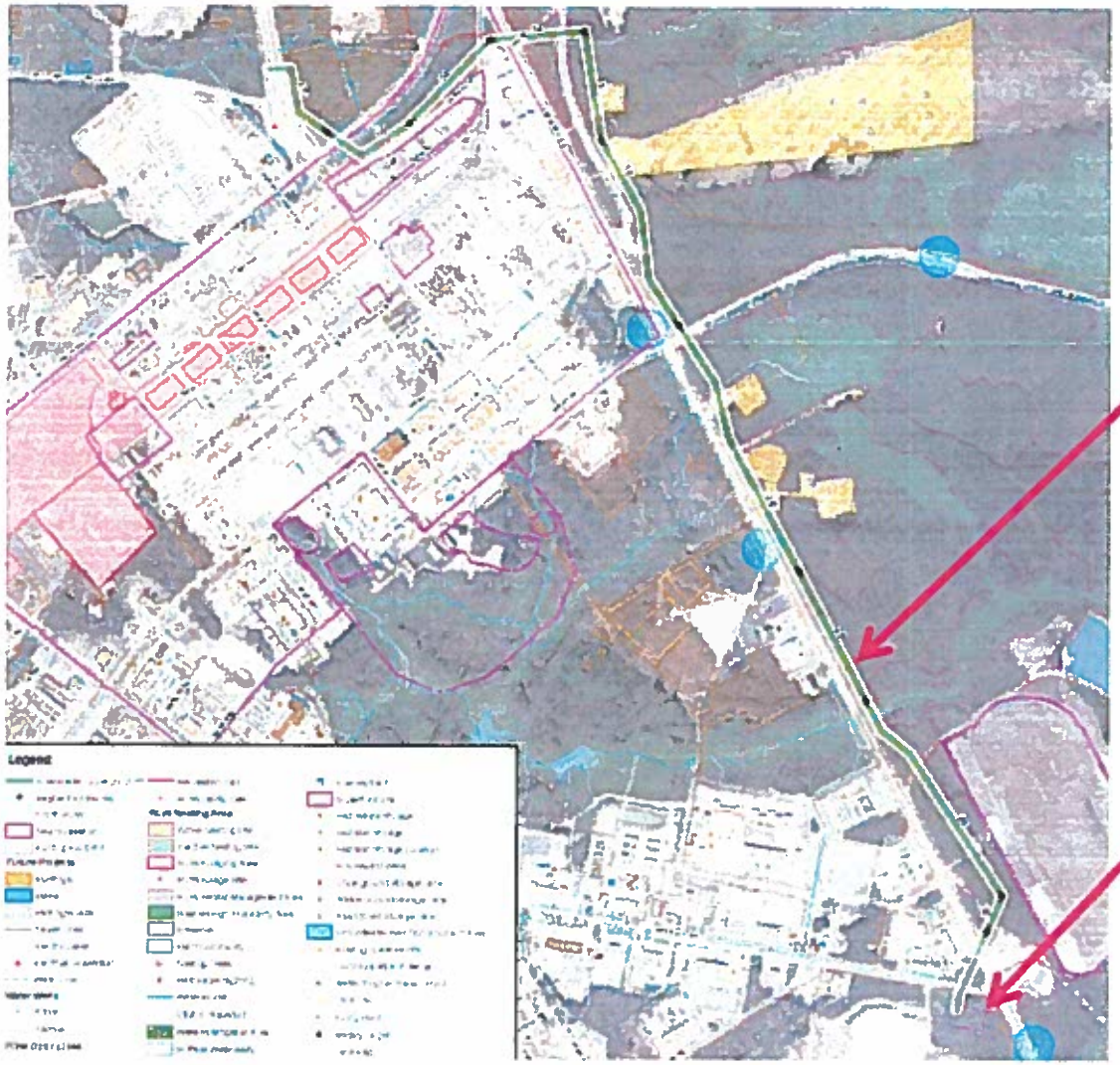
Backup Slide - Work Locations

Hadnot Point and French Creek Areas



New Onslow Beach Circuit will be added to CHB pole line (2nd circuit)

Backup Slide - Progress Energy New 230 KV Transmission Line



New 230 KV Progress Energy Feeder along Sneads Ferry Road

New French Creek Substation (corner of McHugh & Sneads Ferry Rd.)

Backup Slide: Impact Map (typical for Courthouse Bay)

ELECTRICAL ENERGIZED WORK PERMIT ROUTING SLIP 10 May 2012

Project Name & Contract #:		N40085-11-D-4030 HP (P1264) & FC (P1265) Electrical Supply	
Office	**Name**	**Initials Date**	**Comments**
Electrical Engineer	Bob Austin	RA 5-10-12	No.
Parsons Cell Supv.	Keith Rines	5/14/12	NONE
XO	LCDR Jasinski	5/14/12	SEE STICKIES. ADMIN NOTES.
OPS	Ken Lacy	5/14/12	None
DOICC	Hill Hendricks	5/14/12	Comments made & incorporated –
OICC	CDR Marc Delao	5/18/12	Hot work required to do this work
Emergency Response Special Considerations:		All workers CPR certified and trained in First Aid. Naval Hospital is 3 to 8 miles from work sites. All workers will have communication devices and emergency contact list on their person. See attached permit for more information.	
Exposure Mitigation Approach Planned:		HV contractor has extensive experience in energized high voltage work. Recloser(s) will be placed in non-reclose fastest acting position. Install, prepare and stage to maximum extent possible while de-energized. Detailed procedures are provided in the permit.	
Duration of Exposure Expected:		Energized work is required throughout Hadnot Point and French Creek.	

Alternatives Considered:

The base denied use of power outages due to impact on people and mission.
Back feed capability does not exist. Portable generation cannot provide sufficient power. No reasonable alternative exists.

Recommendation:

We recommend that Electrical Energized permit Dated 17 April 2012 be approved. Permit package includes the attached documents: Completed permit form, Arc Flash Analysis, AHA w/training document, Power Outage Request and Base Denial for each of 6 outage requests. The energized brief for this effort is provided separately.

CONTRACTOR ENERGIZED ELECTRICAL WORK PERMIT

PART I: TO BE COMPLETED BY THE REQUESTER: COTRACT NUMBER: N40085-11-D-4030

JO/DO NUMBER: HP & FC Electrical Supply DATE OF REQUEST: 4/17/12
ANTICIPATED DATE WORK WILL BE PERFORMED: Upon Approval DATES OF PERMIT COVERAGE: 6/12 - 5/13

(1) Description of circuit/equipment/job location: Utility upgrade of 12470 volt electrical system MCB Camp Lejeune Hadnot Point & French Creek areas

(2) Description of work to be done: Upgrade electrical utility system to 600 amp system. Work includes building a new substation installing new poles and conductors providing new loop feed capabilities for this area.

(3) Justification of why the circuit/equipment cannot be de-energized or the work deferred until the next scheduled outage: MCB Camp Lejeune has determined it is infeasible to de energize these circuits for the period of time it will take to complete the scope of work in this contract due to operational limitations.

NOTE: ATTACH COPY OF OUTAGE REQUEST INCLUDING REASONS FOR DENIAL

[illegible] / Project Manager — 25-14-12

Requester/Title — Date

PART II: TO BE COMPLETED BY THE ELECTRICALLY QUALIFIED PERSONS DOING THE WORK:

Check when complete

(1) Detailed job description procedure to be used in performing the above detailed work: See Attached [X]

(2) Description of the Safe Work Practices to be employed: See Attached [X]

(3) Results of the Shock Hazard Analysis: 12470 volts NFPA 70E Table 130.2 (C) [X]

(4) Determination of the Shock Protection Boundaries: (a) Limited Approach Boundary:10' (b) Restricted Approach Boundary:2'2" (c) Prohibited Approach Boundary: 0' 7" [X]

(5) Results of the Arc Flash Hazard Analysis: Max incident energy 0.579cal/cm2, Hazard risk category 0 [X]

Arc Flash analysis is attached

(6) Determination of the Arc Flash Protection Boundary: 15" See attached arc flash analysis [X]

(7) Necessary personnel protective equipment to safely perform the assigned task: Class 2 rubber goods, hard hat, glasses, voltage rated tools, hoses and blankets [X]

(8) Means employed to restrict the access of unqualified persons from the work area: [X]

(9) Evidence of completion of a Job Briefing including discussion of any job – related hazards:

(9a) Activity Hazard Analysis (AHA) for electrical permit work completed, accepted and attached: [X] [X]

(10) Concur the above described work can be done safely? Yes [X] No [ ] (If no, return to requester)

Electrically Qualified Person(s) [illegible] Date
Electrically Qualified Person(s) [illegible] Date 4-17-12

PART III: RECOMMEND APPROVAL(S) TO PERFORM THE WORK WHILE ELECTRICALLY ENERGIZED:

PWO/OICC/ROICC SIGNATURE — CI SIGNATURE — OP SIGNATURE

James Hewitt
NAVAL CONTRUCTION SAFETY MANAGER

PART IV: FINAL APPROVAL:

NAVFAC MILANT COMMANDING OFFICER 4/1/12

NOTE: COMPLETED COPY RETAINED BY MIDLANT CONSTRUCTION SAFETY MANAGER

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Requester/Title — Date: 05-14-12

PART II: TO BE COMPLETED BY THE ELECTRICALLY QUALIFIED PERSONS DOING THE WORK:

Check when complete

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(2) Description of the Safe Work Practices to be employed: See Attached ☒

(3) Results of the Shock Hazard Analysis: 12470 volts NFPA 70E Table 130.2 (C) ☒

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(9) Evidence of completion of a Job Briefing including discussion of any job – related hazards: ☒

(9a) Activity Hazard Analysis (AHA) for electrical permit work completed, accepted and attached: ☒

(10) Concur the above described work can be done safely? Yes ☒ No ☐ (If no, return to requester)

Electrically Qualified Person(s) — Date
Electrically Qualified Person(s) — Date 05-14-12

PART III: RECOMMEND APPROVAL(S) TO PERFORM THE WORK WHILE ELECTRICALLY ENERGIZED:

PWO/OICC/ROICC SIGNATURE — CI SIGNATURE — OP SIGNATURE

James Newell
NAVFAC CONTRUCTION SAFETY MANAGER

PART IV: FINAL APPROVAL:

NAVFAC MILANT COMMANDING OFFICER 5/4/12

NOTE: COMPLETED COPY RETAINED BY MIDLANT CONSTRUCTION SAFETY MANAGER

CONTRACTOR ENERGIZED ELECTRICAL WORK PERMIT

PART I: TO BE COMPLETED BY THE REQUESTER: **COTRACT NUMBER:** N40085-11-D-4030

JO/DO NUMBER: HP & FC Electrical Supply DATE OF REQUEST: 4/17/12
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NOTE" ATTACH COPY OF OUTAGE REQUEST INCLUDING REASONS FOR DENIAL

Leon McMillan / Project Manager — 05-14-12

Requester/Title — Date

PART II: TO BE COMPLETED BY THE ELECTRICALLY QUALIFIED PERSONS DOING THE WORK:

Check when complete

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(9a) Activity Hazard Analysis (AHA) for electrical permit work completed, accepted and attached: [X]

(10) Concur the above described work can be done safely? Yes [X] No [ ] (If no, return to requester)

Electrically Qualified Person(s) Leon McMillan Date 05-14-12
Electrically Qualified Person(s) Eddie Prescott Date 05-14-12

PART III: RECOMMEND APPROVAL(S) TO PERFORM THE WORK WHILE ELECTRICALLY ENERGIZED:

CDR, CEC, USN

PWO/OICC/ROICC SIGNATURE — CI SIGNATURE — OP SIGNATURE

NFML CONTRUCTION SAFETY MANAGER

PART IV: FINAL APPROVAL:

NAVFAC MILANT COMMANDING OFFICER

NOTE: COMPLETED COPY RETAINED BY MIDLANT CONSTRUCTION SAFETY MANAGER

CONTRACTOR ENERGIZED ELECTRICAL WORK PERMIT

CONTRACT NUMBER: N40085-11-D-4030 HP (P1264) & FC (P1265) Electrical Supply

Attachment A

Part I (1) Description of circuit/equipment/job location:

Overview: Camp Lejeune electrical distribution system relies on two substations to power the base. Substation #1 is a 50 MVA (Megavolt Ampere) station and substation #2 is a 25 MVA station. This project provides a new 40 MVA substation at French Creek increasing the capacity by over 50%. This will relieve the overload problems at Substation # 1. Three of the feeder circuits in substation #1 will transfer to the new 40MVA substation at French Creek which will be built on the corner of McHugh Blvd. and Sneads Ferry Road, in addition two new circuits will be fed from this new substation. A total of five feeders will be pulled out of the new substation. This will provide additional capacity eliminating the overload issues brought on by the tremendous amount of new construction on base. Multiple Gang Operated Air Break Switches (GOABS) will be installed in locations in the French Creek and Hadnot Point areas which will facilitate many new ties, bypasses and isolation points between Substation #1 and the new French Creek Substation to minimize future outages. Primary metering will be installed on 8 feeders near Substation # 1 and a remote control breaker operating system will be installed inside Substation # 1. The Electrical Distribution project has been divided into 6 phases of work described in following paragraphs:

Part I (2) Description of work to be done:

Phase # 1 Deenergized: All underground utilities will be located before work will begin. We will construct a Deenergized double circuit feeder 75 feet from existing circuit. We will be framing and setting 16 poles and installing required anchors and guy lines. All energized conductors which run perpendicular to the path of our new circuit will be covered with insulating rubber hoses and blankets to prevent any possibility of accidental contact Rollers will be installed on each pole then nonconductive rope will be pulled into the rollers from the beginning to the end of line. Seven 394.5 AAA conductors will be pulled in under tension. Once all conductors are in position linemen will jack all conductors into proper sag. The linemen will then remove the rollers and tie the conductors to the insulators. Linemen will cut a double dead end onto steel arms at pole # S36.

Phase # 1 Energized: The existing Piney Green Tap will be spread to make room to pull the conductors one span to the newly constructed double circuit. Once the line is sagged the new circuit will be connected to the old leaving both energized. We will then cut a double dead end onto steel arms at pole # S50. This new span double circuit will then be installed between the new circuit and the existing circuit. Primary jumpers will then be installed on both S50 poles. This will energize the new construction. Linemen will transfer all primary taps over to the new construction. Linemen will then cut the jumpers feeding the existing circuit along Sneads Ferry Road on both ends and remove the existing line which will clear the right-of-way for road construction.

Phase # 2Deenergized: We will get all underground utilities located before work will begin. We will construct a Deenergized single circuit feeder extension 20 feet from existing triple circuit. We will be framing and setting 28 poles and installing required anchors and guy lines to contract specifications. All energized conductors which run perpendicular to the path of our new circuit will be covered with insulating rubber hoses and blankets to prevent any possibility of accidental contact. Rollers will be

installed on each pole then nonconductive rope will be pulled into the rollers from the first pole to the last. Four 394.5 AAA conductors will be pulled in under tension. Once all conductors are in position linemen will jack all conductors into proper sag with a band hoist. The linemen will then remove the rollers and tie the conductors to the insulators. The trench for the duct bank inside the fence area at Substation # 1 will be hand dug to avoid damage to the ground grid. Conduits will be installed and labeled from each breaker to provide the remote control Data / Alarm Panel Cabinet. All conductors will be pulled to each breaker. We will ask Public Works employees to bypass each breaker one by one so connections can be made with the breaker deenergized.

Phase # 2Energized: The last 4 spans of the line will be built on top of Regimental # 1 feeder. The energized conductors will be spread out onto temporary fiberglass arm extenders to allow for a taller pole replacement out and new conductors to be added on top. These 4 spans will also be pulled in under tension. The last pole to be installed will be installed into an energized feeder. The conductors will be covered and spread using a bucket truck. The pole will be framed and covered with a pole top cover. The pole will be set in line using a digger derrick truck. Linemen will tie the existing conductors to the insulators. The slack span will be installed which will energize the new circuit. The first tap at building 58 which feeds about half the Central Area will be transferred and connected to the new circuit and the pole mounted recloser at this location will be removed. The second tap to the Central Area off McHugh Blvd. will be connected to the new top circuit on the double circuit. Two bucket trucks and one digger derrick will be set up at each site where a double dead end will be cut into an energized circuit.

Phase # 3 Deenergized: For the O Street extension tie circuit we will get all underground utilities located before work will begin. We will construct a single circuit feeder using four 394.5 AAA conductors. We will be framing and setting 13 poles and installing required anchors and guy lines to contract specifications. Rollers will be installed on each pole then nonconductive rope will be pulled into the rollers from the first pole near building 511 to the last across Julian C. Smith Road. Each of the 4- 394.5 AAA conductors will be pulled in under tension when necessary to avoid contact with energized lines. Once all conductors are in position linemen will jack all conductors into proper sag. The linemen will then remove the rollers and tie the conductors to the insulators.

Phase # 3 Energized: Linemen will install jumpers from the new circuit to the energized circuit at both ends. Linemen will cover all energized parts within his work zone with rubber goods. They will then untie the conductors secure them to bucket boom and mount a steel arm on existing pole or change out pole and then mount a steel arm or GOAB switch whichever is specified. They will place a hot hoist on each line and snug the hoist. They will then install mechanical jumpers and cut the conductor between the jumper ends. They will attach the conductors to dead end shoes on both sides. They will install 6 primary jumpers from the line to the connection points on the GOAB Switches. GOAB switches will be closed and mechanical jumpers will be removed. All rubber goods will then be removed from energized conductors and grounds.

Attachment A

Phase # 4 Deenergized: We will get all underground utilities located before work will begin. We will construct a single circuit feeder extension 20 feet from existing double circuit from Lyman Road to McHugh Blvd. We will be framing and setting 44 poles and installing required anchors and guy lines to contract Specifications. Rollers will be installed on each pole then nonconductive rope will be pulled into the rollers from the first pole to the last. Each of the four 394.5 AAA conductors will be pulled in under tension if necessary to avoid energized conductors. Once all conductors are in position linemen will jack all conductors into proper sag using a band hoist. The linemen will then remove the rollers and tie the conductors to the insulators.

Phase # 4 Energized: Linemen will cover all energized conductors which cross the path of our new circuit. Primary jumpers will be installed at Lyman Road which will energize the new line. All the primary taps from Lyman Rd. to French Creek Substation will be connected to the new circuit once it is energized. We will construct a new double circuit feeder on McHugh Blvd. We will be framing and setting 33 poles and installing required anchors, hardware and guy lines to contract specifications. We will move the existing conductors out onto extension arms to allow the space required to replace poles and pull in new conductors. We will then cover all energized conductors and jumpers which cross the path or are in close proximity of our new circuits. Rollers will be installed on each pole then nonconductive rope will be pulled into the rollers from the first pole to the last. Each of the seven, 394.5 AAA conductors will be pulled in under tension. Once all conductors are in position linemen will jack all conductors into proper sag using a band hoist. The linemen will then remove the rollers and tie the conductors to the insulators. Primary Jumpers will be installed at Sneads Ferry Road to temporarily feed the new construction until French Creek Substation is energized. All the tap lines along this section will reconnect to the bottom circuit which is French Creek # 2. We will then remove the old conductors and hardware from the new line.

We will be installing 18 GOAB switches in this phase of the project. Two bucket trucks and one digger derrick will be set up at each site where a double dead end will be cut into an energized circuit. Linemen will cover all energized parts within his work zone with voltage rated insulated rubber goods. They will then untie the conductors secure them to bucket boom and mount the GOAB switch on existing pole or replace pole and then mount GOAB switch. They will place a hot hoist on each conductor and snug the hoist. They will install mechanical jumpers and cut the conductor between the jumper ends. They will attach the conductors to dead end shoes on both sides of the GOAB switch. The existing line on Gonzalez Road from McHugh Blvd. to Connor Road will be upgraded. We will get all underground utilities located before work will begin. We will construct a single circuit feeder in the same line with the existing circuit. We will be framing and setting poles and installing required anchors and guy lines to contract specifications. The energized conductors will be spread out onto temporary fiberglass arm extenders to allow the space required to install poles and new conductors. Linemen will cover all energized conductors which crosses the path of the new circuit. Rollers will be installed on each pole then nonconductive rope will be pulled into the rollers from the first pole to the last. Each of the 4- 394.5 AAA conductors will be pulled in under tension. Once all conductors are in position linemen will jack all conductors into proper sag with a band hoist. The linemen will then remove the rollers and tie the conductors to the insulators. Primary jumpers will be installed on

Attachment A

McHugh Blvd. to energize the new conductors. All taps and transformer banks will then be reconnected to the new circuit. The primary jumpers on the old circuit will be cut at McHugh Blvd. and the old circuit removed from the new pole line. The French Creek 300 and 400 area, in and around Barker Street, most all the poles will be replaced. This is the procedure which will be followed when replacing poles in energized lines. Two bucket trucks and a digger derrick will be used to replace the poles. Linemen will cover all energized conductors within the work zone with voltage rated rubber goods. One lineman will untie two conductors and secure one behind him on the boom and one in the jib arm. The other lineman will untie the other conductor and secure it in the jib arm. The linemen will then move the conductors out away from the work zone. The old pole will be pulled and the new pole installed. The linemen will then place the conductors back onto insulators and secure them. Rubber goods will be removed only after all work is completed in the work zone.

Phase # 5 Deenergized: We will be building a new tie circuit on Connor Street the only hot work required is at each end of the circuit. On the Gonzalez end we will cover with rubber goods the feeder which the new line will pass under. The other end of the circuit runs to Pole # FC73 and turns one span to pole # FC75 where the new circuit ends. We will replace pole # FC73 hot so that the new circuit can be pulled and sagged. Linemen will cover with rubber goods all hot conductors secure to bucket trucks and move them out of the work zone. Crew will pull the old pole out dig hole is same spot and set new pole. Linemen will tie conductors to temporary standoff arms until day of outage. We will ask for an outage to replace pole # FC74 which is a primary riser pole. During the outage we will replace the span between pole # FC73 and pole # FC75.

Phase # 5 Energized: Primary jumpers will be installed to energize the new feeder back to an open GOAB switch near Gonzalez Road. We will be changing out almost all the poles on the line that extends from Connor Street at the Sewage Plant down Gonzalez Road to its dead end on Reasoner Street. From Reasoner Street back out to Gonzales Road and back up to Julian C. Smith Road most all the poles will be replaced. At the dead end of this line near FC520 we will construct a new 3 span loop tie line and install a GOAB switch. On Pole # FR20 linemen will cover all conductors in the work zone and attach a steel arm to the pole and dead end the conductors once new line is sagged primary jumpers will be installed to energize the feeder to an open GOAB switch. On the opposite side of the parking lot linemen will again cover all energized conductors at pole # FC43 and sag the new line from pole # FC44. They will then install primary jumpers at pole # FC43 which will energize the line up to an open GOAB switch. All rubber goods will be removed when linemen are ready to exit the work zone .

Phase # 6 Deenergized: We will be constructing a new double circuit in the existing line. We will get all underground utilities located before work will begin. Once the existing feeder has been move up on all poles rollers will be installed on the bottom circuit then nonconductive rope will be pulled into the rollers from beginning to end of construction. Each of the three 394.5 AAA conductors will be pulled in under tension were necessary to avoid energized lines. Once all conductors are in position linemen will jack all conductors into proper sag with a band hoist. The linemen will then remove the rollers and tie the conductors to the insulators.

Phase # 6 Energized:
Starting at the new French Creek Substation at the corner McHugh Blvd. and Sneads Ferry Road to the intersection of Marines Road and Sneads Ferry Road We will construct a double circuit feeder in the same line as the existing circuit. We will be framing and setting 40 poles and installing required anchors and guy lines to Progress Energy Specifications. Two bucket trucks and a digger derrick will be used to replace the poles. Linemen will cover all energized conductors within the work zone with voltage rated rubber goods. One lineman will untie two conductors and secure one behind him on the boom and one in the jib arm of the bucket truck. The other lineman will untie the neutral and cable TV and let them float then untie the other conductor and secure it in the jib arm. The linemen will then spread the conductors out away from the work zone. The old pole will be pulled and the new pole installed. The linemen will then place the conductors back onto insulators on the top and secure them. We will be installing 1 GOAB switch in this phase of the project. Two bucket trucks and one digger derrick will be set up at each site where a double dead end will be cut into an energized circuit. Linemen will cover all energized parts within his work zone with voltage rated insulated rubber goods. They will then untie the conductors secure them to bucket boom and mount the GOAB switch on existing pole or replace pole and then mount GOAB switch. They will place a hot band hoist on each conductor and snug the hoist. They will install mechanical jumpers and cut the conductor between the jumper ends. They will attach the conductors to dead end shoes on both sides of the GOAB switch. The switch will be closed then the mechanicals will be removed and all the rubber goods.

Part I (3) Justification of why the circuit/equipment cannot be de-energized or the work deferred until the next scheduled outage:

Phase # 1: This phase will affect electrical power to all buildings on Sneads Ferry Road, Piney Green Road, Highway 172, French Creek buildings on Gonzalez Road from FC436 (Main Sewage Plant) out to Sneads Ferry Road, Onslow Beach, Courthouse Bay and the Amphibious Area. Required electrical outages to work this phase de-energized would take 30 working days, energized work will take 30-35 days. Lengthy power outages will degrade the commands ability to perform its duties. Marines, Sailors, Dependents, civilian employees and contractors would be greatly impacted. The main sewage plant, FC436, would have to run on generator power for weeks with limited back up if a generator fails. The command at MCB has turned down our formal request to have the required outages for this phase of construction.

Phase # 2: This phase will affect electrical power to all buildings in the Central Area, the Mall Complex and the Regimental areas from A Street to G Street. and all buildings located south and east of Wallace Creek including all of Piney Green Road. Eight of the eleven feeders that exit Substation # 1 would have to be de-energized for 1 working day each plus

10 working days to pull in the Central area circuit. Lengthy power outages will degrade the commands ability to perform its duties. Required electrical outages will be 18 working days for this phase of the project, energized work will take 18-25 days. Lengthy power outages will degrade the commands ability to perform its duties. Marines, Sailors, Dependents, civilian employees and contractors would be greatly impacted. The command at MCB has turned down our formal request to have the required outages for this phase of construction.

Phase # 3: This phase will affect electrical power to all buildings that are feed from Regimental # 3, Regimental # 2 and French Creek # 1 Feeders. Each feeder will require lengthy power outages for days at the time a total of 60 working days would be required to work this phase de-energized, energized work will take 60-65 days. This will degrade the commands ability to perform its duties. Marines, Sailors, Dependents, civilian employees and contractors would be greatly impacted. The command at MCB has turned down our formal request to have the required outages for this phase of construction.

Phase #4: This phase will affect electrical power to all buildings that are connected to French Creek #2. The areas from Lyman Road down Sneads Ferry to McHugh Blvd. then on McHugh to Daly and South to Conner Street. The feeder will require lengthy power outages for up to 50 working days, energized work will take 50-60 days. This will degrade the commands ability to perform its duties. Marines, Sailors, Dependents, civilian employees and contractors would be greatly impacted. The command at MCB has turned down our formal request to have the required outages for this phase of construction.

Phase #5: This phase will affect electrical power to all buildings from Conner Street Southard to Gonzalez in the French Creek Area. The feeder will require lengthy power outage for 70 working, days energized work will take 70-75 days. This will degrade the commands ability to perform its duties. Marines, Sailors, Dependents, civilian employees and contractors would be greatly impacted. The command at MCB has turned down our formal request to have the required outages for this phase of construction.

Phase # 6: This phase will affect electrical power to all buildings in Courthouse Bay, Amphibious Area, Onslow Beach and all of Hwy.172 buildings. Required electrical outages to work this phase de-energized would take 60 working days, energized work will take 60-70 days. Lengthy power outages will degrade the commands ability to perform its duties. Marines, Sailors, Dependents, civilian employees and contractors would be greatly impacted. The command at MCB has turned down our formal request to have the required outages for this phase of construction.

CONTRACTOR ENERGIZED ELECTRICAL WORK PERMIT

CONTRACT NUMBER: N40085-11-D-4030 HP (P1264) & FC (P1265) Electrical Supply

Attachment A

Part II (1) Detailed job description procedure to be used in performing the above detailed work:

Our Company's competent person will perform a pre-work site inspection, document findings and follow daily go/no-go procedures. All automatic reclosing devices between the work site and the source will be placed in a non-reclosing position. Lockout, tag out procedures will be followed on each of the reclosing devices. When all energized circuits are placed in non-reclosing position hot work can begin. Crew foreman will conduct a site meeting informing his crew of the task to be accomplished and the procedures which will be followed to accomplished the task in a safe matter. He will update crew when necessary as conditions change throughout the day. Linemen will cover all energized conductors and jumpers with voltage rated rubber hoses, blankets or device covers. Rubber goods will only be moved far enough for the lineman to make proper connections and then recover. Energized conductors will be moved and secured in a spread position allowing room to install new and remove old poles, lines, GOABS and other equipment. Linemen will install mechanical insulated jumpers when necessary to keep circuits energized. New circuits, switches, GOABS, jumpers and devices will be connected to the new circuit or reconnected to the old. Rubber cover devices will be removed when all personnel are in the clear the reclosing devices will be put back into automatic reclosing.

Part II (1) Description of Safe Work practices to be employed:

T&D Solutions, Inc. will perform Daily Job Briefing, Pre-Work Site Inspections and follow daily Go/No-Go procedures.

T&D Solutions, Inc. Safety person will perform continuous electrical safety audit per NFPA 70E paragraph 110.7 (H) for all energized work.

T&D Solutions, Inc. will have the appropriate recloser(s) set to one shot fastest acting position and tag/signage placed.

All employees will be CPR and First Aid trained

All Lockout and Tag-out procedures will be in place.

All employees will wear the proper PPE and 8 cal/cm2 clothing.

All aerial devices will have up to date test reports on load test and current leakage.

All rubber goods will be inspected before using and test dates will be visible.

All tools shall be inspected for proper operation prior to use. Pads will be used under outriggers whenever they are deployed. Road signs will be in place at all times when work is near a roadway.

Linemen are required to wear rubber gloves and sleeves at all times unless the circuit is grounded within their eye sight on both sides of their work zone.

Progress Energy

Progress Energy Carolinas
High Voltage Services
350 Arrington Bridge Road
Goldsboro, NC 27530

September 8, 2009

Elwood Whaley
E&R, INC
PO Box 3552
Kinston, NC 28502

Subject: Arc Flash Hazard Analysis – Camp Lejeune Nine (9) 12KV Feeders

Dear Mr. Whaley;

The study for the subject project has been completed and is provided in this report. This study is based on industry standards and guidelines. In addition, specific to this project there are some design and operation guidelines which must be observed as follows:

1. Study is based on the system after the completion of the Wallace Creek feeder improvement project including conductor size, framing, line routing and configuration.
2. Study is based on the existing settings of the feeder circuit relay and other protective devices.
3. Study is based on all work being performed with feeder circuit breaker relays and reclosers having the automatic reclosing feature disabled. The relays shall be set on instantaneous operation only.
4. Camp Lejeune may impose/require additional arc flash protection requirements above those listed in this report.

If you should have any questions concerning these guidelines or interpreting the enclosed information, please contact me.

Thank you for the opportunity to provide this service. If I can be of further assistance, don't hesitate to contact me at office# 919-583-2069 or mobile# 919-812-0767.

Respectfully,

William J. Janning, Jr PE
Project Manager

Enclosures

UTILITY TECHNOLOGY

Engineers-Consultants

Progress Energy
Camp Lejeune Primary Distribution
Report on Arc Flash Hazard Analysis

Project No. 090106
File No. 14.0000
August 28, 2009

Mr. Joey Janning
350 Arrington Bridge Rd.
Goldsboro, NC 27530

Dear Mr.Janning:

UTEC has performed arc flash hazard analyses for selected points on the Camp Lejeune primary electric distribution system as identified in your spreadsheet LEJEUNE #1-#2 FC TOTAL 8-13-09.xls. The objective of the analyses is to determine the arc flash protection boundaries, the levels of incident arc energy, and the hazard/risk categories required by NFPA 70E.

Enclosed is a pdf file of the spreadsheet which has been sealed and signed by Mr. James T. Ghrist, our engineer that was in responsible charge of the analysis. Also enclosed is the spreadsheet in Excel format if you need it for other purposes.

The analyses were made based on the following criteria, using Progress Energy supplied fault current and clearing times.

Arc Hazard Calculation Factors, Equations, and Assumptions

Arc hazard incident energy calculated using ArcPro® Version 2.0, by Kinectrics, Inc.

Arc gap	2	in	See NESC C2-2007, Table 410-1, Note 1
Separation distance	15	in	See NESC C2-2007, Table 410-1, Note 1
Arcing current assumed to equal Max LG fault current			
Arc flash protection boundary energy			See NFPA 70E-2009 ¶ 130.3(A)(2)
Clearing time <= 0.1 sec	1.5	cal/cm²	
Clearing time > 0.1 sec	1.2	cal/cm²	

Please let us know if you have any questions or comments.

Very truly yours,

J. Ted Orrell

J. Ted Orrell, PE
Partner
Utility Technology

Enclosure

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Suite B
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(336) 625-0917 FAX (336) 625-0919

2375 EAST MAIN STREET
SUITE A 206
SPARTANBURG, SC 29307
(864) 579-1577 FAX (864) 579-1583

Camp Lejeune Primary Distribution Arc Hazard Analysis

NORTH CAROLINA PROFESSIONAL SEAL 022236 ENGINEER JAMES T. GHRIST

9/1/09

Limits of Utility Technology, Engineers-Consultants (UTEC) Analysis:

Incident energy, arc flash protection boundaries, and hazard/risk categories have been calculated based on input data provided by Progress Energy. Input data furnished to UTEC includes clearing time and fault current.

Feeder Id	Section Id	kVLN	Clearing Time (Sec) (Note 1)	Equivalent Wire	LLL (Amps)	LLG (Amps)	LL (Amps)	LG Max (Amps)	Protective Device	Total Distance from Sub	Incident Energy (cal/cm²)	Protection Boundary (in)	NFPA 70E Hazard/Risk Category
CRTHSEBAY	Breaker	7.6			12796	13015	11081	13200		0			
CRTHSEBAY	Disconnect	7.6	0.088	#336 ACSR	12793	13011	11079	13195	Bkr QT	1	1.63	15.6	1
CRTHSEBAY	CHB1D	7.6	0.088	#336 ACSR	7705	7156	6673	6045	Bkr QT	3174	0.5590	9.1	0
CRTHSEBAY	CHB1E	7.6	0.088	#336 ACSR	5441	4987	4712	3883	Bkr QT	6502	0.3130	6.8	0
CRTHSEBAY	CHB1G	7.6	0.088	#336 ACSR	3270	2999	2832	2155	Bkr QT	13952	0.1400	4.6	0
CRTHSEBAY	CHB1H1-	7.6	0.088	#336 ACSR	2377	2182	2059	1520	Bkr QT	20942	0.0876	3.6	0
CRTHSEBAY	CHB1J	7.6	0.088	#336 ACSR	2191	2011	1897	1392	Bkr QT	23118	0.0777	3.3	0
CRTHSEBAY	CHB1K	7.6	0.088	#336 ACSR	1701	1562	1473	1064	Bkr QT	31105	0.0524	2.7	0
CRTHSEBAY	CHB1L1	7.6	0.088	#336 ACSR	1481	1361	1283	920	Bkr QT	36404	0.0426	2.4	0
CRTHSEBAY	CHB-B	7.6	0.954	#4 BC	1007	954	872	656	QA 125	45211	0.2910	7.3	0
CRTHSEBAY	CHB-B1	7.6	0.471	#2 ACSR	0	0	0	555	QA 75	50329	0.1110	4.6	0
CRTHSEBAY	CHB-C2	7.6	1.365	#1/0 AL XLP	826	789	716	551	QA 125	52021	0.3190	7.8	0
CRTHSEBAY	CHB-D1	7.6	1.8679	#4 BC	695	670	602	473	QA 125	57678	0.3460	8.6	0
CRTHSEBAY	CHB-F1	7.6	2.720	#4 BC	569	553	493	394	QA 125	65447	0.3930	9.5	0
CRTHSEBAY	CHB-F2	7.6	3.032	#1/0 ACSR	543	528	470	377	QA 125	68417	0.4110	9.3	0
CRTHSEBAY	CHB-F4	7.6	3.336	#1/0 ACSR	528	513	457	366	QA 125	70260	0.4340	9.0	0
CRTHSEBAY	CHB1M-	7.6	0.088	#336 ACSR	1419	1304	1229	880	Bkr QT & OC	38196	0.0402	2.3	0
CRTHSEBAY	CHB1M-5	7.6	0.066	#1/0 CU	1116	1036	967	712	CB-2 WE	46836	0.0288	1.7	0
CRTHSEBAY	CHB1M-7	7.6	0.066	#1/0 CU	1058	983	916	675	CB-2 WE	49012	0.0211	1.7	0
CRTHSEBAY	CHB1M 9	7.6	0.067	#1/0 CU	950	884	822	607	CB-2 WE	53722	0.0181	1.5	0
CRTHSEBAY	CHB1M1-	7.6	0.088	#336 ACSR	1377	1215	1145	817	Bkr QT & OC	41345	0.0366	2.2	0
CRTHSEBAY	CHB1M1-B	7.6	0.911	#4 BC	1056	990	915	671	QA 125	46772	0.2870	7.5	0
CRTHSEBAY	CHB1N	7.6	0.088	#336 ACSR	1166	1072	1010	717	Bkr QT & ST	47463	0.0307	2.0	0
CRTHSEBAY	CHB1N1-	7.6	0.194	#336 ACSR	1074	987	930	659	CB-3 V6H	51943	0.0591	3.2	0
CRTHSEBAY	CHB1N1-D	7.6	0.334	#1/0 AAAC	791	745	685	506	CB-3 V6H	61391	0.0678	3.5	0
CRTHSEBAY	CHB1N3	7.6	0.232	#336 ACSR	973	894	842	595	CB-3 V6H	57831	0.0613	3.3	0
CRTHSEBAY	CHB1N4-	7.6	0.269	#336 ACSR	907	834	786	553	CB-3 V6H	62329	0.0623	3.3	0

12/45

Camp Lejeune Primary Distribution Arc Hazard Analysis

Limits of Utility Technology, Engineers-Consultants (UTEC) Analysis:

Incident energy, arc flash protection boundaries, and hazard/risk categories have been calculated based on input data provided by Progress Energy. Input data furnished to UTEC includes clearing time and fault current.

Feeder Id	Section Id	kVLN	Clearing Time (Sec) (Note 1)	Equivalent Wire	LLL (Amps)	LLG (Amps)	LL (Amps)	LG Max (Amps)	Protective Device	Total Distance from Sub	Incident Energy (cal/cm²)	Protection Boundary (in)	NFPA 70E Hazard/Risk Category
CRTHSEBAY	CHB1N4-4	7.6	0.344	#4 BC	0	750	699	500	CB-3 V6H	66263	0.0683	3.5	0
CRTHSEBAY	CHB1N6	7.6	0.304	#336 ACSR	863	794	748	526	CB-3 V6H	65725	0.0659	3.5	0
CRTHSEBAY	CHB1N6C	7.6	0.0659	394.5 AAAC	844	776	731	514	CB-4 WE	67313	0.0138	1.2	0
CRTHSEBAY	CHB1N9	7.6	0.066	#1/0 CU	784	721	679	476	CB-4 WE	71972	0.0124	1.2	0
CRTHSEBAY	CHB2A	7.6	0.389	#1/0 CU	785	723	680	479	CB-3 V6H	70922	0.0733	3.7	0
CRTHSEBAY	CHB2F	7.6	5.000 (Note 2)	#1/0 CU	643	593	557	392	CB-3 V6H	83543	0.0717	14.6	0
FC#1	Breaker	7.6			12796	13015	11081	13200		0			
FC#1	Disconnect	7.6	0.088	#336 ACSR	12793	13011	11079	13195	Bkr QT	1	1.6300	15.6	1
FC#1	FC1A3	7.6	0.088	#336 ACSR	8162	7758	7069	6476	Bkr QT	2586	0.6130	9.5	0
FC#1	FC1A4	7.6	0.088	#336 ACSR	6802	6370	5890	5054	Bkr QT	3994	0.4390	8.0	0
FC#1	FC1A5	7.6	0.088	#336 ACSR	5773	5339	4999	4179	Bkr QT	5492	0.3440	7.1	0
FC#1	FC1A6	7.6	0.088	#336 ACSR	4875	4463	4222	3453	Bkr QT	7310	0.2690	6.3	0
FC#1	FC1A7	7.6	0.088	#336 ACSR	4186	3805	3625	2918	Bkr QT	9230	0.2150	5.6	0
FC#1	FC1A9	7.6	0.088	#336 ACSR	3627	3288	3141	2468	Bkr QT	11483	0.1710	5.0	0
FC#1	FC1A9B	7.6	0.151	#336 ACSR	3301	2997	2858	2215	FC 1-2 WE	13147	0.2500	6.8	0
FC#1	FC1A9D3	7.6	0.066	#1/0 CU	2680	2451	2321	1793	FC 1-3 WE	16372	0.0815	3.4	0
FC#1	FC1AD7	7.6	0.066	#2/0 ACSR	2199	2028	1904	1480	FC 1-3 WE	19291	0.0635	3.0	0
FC#1	FC1A9G	7.6	0.153	#2/0 ACSR	2464	2264	2134	1657	FC 1-2 WE	17319	0.0170	5.6	0
FC#1	FC1A11	7.6	0.066	#2/0 ACSR	2711	2493	2348	1849	FC 1-1 WE	14863	0.0848	3.5	0
FC#1	FC1A15	7.6	0.0658	#2/0 ACSR	2188	2011	1877	1485	FC 1-1 WE	18115	0.0638	3.0	0
FC#2	Breaker	7.6			12796	13015	11081	13200		0			
FC#2	Disconnect	7.6	0.088	#336 ACSR	12793	13011	11079	13195	Bkr QT	1	1.6300	15.6	1
FC#2	FC2A3	7.6	0.088	#336 ACSR	9462	9122	8194	8118	Bkr QT	1613	0.8300	11.1	0
FC#2	FC2A5	7.6	0.088	#336 ACSR	7508	7040	6502	5993	Bkr QT	3200	0.5530	9.0	0
FC#2	FC2A5-B	7.6	0.052	#4 BC	4506	4253	3902	3352	QA 125	6194	0.1500	4.6	0

Camp Lejeune Primary Distribution Arc Hazard Analysis

Limits of Utility Technology, Engineers-Consultants (UTEC) Analysis:

Incident energy, arc flash protection boundaries, and hazard/risk categories have been calculated based on input data provided by Progress Energy. Input data furnished to UTEC includes clearing time and fault current.

Feeder Id	Section Id	kVLN	Clearing Time (Sec) (Note 1)	Equivalent Wire	LLL (Amps)	LLG (Amps)	LL (Amps)	LG Max (Amps)	Protective Device	Total Distance from Sub	Incident Energy (cal/cm²)	Protection Boundary (in)	NFPA 70E Hazard/Risk Category
FC#2	FC2A5-B2	7.6	0.030	#1/0 ACSR	3410	3271	2953	2526	QA 60	8178	0.0601	2.9	0
FC#2	FC2A5-B3	7.6	0.035	#2 ACSR	0	0	0	2068	QA 60	9740	0.0518	2.7	0
FC#2	FC2A5-G	7.6	0.123	VARIOUS	2470	2419	2139	1895	QA 125	9766	0.1640	5.5	0
FC#2	FC2A5-H	7.6	0.172	#1/0 ACSR	2051	2010	1776	1544	QA 125	12684	0.1750	5.6	0
FC#2	FC2A5-H2	7.6	0.472	#4 BC	1229	1231	1065	927	QA 125	20319	0.2300	6.6	0
FC#2	FC2A5-J	7.6	0.238	#4 BC	1713	1683	1483	1300	QA 125	14945	0.1910	6.0	0
FC#2	FC2A5-J2	7.6	0.375	#2 CU XLP	1357	1332	1175	1038	QA 125	19510	0.2140	6.3	0
FC#2	FC2A5-L	7.6	0.420	#4 BC	1288	1272	1116	982	QA 125	19445	0.1940	6.4	0
FC#2	FC2A5-O	7.6	0.542	#4 BC	1131	1114	979	866	QA 125	22856	0.2420	6.7	0
FC#2	FC2A6	7.6	0.088	#336 ACSR	5225	4782	4525	3865	Bkr QT	6528	0.3110	6.8	0
FC#2	FC2A6D	7.6	0.088	#1/0 CU	4190	3841	3628	2920	Bkr QT	8729	0.2150	5.6	0
FC#2	FC2A6-	7.6	0.119	#4 BC	2672	2562	2314	1939	QA 125	11597	0.1620	5.5	0
FC#2	FC2A6-D	7.6	0.3493	#1/0 ACSR	1483	1424	1284	1075	QA 125	22027	0.2110	6.3	0
FC#2	FC2A9	7.6	0.0657	#336 ACSR	3103	2841	2687	2153	FC2-1 WE	13965	0.1050	3.9	0
FC#2	FC2B	7.6	0.0657	#336 ACSR	2790	2556	2416	1919	FC2-1 WE	16013	0.0889	3.6	0
FC#2	FC2B1	7.6	0.0658	#336 ACSR	2453	2248	2124	1672	FC2-1 WE	18803	0.0746	3.2	0
FC#2	FC2B-A	7.6	0.0658	#2 ACSR	2158	2013	1869	1485	FC2-1 WE	19699	0.0638	3.0	0
FC#2	FC2D	7.6	0.0658	#336 ACSR	2326	2192	2015	1580	FC2-1 WE	20058	0.0693	3.2	0
PP#1	Breaker	7.6			12796	13015	11081	13200		0			
PP#1	Disconnect	7.6	0.088	#336 ACSR	12793	13011	11079	13195	Bkr QT	1	1.6300	15.6	1
PP#1	PP1A1	7.6	0.088	#336 ACSR	7825	7275	6776	6201	Bkr QT	3123	0.5790	9.3	0
PP#1	PP1A2	7.6	0.088	#336 ACSR	6211	5744	5379	4711	Bkr QT	4889	0.4010	7.7	0
PP#1	PP1A3	7.6	0.088	#336 ACSR	5477	5054	4743	4034	Bkr QT	6118	0.3290	7.0	0
PP#1	PP1A4	7.6	0.088	#336 ACSR	4729	4358	4096	3380	Bkr QT	7756	0.2620	6.2	0

Camp Lejeune Primary Distribution Arc Hazard Analysis

Limits of Utility Technology, Engineers-Consultants (UTEC) Analysis:

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Feeder Id	Section Id	kVLN	Clearing Time (Sec) (Note 1)	Equivalent Wire	LLL (Amps)	LLG (Amps)	LL (Amps)	LG Max (Amps)	Protective Device	Total Distance from Sub	Incident Energy (cal/cm²)	Protection Boundary (in)	NFPA 70E Hazard/Risk Category
REG#1	Disconnect	7.6	0.088	#336 ACSR	12793	13011	11079	13195	Bkr QT	1	1.6300	15.6	1
REG#1	REG1A1	7.6	0.088	#336 ACSR	7970	7469	6902	6575	Bkr QT	2879	0.3150	6.8	0
REG#1	REG1A2A	7.6	0.088	#336 ACSR	6282	5808	5440	4870	Bkr QT	4811	0.4180	7.9	0
REG#1	REG1A2B	7.6	0.0446	#4/0 ACSR	4938	4567	4276	3629	R1-1 V6H	6896	0.1450	4.6	0
REG#1	REG1A3	7.6	0.088	#336 ACSR	5631	5196	4877	4268	Bkr QT	5861	0.3540	7.2	0
REG#1	PP1A4A-	7.6	0.088	#336 ACSR	3852	3597	3336	3132	Bkr QT	10185	0.2370	5.9	0
REG#1	REG1BA2	7.6	0.1556	#4/0 ACSR	4363	4036	3778	3158	R1-2 WE	8267	0.4230	8.9	0
REG#1	REG1B2	7.6	0.1546	#336 ACSR	4586	4221	3972	3300	R1-2 WE	8343	0.4450	9.1	0
REG#1	REG1B1A1	7.6	0.1556	#4/0 ACSR	4337	4010	3756	3132	R1-2 WE	8395	0.4190	8.8	0
REG#1	REG1B1-B1-	7.6	0.0656	#4/0 CU XLP	3893	3619	3372	3046	R1-4 WE	10211	0.1710	4.9	0
REG#2	Breaker	7.6			12796	13015	11081	13200		0			
REG#2	Disconnect	7.6	0.088	#336 ACSR	12793	13011	11079	13195	Bkr QT	1	1.6300	15.6	1
REG#2	REG2A2	7.6	0.088	#336 ACSR	6964	6457	6031	5532	Bkr QT	3814	0.4960	8.6	0
REG#2	REG2B1	7.6	0.088	#336 ACSR	5622	5180	4869	4162	Bkr QT	5964	0.3420	7.1	0
REG#2	REG2B2	7.6	0.088	#336 ACSR	4724	4345	4091	3359	Bkr QT	8038	0.2590	6.1	0
REG#2	REG2B7	7.6	0.1512	#336 ACSR	3245	2982	2811	2169	R2-1 WE	19926	0.2420	6.7	0
REG#2	REG2B7A	7.6	0.0659	#1/0 CU	3249	3004	2814	2298	R2-2 WE	19022	0.1160	4.1	0
REG#2	REG2B5A	7.6	0.151	#336 ACSR	3442	3163	2981	2319	R2-1 WE	12851	0.2670	7.1	0
REG#2	REG2D	7.6	0.047	#336 ACSR	4284	3938	3710	2988	R2-3 V6H	9369	0.1190	4.1	0
REG#2	REG2C8	7.6	0.061	#336 ACSR	3778	3472	3272	2615	R2-2 WE	11084	0.1270	4.2	0
REG#3	Breaker	7.6			12796	13015	11081	13200		0			
REG#3	Disconnect	7.6	0.088	#336 ACSR	12793	13011	11079	13195	Bkr QT	1	1.6300	15.6	1
REG#3	REG3A1	7.6	0.088	#4/0 CU	6795	6278	5884	5212	Bkr QT	4019	0.4590	8.2	0

15/45

Camp Lejeune Primary Distribution Arc Hazard Analysis

Limits of Utility Technology, Engineers-Consultants (UTEC) Analysis:

Incident energy, arc flash protection boundaries, and hazard/risk categories have been calculated based on input data provided by Progress Energy. Input data furnished to UTEC includes clearing time and fault current.

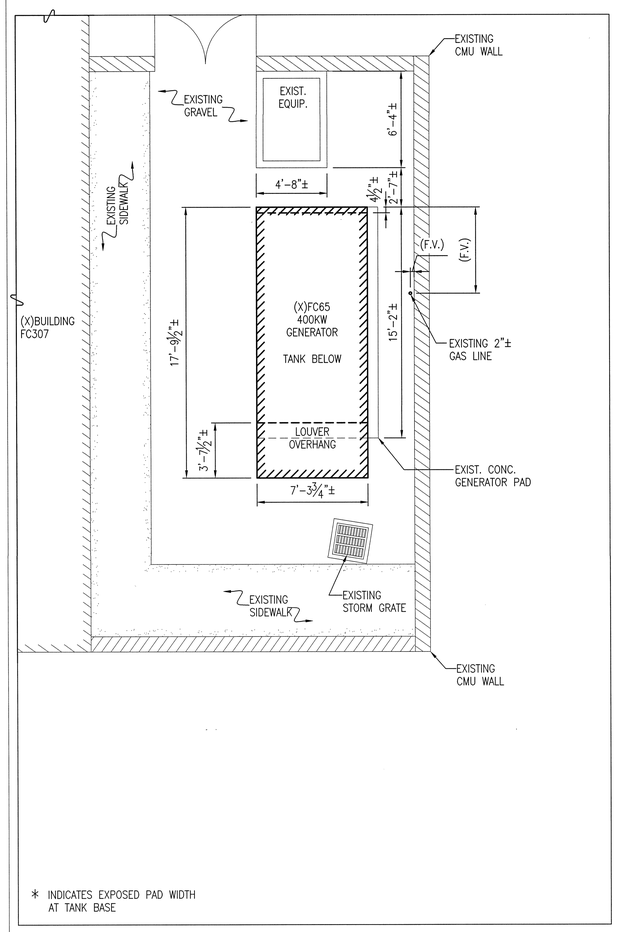
Feeder Id	Section Id	kVLN	Clearing Time (Sec) (Note 1)	Equivalent Wire	LLL (Amps)	LLG (Amps)	LL (Amps)	LG Max (Amps)	Protective Device	Total Distance from Sub	Incident Energy (cal/cm²)	Protection Boundary (in)	NFPA 70E Hazard/Risk Category
REG#3	REG3A2A	7.6	0.088	#4/0 CU	5515	5080	4776	4021	Bkr QT	5964	0.3280	7.0	0
REG#3	REG3B2	7.6	0.088	#1/0 ACSR	3740	3512	3239	2548	Bkr QT	9856	0.1790	5.1	0
REG#3	REG3C	7.6	0.088	#336 ACSR	4712	4335	4081	3320	Bkr QT	7859	0.2550	6.1	0
REG#3	REG3A2F	7.6	0.088	#1/0 ACSR	3694	3455	3199	2632	Bkr QT	10104	0.1870	5.2	0
Wall Crk	Bus	7.6			12796	13015	11081	13200		0			
Wall Crk	Disconnect	7.6	0.088	#336 ACSR	12793	13011	11079	13195	Bkr QT	1	1.6300	15.6	1
Wall Crk	W3	7.6	0.088	#336 ACSR	12093	12172	10473	10969	Bkr QT	258	1.2500	13.7	1
Wall Crk	WC12	7.6	0.088	#394.5 AAAC	9020	8660	7811	7622	Bkr QT	1871	0.7630	10.7	0
Wall Crk	WC9A	7.6	0.088	#336 ACSR	9771	9518	8462	8541	Bkr QT	1364	0.8890	11.5	0
Wall Crk	WC18	7.6	0.088	#336 ACSR	8546	8164	2192	7401	Bkr QT	2192	0.7330	10.5	0
Wall Crk	E21	7.6	0.088	#336 ACSR	2711	2469	2348	1746	Bkr QT	16006	0.1050	3.9	0
Wall Crk	E14	7.6	0.088	#336 ACSR	2565	2328	2222	1644	Bkr QT	17283	0.0972	3.7	0
Wall Crk	A44	7.6	0.088	#336 ACSR	2528	2292	2189	1618	Bkr QT	17632	0.0952	3.7	0
Wall Crk	E21A3	7.6	0.088	#1/0 CU	2458	2226	2129	1580	Bkr QT	17772	0.0923	3.7	0

Notes:

1. Clearing time is for LG Max fault. Where no value is given in Progress Energy input data, and the fault current exceeds the 50G pickup current, a value of 0.088 seconds is used.
2. "No Protection" is indicated in Progress Energy input data. A clearing time of 5 seconds is used on the assumption that the lineman will move away from an arc in no more than 5 seconds.

16/45

REVISIONS			
SYM		DATE	APPROVED

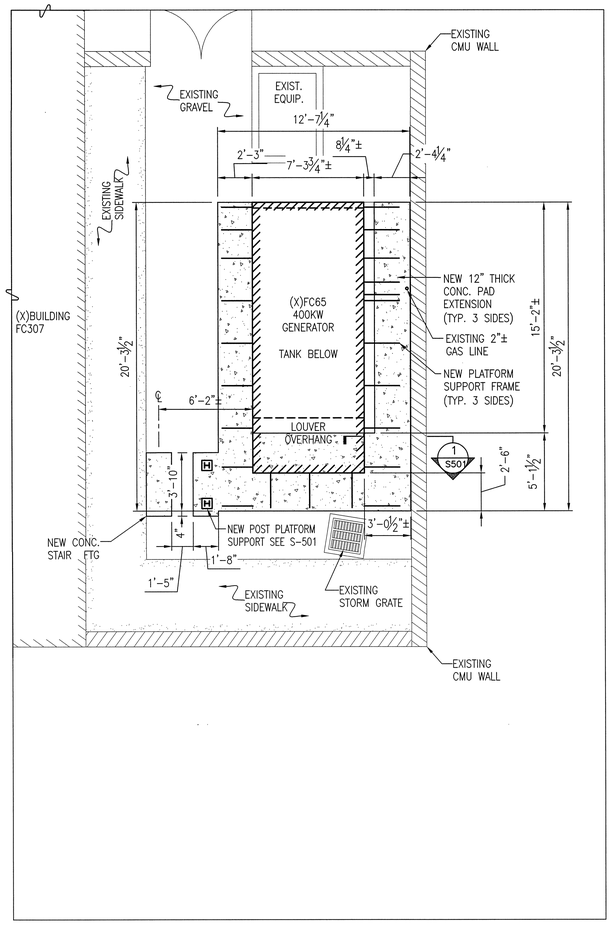


* INDICATES EXPOSED PAD WIDTH AT TANK BASE

EXISTING / DEMOLITION PAD LEVEL PLAN GENERATOR FC65

SCALE: 1/4"=1'-0" T/PAD = 1"± TO 2"± ABOVE GRADE

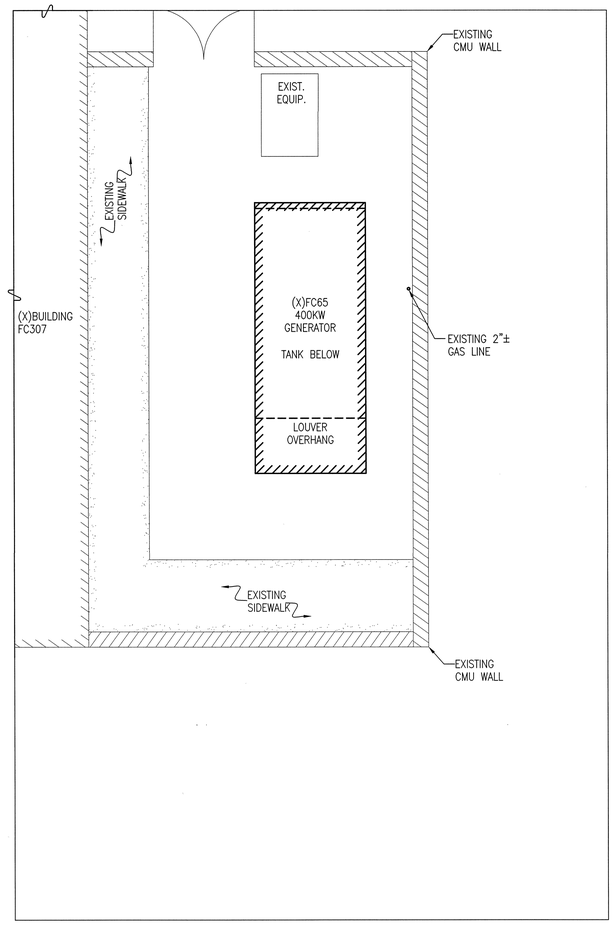
PLAN NORTH



MODIFIED PAD LEVEL PLAN GENERATOR FC65

SCALE: 1/4"=1'-0"

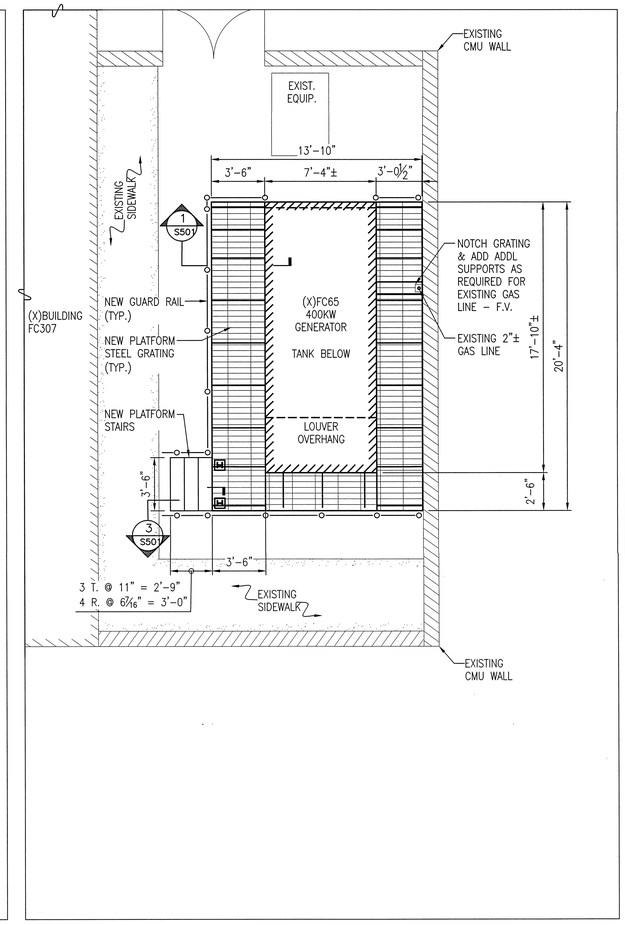
PLAN NORTH



EXISTING PLATFORM LEVEL PLAN (NO WORK) GENERATOR FC65

SCALE: 1/4"=1'-0"

PLAN NORTH



NEW PLATFORM LEVEL PLAN GENERATOR FC65

SCALE: 1/4"=1'-0" T/PLATFORM = 2'-5 3/4" ABOVE PAD

PLAN NORTH

SAMPLE GENERATOR PLATFORM DRAWINGS

DISCLOSURE OF INFORMATION:

CONTRACTOR SHALL COMPLY AS FOLLOWS:

A. THE CONTRACTOR SHALL NOT RELEASE TO ANYONE OUTSIDE THE CONTRACTOR'S ORGANIZATION ANY UNCLASSIFIED INFORMATION, REGARDLESS OF MEDIUM (E.G. FILM, TAPE, DOCUMENT), PERTAINING TO ANY PART OF THIS CONTRACT OR ANY PROGRAM RELATED TO THIS CONTRACT, UNLESS–

1. THE CONTRACTING OFFICER HAS GIVEN PRIOR WRITTEN APPROVAL;
OR
2. THE INFORMATION IS OTHERWISE IN THE PUBLIC DOMAIN BEFORE THE DATE OF THE RELEASE.

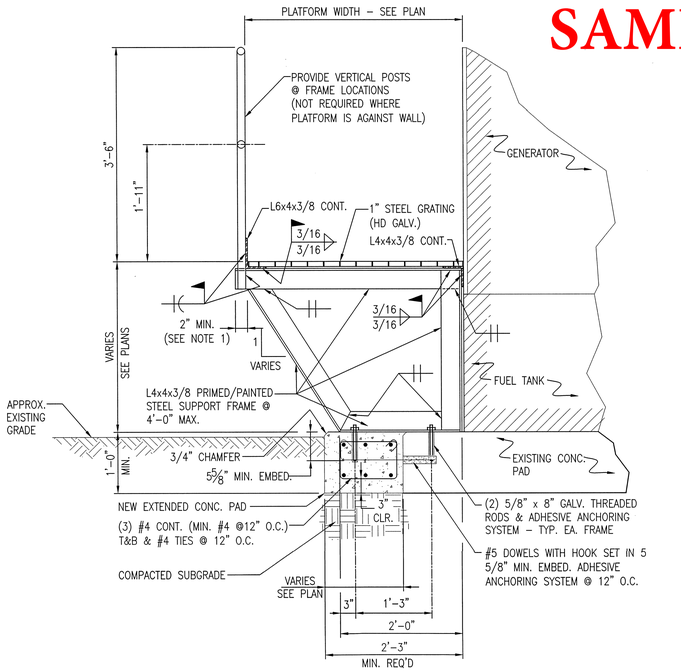
B. REQUESTS FOR APPROVAL SHALL IDENTIFY THE SPECIFIC INFORMATION TO BE RELEASED, THE MEDIUM TO BE USED, AND THE PURPOSE FOR THE RELEASE. THE CONTRACTOR SHALL SUBMIT ITS REQUEST TO THE CONTRACTING OFFICER AT LEAST 45 DAYS BEFORE THE PROPOSED DATE FOR RELEASE.

C. THE CONTRACTOR AGREES TO INCLUDE A SIMILAR REQUIREMENT IN EACH SUBCONTRACT UNDER

[redacted]

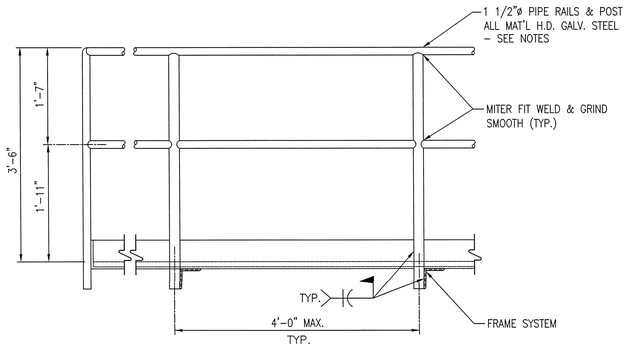
REVISIONS			
SYM		DATE	APPROVED

SAMPLE GENERATOR PLATFORM DRAWING



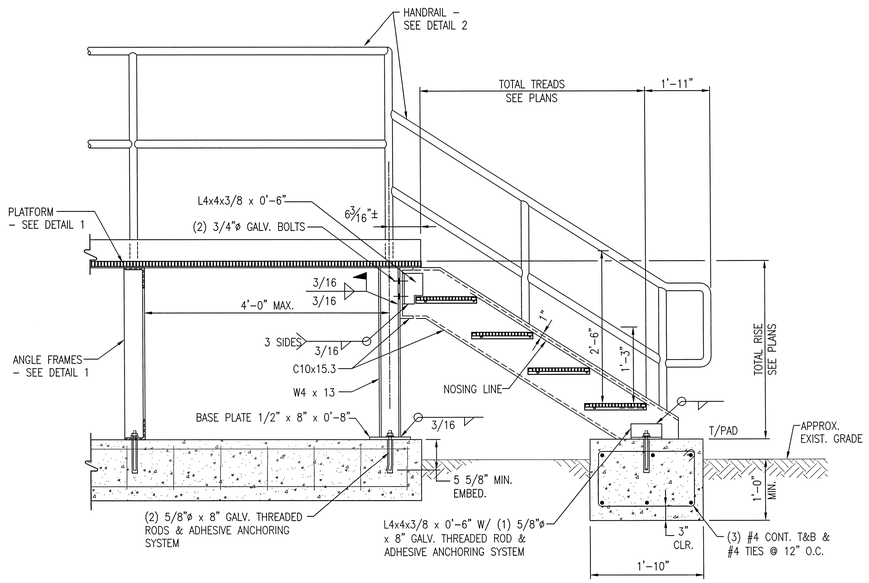
1 - TYPICAL SECTION THRU NEW PLATFORM

SCALE: 1"=1'-0"



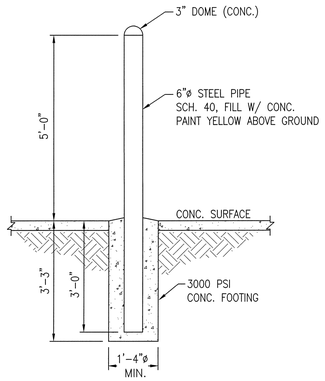
2 - TYPICAL HANDRAIL ELEVATION

SCALE: 1"=1'-0"



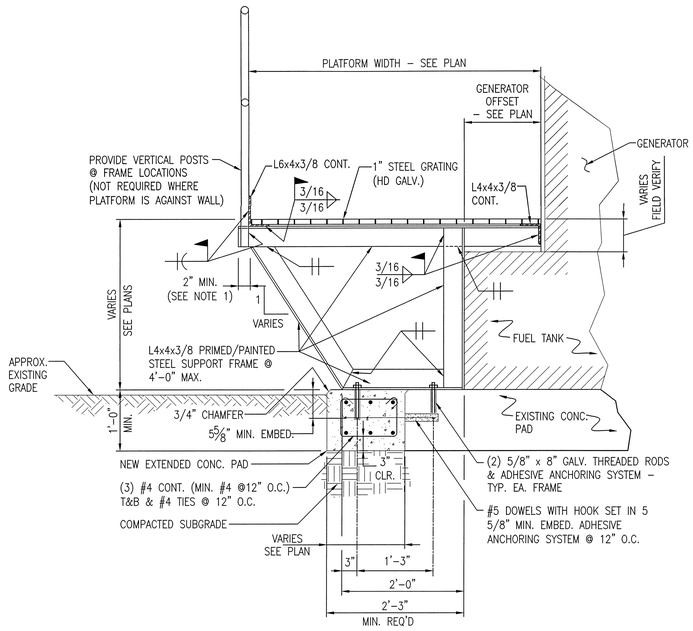
3 - TYPICAL STAIR ELEVATION

SCALE: 1"=1'-0"



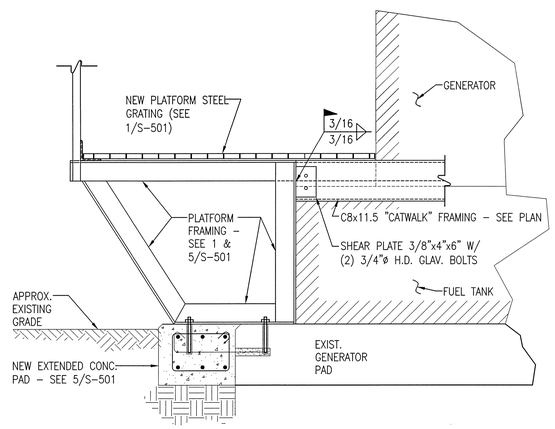
4 - TYPICAL BOLLARD DETAIL

SCALE: N.T.S.



5 - SECTION THRU NEW PLATFORM

SCALE: 1"=1'-0"



6 - SECTION

SCALE: 1"=1'-0"

DISCLOSURE OF INFORMATION:

CONTRACTOR SHALL COMPLY AS FOLLOWS:

A. THE CONTRACTOR SHALL NOT RELEASE TO ANYONE OUTSIDE THE CONTRACTOR'S ORGANIZATION ANY UNCLASSIFIED INFORMATION, REGARDLESS OF MEDIUM (E.G. FILM, TAPE, DOCUMENT), PERTAINING TO ANY PART OF THIS CONTRACT OR ANY PROGRAM RELATED TO THIS CONTRACT, UNLESS–

1. THE CONTRACTING OFFICER HAS GIVEN PRIOR WRITTEN APPROVAL;
OR
2. THE INFORMATION IS OTHERWISE IN THE PUBLIC DOMAIN BEFORE THE DATE OF THE RELEASE.

B. REQUESTS FOR APPROVAL SHALL IDENTIFY THE SPECIFIC INFORMATION TO BE RELEASED, THE MEDIUM TO BE USED, AND THE PURPOSE FOR THE RELEASE. THE CONTRACTOR SHALL SUBMIT ITS REQUEST TO THE CONTRACTING OFFICER AT LEAST 45 DAYS BEFORE THE PROPOSED DATE FOR RELEASE.

C. THE CONTRACTOR AGREES TO INCLUDE A SIMILAR REQUIREMENT IN EACH SUBCONTRACT UNDER

[redacted]

DIVISION 1:

** REFER TO TYPICAL DIVISION 1 PREPARED FOR ALL ECC PROJECTS. **

GENERAL NOTES:

** THESE GENERAL NOTES ARE GENERIC IN NATURE AND ARE NOT SPECIFIC TO ANY PARTICULAR PROJECT. DISREGARD NON-APPLICABLE INSTRUCTIONS AS SHOWN IN THE ROUGH ORDER OF MAGNITUDE MATERIAL TAKE OFF MATRIX OR AS DETERMINED BY THE CONTRACTING OFFICER REPRESENTATIVE (COR). **

GENERAL NOTES AND SPECIFICATIONS

GENERAL NOTES:

1. THE SCOPE OF WORK INDICATES GENERAL CONDITIONS WITH INFORMATION COMPILED FROM FIELD OBSERVATION. CONSTRUCTION AND MATERIALS INDICATED ARE GENERAL IN NATURE AND ARE NOT INTENDED TO FULLY DESCRIBE THE EXISTING CONSTRUCTION PRESENT. THE CONTRACTOR IS RESPONSIBLE TO INSPECT ALL FACILITIES TO BE RENOVATED TO HIS OWN SATISFACTION AND INCLUDE ALL NECESSARY COSTS TO COMPLETELY UPGRADE EACH FACILITY AS DESCRIBED. CONTRACTOR MUST BE RESPONSIBLE FOR ACTUAL FIELD VERIFICATION PRIOR TO BIDDING, ORDERING MATERIALS AND DURING EVERY STEP OF CONSTRUCTION FOR EXISTING SURFACES, DIMENSIONS AND CONDITIONS. NUMBER OF ITEMS AND LOCATIONS SHOWN ARE APPROXIMATE, CONTRACTOR MUST VERIFY ALL CONDITIONS AND INCLUDE IN SCOPE OF WORK ACCORDINGLY.
2. PRIOR TO STARTING DEMOLITION AND/OR RENOVATION ON ANY STRUCTURES OR UTILITIES, THE CONTRACTOR MUST FAMILIARIZE HIMSELF WITH THE EXISTING CONDITIONS OF ANY STRUCTURES AND UTILITIES. THE CONTRACTOR MUST DEVELOP A PLAN OF DEMOLITION AND/OR RENOVATION THAT ENSURES ALL ACTIVITIES ARE COMPLETED IN A SAFE MANNER. PROVIDE ANY TEMPORARY SHORING, SHEETING OR SUPPORT REQUIRED TO COMPLETE WORK IN A SAFE MANNER.
3. COMPLETELY REMOVE ALL STRUCTURE AND UTILITIES INDICATED, BOTH ABOVE GROUND AND BELOW GROUND.
4. WHERE ROADS, SIDEWALKS, ETC ARE INDICATED TO BE CUT AND PATCHED, EACH ONE MUST BE REMOVED AND REPLACED ALONG NEAT SAWCUT LINES, AND TO THE NEAREST JOINT WHERE IT EXISTS.
5. THIS AREA OF WORK IS LOCATED WITHIN RESTRICTED AREAS. ACCESS TO THIS AREA MUST BE COORDINATED WITH RANGE CONTROL THROUGH THE COR.
6. REPAIR AND REFINISH AREAS DAMAGED OR DISTURBED BY NEW WORK TO BE PROVIDED UNDER THIS CONTRACT.
7. DIMENSIONS/AREAS SHOWN ON EXISTING ITEMS ARE PROVIDED TO AID THE CONTRACTOR UNDERSTAND THE SCOPE OF WORK. FIELD VERIFY ALL CONDITIONS. ALL THE DIMENSIONS/AREAS SHOWN ARE APPROXIMATE ONLY.
8. METHOD OF REMOVAL OF ANY BUILDING COMPONENT MUST BE APPROVED BY THE COR. THE CONTRACTOR MUST BE RESPONSIBLE FOR ENSURING THAT REMOVAL OF EXISTING COMPONENTS DO NOT AFFECT ADJACENT OCCUPIED AREAS.
9. DEMOLITION AND/OR RENOVATION OPERATIONS MUST BE COMPLETED IN COMPLIANCE WITH ALL STATE AND FEDERAL REGULATIONS, MCBCL STANDARDS AND REQUIREMEMENTS, AND AS SPECIFIED.
10. ALL CONSTRUCTION ACTIVITIES MUST BE IN ACCORDANCE WITH OSHA STANDARDS, AND GOVERNMENT REQUIREMENTS
11. THE NOTATION (TYP) INDICATES THAT THE CONDITION OCCURS IN MORE THAN ONE PLACE INCLUDING ALL SIMILAR CONDITIONS NOT INDIVIDUALLY NOTED.
12. COORDINATE STAGING AREA, SITE ACCESS, TOILET USE WITH THE COR.
13. CONTRACTOR MUST BE RESPONSIBLE FOR SITE SECURITY AND JOB SAFETY.
14. AREAS OUTSIDE THE LIMITS OF PROPOSED WORK DISTURBED BY THE CONTRACTOR'S OPERATIONS MUST BE RESTORED BY THE CONTRACTOR TO THEIR ORIGINAL CONDITION AT THE CONTRACTOR'S EXPENSE AS SO0N AS PRACTICABLE.
15. CONTRACTOR MUST MINIMIZE DUST, SEDIMENT AND DEBRIS FROM EXITING THE CONSTRUCTION SITE AND MUST BE RESPONSIBLE FOR CLEANUP, REPAIRS AND CORRECTIVE ACTION IF SUCH OCCURS. CONTRACTOR MUST DISPOSE OF DEBRIS IN ACCORDANCE WITH APPLICABLE FEDERAL, STATE, AND LOCAL REGULATIONS, ORDINANCE AND STATUTES.
16. BURNING WILL NOT BE ALLOWED ON THE PROJECT SITE UNLESS AUTHORIZED IN WRITING BY THE COR.
17. ADJACENT STRUCTURES AND UTILITIES MUST REMAIN IN OPERATION DURING DEMOLITION AND/OR RENOVATION. ACTIVITIES. EXISTING ROADS MUST REMAIN OPEN AND ACCESSIBLE BY VEHICULAR AND PEDESTRIAN TRAFFIC. IF ROADWAY CLOSURE IS REQUIRED, APPROVAL MUST BE SECURED FROM THE COR. THE CONTRACTOR MUST PROVIDE BARRICADES, LIGHTS, SIGNAGE AND OTHER PROTECTIVE DEVICES IN ACCORDANCE
18. CONTRACTOR'S PERSONNEL MUST WEAR IDENTIFICATION AT ALL TIMES.

GENERAL NOTES AND SPECIFICATIONS

EROSION AND SEDIMENTATION CONTROL NOTES:

1. INSTALL GRAVEL CONTROL ENTRANCE AT DESIGNATED PROJECT ENTRANCE.
2. INSTALL SILT FENCING, CHECK DAMS, DROP INLET PROTECTION AS INDICATED OR REQUIRED IF NOT SHOWN. ADDITIONAL MISCELLANEOUS EROSION CONTROL MEASURES MAY BE REQUIRED BY THE COR.
3. TEMPORARY STABILIZATION: IF FINE GRADE SITE IS FOUND, STABILIZE AND SEED ALL AREAS NOT TO BE FURTHER DISTURBED BY CONSTRUCTION ACTIVITIES TO MATCH EXISTING CONDITIONS. FINAL LANDSCAPE: INSTALL SOD TO ESTABLISH FINAL VEGETATION.
4. REMOVE SILT FENCING, GRAVEL CONTROL ENTRANCE, CHECK DAMS AND DROP INLET PROTECTION ONCE VEGETATION IS 95% ESTABLISHED MINIMUM.
5. ALL EROSION AND SEDIMENTATION CONTROL DEVICES MUST BE CHECKED FOR STABILITY AND OPERATION FOLLOWING EVERY RUNOFF-PRODUCING RAINFALL EVENT BUT IN NO CASE LESS THAN ONCE EVERY WEEK. ANY NEEDED REPAIRS MUST BE MADE IMMEDIATELY TO MAINTAIN ALL DEVICES IN THE OPERATIONAL CONDITIONS INTENDED.
6. ALL DISTURBED AREAS MUST BE FERTILIZED, SEEDED/SODED AS NECESSARY AND MULCHED ACCORDING TO SPECIFICATIONS IN THE VEGETATION PLAN IN ORDER TO ESTABLISH AND MAINTAIN A VIGOROUS, DENSE VEGETATIVE COVER.
7. ANY SEDIMENT TRACKED ONTO THE ADJACENT ROADS MUST BE REMOVED ON A DAILY BASIS.
8. SEDIMENT MUST BE REMOVED FROM BEHIND SILT FENCING, CHECK DAMS, AND DROP INLET PROTECTION PRIOR TO THE SEDIMENT ACCUMULATING TO A MAXIMUM DEPTH OF SIX INCHES.
9. ALL FILL MATERIAL NEEDED TO EXECUTE THIS PROJECT MUST BE OBTAINED FROM AN NCDENR LAND QUALITY SECTION PERMITTED BORROW PIT.
10. ALL DENUDED AREAS MUST, WITHIN 7 CALENDAR DAYS OF COMPLETION OF ANY PHASE OF GRADING OR CEASING OF GRADING ACTIVITIES, BE PLANTED AND PROVIDED WITH TEMPORARY OR PERMANENT GROUND COVER, DEVICES, OR STRUCTURES SUFFICIENT TO RESTRAIN EROSION.
11. PROVIDE PERMANENT GROUND COVER TO ALL DENUDED AREAS WITHIN 7 DAYS OF COMPLETION OF CONSTRUCTION.

UTILITIES DEMOLITION NOTES:

1. THE LOCATION AND DEPTHS OF EXISTING UTILITIES IF SHOWN ARE APPROXIMATE. THE CONTRACTOR MUST SECURE THE SERVICES OF A PROFESSIONAL UTILITY LOCATE CONTRACTOR TO MARK ALL EXISTING UTILITIES IN THE AREA OF WORK. UTILITY MARKINGS MUST BE MAINTAINED FOR THE DURATION OF DEMOLITION ACTIVITIES.
2. ALL UTILITY LINES IF SHOWN TO REMAIN MUST REMAIN ACTIVE AND MUST BE PROTECTED DURING DEMOLITION ACTIVITIES.
3. EXISTING UTILITIES MUST NOT BE INTERRUPTED WITHOUT THE APPROVAL OF THE COR.
4. THE CONTRACTOR MUST BE RESPONSIBLE TO REPAIR OR REPLACE, TO ORIGINAL CONDITION, ANY UTILITIES DAMAGED DURING DEMOLITION ACTIVITIES FROM THE CONTRACTOR'S OPERATIONS.
5. ALL COSTS ASSOCIATED WITH LOCATING, DISCONNECTING ABANDONING AND CAPPING OF UTILITY LINES MUST BE THE RESPONSIBILITY OF THE CONTRACTOR.
6. THE CONTRACTOR MUST BE RESPONSIBLE TO COORDINATE THE REMOVAL OF ALL UTILITIES INDICATED WITH THEIR RESPECTIVE UTILITY PURVEYORS.
7. ALL PIPES AND CONDUITS IF SHOWN THAT ARE TO BE ABANDONED IN PLACE, MUST BE CAPPED OR PLUGGED TO SECURE ALL OPEN ENDS TO FORM A WATERTIGHT SEAL.
8. ALL ELECTRICAL WORK MUST BE COMPLETED IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE.
9. ALL EXCAVATIONS CREATED BY DEMOLITION ACTIVITIES MUST BE BACKFILLED WITH COMMON FILL, MUST BE GRADED TO CREATE POSITIVE DRAINAGE, AND MUST BE VEGETATED IN ACCORDANCE WITH THE PROJECT VEGETATION PLAN OR AS INDICATED BY THE COR. GRAVEL AND PAVED SURFACES MUST BE RESTORED TO THEIR ORIGINAL CONDITION.
10. ALL EROSION CONTROL FEATURES MUST BE INSTALLED PRIOR TO DEMOLITION ACTIVITIES STARTING.

11. ANY FILL MATERIAL REQUIRED TO ESTABLISH THE FINISH GRADES SHOWN MUST BE OBTAINED FROM A PROPERLY PERMITTED BORROW PIT. ANY EXCESS SOIL MATERIAL GENERATED FROM DEMOLITION ACTIVITIES MUST BE DISPOSED OF OFF OF THE GOVERNMENT PROPERTY.
12. CONTACT THE EMD (ENVIRONMENTAL MANAGEMENT DIVISION) AT CAMP LEJEUNE BEFORE ANY DIGGING IS STARTED AT EACH BUILDING, TOWER, AND SITE FEATURE. CONTRACTOR MUST PROVIDE THE SERVICES OF A PROFESSIONAL UTILITY LOCATION SERVICE FOR LOCATING AND IDENTIFYING UNDERGROUND UTILITIES.
13. MONITORING WELLS FOUND AT BUILDINGS AND SITE FEATURES MUST REMAIN IN PLACE, UNLESS SPECIFICALLY STATED OTHERWISE.
14. CONTRACTOR MUST REMOVE ELECTRICAL, COMMUNICATIONS, WATER, STEAM, AND SEWER SERVICES BACK TO THE NEAREST JUNCTION UNLESS INDICATED OTHERWISE.
15. WHERE EXISTING PIPING AND OTHER UTILITY SERVICES ARE TO BE REMOVED TO A TERMINATION POINT AND CAPPED, AS NECESSARY FOR A SAFE AND FINISHED TERMINATION PROVIDE NEW MATERIAL OF SAME TYPE AND QUALITY AS EXISTING IN QUESTION OR PROVIDE IN ACCORDANCE WITH UTILITY REQUIREMENTS. ABANDONED PIPING AND LINES MUST BE REMOVED UNLESS NOTED OTHERWISE. UNDERGROUND SERVICES ABANDONED BY THIS WORK MUST BE REMOVED, INCLUDING CONDUIT, PIPING, OR OTHER ITEMS.
16. THE DRAWINGS SHOW OR NOTE CERTAIN ITEMS AND FEATURES TO REMAIN. IT IS THE CONTRACTOR'S RESPONSIBILITY TO PROTECT FEATURES TO REMAIN FROM DAMAGE. DAMAGE TO FEATURES MUST BE CORRECTED AS DIRECTED BY THE COR.
17. IF THE CONTRACTOR ENCOUNTERS AN ITEM OR FEATURE AT THE SITE THAT THE DRAWINGS DO NOT ADDRESS, CONTACT THE COR FOR DIRECTIONS.
18. UTILITIES, PIPING, METERS, VALVES, MANHOLES, UNDERGROUND LINES, ETC. HAVE BEEN LOCATED BY VISUAL OBSERVATION AND BASE UTILITY MAPS WHEN AVAILABLE. IN SOME CASES THE EXACT LOCATION AND TERMINATION OF UTILITIES MAY DIFFER FROM WHAT IS INDICATED. CONTRACTOR MUST FIELD VERIFY AND CONSULT WITH COR AND BASE UTILITIES BEFORE REMOVING UNDERGROUND UTILITIES.
19. ALL UTILITIES AND EXISTING FEATURES ARE TO BE FIELD VERIFIED PRIOR TO CONSTRUCTION. CONTRACTOR MUST BE RESPONSIBLE FOR ANY DAMAGE TO EXISTING UTILITIES.

HAZARDOUS WASTE NOTES:

1. HAZARDOUS MATERIALS REPORTS WILL BE MADE AVAILABLE IF IN EXISTENCE. THE CONTRACTOR MUST TEST ALL ITEMS FOR HAZARDOUS MATERIALS (LEAD AND ASBESTOS). IF FOUND THE CONTRACTOR MUST ABATE ALL HAZARDOUS MATERIALS BEFORE THEIR DISPOSAL. COMPLY WITH ALL FEDERAL, MCBCL, AND STATE LAWS AND REGULATIONS
2. THE CONTRACTOR TO ASSUME THAT SOME OF THE MATERIALS CONTAIN ASBESTOS UNTIL SAMPLED AND TESTED BY ACCREDITED AND LICENSED ASBESTOS PROFESSIONALS. CONTRACTOR TO REVIEW ASBESTOS INSPECTION REPORT AND SPECIFICATIONS BEFORE COMMENCING DEMOLITION.
3. IF HAZARDOUS MATERIALS ARE SUSPECTED TO BE PRESENT, ENSURE THAT SUBJECT BUILDING(S) / STRUCTURE(S) ARE EVALUATED FOR ASBESTOS / LEAD CONTAINING MATERIALS BY A CERTIFIED PROFESSIONAL PRIOR TO THE DEMOLITION.
4. IF DURING DEMOLITION, ANY SOILS ARE ENCOUNTERED THAT ARE SUSPECTED OF BEING CONTAMINATED, WORK MUST CEASE IMMEDIATELY AND THE COR MUST BE CONTACTED FOR RESOLUTION. CALL 911 AND CONTACT EQB AT (910) 451-9017 FOR INSTRUCTIONS.
5. ALL HAZARDOUS WASTE GENERATED BY THIS PROJECT MUST MEET RCRA STANDARDS.
6. COORDINATE WITH ANTHONY L. RECOB, SUPERVISOR RESOURCE CONSERVATION & SECTION ENVIRONMENT PROTECTION SPECIALIST ENVIRONMENTAL MANAGEMENT DIVISION MARINE CORPS BASE CAMP LEJEUNE. TELEPHONE: (910)-451-5306. E-MAIL: ANTHONY.RECOB@USMC.MIL
7. REMOVAL OR ENCAPSULATION OF LEAD PAINT PRIOR TO BUILDING DEMOLITION IS NOT REQUIRED, ALL WORK SHOULD BE CONDUCTED BY WORKERS TRAINED IN "LEAD SAFE WORK PRACTICES" AS OUTLINED BY THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA). CONTRACTOR TO REVIEW LEAD INSPECTION REPORT AND SPECIFICATIONS BEFORE COMMENCING DEMOLITION. IF ADDITIONAL COATINGS ARE FOUND DURING DEMOLITION THAT ARE NOT ON THE

SURVEY REPORT, CONTRACTOR TO ASSUME THESE MATERIALS ARE LEAD CONTAINING COATINGS UNTIL SAMPLED AND TESTED BY ACCREDITED AND LICENSED LEAD PROFESSIONALS.

8. ASBESTOS CONTAINING MATERIALS (ACM): REMOVE ACM FROM BUILDINGS AND SITES. COMPLETED PROJECT SITES MUST BE FREE FROM ACM. ACM MAY OCCUR IN LOCATIONS AND IN QUANTITIES DIFFERENT FROM THOSE ESTIMATED. NOTIFY COR IF SUSPECT ACM IS ENCOUNTERED THAT HAS NOT BEEN TESTED. SUSPECT ACM MUST BE TREATED AS REGULATED ACM UNLESS TESTED AND DETERMINED TO NOT BE ACM. TAKE PRECAUTIONS AS SPECIFIED. COORDIANTE WITH THE COR.
9. LEAD BASE PAINT (LBP): WHERE WORK IN PROJECT DISTURBS SURFACES WITH LBP OR WHERE ITEMS WITH LBP ARE TO BE REMOVED, TAKE PRECAUTIONS AS SPECIFIED AND AS REQUIRED BY AGENCIES HAVING JURISDICTION AND TO MAINTAIN SAFE CONDITIONS. DUE TO THE AGE OF THE BUILDINGS AND THE NUMBER OF TIMES THEY HAVE BEEN PAINTED, LBP LEVELS IN DIFFERENT AREAS MAY VARY FROM THE TESTING DATA. TAKE PRECAUTIONS WHEN WORKING WITH PAINTED SURFACES REGARDLESS OF TESTING DATA. IT IS RECOMMENDED THAT ITEMS AND MATERIALS WITH LBP BE REMOVED INTACT OR AS UNITS. REMOVAL BY SANDING, ABRASIVE BLASTING, OR CHEMICALS IS NOT RECOMMENDED AND WILL CREATE CONCENTRATED LEVELS OF LEAD THAT MUST BE DISPOSED OF AS HAZARDOUS WASTE. SEE SPECIFICATIONS. COORDIANTE WITH COR.
10. IF HAZARDOUS MATERIALS ARE FOUND, WORKERS MUST WEAR PROTECTIVE GEAR AND RESPIRATORS. CONTRACTOR MUST SUBMIT PROPOSED CLEANING PROCEDURES FOR REMOVAL OF LEAD DUST BEFORE STARTING DEMOLITION ACTIVITIES. CLEANING AND REMOVAL MUST BE IN ACCORDANCE WITH FEDERAL, STATE, AND BASE ENVIRONMENTAL REQUIREMENTS AND FINAL PROPOSAL MUST BE APPROVE BY USMC-CL ENVIRONMENTAL MANAGEMENT OFFICE.

DIVISION 02, 05, 26, 31 AND 33:

** THESE SPECIFICATIONS ARE GENERIC IN NATURE AND ARE NOT SPECIFIC TO ANY PARTICULAR PROJECT. DISREGARD NON-APPLICABLE INSTRUCTIONS AS SHOWN IN THE ROUGH ORDER OF MAGNITUDE MATERIAL TAKE OFF MATRIX OR AS DEERMINED BY THE CONTRACTING OFFICER REPRESENTATIVE (COR). **

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SECTION 02 41 00

DEMOLITION
05/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI Guideline K	(2009) Guideline for Containers for Recovered Non-Flammable Fluorocarbon Refrigerants

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.6	(2006) Safety Requirements for Demolition Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 2011) Safety and Health Requirements Manual

U.S. DEFENSE LOGISTICS AGENCY (DLA)

DLA 4145.25	(Jun 2000; Reaffirmed Oct 2010) Storage and Handling of Liquefied and Gaseous Compressed Gases and Their Full and Empty Cylinders http://www.aviation.dla.mil/UserWeb/aviationengineering/

U.S. DEPARTMENT OF DEFENSE (DOD)

DOD 4000.25-1-M	(2006) MILSTRIP - Military Standard Requisitioning and Issue Procedures
MIL-STD-129	(2014; Rev R) Military Marking for Shipment and Storage

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 82	Protection of Stratospheric Ozone
49 CFR 173.301	Shipment of Compressed Gases in Cylinders and Spherical Pressure Vessels

1.2 PROJECT DESCRIPTION

1.2.1 Demolition Plan

Prepare a Demolition Plan and submit proposed salvage, demolition, and removal procedures for approval before work is started. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule, utility services and a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Identify components and materials to be salvaged for reuse or recycling with reference to paragraph Existing Facilities to be Removed. Append tracking forms for all removed materials indicating type, quantities, condition, destination, and end use. Provide procedures for safe conduct of the work in accordance with EM 385-1-1. Plan shall be approved by Contracting Officer prior to work beginning.

1.2.2 General Requirements

Do not begin demolition until authorization is received from the Contracting Officer. The work of this section is to be performed in a manner that maximizes the value derived from the salvage and recycling of materials. Remove rubbish and debris from the project site; do not allow accumulations inside or outside the buildings . The work includes demolition, , salvage of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the Contracting Officer. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.3 ITEMS TO REMAIN IN PLACE

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the Contracting Officer. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements . Provide new supports and reinforcement for existing construction weakened by demolition, or removal work. Repairs, reinforcement, or structural replacement require approval by the Contracting Officer prior to performing such work.

1.3.1 Existing Construction Limits and Protection

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove dust, dirt, and debris from work areas daily.

1.3.2 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of

existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas.

1.3.3 Trees

Protect trees within the project site which might be damaged during demolition, and which are indicated to be left in place, by a 6 foot high fence. Erect and secure fence a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Replace any tree designated to remain that is damaged during the work under this contract with like-kind or as approved by the Contracting Officer.

1.3.4 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition operations. Prior to start of work, utilities serving each area of alteration or removal will be shut off by the Government and disconnected and sealed by the Contractor.

1.3.5 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished or deconstructed, unless directed otherwise by the Contracting Officer. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.4 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted. Where burning is permitted, adhere to federal, state, and local regulations.

1.5 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Demolition Plan

Existing Conditions

SD-07 Certificates

Notification

SD-11 Closeout Submittals

Receipts

1.6 QUALITY ASSURANCE

Submit timely notification of demolition and renovation projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61, Subpart M. Notify the State's environmental protection agency and the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSE/SAFE A10.6. Comply with the Environmental Protection Agency requirements specified. Use of explosives will not be permitted.

1.6.1 Dust and Debris Control

Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution. Vacuum and dust the work area daily .

1.7 PROTECTION

1.7.1 Traffic Control Signs

a. Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Notify the Contracting Officer prior to beginning such work.

1.7.2 Protection of Personnel

Before, during and after the demolition work continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the project site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.8 FOREIGN OBJECT DAMAGE (FOD)

Aircraft and aircraft engines are subject to FOD from debris and waste material lying on airfield pavements. Remove all such materials that may appear on operational aircraft pavements due to the Contractor's operations. If necessary, the Contracting Officer may require the Contractor to install a temporary barricade at the Contractor's expense to control the spread of FOD potential debris. The barricade shall include a fence covered with a fabric designed to stop the spread of debris. Anchor the fence and fabric to prevent displacement by winds or jet/prop blasts. Remove barricade when no longer required.

1.9 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair or replace items to be relocated which are damaged by the Contractor with new undamaged items as approved by the Contracting Officer.

1.10 EXISTING CONDITIONS

Before beginning any demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs sized 4 inch will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, finish floor elevations, possible conflicting electrical conduits, plumbing lines, alarms systems, the location and extent of existing cracks and other damage and description of surface conditions that exist prior to before starting work. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the record document. Submit survey results.

PART 2 PRODUCTS

2.1 FILL MATERIAL

a. Comply with excavating, backfilling, and compacting procedures for soils used as backfill material to fill basements, voids, depressions or excavations resulting from demolition of structures. Fill material shall be waste products from demolition until all waste appropriate for this purpose is consumed.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

Inspect and evaluate existing structures onsite for reuse. Existing construction scheduled to be removed for reuse shall be disassembled. Dismantled and removed materials are to be separated, set aside, and prepared as specified, and stored or delivered to a collection point for reuse, remanufacture, recycling, or other disposal, as specified. Materials shall be designated for reuse onsite whenever possible.

3.1.1 Structures

a. Remove existing structures indicated to be removed to __1.5___ feet below grade]. Break up basement slabs to permit drainage. Remove sidewalks, curbs, gutters and street light bases as indicated.

b. Demolish structures in a systematic manner from the top of the structure to the ground. Complete demolition work above each tier or floor before the supporting members on the lower level are disturbed. Demolish concrete and masonry walls in small sections. Remove structural framing members and lower to ground by means of derricks, platforms hoists, or other suitable methods as approved by the Contracting Officer.

c. Locate demolition and deconstruction equipment throughout the structure and remove materials so as to not impose excessive loads to supporting walls, floors, or framing.

3.1.2 Utilities and Related Equipment

3.1.2.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Contracting Officer. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

3.1.2.2 Disconnecting Existing Utilities

Remove existing utilities , as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer. When utility lines are encountered but are not indicated on the drawings, notify the Contracting Officer prior to further work in that area. Remove meters and related equipment and deliver to a location on the station in accordance with instructions of the Contracting Officer.

3.1.3 Chain Link Fencing

Remove chain link fencing, gates and other related salvaged items scheduled for removal and transport to designated areas. Remove gates as whole units. 3.1.4 Paving and Slabs

Remove concrete and asphaltic concrete paving and slabs including aggregate base as indicated to a depth of [_18____] inches below grade. Provide neat sawcuts at limits of pavement removal as indicated. Pavement and slabs designated to be recycled and utilized in this project shall be moved, ground and stored as directed by the Contracting Officer. Pavement and slabs not to be used in this project shall be removed from the Installation at Contractor's expense.3.1.5 Masonry

Sawcut and remove masonry so as to prevent damage to surfaces to remain, to removed materials being salvaged and to facilitate the installation of new work. Where new masonry adjoins existing, the new work shall abut or tie into the existing construction as indicated . Provide square, straight edges and corners where existing masonry adjoins new work and other locations. Masonry removed in whole blocks shall be salvaged and stored for reuse. .

3.1.6 Concrete

Saw concrete along straight lines to a depth of a minimum 2 inch. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.

3.1.7 Structural Steel

Dismantle structural steel at field connections and in a manner that will prevent bending or damage. Salvage for [reuse] recycle structural steel, steel joists, girders, angles, plates, columns and shapes. Transport steel joists and girders as whole units and not dismantled. Transport

structural steel shapes to a designated area as directed by the Contracting Officer, stacked according to size, type of member and length, and stored off the ground, protected from the weather.3.1.8 Miscellaneous Metal

Salvage shop-fabricated items such as access doors and frames. Salvage light-gage and cold-formed metal framing. Scrap metal shall become the Contractor's property. Recycle scrap metal as part of demolition operations. Provide separate containers to collect scrap metal and transport to a scrap metal collection or recycling facility, in accordance with the Waste Management Plan.

3.1.9 Carpentry

Salvage for recycle lumber, millwork items, and finished boards, and sort by type and size.

3.1.10 Patching

Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces, using on-site materials when available. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish. Patching shall be as specified and indicated.

a. Concrete and Masonry: Completely fill holes and depressions, caused by previous physical damage or left as a result of removals in existing masonry walls to remain, with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.

3.1.11 Electrical Equipment and Fixtures

Salvage motors, motor controllers, and operating and control equipment that are attached to the driven equipment. Salvage wiring systems and components. Box loose items and tag for identification. Disconnect primary, secondary, control, communication, and signal circuits at the point of attachment to their distribution system.

3.1.11.1 Fixtures

Remove and salvage electrical fixtures. Salvage unprotected glassware from the fixture and salvage separately. Salvage incandescent, mercury-vapor, and fluorescent lamps and fluorescent ballasts manufactured prior to 1978, boxed and tagged for identification, and protected from breakage.

3.1.11.2 Electrical Devices

Remove and salvage switches, switchgear, transformers, conductors including wire and nonmetallic sheathed and flexible armored cable, regulators, meters, instruments, plates, circuit breakers, panelboards, outlet boxes, and similar items. Box and tag these items for identification according to type and size.

3.1.11.3 Wiring Ducts or Troughs

Remove and salvage wiring ducts or troughs. Dismantle plug-in ducts and wiring troughs into unit lengths. Remove plug-in or disconnecting devices

from the busway and store separately.

3.1.11.4 Conduit and Miscellaneous Items

Salvage conduit except where embedded in concrete or masonry. Consider corroded, bent, or damaged conduit as scrap metal. Sort straight and undamaged lengths of conduit according to size and type. Classify supports, knobs, tubes, cleats, and straps as debris to be removed and disposed.

3.1.12 Items With Unique/Regulated Disposal Requirements

Remove and dispose of items with unique or regulated disposal requirements in the manner dictated by law or in the most environmentally responsible manner.

3.2 DISPOSITION OF MATERIAL

3.2.1 Title to Materials

Except for salvaged items specified in related Sections, and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor and shall be removed from Government property unless noted otherwise on the plans. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition, and removal procedures, and authorization by the Contracting Officer to begin demolition . The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

3.2.2 Salvaged Materials and Equipment

Remove materials and equipment that are listed in the Demolition Plan to be removed by the Contractor and that are to remain the property of the Government, and deliver to a storage site , as directed within 5 miles of the work site.

a. Salvage items and material to the maximum extent possible.

b. Store all materials salvaged for the Contractor as approved by the Contracting Officer and remove from Government property before completion of the contract. On site sales of salvaged material is prohibited.

c. Remove salvaged items to remain the property of the Government in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage must be repaired or replaced to match existing items. Properly identify the contents of containers.

d. Remove and capture all Class I ODS refrigerants in accordance with the Clean Air Act Amendment of 1990, and turn in to the Navy as directed by the Commanding Officer.

3.2.3 Disposal of Ozone Depleting Substance (ODS)

Class I and Class II ODS are defined in Section, 602(a) and (b), of The

Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting AHRI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. Recovered ODS shall be turned over to the Contracting Officer . Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g. residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82. Submit Receipts or bills of lading, as specified. Submit a shipping receipt or bill of lading for all containers of ozone depleting substance (ODS) shipped to the Defense Depot, Richmond, Virginia.

3.2.3.1 Special Instructions

No more than one type of ODS is permitted in each container. A warning/hazardous label shall be applied to the containers in accordance with Department of Transportation regulations. All cylinders including but not limited to fire extinguishers, spheres, or canisters containing an ODS shall have a tag with the following information:

a. Activity name and unit identification code

b. Activity point of contact and phone number

c. Type of ODS and pounds of ODS contained

d. Date of shipment

e. National stock number (for information, call (804) 279-4525).

3.2.3.2 Fire Suppression Containers

Deactivate fire suppression system cylinders and canisters with electrical charges or initiators prior to shipment. Also, safety caps must be used to cover exposed actuation mechanisms and discharge ports on these special cylinders.

3.2.4 Transportation Guidance

Ship all ODS containers in accordance with MIL-STD-129, DLA 4145.25 (also referenced one of the following: Army Regulation 700-68, Naval Supply Instruction 4440.128C, Marine Corps Order 10330.2C, and Air Force Regulation 67-12), 49 CFR 173.301, and DOD 4000.25-1-M.

3.2.5 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable and non-recyclable combustible material off the site.

3.3 CLEANUP

Remove debris and rubbish from basement and similar excavations. Remove and transport the debris in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

3.4 DISPOSAL OF REMOVED MATERIALS

3.4.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials

resulting from removal operations with all applicable federal, state and local regulations as contractually specified . Storage of removed materials on the project site is prohibited.

3.4.2 Removal from Government Property

Transport waste materials removed from demolished and deconstructed structures, except waste soil, from Government property for legal disposal. Dispose of waste soil as directed.

-- End of Section --

SECTION 05 12 00

STRUCTURAL STEEL
05/14

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	(2011) Steel Construction Manual
AISC 326	(2009) Detailing for Steel Construction
AISC 360	(2010) Specification for Structural Steel Buildings

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2012) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	(2010; Errata 2011) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B46.1	(2009) Surface Texture, Surface Roughness, Waviness and Lay

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A193/A193M	(2014a) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A276/A276M	(2015) Standard Specification for Stainless Steel Bars and Shapes
ASTM A307	(2014) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A325	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A36/A36M	(2014) Standard Specification for Carbon

	Structural Steel
ASTM A490	(2014a) Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A563	(2007a; R2014) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A6/A6M	(2014) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A780/A780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A992/A992M	(2011) Standard Specification for Structural Steel Shapes
ASTM F1554	(2007a; E 2011) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F2329	(2013) Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
ASTM F436	(2011) Hardened Steel Washers
ASTM F844	(2007a; R 2013) Washers, Steel, Plain (Flat), Unhardened for General Use

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication drawings including description of connections;

SD-03 Product Data

Welding electrodes and rods

SD-06 Test Reports

Bolts, nuts, and washers

Weld Inspection Reports

Bolt Testing Reports

SD-07 Certificates

Steel

Bolts, nuts, and washers

Galvanizing

Welding procedures and qualifications

Welding electrodes and rods

1.3 QUALITY ASSURANCE

1.3.1 Fabrication Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 326 and AISC 325. Fabrication drawings must not be reproductions of contract drawings. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS A2.4 standard welding symbols. as part of the drawings. Any deviations from the details shown on the contract drawings must be clearly highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

1.3.2 Certifications

1.3.2.1 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests.

Conform to all requirements specified in AWS D1.1/D1.1M.

PART 2 PRODUCTS

2.1 STEEL

2.1.1 Structural Steel

Wide flange and WT shapes, ASTM A992/A992M. Angles, Channels and Plates, ASTM A36/A36M.

2.2 BOLTS, NUTS, AND WASHERS

Submit the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

2.2.1 High-Strength Bolts

2.2.1.1 Bolts

ASTM A325, Type 1 ; hot-dipped galvanized

2.2.1.2 Nuts

ASTM A563, Grade and Style as specified in the applicable ASTM bolt standard.

2.2.1.3 Washers

ASTM F436, plain carbon steel.

2.2.2 Foundation Anchorage

2.2.2.1 Anchor Rods

ASTM F1554 Gr 36 , Class 1A . ASTM A193/A193M.

2.2.2.2 Anchor Nuts

ASTM A563, Grade A, hex style. ASTM A193/A193M

2.2.2.3 Anchor Washers

ASTM F844. conforming to ASTM A276/A276M.

2.3 STRUCTURAL STEEL ACCESSORIES

2.3.1 Welding Electrodes and Rods

AWS D1.1/D1.1M.

2.4 GALVANIZING

ASTM F2329 for threaded parts or ASTM A123/A123M for structural steel members, as applicable, unless specified otherwise galvanize after fabrication where practicable.

2.5 FABRICATION

Fabrication must be in accordance with the applicable provisions of AISC 325. Fabrication and assembly must be done in the shop to the greatest extent possible. Punch, subpunch and ream, or drill bolt holes perpendicular to the surface of the member.

Compression joints depending on contact bearing must have a surface roughness not in excess of 500 micro inch as determined by ASME B46.1, and ends must be square within the tolerances for milled ends specified in ASTM A6/A6M.

Shop splices of members between field splices will be permitted only where indicated on the Contract Drawings. Splices not indicated require the approval of the Contracting Officer.

2.5.1 Markings

Prior to erection, members must be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections must be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. Affix embossed tags to hot-dipped galvanized members.

2.6 DRAINAGE HOLES

Adequate drainage holes must be drilled to eliminate water traps. Hole diameter must be 1/2 inch and location must be indicated on the detail drawings. Hole size and location must not affect the structural integrity.

PART 3 EXECUTION

3.1 ERECTION

a. Erection of structural steel, except as indicated in item b. below, must be in accordance with the applicable provisions of AISC 325.

3.1.1 STORAGE

Material must be stored out of contact with the ground in such manner and location as will minimize deterioration.

3.2 CONNECTIONS

Except as modified in this section, connections not detailed must be designed in accordance with AISC 360. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Holes must not be cut or enlarged by burning. Bolts, nuts, and washers must be clean of dirt and rust, and lubricated immediately prior to installation.

3.2.1 Common Grade Bolts

ASTM A307 bolts must be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Contracting Officer for further instructions.

3.2.2 High-Strength Bolts

Provide direct tension indicator washers in all ASTM A325 and ASTM A490 bolted connections. Bolts must be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts must then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

3.3 GAS CUTTING

Use of gas-cutting torch in the field for correcting fabrication errors will not be permitted on any major member in the structural framing. Use of a gas cutting torch will be permitted on minor members not under stress only after approval has been obtained from the Contracting Officer.

3.4 WELDING

Welding must be in accordance with AWS D1.1/D1.1M. Grind exposed welds smooth as indicated. Provide AWS D1.1/D1.1M qualified welders, welding operators, and tackers.

Develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures.

Prequalified procedures may be submitted for information only; however, procedures that are not prequalified must be submitted for approval.

3.4.1 Removal of Temporary Welds

Remove only from finished areas.

3.5 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.5.1 Field Priming

Steel exposed to the weather, or located in building areas without HVAC for control of relative humidity must be field primed. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat must be cleaned and primed with paint of the same quality as that used for the shop coat.

3.6 GALVANIZING REPAIR

Repair damage to galvanized coatings using ASTM A780/A780M zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.7 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing, except that electric power for field tests will be furnished as set forth in Division 1. The Contracting Officer must be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of the inspection.

3.7.1 Welds

3.7.1.1 Visual Inspection

AWS D1.1/D1.1M. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections.

Inspect proper preparation, size, gaging location, and acceptability of welds; identification marking; operation and current characteristics of welding sets in use.

3.7.1.2 Nondestructive Testing

Nondestructive testing must be in accordance with AWS D1.1/D1.1M. Test locations shall beselected by the Contracting Officer. If more than 10 percent of welds made by a welder contain defects identified by testing, then all welds made by that welder must be tested by ultrasonic testing, as approved by the Contracting Officer. When all welds made by an individual welder are required to be tested, magnetic particle testing must be used only in areas inaccessible to ultrasonic testing. Retest defective areas after repair. Submit weld inspection reports.

Testing frequency: Provide the following types and number of tests:

Test Type	Number of Tests
Ultrasonic	10% Random
Dye Penetrant	10% Random

3.7.2 High-Strength Bolts

3.7.2.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of 3 bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in AISC 360, depending on bolt size and grade. The bolt tension must be developed by tightening the nut. A representative of the manufacturer or supplier must be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements. Submit bolt testing reports.

3.7.2.2 Inspection

Inspection procedures must be in accordance with AISC 360. Confirm and report to the Contracting Officer that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

The Contractor shallinspect calibration of torque wrenches for high-strength bolts.

3.7.2.3 Testing

The Government has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. Provide the required access for the Government to perform the tests. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations must be selected by the Contracting Officer. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, must be tested at the Contractor's expense. Retest new bolts after installation at the Contractor's expense.

-- End of Section --

SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS
05/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	(2010) Code of Standard Practice for Steel Buildings and Bridges

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2010; Errata 2011) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2014) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A653/A653M	(2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A924/A924M	(2014) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

ASTM D1187/D1187M	(1997; E 2011; R 2011) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM E488/E488M	(2010) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	(Oct 2009) Alkyd Anti-Corrosive Metal Primer

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531	(2009) Metal Bar Grating Manual

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Floor gratings and roof walkways, installation drawings;

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction.

SD-03 Product Data

Floor gratings and roof walkways

1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Structural Carbon Steel

ASTM A36/A36M.

2.1.2 Gratings

c. Metal bar type grating NAAMM MBG 531.

2.1.3 Anchor Bolts

ASTM A307. Where exposed, shall be of the same material, color, and finish as the metal to which applied.

2.1.3.1 Adhesive Anchors

Provide 5/8in. diameter adhesive anchors. Minimum concrete embedment shall be 5-5/8in. Design values listed shall be as tested according to ASTM E488/E488M.

a. Minimum ultimate pullout value shall be 11,400lb.

b. Minimum ultimate shear value shall be 24,550lb.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, G90, as applicable.

2.2.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A780/A780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.3 FLOOR GRATINGS AND ROOF WALKWAYS

Design steel grating in accordance with NAAMM MBG 531 for bar type grating or manufacturer's charts for plank grating. Galvanize steel floor gratings.

a. Design floor gratings to support a live load of 125 pounds per square foot and a concentrated load of 250 lbs for the spans indicated, with maximum deflection of L/240.

b. NAAMM MBG 531, band edges of grating with bars of the same size as the bearing bars. Weld banding in accordance with the manufacturer's standard for trim . Design tops of bearing bars, cross or intermediate bars to be in the same plane and match grating finish.

c. Anchor gratings to structural members with bolts, toggle bolts, or expansion shields and bolts.

d. Slip resistance requirements must exceed both wet and dry a static coefficient of friction of 0.5.

2.4 GUARD POSTS (BOLLARDS)

Provide 6 inch prime coated and paintedstandard weight steel pipe as specified in ASTM A53/A53M. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strength of 2500 psi.

2.5

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners shall be cause for rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Form joints exposed to the weather shall be formed to exclude water. Items listed below require additional procedures.

3.2 WORKMANSHIP

Provide miscellaneous metalwork that is well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Provide continuous welding along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections of work in place and ground smooth. Provide a smooth finish on exposed surfaces of work in place and unless otherwise approved, flush exposed riveting. Mill joints where tight fits are required. Corner joints shall be coped or mitered, well formed, and in true alignment. Accurately set work to established lines and elevations and securely fastened in place. Install in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion shields, and powder-driven fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous

attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

3.4 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

3.5 FINISHES

3.5.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D1187/D1187M, asphalt-base emulsion.

3.6 INSTALLATION OF GUARD POSTS (BOLLARDS/PIPE GUARDS)

Set pipe guards vertically in concrete piers. Construct piers of, and the hollow cores of the pipe filled with, concrete having a compressive strength of 3000 psi.

-- End of Section --

SECTION 05 51 00

METAL STAIRS
02/12

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2010; Errata 2011) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B18.21.1	(2009) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A283/A283M	(2013) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A307	(2014) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Iron and Steel Hardware

Steel Shapes, Plates, Bars and Strips

Metal Stair System

SD-03 Product Data

Structural Steel Plates, Shapes, and Bars

SD-08 Manufacturer's Instructions

Structural Steel Plates, Shapes, and Bars

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

Submit complete and detailed fabrication drawings for all iron and steel hardware, and for all steel shapes, plates, bars and strips used in accordance with the design specifications referenced in this section.

Pre-assemble items in the shop to the greatest extent possible. Disassemble units only to the extent necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

For the fabrication of work exposed to view, use only materials that are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove blemishes by grinding, or by welding and grinding, prior to cleaning, treating, and application of surface finishes, including zinc coatings.

2.2 STRUCTURAL STEEL PLATES, SHAPES AND BARS

Structural-size shapes and plates, conforming to ASTM A36/A36M, unless otherwise noted, except bent or cold-formed plates.

Steel plates - bent or cold-formed, conforming to ASTM A283/A283M, Grade C.

Steel bars and bar-size shapes, conforming to ASTM A36/A36M, unless otherwise noted for steel bars and bar-size shapes.

2.3 FASTENERS

Galvanized zinc-coated fasteners in accordance with ASTM A153/A153M and used for exterior applications or where built into exterior walls or floor systems. Select fasteners for the type, grade, and class required for the installation of steel stair items.

Standard/regular hexagon-head bolts and nuts be conforming to ASTM A307, Grade A.

Plain washers, round, general-assembly-grade, carbon steel conforming to ASME B18.21.1.

2.4 GENERAL FABRICATION

Prepare and submit metal stair system shop drawings with detailed plans and elevations at not less than 1 inch to 1 foot with details of sections and connections at not less than 3 inches to 1 foot. Also detail placement drawings, diagrams, templates for installation of anchorage, including but not limited to, concrete inserts, anchor bolts, and miscellaneous metal items having integral anchorage devices.

Use materials of size and thicknesses indicated or, if not indicated, of

required size and thickness to produce adequate strength and durability in finished product for intended use. Work materials to dimensions indicated on approved detail drawings, using proven details of fabrication and support. Use type of materials indicated or specified for the various components of work.

Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32 inch, and bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

Provide and coordinate anchorage of the type indicated with the supporting structure. Fabricate anchoring devices, space as indicated and required to provide adequate support for the intended use of the work.

Use hot-rolled steel bars for work fabricated from bar stock unless work is indicated or specified as fabricated from cold-finished or cold-rolled stock.

PART 3 EXECUTION

3.1 STEEL STAIRS

Provide anchor bolts, grating fasteners, washers, and all parts or devices necessary for proper installation. Provide lock washers under nuts.

3.2 FIELD WELDING

Execute procedures of manual shielded metal arc welding, appearance and quality of welds made, and methods used in correcting welding work in compliance with AWS D1.1/D1.1M.

3.3 TOUCHUP PAINTING

Immediately after installation, clean all field welds, bolted connections, and abraded areas of the shop painted material, and repaint exposed areas with the same paint used for shop painting. Apply paint by brush or spray to provide a minimum dry-film thickness of 2 mils.

-- End of Section --

SECTION 05 52 00

PIPE RAILS

04/94

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53/A 53M	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 153/A 153M	(2000) Zinc-Coating (Hot-Dip) on Iron and Steel Hardware

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures".

SD-02 Shop Drawings

Pipe rail system

Shop drawings of the entire pipe rail system shall be submitted and approved before any rails or similar material are delivered to the site

PART 2 PRODUCTS

2.1 GENERAL

Railing shall be complete with standards, brackets, caps, plugs and all other accessories and fastenings necessary for a complete installation.

2.2 PIPE RAIL SYSTEM

2.2.1 PIPE

Pipe shall conform ASTM A 53/A 53M with zinc-coating conforming to ASTM A 153/A 153M. Sections shall not be hot-dip galvanized after fabrication.

2.2.2 BENDS

Bends shall be uniform curvature with no distortion of the circular cross-section of the pipe.

2.2.3 WELDS

Welds shall be continuous around the joint. Welds shall be ground smooth and free of burrs.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in a manner to provide rigid rail, capable of withstanding a 300-pound force anywhere on the rails without dislodging or permanent distortion of any upright.

-- End of Section --

SECTION 26 00 00

BASIC ELECTRICAL MATERIALS AND METHODS

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 709	(2000) Laminated Thermosetting Materials

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.147	Control of Hazardous Energy (Lock Out/Tag Out)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 100	(1996) Dictionary of Electrical and Electronics Terms (IEEE)
IEEE C2	(1997) National Electrical Safety Code (IEEE)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C57.12.28	(1999) Pad-Mounted Equipment - Enclosure Integrity (Revision of ANSI C57.12.28-88)
NEMA ICS 6	(1993; R 2011) Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3 2014) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to all sections of Division 26, "Electrical," of this project specification unless specified otherwise in the individual sections.

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 480/277 and 208/120 volts secondary, three phase, four wire.

1.5 SUBMITTALS

Submittals required in the sections which refer to this section shall conform to the requirements of Section 01 33 00, "Submittal Procedures" and to the following additional requirements. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and technical paragraph reference. Submittals shall also include applicable federal, military, industry, and technical society publication references, and years of satisfactory service, and other information necessary to establish contract compliance of each item to be provided. Photographs of existing installations are unacceptable and will be returned without approval.

1.5.1 Manufacturer's Catalog Data

Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts. Handwritten and typed modifications and other notations not part of the manufacturer's preprinted data will result in the rejection of the submittal. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for certificates of compliance.

1.5.2 Drawings

Submit drawings a minimum of 14 by 20 inches in size using a minimum scale of 1/8 inch per foot. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.5.3 Instructions

Where installation procedures or part of the installation procedures are required to be in accordance with manufacturer's instructions, submit printed copies of those instructions prior to installation. Installation of the item shall not proceed until manufacturer's instructions are

received. Failure to submit manufacturer's instructions shall be cause for rejection of the equipment or material.

1.5.4 Certificates

Submit manufacturer's certifications as required for products, materials, finishes, and equipment as specified in the technical sections. Certificates from material suppliers are not acceptable. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance.

1.5.4.1 Reference Standard Compliance

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

1.5.4.2 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.5.5 Operation and Maintenance Manuals

Comply with the requirements of Section 01 78 23, "Operation and Maintenance Data" and the technical sections.

1.5.5.1 Operating Instructions

Submit text of posted operating instructions for each system and principal item of equipment as specified in the technical sections.

1.6 QUALITY ASSURANCE

1.6.1 Material and Equipment Qualifications

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on

the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.6.2 Regulatory Requirements

Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70.

1.6.3 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.4 Service Support

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.6.5 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.6.6 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer.

1.6.7 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.8 NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.9 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with NEMA C57.12.28, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

1.10 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.10.1 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment under Section 26 20 00, "Interior Distribution System." Power wiring and conduit shall conform to Section 26 20 00, "Interior Distribution System." Control wiring and conduit shall be provided under, and conform to the requirements of the section specifying the associated equipment.

1.11 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of

competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section.

1.12 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147. Mechanical isolation of machines and other equipment shall be in accordance with requirements of Division 23, "Mechanical."

1.13 EQUIPMENT INVENTORY UPDATE

Submit information for each piece of equipment removed and supplied for use of Camp Lejeune to update the Maximo equipment inventory. For the purposes of this paragraph, inventoried equipment is defined as equipment listed on the Maximo Equipment Inventory Update form.

1.13.1 Requirements

The contractor shall prepare and submit one Maximo Equipment Inventory Update form for each individual item of inventoried equipment that is demolished, removed, replaced, or installed. (ex: three new condensing units would require the submission of three Equipment Inventory Update forms. The replacement of two existing air handling units with two new air handling units would require the submission of two Equipment Inventory Update forms). The contractor shall prepare and submit a VAV/TAB Room Number List for each VAV/Tab model installed in a single building. Only one Maximo Equipment Inventory Update form is required for each model of VAV or TAB in a single building.

1.13.1.1 Demolition of all equipment in a structure or facility

When all the inventoried equipment in a building or structure is demolished or removed, and not replaced, an Equipment Inventory Update form is not required.

1.13.1.2 Standards

The contractor shall provide accurate, complete, and legible information on all required forms. All required forms shall be completed and delivered to the Contracting Officer on or before the Beneficial Occupancy Date. All information on Equipment Inventory Update forms shall be obtained by visual inspection of equipment data plate(s).

1.13.1.3 Form Preparation

Each required Maximo Equipment Inventory Update form shall contain the following information:

(1) The name and telephone number of an individual who can be contacted for clarification or additional information pertaining to the data on

the form.

(2) The date of data collection

(3) The building or structure identification number and the specific location of the equipment within the structure (ex: 3d deck mech room)

(4) A check adjacent to the description of the new or replacement item, and a check adjacent to the supplemental description if applicable (ex: circulating pump and HVAC or steam)

(5) The Maximo number or serial number of the demolished or removed item, if applicable

(6) All applicable data from the equipment data plate

Each Room Number List form shall contain the following information:

(1) The name and telephone number of the individual providing the information

(2) The date the form was completed

(3) The building or structure identification number

(4) A check in the box adjacent to each applicable room number

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PAINTING OF EQUIPMENT

3.1.1 Factory Applied

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test.

3.1.2 Field Applied

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in the section specifying the associated electrical equipment.

3.2 NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

-- End of Section --

SECTION 26 05 00.00 40

COMMON WORK RESULTS FOR ELECTRICAL
08/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2017) Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM D709	(2017) Standard Specification for Laminated Thermosetting Materials

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 480	(1981) Toggle Switches

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C57.12.28	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE Stds Dictionary	(2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI Z535.1	(2017) Safety Colors
ANSI/NEMA OS 1	(2013) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA FB 1	(2014) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
NEMA KS 1	(2013) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
NEMA RN 1	(2005; R 2013) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

NEMA TC 2	(2013) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2016) Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA WD 1	(1999; R 2015) Standard for General Color Requirements for Wiring Devices

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14; TIA 17-15; TIA 17-16; TIA 17-17) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1	(2005; Reprint Aug 2017) UL Standard for Safety Flexible Metal Conduit
UL 1242	(2006; Reprint Mar 2014) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 489	(2016) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 6	(2007; Reprint Nov 2014) Electrical Rigid Metal Conduit-Steel
UL 797	(2007; Reprint Mar 2017) UL Standard for Safety Electrical Metallic Tubing -- Steel
UL 870	(2016) UL Standard for Safety Wireways, Auxiliary Gutters, and Associated Fittings

1.2 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE Stds Dictionary.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. Vertical assembly: A vertical assembly is a pole, tower or other such support, mounting hardware, arms, brackets and the load. Load can be a luminaire, siren, loudspeaker or other device. All components of a vertical assembly will be rated by the manufacturer to withstand 130 mph wind loading in accordance with ASCE 7.

1.3 SUBMITTALS

Submittals required in the sections which refer to this section shall conform to the requirements of Section 01 33 00, "Submittal Procedures" and to the following additional requirements. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and technical paragraph reference. Submittals shall also include applicable federal, military, industry, and technical society publication references, and years of satisfactory service, and other information necessary to establish contract compliance of each item to be provided. Photographs of existing installations are unacceptable and will be returned without approval.

SD-01 Preconstruction Submittals

Material, Equipment, and Fixture Lists

SD-03 Product Data

Conduits and Raceways;

Wire and Cable;

Splices and Connectors;

Switches;

Receptacles;

Outlet Boxes, Pull Boxes and Junction Boxes;

Circuit Breakers;

Panelboards;

Lamps and Lighting Fixtures;

Dry-Type Distribution Transformers;

SD-06 Test Reports

Continuity Test;

Phase-Rotation Tests;

Insulation Resistance Test;

SD-08 Manufacturer's Instructions

Manufacturer's Instructions

1.4 QUALITY CONTROL

1.4.1 Predictive Testing and Inspection Technology Requirements

This section contains systems and equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I)

technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed have been installed properly and contain no identifiable defects that shorten the design life of a system and its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

PART 2 PRODUCTS

2.1 EQUIPMENT

Provide the standard cataloged materials and equipment of manufacturers regularly engaged in the manufacture of the products. For material, equipment, and fixture lists submittals, show manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

2.1.1 Conduits and Raceways

2.1.1.1 Rigid Steel Conduit

Provide hot dipped galvanized rigid steel conduit complying with UL 6. Except where installed underground, or in corrosive areas, provide polyvinylchloride (PVC), or painted with bitumastic coated rigid steel conduit in accordance with NEMA RN 1.

Use threaded fittings for rigid steel conduit.

Use solid gaskets. Ensure conduit fittings with blank covers have gaskets, except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

Provide covers with captive screws and are accessible after the work has been completed.

2.1.1.2 Electrical Metallic Tubing (EMT)

Ensure EMT is in accordance with UL 797 and is zinc coated steel. Provide zinc-coated couplings and connectors that are raintight, gland compression type with insulation throat. Crimp, spring, or setscrew type fittings are not acceptable.

2.1.1.3 Flexible Metallic Conduit

Ensure flexible metallic conduit is galvanized steel and complies with UL 1.

Ensure fittings for flexible metallic conduit are specifically designed for such conduit.

Provide liquidtight flexible metallic conduit with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

Ensure fittings for liquidtight flexible metallic conduit are specifically designed for such conduit.

2.1.1.4 Intermediate Metal Conduit

Ensure intermediate metal conduit is galvanized steel and complies with UL 1242.

2.1.1.5 Rigid Nonmetallic Conduit

Ensure rigid nonmetallic conduit complies with NEMA TC 2 and NEMA TC 3 with a wall thickness not less than Schedule 40.

2.1.1.6 Wireways and Auxiliary Gutters

Ensure wireways and auxiliary gutters are a minimum 4 by 4-inch trade size conforming to UL 870.

2.1.1.7 Surface Raceways and Assemblies

Ensure surface metal raceways and multi-outlet assemblies conform to NFPA 70, and have receptacles conforming to NEMA WD 1, Type 5-20R.

2.1.2 Wire and Cable

Use copper 600-volt type THHN or THWN for conductors installed in conduit. Ensure all conductors AWG No. 8 and larger, are stranded. All conductors smaller than AWG No. 8 are solid.

Ensure flexible cable is Type SO and contains a grounding conductor with green insulation.

Ensure conductors installed in plenums are marked plenum rated.

2.1.3 Switches

2.1.3.1 Safety Switches

Ensure safety switches comply with NEMA KS 1, and are the heavy-duty type with enclosure, voltage, current rating, number of poles, and fusing as indicated on the drawings. Ensure switch construction is such that, when the switch handle in the "ON" position, the cover or door cannot be opened. Cover release device is coinproof and so constructed that an external tool is used to open the cover. Make provisions to lock the handle in the "OFF" position. Ensure the switch is not capable of being locked in the "ON" position.

Provide switches of the quick-make, quick-break type and terminal lugs for use with copper conductors.

Ensure safety color coding for identification of safety switches conforms to ANSI Z535.1.

2.1.3.2 Toggle Switches

Ensure toggle switches comply with EIA 480, control incandescent, mercury, and fluorescent lighting fixtures and are the heavy duty, general purpose, noninterchangeable flush-type.

Provide commercial grade toggle switches, devices rated 20 amperes at 277 volts, 60 hertz alternating current (ac) only.

Ensure all toggle switches are products of the same manufacturer.

2.1.4 Outlet Boxes, Pull Boxes and Junction Boxes

Ensure outlet boxes for use with conduit systems are in accordance with NEMA FB 1 and ANSI/NEMA OS 1 and are not less than 1-1/2 inches deep. Furnish all pull and junction boxes with screw-fastened covers.

2.1.5 Circuit Breakers

Ensure circuit breaker interrupting rating is not less than those indicated and in no event less than 10,000 amperes root-mean-square (rms) symmetrical at 208 volts, respectively. Provide multipole circuit breakers of the common-trip type with a single handle. Molded case circuit breakers are bolt-on type conforming to UL 489.

2.1.6 Manufacturer's Nameplate

Ensure each item of equipment has a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent is not acceptable.

2.1.7 Warning Signs

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

a. Enclosure integrity to conform with IEEE C57.12.28, such as for pad-mounted transformers. Provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Provide decal signs with nominal dimensions of 7 by 10 inches. Print the legend "DANGER HIGH VOLTAGE" in two lines of nominal 2 inch high letters. Show the word "DANGER" in white letters on a red background and the words "HIGH VOLTAGE" in black letters on a white background.

b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3-inch high white letters on a red and black field.

2.1.8 [Enter Appropriate Subpart Title Here]

PART 3 EXECUTION

3.1 PREPARATION

Submit manufacturer's instructions including special provisions required to install equipment components and system packages. Special provisions include impedances, hazards and safety precautions.

Clean and paint conduit, supports, fittings, cabinets, pull boxes, and racks as specified in Section 09 96 00 HIGH-PERFORMANCE COATINGS.

Protect metallic materials against corrosion. Provide equipment enclosures with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and abrasive action), and all outdoor installations, refer to

Section 09 96 00 HIGH-PERFORMANCE COATINGS. Do not use aluminum when in contact with earth or concrete and, where connected to dissimilar metal, protect by using approved fittings and treatment. Except where other equivalent protective treatment is specifically approved in writing, provide hot-dip galvanized ferrous metals for items such as, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous items not made of corrosion-resistant steel.

3.2 INSTALLATION

3.2.1 Conduits, Raceways and Fittings

Ensure that conduit runs between outlet and outlet, between fitting and fitting, or between outlet and fitting does not contain more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting.

Do not install crushed or deformed conduit. Avoid trapped conduit runs where possible. Take care to prevent the lodgment of foreign material in the conduit, boxes, fittings, and equipment during the course of construction. Clear any clogged conduit of obstructions or replace conduit.

Conduit and raceway runs concealed in or behind walls, above ceilings, or exposed on walls and ceilings 5 feet or more above finished floors and not subject to mechanical damage may be electrical metallic tubing (EMT).

3.2.1.1 Rigid Steel Conduit

Make field-made bends and offsets with approved Hickey bending tool or conduit bending machine. Use long radius conduit for elbows larger than 2-1/2 inches.

Provide a flush coupling for all conduit stubbed-up through concrete floors for connections to free-standing equipment with the exception of motor-control centers, cubicles, and other such items of equipment, when the floor slab is of sufficient thickness. Otherwise, provide a floor box set flush with the finished floor. For conduits installed for future use, terminate with a coupling and plug; set flush with the floor.

3.2.1.2 Electrical Metallic Tubing (EMT)

Ground EMT in accordance with NFPA 70, using pressure grounding connectors especially designed for EMT.

3.2.1.3 Flexible Metallic Conduit

Use flexible metallic conduit to connect recessed fixtures from outlet boxes in ceilings, transformers, and other approved assemblies.

Use bonding wires in flexible conduit as specified in NFPA 70, for all circuits. Flexible conduit is not considered a ground conductor.

Make electrical connections to vibration-isolated equipment with flexible metallic conduit.

Use liquidtight flexible metallic conduit in wet and oily locations and to complete the connection to motor-driven equipment.

3.2.1.4 Intermediate Conduit

Make all field-made bends and offsets with approved Hickey bending tool or conduit bending machine. Use intermediate metal conduit only for indoor installations.

3.2.1.5 Rigid Nonmetallic Conduit

Ensure rigid PVC conduit is direct buried.

Install a green insulated copper grounding conductor in conduit with conductors and solidly connect to ground at each end. Size grounding wires in accordance with NFPA 70.

3.2.1.6 Wireway and Auxiliary Gutter

Bolt together straight sections and fittings to provide a rigid, mechanical connection and electrical continuity. Close dead ends of wireways and auxiliary gutters. Plug all unused conduit openings.

Support wireways for overhead distribution and control circuits at maximum 5 -foot intervals.

Ensure auxiliary gutters used to supplement wiring spaces for equipment not contained in a single enclosure contains no switches, overcurrent devices, appliances, or apparatus and is not more than 30 feet long.

3.2.1.7 Surface Raceways and Assemblies

Mount surface raceways plumb and level, with the base and cover secured. Minimum circuit run is three-wire, with one wire designated as ground.

3.2.1.8 Cable Trays

Support cable trays from ceiling hangers, equipment bays, or floor or wall supports. Cable trays may be mounted on equipment racks. Provide support when the free end extends beyond 3 feet. Maximum support spacing is 6 feet. Support trays 10-inches wide or less by one hanger. Support trays greater than 10 inches wide by two hangers. Bond cable trays at splices.

3.2.1.9 Splices and Connectors

Make all splices in AWG No. 8 and smaller with approved insulated electrical type .

Make all splices in AWG No. 6 and larger with indentor crimp-type connectors and compression tools . Wrap joints with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor.

3.2.2 Wiring

Color code feeder and branch circuit conductors as follows:

CONDUCTOR	COLOR AC
Phase A	NEC

CONDUCTOR	COLOR AC
Phase B	NEC
Phase C	NEC
Neutral	White
Equipment Grounds	Green

Use conductors up to and including AWG No. 2 that are manufactured with colored insulating materials. For conductors larger than AWG No. 2, have ends identified with color plastic tape in outlet, pull, or junction boxes.

Splice in accordance with the NFPA 70. Provide conductor identification within each enclosure where a tap, splice, or termination is made and at the equipment terminal of each conductor. Match terminal and conductor identification as indicated.

Where several feeders pass through a common pullbox, tag the feeders to clearly indicate the electrical characteristics, circuit number, and panel designation.

3.2.3 Safety Switches

Securely fasten switches to the supporting structure or wall, utilizing a minimum of four 1/4 inch bolts. Do not use sheet metal screws and small machine screws for mounting. Do not mount switches in an inaccessible location or where the passageway to the switch may become obstructed. Mounting height 5 feet above floor level, when possible.

3.2.4 Wiring Devices

3.2.4.1 Wall Switches and Receptacles

Install wall switches and receptacles so that when device plates are applied, the plates are aligned vertically to within 1/16 inch.

Bond ground terminal of each flush-mounted receptacle to the outlet box with an approved green bonding jumper when used with dry wall type construction.

3.2.4.2 Device Plates

Ensure device plates for switches are suitably engraved with a description of the loads when not within sight of the loads controlled.

Mark device plates and receptacle cover plates for receptacles other than 125-volt, single-phase, duplex, convenience outlets. Show the circuit number, voltage, frequency, phasing, and amperage available at the receptacle. Use self-adhesive labels having 1/4 inch embossed letters.

Similarly mark device plates for convenience outlets indicating the supply panel and circuit number.

3.2.5 Boxes and Fittings

Provide pullboxes where necessary in the conduit system to facilitate conductor installation. For conduit runs longer than 100 feet or with more than three right-angle bends, install a pullbox at a convenient intermediate location.

Securely mount boxes and enclosures to the building structure using supports that are independent of the conduit entering or leaving the boxes.

3.2.6 Field Fabricated Nameplates

Ensure nameplates conform to ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device, as specified or as indicated on the drawings. Each nameplate inscription identifies the function and, when applicable, the position. Provide nameplates that are melamine plastic, 0.125-inch thick, white with black center core and a matte finish surface with square corners. Accurately align lettering and engrave into the core. Minimum size of nameplates is 1 by 2.5 inches. Lettering is a minimum of 0.25-inch high normal block style.

3.2.7 Identification Plates and Warnings

Provide identification plates for lighting and power panelboards, motor control centers, all line voltage heating and ventilating control panels, fire detector and sprinkler alarms, door bells, pilot lights, disconnect switches, manual starting switches, and magnetic starters. Attach identification plates to process control devices and pilot lights.

Install identification plates for all line voltage enclosed circuit breakers, identifying the equipment served, voltage, phase(s) and power source. For circuits 480 volts and above, install conspicuously located warning signs in accordance with OSHA requirements.

3.2.8 Posted Operating Instructions

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Ensure operating instructions do not fade when exposed to sunlight. Secure instructions to prevent easy removal or peeling.

Ensure each system and principal item of equipment is as specified in the technical sections for use by operation and maintenance personnel. Include the following information with the operating instructions:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer.

3.3 FIELD QUALITY CONTROL

After completion of the installation and splicing, and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified before the conductors are energized.

Provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.

Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Use substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices to isolate the circuits under test.

Perform insulation-resistance test on each field-installed conductor with respect to ground and adjacent conductors. Applied potential is 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Take readings after 1 minute and until the reading is constant for 15 seconds. Minimum insulation-resistance values is not less than 25 Megohms for 300 volt rated cable and 100 Megohms for 600 volt rated cable. For circuits with conductor sizes AWG No. 8 and smaller insulation resistance testing is not required.

Perform continuity test to insure correct cable connection end-to-end (i.e correct phase conductor, grounded conductor, and grounding conductor wiring). Repair and verify any damages to existing or new electrical equipment resulting from mis-wiring. Receive approval for all repairs from the Contracting Officer prior to commencement of the repair.

Conduct phase-rotation tests on all three-phase circuits using a phase-rotation indicating instrument. Perform phase rotation of electrical connections to connected equipment in a clockwise direction, facing the source.

Submit test reports in accordance with referenced standards in this section.

Final acceptance requires the successful performance of wire and cable under test. Do not energize any conductor until the final test reports are reviewed and approved by the Contracting Officer.

-- End of Section --

SECTION 26 05 13.00 40

MEDIUM-VOLTAGE CABLES
11/16

PART 1 GENERAL

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC C8	(2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV
AEIC CS1	(2012) Impregnated-Paper-Insulated, Metallic Sheathed Cable, Solid Type

ASTM INTERNATIONAL (ASTM)

ASTM B3	(2013) Standard Specification for Soft or Annealed Copper Wire
ASTM D746	(2014) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 383	(2015) Qualifying Class 1E Electric Cables and, Field Splices for Nuclear Power Generating Stations 2004
IEEE 400.2	(2013) Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA WC 71/ICEA S-96-659	(2014) Standard for Nonshielded Cables Rated 2001-5000 Volts for use in the Distribution of Electric Energy
NEMA WC 27500	(2015) Standard for Aerospace and Industrial Electrical Cable
NEMA WC 70	(2009) Power Cable Rated 2000 V or Less for the Distribution of Electrical Energy--S95-658
NEMA WC 74/ICEA S-93-639	(2012) 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution

of Electric Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14; TIA 17-15; TIA 17-16; TIA 17-17) National Electrical Code

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-228	(Rev A) Testing Methods for Cable and Wire, Insulated

1.2 DEFINITIONS

Medium-voltage power cables include all cables rated above 600 volts up to 35,000 volts.

1.3 SUBMITTALS

Submittals required in the sections which refer to this section shall conform to the requirements of Section 01 33 00, "Submittal Procedures" and to the following additional requirements. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and technical paragraph reference. Submittals shall also include applicable federal, military, industry, and technical society publication references, and years of satisfactory service, and other information necessary to establish contract compliance of each item to be provided. Photographs of existing installations are unacceptable and will be returned without approval.

SD-03 Product Data

Multiple-Conductor Shielded Cables;

Multiple-Conductor Nonshielded Cables;

Single-Conductor Shielded Cables;

Single-Conductor Nonshielded Cables;

Portable Cables;

Nonmetallic Jacket;

SD-06 Test Reports

Dielectric-Absorption Tests

Medium-Voltage Tests

Radiographic Tests;

SD-07 Certificates

Lead Sheath

Flammability

Minimum Bending Radius

Medium-Voltage Tests

Dielectric Absorption Tests

Cable Splicers

SD-08 Manufacturer's Instructions

Medium-Voltage Power Cables

Pothead Terminations

1.4 QUALITY CONTROL

Provide a list of installed products to the Contracting Officer before performing the specified work. Show the qualifications of the cable splicers .

Ensure that cable splicers performing splicing have [5] [_____] years of experience in cable splicing and terminations. Ensure that once a termination or splice has been started by a worker, the same person completes that particular splice. Start and complete each termination and splice in one continuous work period.

1.5 DELIVERY, STORAGE, AND HANDLING

Ship cables on reels in a way that protects the cable from mechanical injury. Hermetically seal and attach each end of each length of cable to the reel.

Make the minimum reel drum diameter 14 times the overall diameter of the cable. Ensure that each cable length is installed with a pulling eye installed by the manufacturer, for installation in ducts, manholes, and utility tunnels.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Cable Voltage Ratings

Provide medium-voltage power cables including multiple- and single-conductor cables rated as follows, phase-to-phase, for grounded and ungrounded neutral systems:

15,000 volts, ungrounded neutral, on 12,470-volt, three-phase, 60-hertz distribution systems.

2.2 EQUIPMENT

Ensure that ethylene-propylene rubber and cross-linked polyethylene-insulated conductors are lead-free.

2.2.1 Multiple-Conductor Shielded Cables

2.2.1.1 Varnished Cambric and Lead

Provide multiple-conductor, varnished-cambric-insulated, lead-covered, shielded cable that conforms to NEMA WC 27500.

Provide cables that have a nonmetallic jacket over the lead sheath in accordance with paragraph NONMETALLIC JACKET.

2.2.1.2 Varnished Cambric with Interlocked Armor

Provide multiple-conductor, varnished-cambric-insulated, interlocked-armor-covered, shielded cable that conforms to NEMA WC 27500.

Apply close-fitting, interlocked-armor tape of over the jacket.

2.2.1.3 Synthetic Rubber with Interlocked Armor

Provide multiple-conductor, synthetic-rubber-insulated, interlocked-armor-covered, shielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659 and NEMA WC 74/ICEA S-93-639.

Apply close-fitting, interlocked-armor tape of galvanized steel over the jacket.

2.2.1.4 Butyl Rubber with Neoprene Jacket

Apply multiple-conductor, butyl-rubber-insulated, neoprene-jacketed, shielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659 and NEMA WC 74/ICEA S-93-639.

2.2.1.5 Cross-Linked Polyethylene with PVC Jacket

Provide multiple-conductor, cross-linked polyethylene-insulated, polyvinylchloride-jacketed, shielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8. Provide taped shielding that consists of 5-mil thick copper shielding lap applied over 12-mil thick semiconducting tape. Wrap both helically with 10 -percent overlap, providing 100-percent coverage.

[Shield cross-linked polyethylene (XLP) single- and multiple-conductor cables for grounded and ungrounded neutral voltage ratings of 2,000 volts or more.

]2.2.1.6 Ethylene Propylene Rubber (EPR) with Jacketed Interlocked Armor

Provide multiple-conductor ethylene propylene rubber insulated interlocked armor covered shielded cables that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

[Shield ethylene propylene (EP) or ethylene propylene rubber (EPR), single- and multiple-conductor cables for grounded or ungrounded neutral voltage ratings of more than 8,000 volts.

]2.2.2 Multiple-Conductor, Nonshielded Cables

2.2.2.1 Synthetic Rubber with Neoprene Jacket

Provide multiple-conductor, synthetic-rubber-insulated, neoprene-jacketed, nonshielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659 and NEMA WC 74/ICEA S-93-639.

2.2.2.2 Butyl Rubber with Neoprene Jacket

Provide multiple-conductor, synthetic-rubber-insulated, neoprene-jacketed, nonshielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659 and NEMA WC 74/ICEA S-93-639.

2.2.2.3 Cross-Linked Polyethylene with PVC Jacket

Provide multiple-conductor, polyethylene-insulated, polyvinylchloride-jacketed, nonshielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

2.2.2.4 Ethylene-Propylene with PVC Jacket

Provide multiple-conductor, ethylene-propylene-insulated, PVC-jacketed, nonshielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

2.2.3 Single-Conductor Shielded Cables

2.2.3.1 Butyl Rubber with Neoprene Jacket

Provide single-conductor, butyl-rubber-insulated, neoprene-jacketed, shielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659 and NEMA WC 74/ICEA S-93-639.

2.2.3.2 Cross-Linked Polyethylene with PVC Jacket

Provide single-conductor, polyethylene-insulated, PVC-jacketed, shielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

2.2.3.3 Cross-Linked Polyethylene with Interlocked Armor

Provide single-conductor, polyethylene-insulated, PVC-jacketed, shielded cable with interlocked armor that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

Apply a close-fitting, interlocked-armor tape of aluminum over the jacket.

2.2.3.4 Ethylene-Propylene-Rubber-Insulated with PVC Jacket

Provide single-conductor 15 kV rated cable assemblies that consist of the following: Class B stranded copper conductors, an extruded semiconducting shield over the conductors, 220 mils of ethylene propylene rubber insulation, an extruded or other approved semiconducting shield, a 5-mil minimum copper tape shield wrapped helically with a minimum 12.5 percent overlap and a PVC jacket.

Provide single-conductor, ethylene-propylene-insulated, PVC-jacketed, shielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659,

NEMA WC 74/ICEA S-93-639 and AEIC C8.

2.2.4 Single-Conductor Nonshielded Cables

2.2.4.1 Butyl Rubber with Neoprene Jacket

Provide single-conductor, butyl-rubber-insulated, neoprene-jacketed, nonshielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659 and NEMA WC 74/ICEA S-93-639.

2.2.4.2 Cross-Linked Polyethylene

Provide single-conductor, cross-linked polyethylene-insulated, nonshielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

2.2.4.3 Ethylene-Propylene-Rubber-Insulated with PVC Jacket

Provide single-conductor, ethylene-propylene-rubber-insulated, PVC-jacketed, nonshielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

2.2.5 Portable Cables

Provide SHD multiple-conductor, butyl-rubber-insulated, neoprene-jacketed, shielded portable cable conforming to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659 and NEMA WC 74/ICEA S-93-639.

2.2.6 Cable Supports and Fittings

Provide cable supports, related fittings, and accessories for use in corrosive underground locations, such as manholes and utility tunnels, with a factory-applied coating of PVC of at least 20 mils thick. Provide PVC coated items that have a uniform thickness and are free of blisters, breaks, and holidays. Provide PVC compound that conforms to ASTM D746.

2.3 COMPONENTS

2.3.1 Cable Identification

Provide cables that have a tape placed immediately under the lead sheath or outer jacket showing the name of the manufacturer, the year in which the cable was manufactured, and a unique number for identification purposes. Closely group information on the tape at 1-foot intervals to permit complete identification.

2.3.2 Nonmetallic Jacket

2.3.2.1 Interlock Armored Cable

Provide a nonmetallic, corrosion-resistant jacket over interlock-armored cable that is black polyethylene conforming to .

2.3.2.2 Lead-Sheathed Cable

Provide a nonmetallic, corrosion-resistant jacket over lead-sheathed cable that is PVC at least 0.11 inch thick. Provide cover that fits tightly against the lead sheath and is coated with a slipper compound.

2.3.2.3 Terminations

Provide potheads with grounding terminals and cast-iron bells that are rated as follows:

Indoor - 15 kV rating, to withstand 45 kV ac for 10 seconds, minimum

Outdoor - 25 kV rating, to withstand 60 kV ac for 10 seconds, minimum

2.4 MATERIALS

2.4.1 Conductors

Ensure that conductors conform to the applicable requirements of NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639. Ensure that conductors are solid copper conforming to ASTM B3 and that they are bare, or tin- or lead-alloy-coated, according to the type of insulation used. [Ensure that aluminum conductors are Type AA-8000 aluminum conductors. Do not use Type 1350 aluminum conductors. Do not intermix copper and aluminum conductors in the same raceway.]"

2.5 TESTS, INSPECTIONS, AND VERIFICATIONS

Provide certificates showing that the cable manufacturer has made the following factory-conducted tests on each shipping length of cable. Before cable is delivered, provide certified copies of test data that shows conformance with the referenced standards and is approved.

[a. Flammability

For cables not to be enclosed in metallic conduit, test for flammability in accordance with [FED-STD-228, Method 5221 [vertical], [spark]][IEEE 383, 70,000 Btu per hour per hour vertical tray flame test].

][b. Minimum Bending Radius

]PART 3 EXECUTION

3.1 INSTALLATION

Install medium-voltage cables in accordance with NFPA 70.

Install cable in underground duct banks, in conduit above and below grade, inside buildings, by open wire method, on insulator hooks; on racks, in wall and ceiling-mounted cable trays in utility tunnels and manholes, and by direct burial.

Secure cables with heavy-duty cable ties in existing or new trays mounted horizontally, where the cable rests on the tray bottom. Install cable ties at a minimum of [10] foot intervals.

Secure cables with [PVC-coated] [metallic] [non-metallic] cable clamps, straps, hangers, or other approved supporting devices to tunnel walls, ceilings, and in new or existing cable trays mounted vertically, where the tray bottom is in a vertical plane.

When field cuts or other damage occurs to the PVC coating, apply a liquid PVC patch to maintain the integrity of the coating. After the installation is complete, perform an inspection to ensure that the coating has no voids,

pinholes, or cuts.

Before installing new armored cable, ensure that cable trays are properly secured and supported. Add new permanent or temporary tray support devices as required to preclude cable tray failure during cable pulling or after cable is installed.

Cable or conductors of a primary distribution system will be rejected by the Contracting Officer when installed openly in cable trays or openly racked along interior walls; in the same raceway or conduit with ac or dc control circuits or ac power circuits operating at less than 600 volts; or in a manner allowing cable to support its own weight.

3.1.1 Moisture-Testing Before Pulling

Moisture-test cable that has paper insulation before pulling the cable into underground ducts. Ensure that radii of bends, potheads, fittings, cable risers, and other conditions are suitable for the cable and conform to the recommendations of the cable manufacturer.

3.1.2 Protection During Splicing Operations

Provide a blower to force fresh air into manholes or confined areas where free movement or circulation of air is obstructed. Have waterproof protective coverings available on the work site to protect against moisture while a splice is being made. Use pumps to keep manholes dry during splicing operations. Never make a splice or termination with the interior of a cable exposed to moisture. Moisture-test the conductor insulation paper before the splice is made. Use a manhole ring at least [6] inches above ground around the manhole entrance to keep surface water from entering the manhole. Before starting the splice, plug unused ducts and stop water seepage through ducts in use.

3.1.3 Duct Cleaning

Thoroughly clean ducts before installation of power cables. Pull a standard flexible mandrel through each duct to loosen particles of earth, sand, or foreign material in the line. Use a mandrel that is not less than [12] inches long with a diameter 1/2 inch less than the inside diameter of the duct. Then pull a brush with stiff bristles through each duct to remove the loosened particles. Use a brush with a diameter that is the same as or slightly larger than the diameter of the duct.

3.1.4 Pulling Cables in Ducts, Manholes and Utility Tunnels

Pull medium-voltage cables into ducts and utility tunnels with equipment designed for this purpose, including a power-driven winch, cable-feeding flexible tube guide, cable grips, and lubricants. Employ a sufficient number of trained personnel and equipment to ensure correct installation of the cable.

Set up the cable reel at the side of the manhole or tunnel hatch opening and above the duct or hatch level, allowing the cable to enter through the opening without reverse bending. Install a flexible tube guide through the opening in a manner that prevents the cable from rubbing against the edges of structural members.

Ensure that the pulling force for a cable grip on lead-sheathed cable does not exceed manufacturer specifications . Use a dynamometer in the pulling

line to ensure that the pulling force is not exceeded. Ensure that the pulling force for a nonmetallic-sheathed cable does not exceed the smaller of 1,000 pounds or a value computed from the following equation:

TM = 0.008 X N X CM

Where: TM = maximum allowable pulling tension in pounds

N = number of conductors in the cable

CM = cross-sectional area of each conductor in circular mils

Unreel cable from the top of the reel. Carefully control payout. Attach cable to be pulled through a swivel to the main pulling wire by means of a [pulling eye] [suitable cable grip permitted only on cables less than 200 feet long and less than 2 inches in diameter].

When pulling small cables and short straight lengths of heavier cables,use woven-wire cable grips to grip the cable end.

Attach pulling eyes to the cable conductors to prevent damage to the cable structure.

To prevent damage to the cable structure, use pulling eyes and cable grips together for nonmetallic sheathed cables.

Provide a minimum bending radius in accordance with the following:

CABLE TYPE	MINIMUM BENDING RADIUS MULTIPLIER TIMES CABLE DIAMETER
RUBBER- AND PLASTIC-INSULATED CABLE WITH OR WITHOUT INTERLOCKED ARMOR	
[Nonshielded cables]	[8]
[Shielded cables with shielding wire]	[12]
[Shielded cables with shielding tape]	[8]
PAPER-INSULATED AND LEAD- COVERED CABLES, SHIELDED OR NONSHIELDED	
[Cables without armor]	[10]
[Cables with wire armor]	[12]
VARNISHED-CAMBRIC-INSULATED CABLES WITH OR WITHOUT LEAD SHEATH, SHIELDED OR NONSHIELDED	
[Cables without armor]	[8]
[Cables with wire armor]	[12]

Liberally coat cables with a suitable cable-pulling lubricant as the cable enters the tube guide or duct. Use grease and oil lubricants only on lead-sheathed cables. Cover nonmetallic sheathed cables with wire-pulling compounds that have no deleterious effects on the cable. Provide rollers, sheaves, or tube guides around which the cable is pulled that conform to the minimum bending radius of the cable.

Pull cables into ducts at a speed not to exceed [50] feet per minute and not in excess of maximum permissible pulling tension specified by the cable manufacturer. Ensure that cable pulling is done without using a vehicle. Stop pulling operations immediately if binding or obstruction is indicated and do not resume pulling operations until such difficulty is corrected. Provide sufficient slack for the cable to move freely when the cable expands or contracts.

Use cable racks to support cables when making cable splices in manholes or utility tunnels. Do not pull cable splices in ducts. Overlap cable ends at the ends of a section to provide sufficient undamaged cable for splicing. Make cables to be spliced in manholes or utility tunnels overlap the centerline of the proposed joint by not less than [2] feet.

Immediately seal cables cut in the field to keep out moisture. Seal nonleaded cables with rubber tape wrapped down to [3] inches from the cable end. Cover-wrap rubber tape with PVC tape. Seal lead-covered cables with wiping metal making a firm bond with the end of the sheath or with a disk of lead fitted over the end and wiped to the sheath.

3.1.5 Splices and Terminations

Make splices in manholes or tunnels except where cable terminations are specifically indicated. Expedite splicing and terminating of cables in order to minimize exposure and cable deterioration.

Terminate cables in potheads. Use dry terminations with medium-voltage pennants, preformed, and hand-wrapped stress cones for terminating cables. Install potheads with a means for making external connections to the cable conductors of [single-] [multiple-] conductor cables; protecting the cable insulation against moisture, oil, or other contaminant; physically protecting and supporting cables; and maintaining the insulation of the cable.

Field-fabricate pothead terminations from termination kits supplied by and in accordance with the pothead manufacturer's recommendations for the type, size, and electrical characteristics of the cable.

Ensure that installation includes built-up or prefabricated heat or cold shrink stress-relief cones at the terminals of all shielded cables and at the terminals of single-conductor lead-covered cables rated 15 kV and above, ungrounded.

Field-fabricate cable splices from splicing kits supplied by and in accordance with the cable manufacturer's recommendations for the type, size, and electrical characteristics of the cable specified. Locate cable splices in manholes midway between the cable racks on the walls of the manholes and supported with cable arms at approximately the same elevation as the enclosing duct.

If cable splices in the tunnel are not installed in cable trays, install the cable splices on cable racks or by other approved methods that minimize physical stress on the splice connections. Support splices at approximately the same elevation as the installed cable except where space limitations or existing cable length limitations make this method impractical or impossible.

Support all universal demountable splices in a manner that minimizes physical stress on the splice connections. Support each cable end

termination using a pair of saddle supports under the cable end termination or cable with a minimum [12] inches and a maximum [30] inches separation between the supports. Secure the cable end termination and cable to the supports in a manner that prevents movement of termination or cable at the support. Install saddle supports on a galvanized steel framing channel that is anchored to the wall, securely fastened to the cable tray, or installed by other approved methods.

3.2 FIELD QUALITY CONTROL

Subject each installation to dielectric-absorption tests and medium-voltage tests after the installation of medium-voltage power cables has been completed, including splices, joints, and terminations, and before the cable is energized.

Provide test equipment, labor, and technical personnel to perform the electrical acceptance tests.

Make arrangements to have tests witnessed and approved by the Contracting Officer.

Completely isolate each power-cable installation from extraneous electrical connections at cable terminations and joints. Observe safety precautions.

First give each power cable a full dielectric absorption test with a 5000-volt insulation-resistance test set. Apply the test for enough time to fully charge the cable. Record readings every 15 seconds during the first 3 minutes of the test and at 1-minute intervals thereafter. Continue the test until three equal readings, 1 minute apart, are obtained. Ensure that the minimum reading is 200 megohms at an ambient temperature of 68 degrees F. Correct the readings that were not taken at 68 degrees F ambient temperature.

Upon successful completion of the dielectric absorption tests, subject the cable to a direct-current high-potential test for 5 minutes applying test voltages in accordance with AEIC CS1 and IEEE 400.2 for paper-impregnated, lead-covered cable; AEIC C8 and IEEE 400.2 for cross-linked, polyethylene-insulated cable; and AEIC C8 and IEEE 400.2 for ethylene propylene rubber-insulated cable.

Record leakage current readings every 30 seconds during the first 2 minutes and every minute thereafter for the remainder of the test. When the leakage current continues to increase after the first minute, immediately terminate the test and take steps to find and correct the fault. When a second test becomes necessary, repeat this test procedure.

Upon satisfactory completion of the high-potential test, give the cable a second dielectric-absorption test as before.

Provide results of the second dielectric-absorption test that agree with the first test and that indicate no evidence that the cable has been permanently injured by the high-potential test.

Record test data identifying the cable and location, megohm readings versus time, leakage current readings versus time, and cable temperature versus time.

Final acceptance depends upon the satisfactory performance of the cable under test. Do not energize cable until recorded test data has been approved by the Contracting Officer. Provide final test reports of the dielectric absorption tests and medium-voltage tests to the Contracting Officer. Provide reports with a cover letter/sheet clearly marked with the system name, date, and the words "Final Test Report - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

Perform radiographic tests on all potheads at the discretion of the Contracting Officer to determine if voids exist in the pothead. Rework unacceptable terminations at no additional expense to the Government.

3.3 CLOSEOUT ACTIVITIES

Provide manufacturer's instructions showing the recommended sequence and method of installation for medium-voltage power cables and pothead terminations.

-- End of Section --

SECTION 26 08 00

APPARATUS INSPECTION AND TESTING
08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2013) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

1.2 RELATED REQUIREMENTS

Section 26 00 00 BASIC ELECTRICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Acceptance tests and inspections

SD-07 Certificates

Qualifications of organization, and lead engineering technician

Acceptance test and inspections procedure

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Contractor shall engage the services of a qualified testing organization to provide inspection, testing, calibration, and adjustment of the electrical distribution system and generation equipment listed in paragraph entitled "Acceptance Tests and Inspections" herein. Organization shall be independent of the supplier, manufacturer, and installer of the equipment. The organization shall be a first tier subcontractor. No work required by this section of the specification shall be performed by a second tier subcontractor.

a. Submit name and qualifications of organization. Organization shall have been regularly engaged in the testing of electrical materials, devices, installations, and systems for a minimum of 5 years. The organization shall have a calibration program, and test instruments used shall be calibrated in accordance with NETA ATS.

b. Submit name and qualifications of the lead engineering technician performing the required testing services. Include a list of three comparable jobs performed by the technician with specific names and telephone numbers for reference. Testing, inspection, calibration, and adjustments shall be performed by an engineering technician, certified by NETA or the National Institute for Certification in Engineering Technologies (NICET) with a minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.

1.4.2 Acceptance Tests and Inspections Reports

Submit certified copies of inspection reports and test reports. Reports shall include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test reports documenting the results of each test not more than 10 days after test is completed.

1.4.3 Acceptance Test and Inspections Procedure

Submit test procedure reports for each item of equipment to be field tested at least 45 days prior to planned testing date. Do not perform testing until after test procedure has been approved.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 ACCEPTANCE TESTS AND INSPECTIONS

Testing organization shall perform acceptance tests and inspections. Test methods, procedures, and test values shall be performed and evaluated in accordance with NETA ATS, the manufacturer's recommendations, and paragraph entitled "Field Quality Control" of each applicable specification section. Tests identified as optional in NETA ATS are not required unless otherwise specified. Equipment shall be placed in service only after completion of required tests and evaluation of the test results have been completed. Contractor shall supply to the testing organization complete sets of shop drawings, settings of adjustable devices, and other information necessary for an accurate test and inspection of the system prior to the performance of any final testing. Contracting Officer shall be notified at least 14 days in advance of when tests will be conducted by the testing organization. Perform acceptance tests and inspections on applicable equipment and systems specified in the following sections:

a. Section 26 32 13 SINGLE OPERATION GENERATOR SETS. Functional engine shutdown tests, vibration base-line test, and load bank test shall not be performed by the testing organization. These tests shall be performed by the start-up engineer.

b. Section 26 12 19.10 THREE-PHASE PAD-MOUNTED TRANSFORMERS

c. Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION

d. Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Medium voltage cables and grounding systems only.

e. Section 26 36 23.00 20 AUTOMATIC TRANSFER SWITCHES

3.2 SYSTEM ACCEPTANCE

Final acceptance of the system is contingent upon satisfactory completion of acceptance tests and inspections.

3.3 PLACING EQUIPMENT IN SERVICE

A representative of the approved testing organization shall be present when equipment tested by the organization is initially energized and placed in service.

-- End of Section --

SECTION 26 12 19.10

THREE-PHASE PAD-MOUNTED TRANSFORMERS

04/04

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 318M/318RM	(1999) Metric Building Code Requirements for Structural Concrete and Commentary

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM C 260	(2001) Air-Entraining Admixtures for Concrete
ASTM D 92	(2002; Rev. A) Flash and Fire Points by Cleveland Open Cup IP Designation: 36/84 (89); AASHTO No.: T 48; DIN 51 376
ASTM D 97	(2002) Pour Point of Petroleum Products IP Designation: 15/95
ASTM D 877	(2002) Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
ASTM D 1535	(1997) Specifying Color by the Munsell System

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 712-C-98-075	(1998) Fate, Transport and Transformation Test Guidelines - OPPTS 835.3100- "Aerobic Aquatic Biodegradation"
EPA 600/4-90/027F	(1993) Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825	(2003) Approval Guide

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 386	(1995; R 2001) Separable Insulated Connection
IEEE C2	(2002) National Electrical Safety Code (IEEE)
IEEE C57.12.00	(2000) Liquid-Immersed Distribution, Power, and Regulating Transformers (IEEE)
IEEE C57.12.80	(2002) Terminology for Power and Distribution Transformers (IEEE)
IEEE C57.12.90	(1999) Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers (IEEE)
IEEE C57.98	(1993; Correction 1998) Guide for Transformer Impulse Tests (IEEE)
IEEE C62.11	(1999) Metal-Oxide Surge Arresters for AC Power Circuits (> 1 kV) (IEEE)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C37.47	(2000) High Voltage Current-Limiting Type Distribution Class Fuses and Fuse Disconnecting Switches
NEMA C57.12.26	(1993) Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, High-Voltage, 34 500 Grd Y/19 920 Volts and Below; 2500 kVA and Smaller
NEMA C57.12.28	(1999) Pad-Mounted Equipment - Enclosure Integrity
NEMA C57.12.29	(1999; Errata 2000) Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1999) Electrical Power Distribution Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

ORGANIZATION OF ECONOMIC COOPERATION AND DEVELOPMENT (OECD)

OECD Test 203	(1993) Fish Acute Toxicity Test

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 431	Energy Efficiency Program for Certain Commercial and Industrial Equipment

UNDERWRITERS LABORATORIES (UL)

UL 467	(1993; R 2001) Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 26 00 00, "Basic Electrical Materials and Methods," and Section 26 0 8 00, "Apparatus Inspection and Testing," apply to this section, with the additions and modifications specified herein.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

As an exception to this paragraph, transformers manufactured by ABB in Jefferson City, MO; by Cooper Power Systems in Waukesha, WI; by GE in Shreveport, LA; or by Howard Industries in Laurel, MS need not meet the submittal requirements of this contract. Instead, the following shall be submitted:

a. A certification, from the manufacturer, that the technical requirements of this specification shall be met.

b. An outline drawing of the transformer with devices identified (paragraph entitled "Pad-Mounted Transformer Drawings", item a).

c. ANSI nameplate data of the transformer (paragraph entitled "Pad-Mounted Transformer Drawings", item b).

d. Manufacturer's published time-current curves (on full size logarithmic paper) of the transformer high side fuses (paragraph entitled "Pad-Mounted Transformer Drawings", item e).

e. Routine and other tests (in PART 2, see paragraph entitled "Routine and Other Tests"), shall be conducted by the manufacturer and may be witnessed by the government (in Part 2, see paragraph entitled "Source Quality Control"). Provide transformer test schedule required by submittal item "SD-11 Closeout Submittals". Provide certified copies of the tests.

f. Provide acceptance test reports required by submittal item "SD-06 Test Reports".

g. Provide operation and maintenance manuals required by submittal item "SD-10 Operation and Maintenance Data".

SD-02 Shop Drawings

Pad-mounted transformer drawings

SD-03 Product Data

Pad-mounted transformers

SD-06 Test Reports

Acceptance checks and tests

SD-07 Certificates

Transformer losses

SD-09 Manufacturer's Field Reports

Pad-mounted transformer design tests

Pad-mounted transformer routine and other tests

SD-10 Operation and Maintenance Data

Transformer(s), Data Package 5

SD-11 Closeout Submittals

Transformer test schedule

1.4 QUALITY ASSURANCE

1.4.1 Pad-Mounted Transformer Drawings

Drawings shall indicate, but not be limited to the following:

a. An outline drawing, with front, top, and side views.

b. ANSI nameplate data.

c. Elementary diagrams and wiring diagrams with terminals identified of watthour meter and current transformers.

d. One-line diagram, including switch(es), current transformers, meters, and fuses.

e. Manufacturer's published time-current curves (on full size logarithmic paper) of the transformer high side fuses.

1.4.2 Transformer Losses

Submit certification from the manufacturer indicating conformance with the paragraph entitled "Specified Transformer Losses."

1.4.3 Transformer Product Data

Submittal shall include manufacturer's information for each component, device, and accessory provided with the transformer.

1.4.4 Test Results

Submit report of test results as specified by paragraph entitled "Field Quality Control"

1.5 MAINTENANCE

1.5.1 Additions to Operation and Maintenance Data

In addition to requirements of Data Package 5, include the following on the actual transformer(s) provided:

a. An instruction manual with pertinent items and information highlighted

b. An outline drawing, front, top, and side views

c. Prices for spare parts and supply list

d. Routine and field acceptance test reports

e. Fuse curves for primary fuses

f. Actual nameplate diagram

g. Date of purchase

1.5.2 Operation and Maintenance Data

Submit operation and maintenance data in accordance with Section 01 78 23, "Operation and Maintenance Data" and as specified herein.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be pad-mounted transformers and related accessories are specified in Section 33 71 01, "Overhead Transmission and Distribution", Section 33 71 02, "Underground Transmission and Distribution", and Section 26 20 00, "Interior Distribution System".

2.2 THREE-PHASE PAD-MOUNTED TRANSFORMERS

NEMA C57.12.28, NEMA C57.12.29 and as specified herein.

2.2.1 Compartments

The high- and low-voltage compartments shall be separated by steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.2.1.1 High Voltage, Dead-Front

High-voltage compartment shall contain the incoming line, insulated high-voltage load-break connectors, bushing well inserts, feed-thru inserts, six high-voltage bushing wells configured for loop feed application, access to oil-immersed fuses, dead-front surge arresters, tap changer handle, connector parking stands with insulated standoff bushings, protective caps, and ground pad.

a. Insulated high-voltage load-break connectors: IEEE Std 386, rated 15 kV, 95 kV BIL. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms symmetrical for a time duration of 0.17 seconds. Connector shall have a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.

b. Bushing well inserts and feed-thru inserts: IEEE Std 386, 200 amperes, 15 kV Class. Provide a bushing well insert for each bushing well unless indicated otherwise. Provide feed-thru inserts as indicated.

c. Provide bayonet type, oil-immersed, expulsion fuses in series with oil-immersed, partial-range, current-limiting fuses. Bayonet fuse links shall sense both high currents and high oil temperature in order to provide thermal protection to the transformer. Coordinate transformer protection with expulsion fuse clearing low-current faults and current-limiting fuse clearing high-current faults beyond the interrupting rating of the expulsion fuse. In order to eliminate or minimize oil spills, the bayonet fuse assembly shall include an oil retention valve inside the housing which closes when the fuse holder is removed and an external drip shield. Warning shall be conspicuously displayed within the high-voltage compartment cautioning against removing or inserting fuses unless the load-break switch is in the open position and the tank pressure has been released.

   Bayonet fuse assembly: 150 kV BIL.

   Oil-immersed current-limiting fuses: NEMA C37.47; 50,000 rms amperes symmetrical interrupting rating at the system voltage specified.

d. Surge arresters: IEEE C62.11, rated 10 kV, fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap, suitable for plugging into inserts. Provide six arresters for loop feed circuits.

e. Parking stands: Provide a parking stand near each bushing well. Provide insulated standoff bushings for parking of energized load-break connectors on parking stands.

f. Protective caps: IEEE Std 386, 200 amperes, 15 kV Class. Provide insulated protective caps (not shipping caps) for insulating and sealing out moisture from unused bushing well inserts and insulated standoff bushings.

2.2.1.2 Low Voltage

Low-voltage compartment shall contain low-voltage bushings with NEMA spade terminals, accessories, metering, stainless steel or laser-etched anodized aluminum diagrammatic transformer nameplate, and ground pad.

a. Accessories shall include drain valve with sampler device, fill plug, pressure relief device, liquid level gage, pressure-vacuum gage, and dial type thermometer with maximum temperature indicator.
   Metering: Provide as specified in Section 26 27 14.00 20 ELECTRICITY METERING

2.2.2 Transformer

a. Less-flammable liquid-insulated, two winding, 60 hertz, 65 degrees C

rise above a 30 degrees C average ambient, self-cooled type.

b. Transformer shall be rated 500 or as indicated kVA, 95 kV BIL.

c. Transformer voltage ratings: 12,470Y/7200 V - 480/277 V or 208/120 as indicated.

d. Tap changer shall be externally operated, manual type for changing tap setting when the transformer is de-energized. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage. Tap changers shall clearly indicate which tap setting is in use.

e. Minimum tested impedance shall not be less than at 85 degrees C.
   2.50 for units rated 75kVA and below
   2.87 for units rated 112.5kVA to 300kVA
   4.03 for 500kVA rated units
   5.32 for units rated 750kVA and above

f. Audible sound levels shall comply with the following:

kVA	DECIBELS (MAX)
75	51
112.5	55
150	55
225	55
300	55
500	56
750	57
1000	58
1500	60

g. Transformer shall include lifting lugs and provisions for jacking under base. The transformer base construction shall be suitable for using rollers or skidding in any direction. Provide transformer top with an access handhole. Transformer shall have its kVA rating conspicuously displayed on its enclosure. The transformer shall have an insulated low-voltage neutral bushing with NEMA spade terminal, and with removable ground strap.

2.2.2.1 Specified Transformer Losses

Provide transformer efficiency calculations utilizing the actual no-load and load loss values obtained during the routine tests performed on the actual transformer(s) prepared for this project. No-load losses (NLL) shall be referenced at 20 degrees C. Load losses (LL) shall be referenced at 55 degrees C and at 50 percent of the nameplate load. The transformer is not acceptable if the calculated transformer efficiency is less than the efficiency indicated in the "KVA / Efficiency" table below. That table is based on requirements contained within 10 CFR 431, Subpart K. Example for a 500 kVA is provided below.

kVA	EFFICIENCY (percent)
15	98.65
30	98.83

45	98.92
75	99.03
112.5	99.11
150	99.16
225	99.23
300	99.27
500	99.35
750	99.40
1000	99.43
1500	99.48
2000	99.51
2500	99.53
above 2500	99.54

2.2.3 Insulating Liquid

a. Less-flammable transformer liquids: NFPA 70 and FM P7825 for less-flammable liquids having a fire point not less than 300 degrees C tested per ASTM D 92 and a dielectric strength not less than 33 kV tested per ASTM D 877. Provide identification of transformer as "non-PCB" and "manufacturer's name and type of fluid" on the nameplate.

The fluid shall be a biodegradable electrical insulating and cooling liquid classified by UL and approved by FM as "less flammable" fluids. The fluid shall meet the following fluid properties:

1. Pour point: ASTM D 97, less than -15 degree C

2. Aquatic biodegradation: EPA 712-C-98-075, 100%

3. Trout toxicity: OECD Test 203, zero mortality of EPA 600/4-90/027F, pass

2.2.3.1 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with nameplate information in accordance with IEEE C57.12.00 and as modified or supplemented by this section.

2.2.4 Corrosion Protection

Bases and cabinets of transformers shall be corrosion resistant and shall be fabricated of stainless steel conforming to ASTM A 167, Type 304 or 304L. Base shall include any part of pad-mounted transformer that is within

3 inches of concrete pad. Paint bases, cabinets, and tanks Munsell 7GY3.29/1.5 green. Paint coating system shall comply with NEMA C57.12.28 regardless of base, cabinet, and tank material. The Munsell color notation is specified in ASTM D 1535.

2.3 WARNING SIGNS

Provide as specified in Section 26 00 00, "Basic Electrical Materials and Methods."

2.4 GROUNDING AND BONDING

UL 467. Provide grounding and bonding as specified in Section 33 71 02, "Underground Transmission and Distribution."

2.5 CAST-IN-PLACE CONCRETE

Shall be composed of fine aggregate, coarse aggregate, portland cement, and water so proportioned and mixed as to produce a plastic, workable mixture. Fine aggregate shall be of hard, dense, durable, clean, and uncoated sand. The coarse aggregate shall be reasonably well graded from 3/16 inch to 1 inch. The fine and coarse aggregates shall be free from injurious amounts of dirt, vegetable matter, soft fragments or other deleterious substances. Water shall be fresh, clean, and free from salts, alkali, organic matter, and other impurities. Concrete associated with electrical work for other than encasement of underground ducts shall be 4000 psi minimum 28-day compressive strength unless specified otherwise. Slump shall not exceed 4 inches. Retempering of concrete will not be permitted. Exposed, unformed concrete surfaces shall be given a smooth, wood float finish. Concrete shall be cured for a period of not less than 7 days, and concrete made with high early strength portland cement shall be repaired by patching honeycombed or otherwise defective areas with cement mortar as directed by the Contracting Officer. Air entrain concrete exposed to weather using an air-entraining admixture conforming to ASTM C 260. Air content shall be between 4 and 6 percent.

2.6 SOURCE QUALITY CONTROL

2.6.1 Transformer Test Schedule

The Government reserves the right to witness tests. Provide transformer test schedule for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

1. The manufacturer shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.

3. Instrument calibration frequency schedule shall not exceed 12 months for both test floor instruments and leased specialty

equipment.

4. Dated calibration labels shall be visible on all test equipment.

5. Calibrating standard shall be of higher accuracy than that of the instrument tested.

6. Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

   (a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

   (b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.6.2 Design Tests

IEEE C57.12.00, and IEEE C57.12.90. Section 5.1.2 in IEEE C57.12.80 states that "design tests are made only on representative apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the catalog data and drawings for the specified transformer(s). Design tests shall have been performed prior to the award of this contract.

a. Tests shall be certified and signed by a registered professional engineer.

b. Temperature rise: "Basically the same design" for the temperature rise test means a pad-mounted transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (ONAN), the same temperature rise rating, and the same insulating liquid as the transformer specified.

c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a pad-mounted transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests shall include both the primary and secondary windings of that transformer.

   1. IEEE C57.12.90, paragraph 10.3 entitled "Lightning Impulse Test Procedures," and IEEE C57.98.

   2. State test voltage levels.

   3. Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.

d. Lifting and moving devices: "Basically the same design" requirement for the lifting and moving devices test means a test report confirming that the lifting device being used is capable of handling the weight of the specified transformer in accordance with NEMA C57.12.26.

e. Pressure: "Basically the same design" for the pressure test means a pad-mounted transformer with a tank volume within 30 percent of the tank volume of the transformer specified.

2.6.3 Routine and Other Tests

IEEE C57.12.00. Routine and other tests shall be performed by the manufacturer on the actual transformer(s) prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests and testing sequence shall be as follows:

a. Cold resistance measurements (provide reference temperature)

b. Phase relation

c. Ratio

d. No-load losses (NLL) and excitation current

e. Load losses (LL) and impedance voltage

f. Dielectric

1. Impulse

(a) State test voltage levels

(b) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test reports. As an alternative, photographs of oscilloscope display waveforms or plots of digitized waveforms may be hand-delivered at the factory witness test.

(c) The Officer in Charge (OIC) will select the transformers to be tested.

2. Applied voltage

3. Induced voltage

g. Leak

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

NFPA 70 and IEEE C2, except that grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02, "Underground Transmission and Distribution". Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide

compression connectors at equipment end of ground conductors.

3.2.2 Pad-Mounted Transformer Grounding

Provide separate copper grounding conductors and connect them to the ground loop as indicated. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Exothermic welds and compression connectors shall be installed as specified in Section 33 71 02, "Underground Transmission and Distribution."

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect pad-mounted transformers furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.4 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount transformer on prefabricated concrete support as indicated on drawing or attachmentss. Slab shall be placed on a 6 inch thick, well-compacted gravel base. Top of concrete support shall be approximately 12 inches above finished grade with gradual slope for drainage.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete support. Coordinate dimensions of cable wells with transformer cable training areas.

3.4.1 Cast-In-Place Concrete

Cast-in-place concrete work shall conform to the requirements of ACI 318M/318RM.

3.4.2 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.5 FIELD QUALITY CONTROL

3.5.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.5.1.1 Pad-Mounted Transformers

a. Visual and mechanical inspection

1. Compare equipment nameplate information with specifications and approved shop drawings.

2. Inspect physical and mechanical condition. Check for damaged or cracked insulators and leaks.

3. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

4. Verify correct liquid level in tanks.

5. Perform specific inspections and mechanical tests as recommended by manufacturer.

6. Verify correct equipment grounding.

7. Verify the presence of transformer surge arresters.

b. Electrical tests

1. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

2. Perform insulation-resistance tests.

3. Perform turns-ratio tests.

4. Perform insulation power-factor/dissipation-factor tests on windings.

5. Sample insulating liquid. Sample shall be tested for:

(a) Dielectric breakdown voltage

(b) Acid neutralization number

(c) Specific gravity

(d) Interfacial tension

(e) Color

(f) Visual condition

(g) Water in insulating liquid

(h) Measure dissipation factor or power factor

6. Perform dissolved gas analysis (DGA).

7. Test for presence of PCB.

8. Verify that the tap-changer is set at specified ratio.

9. Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

3.5.1.2 Current Transformers

a. Visual and mechanical inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify correct connection.

4. Verify that adequate clearances exist between primary and secondary circuit.

5. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

6. Verify that required grounding and shorting connections provide good contact.

b. Electrical tests

1. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

2. Perform insulation-resistance test.

3. Perform a polarity test.

4. Perform a ratio-verification test.

3.5.1.3 Watthour Meter

a. Visual and mechanical inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify tightness of electrical connections.

b. Electrical tests

1. Calibrate watthour meters according to manufacturer's published data.

2. Verify that correct multiplier has been placed on face of meter, where applicable.

3. Verify that current transformer secondary circuits are intact.

3.5.1.4 Grounding System

a. Visual and mechanical inspection

1. Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

1. Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

2. Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.5.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

SECTION 26 12 21

SINGLE-PHASE PAD-MOUNTED TRANSFORMERS
05/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	(2008) Electric Meters Code for Electricity Metering

ASTM INTERNATIONAL (ASTM)

ASTM A240/A240M	(2017) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM D117	(2010) Standard Guide for Sampling, Test Methods, Specifications and Guide for Electrical Insulating Oils of Petroleum Origin
ASTM D1535	(2014; R 2018) Standard Practice for Specifying Color by the Munsell System
ASTM D3487	(2016; E2017) Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus
ASTM D877/D877M	(2013) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
ASTM D92	(2012a) Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
ASTM D97	(2017b) Standard Test Method for Pour Point of Petroleum Products

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 386	(2016) Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code
IEEE C37.47	(2011) Standard for High Voltage Distribution Class Current-Limiting Type Fuses and Fuse Disconnecting Switches
IEEE C57.12.00	(2015) General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.25	(1990) Standard for Transformers - Pad-Mounted, Compartmental-Type, Self-Cooled, Single-Phase Distribution Transformers With Separable Insulated High-Voltage Connectors; High Voltage, 34,500 Grdy/ 19,920 Volts and Below; Low Voltage, 240/120 Volts; 167 kVa and Smaller Requirements
IEEE C57.12.28	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments
IEEE C57.12.80	(2010) Standard Terminology for Power and Distribution Transformers
IEEE C57.12.90	(2015; Corr 2017) Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.98	(2011) Guide for Transformer Impulse Tests
IEEE C62.11	(2012) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)
IEEE Stds Dictionary	(2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2017; Errata 2017) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 260	(1996; R 2004) Safety Labels for Pad-Mounted Switchgear and Transformers Sited in Public Areas
NEMA Z535.4	(2011; R 2017) Product Safety Signs and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14; TIA 17-15; TIA 17-16; TIA 17-17) National Electrical Code

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)

OECD Test 203	(1992) Fish Acute Toxicity Test

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 712-C-98-075	(1998) Fate, Transport and Transformation Test Guidelines - OPPTS 835.3100- "Aerobic Aquatic Biodegradation"
EPA 821-R-02-012	(2002) Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 431	Energy Efficiency Program for Certain Commercial and Industrial Equipment

UNDERWRITERS LABORATORIES (UL)

UL 467	(2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this Section, with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE Stds Dictionary.

1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Pad-Mounted Transformer Drawings;]

SD-03 Product Data

Single-Phase Pad-Mounted Transformers (Dead-Front);

SD-06 Test Reports

Acceptance Checks and Tests;

SD-07 Certificates

Transformer Efficiencies;

SD-09 Manufacturer's Field Reports

Transformer Test Schedule;

Pad-Mounted Transformer Design Tests;

Pad-Mounted Transformer Routine and Other Tests;

SD-10 Operation and Maintenance Data

Transformer(s), Data Package 5; GMCB Camp Lejeune1.5 QUALITY ASSURANCE

1.5.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" or "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with NFPA 70 unless more stringent requirements are specified or indicated.

1.5.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship, and:

a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.

b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site are not acceptable.

1.6 MAINTENANCE

1.6.1 Additions to Operation and Maintenance Data

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein. In addition to requirements of Data Package 5, include the following on the actual transformer(s) provided:

a. An instruction manual with pertinent items and information highlighted.

b. An outline drawing, front, top, and side views.

c. Prices for spare parts and supply list.

d. Routine and field acceptance test reports.

e. Fuse curves for primary fuses.

f. Information on watthour demand meter, CT's, and fuse block.

g. Actual nameplate diagram.

h. Date of purchase.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be pad-mounted transformers and related accessories are specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.2 SINGLE-PHASE PAD-MOUNTED TRANSFORMERS (DEAD-FRONT)

IEEE C57.12.25, IEEE C57.12.28 and as specified herein. Submit manufacturer's information for each component, device, insulating fluid, and accessory provided with the transformer.

2.2.1 Compartment Construction

b. Two compartment: Provide high- and low-voltage compartments separated by steel isolating barriers extending the full height and depth of the compartments. Compartment doors:

(1) Hinged lift-off type with stop in open position and three-point latching.

(2) High voltage door fastening accessible only after the low voltage door has been opened.

2.2.1.1 High Voltage

High-voltage portion contains: the incoming line, insulated high-voltage load-break connectors, bushing well inserts, feed-through inserts, high-voltage bushing wells configured for loop feed application, load-break switch handle(s), access to oil-immersed fuses, dead-front surge arresters, tap changer handle, connector parking stands with insulated standoff bushings, protective caps, and ground pad.

a. Insulated high-voltage load-break connectors: IEEE 386, rated 15 kV, 95 kV BIL. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms symmetrical for a time duration of 0.17 seconds. Provide connectors and inserts from the same manufacturer. Provide connectors with a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.

c. Bushing well inserts and feed-through inserts: IEEE 386, 200 amperes, 15 kV class. Provide a bushing well insert for each bushing well unless indicated otherwise. Provide feed-through inserts as indicated.

f. Provide bayonet oil-immersed, expulsion fuses in series with oil-immersed, partial-range, current-limiting fuses. The bayonet fuse links sense both high currents and high oil temperature in order to provide thermal protection to the transformer. Coordinate transformer protection with expulsion fuse clearing low-current faults and current-limiting fuse clearing high-current faults beyond the interrupting rating of the expulsion fuse. Include an oil retention valve inside the bayonet assembly housing, which closes when the fuse holder is removed, and an external drip shield to minimize oil spills. Display a warning label adjacent to the bayonet fuse(s) cautioning against removing or inserting fuses unless the transformer has been de-energized and the tank pressure has been released.

   Bayonet fuse assembly: 150 kV BIL.

   Oil-immersed current-limiting fuses: IEEE C37.47; 50,000 rms amperes symmetrical interrupting rating at the system voltage specified.

g. Surge arresters: IEEE C62.11, rated 10 kV, fully shielded, dead-front metal-oxide-varistor, elbow type with resistance-graded gap suitable for plugging into inserts as indicated.

h. Parking stands: Provide a parking stand near each bushing well. Provide insulated standoff bushings for parking of energized load-break connectors on parking stands.

2.2.1.2 Low Voltage

Low-voltage portion contains: low-voltage bushings with NEMA spade terminals, accessories, metering, stainless steel or laser-etched anodized aluminum diagrammatic transformer nameplate, and ground pad.

a. Include the following accessories: drain plug, fill plug, pressure relief device and a liquid level sight gage.

b. Metering

For two-compartment transformers, provide as specified in Section 26 27 13.10 30 ELECTRIC METERS.

2.2.2 Transformer

a. Less-flammable bio-based liquid-insulated or oil-insulated, two winding, 60 hertz, 65 degrees C rise above a 30 degrees C average ambient, self-cooled type.

b. Rated variable KVA by site. See attached locations.c. Voltage ratings: 7200 V - [240/120][480/240] V.

d. Tap changer: externally operated, manual type for changing tap setting when the transformer is de-energized. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage. Indicate which tap setting is in use, clearly visible when the compartment is opened.

e. Minimum tested percent impedance at 85 degrees C:

2.50 for units rated 25 kVA and below
2.87 for units rated 37.5 kVA to 100 kVA
4.03 for 167 kVA rated units

f. Comply with the following audible sound level limits:

kVA	DECIBELS (MAX)
10	48
15	48
25	48
37.5	48
50	48
75	51
100	51
167	55

g. Include:

(1) Lifting lugs and provisions for jacking under base, with base construction suitable for using rollers or skidding in any direction.

(2) An insulated low-voltage neutral bushing with NEMA spade terminal, and with removable ground strap.

2.2.2.1 Specified Transformer Efficiencies

Provide transformer efficiency calculations utilizing the actual no-load and load loss values obtained during the routine tests performed on the actual transformer(s) prepared for this project. Reference no-load losses (NLL) at 20 degrees C. Reference load losses (LL) at 55 degrees C and at

50 percent of the nameplate load. The transformer is not acceptable if the calculated transformer efficiency is less than the efficiency indicated in the "KVA / Efficiency" table below. The table is based on requirements contained within 10 CFR 431, Subpart K. Submit certification, including supporting calculations, from the manufacturer indicating conformance.

kVA	EFFICIENCY (percent)
10	98.70
15	98.82
25	98.95
37.5	99.05
50	99.11
75	99.19
100	99.25
167	99.33

2.3 INSULATING LIQUID

a. Less-flammable bio-based transformer liquids: NFPA 70 and FM APP GUIDE for less-flammable liquids having a fire point not less than 300 degrees C tested per ASTM D92 and a dielectric strength not less than 33 kV tested per ASTM D877/D877M. Provide identification of transformer as "non-PCB" and "manufacturer's name and type of fluid" on the nameplate.

   Provide a fluid that is a biodegradable, electrical insulating, and cooling liquid classified by UL and approved by FM as "less flammable" with the following properties:

   (1) Pour point: ASTM D97, less than -15 degree C.

   (2) Aquatic biodegradation: EPA 712-C-98-075, 100 percent.

   (3) Trout toxicity: OECD Test 203, zero mortality of EPA 821-R-02-012, pass.

b. Mineral oil: ASTM D3487, Type II, tested in accordance with ASTM D117. Provide identification of transformer as non-PCB and Type II mineral oil on the nameplate.

2.4 LIQUID-FILLED TRANSFORMER NAMEPLATES

Provide nameplate information in accordance with IEEE C57.12.00 and as modified or supplemented by this section.

2.5 CORROSION PROTECTION

Provide corrosion resistant bases and cabinets of transformers, fabricated of stainless steel conforming to ASTM A240/A240M, Type 304 or 304L. Base includes any part of pad-mounted transformer that is within 3 inches of concrete pad.

Paint entire transformer assembly Munsell 7GY3.29/1.5 green, with paint coating system complying with IEEE C57.12.28 and IEEE C57.12.29 regardless of base, cabinet, and tank material. The Munsell color notation is specified in ASTM D1535.

2.6 WARNING SIGNS AND LABELS

Provide warning signs for the enclosures of pad-mounted transformers having a nominal rating exceeding 600 volts in accordance with NEMA Z535.4 and NEMA 260.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28, such as for pad-mounted transformers, provide self-adhesive warning labels (decals, Panduit No. PPSO710D72 or approved equal) on the outside of the high voltage compartment door(s) with nominal dimensions of 7 by 10 inches with the legend "WARNING HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. Include the word "WARNING" in white letters on an orange background and the words "HIGH VOLTAGE" in black letters on a white background.

b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "WARNING HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on an orange and black field.

Provide arc flash warning label for the enclosure of pad-mounted transformers. Locate this self-adhesive warning label on the outside of the high voltage compartment side warning of potential electrical arc flash hazards and appropriate PPE required. Provide label format as indicated.

2.7 GROUNDING AND BONDING

UL 467. Provide grounding and bonding as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.8 CAST-IN-PLACE CONCRETE

Provide concrete associated with electrical work as follows:

a. Composed of fine aggregate, coarse aggregate, portland cement, and water so proportioned and mixed as to produce a plastic, workable mixture.

b. Fine aggregate: hard, dense, durable, clean, and uncoated sand.

c. Coarse aggregate: reasonably well graded from 3/16 inch to 1 inch.

d. Fine and coarse aggregates: free from injurious amounts of dirt, vegetable matter, soft fragments or other deleterious substances.

e. Water: fresh, clean, and free from salts, alkali, organic matter, and other impurities.

f. Concrete associated with electrical work for other than encasement of

underground ducts: 4000 psi minimum 28-day compressive strength unless specified otherwise.

g. Slump: Less than 4 inches. Retempering of concrete will not be permitted.

h. Exposed, unformed concrete surfaces: smooth, wood float finish.

i. Concrete must be cured for a period of not less than 7 days, and concrete made with high early strength portland cement must be repaired by patching honeycombed or otherwise defective areas with cement mortar as directed by the Contracting Officer.

j. Air entrain concrete exposed to weather using an air-entraining admixture conforming to ASTM C260/C260M.

k. Air content: between 4 and 6 percent.

2.9 SOURCE QUALITY CONTROL

2.9.1 Transformer Test Schedule

The Government reserves the right to witness tests. Provide transformer test schedule for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

2.9.2 Test Instrument Calibration

a. Provide a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

b. Accuracy: Traceable to the National Institute of Standards and Technology.

c. Instrument calibration frequency schedule: less than or equal to 12 months for both test floor instruments and leased specialty equipment.

d. Dated calibration labels: visible on all test equipment.

e. Calibrating standard: higher accuracy than that of the instrument tested.

f. Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

(1) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

(2) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.9.3 Design Tests

IEEE C57.12.00, and IEEE C57.12.90. Section 5.1.2 in IEEE C57.12.80 states

that "design tests are made only on representative apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the catalog data and drawings for each of the specified transformer(s), with design tests performed prior to the award of this contract.

a. Tests: certified and signed by a registered professional engineer.

b. Temperature rise: "Basically the same design" for the temperature rise test means a pad-mounted transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (ONAN), the same temperature rise rating, and the same insulating liquid as the transformer specified.

c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a pad-mounted transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests includes the primary windings only of that transformer.

   (1) IEEE C57.12.90, paragraph 10.3 entitled "Lightning Impulse Test Procedures," and IEEE C57.98.

   (2) State test voltage levels.

   (3) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.

d. Lifting and moving devices: "Basically the same design" requirement for the lifting and moving devices test means a test report confirming that the lifting device being used is capable of handling the weight of the specified transformer in accordance with IEEE C57.12.25.

e. Pressure: "Basically the same design" for the pressure test means a pad-mounted transformer with a tank volume within 30 percent of the tank volume of the transformer specified.

f. Short circuit: "Basically the same design" for the short circuit test means a pad-mounted transformer with the same kVA as the transformer specified.

2.9.4 Routine and Other Tests

IEEE C57.12.00. Routine and other tests: performed by the manufacturer on each of the actual transformer(s) prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests include:

a. Polarity.

b. Ratio.

c. No-load losses (NLL) and excitation current.

d. Load losses (LL) and impedance voltage.

e. Dielectric.

(1) Impulse.

(2) Applied voltage.

(3) Induced voltage.

f. Leak.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to IEEE C2, NFPA 70, and to requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

NFPA 70 and IEEE C2, except provide grounding systems with a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Pad-Mounted Transformer Grounding

Provide a ground ring around the transformer with 4/0 AWG bare copper. Provide four ground rods in the ground ring, one per corner. Install the ground rods at least 10 feet apart from each other. Provide separate copper grounding conductors and connect them to the ground loop as indicated. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the provision of the contract covering "Changes" applies.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Install exothermic welds and compression connectors as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect pad-mounted transformers furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.3.1 Meters and Current Transformers

ANSI C12.1.

3.4 FIELD APPLIED PAINTING

Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

3.5 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

3.6 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount transformer on concrete slab as follows:

a. Unless otherwise indicated, provide the slab with dimensions at least 8 inches thick, reinforced with a 6 by 6 inches - W2.9 by W2.9 mesh placed uniformly 4 inches from the top of the slab.

b. Place slab on a 6 inch thick, well-compacted gravel base.

c. Install slab such that top of concrete slab is approximately 4 inches above the finished grade with gradual slope for drainage.

d. Provide edges above grade with 1/2 inch chamfer.

e. Provide slab of adequate size to project at least 8 inches beyond the equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training areas.

3.6.1 Cast-In-Place Concrete

Provide cast-in-place concrete work in accordance with the requirements of ACI 318.

3.6.2 Sealing

When the installation is complete, seal all entries into the equipment enclosure with an approved sealing method. Provide seals of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.7 FIELD QUALITY CONTROL

3.7.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS. Submit reports, including acceptance criteria and limits for each test in accordance with NETA ATS "Test Values".

3.7.1.1 Pad-Mounted Transformers

a. Visual and mechanical inspection.

(1) Compare equipment nameplate information with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition. Check for damaged or cracked insulators and leaks.

(3) Inspect anchorage, alignment, and grounding.

(4) Verify the presence of PCB content labeling.

(5) Verify the bushings and transformer interiors are clean.

(6) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(7) Verify correct liquid level in tanks.

(8) Verify that positive pressure is maintained on gas-blanketed transformers.

(9) Perform specific inspections and mechanical tests as recommended by manufacturer.

(10) Verify correct equipment grounding.

(11) Verify the presence of transformer surge arresters.

b. Electrical tests.

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter.

(2) Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

3.7.1.2 Current Transformers

a. Visual and mechanical inspection.

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify correct connection.

(4) Verify that adequate clearances exist between primary and secondary circuit wiring.

(5) Verify the unit is clean.

(6) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(7) Verify that all required grounding and shorting connections

provide good contact.

(8) Verify correct operation of transformer withdrawal mechanism and grounding operation.

(9) Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

b. Electrical tests.

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

(2) Perform insulation-resistance test.

(3) Perform a polarity test.

(4) Perform a ratio-verification test.

3.7.1.3 Grounding System

a. Visual and mechanical inspection.

(1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests.

(1) Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground resistance tester in accordance with manufacturer's instructions to test each ground or group of grounds. Use an instrument equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

(2) Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.7.1.4 Surge Arresters, Medium- and High-Voltage

a. Visual and mechanical inspection.

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Inspect anchorage, alignment, grounding, and clearances.

(4) Verify the arresters are clean.

(5) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(6) Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.

b. Electrical tests.

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

(2) Perform an insulation-resistance test on each arrester, phase terminal-to-ground.

(3) Test grounding connection.

3.7.2 Follow-Up Verification

Upon completion of acceptance checks and tests, show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, notify the Contracting Officer 5 working days in advance of the dates and times of checking and testing.

-- End of Section --

SECTION 26 18 23.00 40

MEDIUM-VOLTAGE SURGE ARRESTERS
08/16

PART 1 GENERAL

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 386	(2016) Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV
IEEE C62.11	(2012) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14; TIA 17-15; TIA 17-16; TIA 17-17) National Electrical Code

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings;

Installation Drawings;

SD-03 Product Data

Equipment and Performance Data;

Mounting Brackets;

SD-08 Manufacturer's Instructions

Installation Instructions

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

1.3 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems have been installed properly and contain no identifiable defects that shorten the design life of a system and its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

PART 2 PRODUCTS

Submit surge arrester equipment and performance data, including life, test, system functional flows, safety features, and mechanical automated details.

Submit fabrication drawings that show assembly and fabrication details performed in the factory.

2.1 EQUIPMENT

Provide arresters that comply with IEEE C62.11 for design, fabrication, testing, and performance.

Provide arresters that utilize metal oxide varistor and gapped arrester technologies.

Provide arresters that are contained within a polymer housing. Ensure arrester is designed as non-fragmenting. For arresters utilizing a hanger frame type mounting bracket, provide a frame that is a non-corrosive track resistant glass filled polyester or other suitable non-corrosive and non-conductive material that provides high mechanical strength. Provide arrester mounting hardware designed for installation in a severe salt-spray atmosphere and is a zinc-coated or corrosion-resistant metal in accordance with ASTM A123/A123M .

Provide an arrester housing molded of EPDM insulating rubber in an insulated, fully shielded, submersible, dead-front device that conforms to IEEE 386.

2.1.1 Surge Arresters

2.1.1.1 Distribution

Provide combination spark gap and metal oxide varistor type distribution arresters. Provide corrosion resistant mounting hardware.

a. Distribution - Riser-Pole Class

Provide combination spark gap and metal oxide varistor type riser-pole class.

b. Distribution - Underground

Provide arresters that are combination spark gap and metal oxide varistor type technology in a premolded rubber elbow.

2.1.1.2 Intermediate

Provide single-phase, single-pole, self-supporting type arresters for pedestal, platform, or bracket mounting.

2.1.1.3 Station

Provide single-phase, single-pole, self-supporting type arresters for pedestal, platform, or bracket mounting.

2.1.2 Surge Protection for Rotating AC Machines

Provide arresters for rotating alternating current equipment that are the type and rating as recommended by the equipment manufacturer.

2.1.3 Mounting Brackets

Provide arresters equipped with suitable mounting brackets for the applicable method of mounting.

PART 3 EXECUTION

3.1 INSTALLATION

Submit installation drawings for surge arrestors.

Install and connect arresters in accordance with the manufacturer's installation instructions.

Make ground connection to a driven ground rod, counterpoise, or station grounding system and meet the intent of the National Electrical Code, NFPA 70.

Connect lightning arresters as close as practicable to the apparatus being protected. When connecting arresters to overhead conductors, use a hot line clamp. Provide a hot line clamp that is compatible with the conductor material being used, i.e. aluminum or copper.

3.1.1 Installation Instructions, Surge Arresters

Submit manufacturer's installation instructions for surge arresters including special provisions required to install equipment components and

system packages. Provide special notices that detail impedances, hazards and safety precautions.

3.1.2 Arresters

3.1.2.1 Distribution Type

Install distribution class arresters on all overhead lines, pad mounted transformers and on distribution load break switches, sectionalizers and fault interrupters. Install riser-pole class arrestors on all riser poles.

3.1.2.2 Intermediate Type

Install intermediate type arrestors on grounded support brackets and structures suitable to adequately support the weight of the arrestor.

3.1.2.3 Station Type

Install station type arrestors on grounded structures suitable to adequately support the weight of the arrestor.

3.2 FIELD QUALITY CONTROL

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

3.3 CLOSEOUT ACTIVITIES

Submit operation and maintenance manuals for the specified surge arresters.

-- End of Section --

SECTION 26 20 00

INTERIOR DISTRIBUTION SYSTEM

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(2001) Hard-Drawn Copper Wire
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C80.1	(1994) Rigid Steel Conduit - Zinc Coated
NEMA C80.3	(1994) Electrical Metallic Tubing - Zinc Coated (EMT)
NEMA ICS 6	(1993; R 2011) Enclosures
NEMA TC 14	(2002) Filament-Wound Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
NEMA TC 2	(1998) Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
NEMA TC 3	(1999) PVC Fittings for Use with Rigid PVC Conduit and Tubing

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3 2014) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1	(2000) Flexible Metal Conduit
UL 1242	(2000; R 2001, Bul. 2002) Intermediate Metal Conduit
UL 1449	(1996; R 2002) Transient Voltage Surge

	Suppressors
UL 1660	(2000; R 2002, Bul. 2002) Liquid-Tight Flexible Nonmetallic Conduit
UL 360	(1996; R 2001, Bul. 2002) Liquid-Tight Flexible Steel Conduit
UL 44	(1999; R 2002, Bul. 2002) Thermoset-Insulated Wires and Cables
UL 467	(1993; R 2001) Grounding and Bonding Equipment
UL 486A	(1997; R 2001, Bul. 2002, 2003) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; R 2001, Bul. 2002, 2003) Wire Connectors for Use with Aluminum Conductors
UL 486C	(2000; R 2002) Splicing Wire Connectors
UL 489	(2002; R 2002, Bul. 2003) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 50	(1995; R 1999, Bul. 2001) Enclosures for Electrical Equipment
UL 510	(1994; R 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(1996; R 2001, Bul. 2002) Metallic Outlet Boxes
UL 514B	(1997; R 2002, Bul. 2002) Fittings for Cable and Conduit
UL 514C	(1996; R 2002) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 6	(2000; Bul. 2001, 2002) Rigid Metal Conduit- Steel
UL 651	(1995; R 2002) Schedule 40 and 80 Rigid PVC Conduit
UL 797	(2000; Bul. 2002) Electrical Metallic Tubing
UL 83	(1998; R 2001, Bul. 2002) Thermoplastic-Insulated Wires and Cables
UL 854	(1999; R 2002) Service-Entrance Cables
UL 943	(1993; R 2002, Bul. 2002) Ground-Fault Circuit-Interrupters

1.2 RELATED REQUIREMENTS

Section 26 00 00, "Basic Electrical Materials and Methods," applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

SD-03 Product Data

Transformers

Enclosed circuit breakers

Surge protective devices

SD-06 Test Reports

600-volt wiring test

Grounding system test

SD-10 Operation and Maintenance Data

Electrical Systems, Data Package 5

Submit operation and maintenance data in accordance with Section 01 78 00, "Closeout Submittals" and as specified herein.

1.4 QUALITY ASSURANCE

1.4.1 Fuses

Submit coordination data as specified in article entitled, "FUSES" of this section.

1.5 MAINTENANCE

1.5.1 Electrical Systems

Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. This shall include:

a. Single line diagram of the "as-built" building electrical system.

b. Schematic diagram of electrical control system (other than HVAC,

covered elsewhere).

c. Manufacturers' operating and maintenance manuals on active electrical equipment.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70.

2.2 CONDUIT AND FITTINGS

Shall conform to the following:

2.2.1 Rigid Metallic Conduit

2.2.1.1 Rigid, Threaded Zinc-Coated Steel Conduit

NEMA C80.1, UL 6.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40, and EPC-80 in accordance with NEMA TC 2,UL 651 in accordance with NEMA TC 14.

2.2.3 Intermediate Metal Conduit (IMC)

UL 1242, zinc-coated steel only.

2.2.4 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797, NEMA C80.3.

2.2.5 Flexible Metal Conduit

UL 1.

2.2.5.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360.

2.2.6 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit

UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B.

2.2.6.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.2.6.2 Fittings for EMT

Steel compression type.

2.2.7 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3, UL 514B.

2.2.8 Liquid-Tight Flexible Nonmetallic Conduit

UL 1660.

2.3 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal. UL 514C, if nonmetallic.

2.4 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 100 cubic inches, UL 50, hot-dip, zinc-coated, if sheet steel.

2.5 WIRES AND CABLES

Wires and cables shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

2.5.1 Conductors

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.5.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to satisfy manufacturer's requirements.

2.5.1.2 Minimum Conductor Sizes

Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; for Class 2 low-energy, remote-control and signal circuits, No. 16 AWG; and for Class 3 low-energy, remote-control, alarm and signal circuits, No. 22 AWG.

2.5.2 Color Coding

Provide for service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutral shall be white with colored (not green) stripe. Color of ungrounded conductors in different voltage systems shall be as follows:

a. 208/120 volt, three-phase

(1) Phase A - black

(2) Phase B - red

(3) Phase C - blue

b. 480/277 volt, three-phase

(1) Phase A - brown

(2) Phase B - orange

(3) Phase C - yellow

2.5.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN/THHN conforming to UL 83 or Type XHHW conforming to UL 44, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.5.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.5.5 [Service Entrance Cables

Service Entrance (SE) and Underground Service Entrance (USE) Cables, UL 854.

]2.5.6 [Enter Appropriate Subpart Title Here]

2.6 SPLICES AND TERMINATION COMPONENTS

UL 486A and UL 486B, as applicable, for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.7 DEVICE PLATES

Provide UL listed, one-piece device plates for outlets to suit the devices installed. For metal outlet boxes, plates on unfinished walls shall be of zinc-coated sheet steel or cast metal having round or beveled edges. Plates on finished walls shall be satin finish stainless steel or brushed-finish aluminum, minimum 0.03 inch thick. Screws shall be machine-type with countersunk heads in color to match finish of plate. Sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed and UL listed for "wet locations."

2.8 [Enter Appropriate Subpart Title Here]

2.8.1 Weatherproof Receptacles

Provide in cast metal box with gasketed, weatherproof, cast-metal cover

plate and gasketed cap over each receptacle opening. Provide caps with a spring-hinged flap. Receptacle shall be UL listed for use in "wet locations with plug in use."

2.8.2 Ground-Fault Circuit Interrupter Receptacles

UL 943, duplex type for mounting in standard outlet box. Device shall be capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A GFI devices. Provide screw-type, side-wired wiring terminals or pre-wired (pigtail) leads.

2.9 [Enter Appropriate Subpart Title Here]2.9.1 [Enter Appropriate Subpart Title Here]

2.9.2 Circuit Breakers

UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker shall be mounted. Breaker terminals shall be UL listed as suitable for type of conductor provided. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.9.2.1 Multipole Breakers

Provide common trip-type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.9.2.2 Circuit Breaker With GFCI

UL 943 and NFPA 70. Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect and trip on current imbalance of 6 milliamperes or greater per requirements of UL 943 for Class A GFI devices, for personnel protection.

2.10 ENCLOSED CIRCUIT BREAKERS

UL 489. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit current interrupting rating as indicated. Enclosure type as indicated. Provide solid neutral.

2.11 GROUNDING AND BONDING EQUIPMENT

UL 467. Ground rods shall be copper-clad steel, with minimum diameter of 3/4 in and minimum length of 10 ft.

2.12 NAMEPLATES

Provide as specified in Section 26 00 00, "Basic Electrical Materials and Methods."

2.13 SURGE PROTECTIVE DEVICES

Provide parallel type surge protective devices which comply with UL 1449 at the service entrance panelboard. Provide surge protectors in a NEMA 1 enclosure per NEMA ICS 6. Provide the following modes of protection:

FOR SINGLE PHASE AND THREE PHASE WYE CONNECTED SYSTEMS-
Each phase to neutral (L-N)
Neutral to ground (N-G)
Phase to ground (L-G)

Surge protective devices at the service entrance shall have a minimum surge current rating of 80,000 amperes per mode minimum . The maximum line to neutral (L-N) Suppressed Voltage Rating (SRV) shall be:

900V for 480Y/277V, three phase system

The minimum MCOV (Maximum Continuous Operating Voltage) rating shall be:

600/320V for 480Y/277V, three phase system

EMI/RFI filtering shall be provided for each mode with the capability to attenuate high frequency noise. Minimum attenuation shall be 20db.

2.14 SOURCE QUALITY CONTROL

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to requirements of NFPA 70 and to requirements specified herein.

3.1.1 Underground Service

Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.

3.1.2 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures shall be labeled and identified as such.

3.1.2.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, each enclosure, new and existing, shall be labeled as one of several enclosures containing service entrance disconnect devices. Label, at minimum, shall indicate number of service disconnect devices housed by enclosure and shall indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph entitled "Nameplates." Use lettering of at least 0.25 in in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure, shall be provided only as permitted by NFPA 70.

3.1.3 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, or rigid nonmetallic conduit, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Minimum conduit size shall be 1/2 in in

diameter for low voltage lighting and power circuits.

3.1.3.1 Restrictions Applicable to EMT

a. Do not install underground.

b. Do not encase in concrete, mortar, grout, or other cementitious materials.

c. Do not use in areas subject to severe physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.

d. Do not use in hazardous areas.

e. Do not use outdoors.

f. Do not use in fire pump rooms.

3.1.3.2 Restrictions Applicable to Nonmetallic Conduit

a. PVC Schedule 40 and PVC Schedule 80

(1) Do not use in areas where subject to severe physical damage, including but not limited to, mechanical equipment rooms, electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.

(2) Do not use in hazardous (classified) areas.

(3) Do not use in fire pump rooms.

(4) Do not use in penetrating fire-rated walls or partitions, or fire-rated floors.

(5) Do not use above grade, except where allowed in this section for rising through floor slab or indicated otherwise.

3.1.3.3 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph entitled "Flexible Connections."

3.1.3.4 Service Entrance Conduit, Underground

PVC, Type-EPC 40, galvanized rigid steel or steel IMC. Underground portion shall be encased in minimum of 3 in of concrete and shall be installed minimum 18 in below slab or grade.

3.1.3.5 Underground Conduit Other Than Service Entrance

Plastic-coated rigid steel; PVC, Type EPC-40.

3.1.4 Conduit Installation

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 in away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members

where located above accessible ceilings and where conduit will be visible after completion of project.

3.1.4.1 Conduit Installed Under Floor Slabs

Conduit run under floor slab shall be located a minimum of 12 in below the vapor barrier. Seal around conduits at penetrations thru vapor barrier.

3.1.4.2 Conduit Through Floor Slabs

Where conduits rise through floor slabs, curved portion of bends shall not be visible above finished slab.

3.1.4.3 Conduit Support

Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 1 1/2 in in reinforced concrete beams or to depth of more than 3/4 in in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems shall be supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Installation shall be coordinated with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. For conduits greater than 2 1/2 in inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.4.4 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.4.5 Pull Wire

Install pull wires in empty conduits. Pull wire shall be plastic having minimum 200-lb tensile strength. Leave minimum 36 in of slack at each end of pull wire.

3.1.4.6 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.4.7 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 in above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.4.8 Flexible Connections

Provide flexible steel conduit between 3 and 6 ft in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 1/2 in diameter. Provide liquidtight flexible nonmetallic conduit in wet and damp locations for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

3.1.5 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when surface mounted on interior walls exposed up to 7 ft above floors and walkways, or when installed in hazardous areas and when specifically indicated. Boxes in other locations shall be sheet steel, except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic conduit system. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 4 in square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type

fastener maximum 24 in from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.5.1 Boxes

Boxes for use with raceway systems shall be minimum 1 1/2 in deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 4 in square, except that 4 by 2 in boxes may be used where only one raceway enters outlet. Telephone outlets shall be minimum of 4 in square by 2 1/8 in deep , except for wall mounted telephones.

3.1.5.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or galvanized sheet steel, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.6 Mounting Heights

Mount panelboards, enclosed circuit breakers, and disconnecting switches so height of operating handle at its highest position is maximum 78 in above floor. Mount lighting switches and receptacles as indicated. Measure mounting heights of wiring devices and outlets to center of device or outlet.

3.1.7 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations in accordance with manufacturer's recommendations.

3.1.8 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.9 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 in. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.10 Electrical Penetrations

Seal openings around electrical penetrations through exterior walls water tight.

3.1.11 Grounding and Bonding

In accordance with NFPA 70. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, telephone system grounds, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with NFPA 70. Make ground connection to driven ground rods on exterior of building. Interconnect all grounding media in or on the structure to provide a common ground potential. This shall include electrical service, telephone system grounds, as well as underground metallic piping systems. Interconnection to the gas line shall be made on the customer's side of the meter. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.11.1 Resistance

Maximum resistance-to-ground of grounding system shall not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact Contracting Officer for further instructions.

3.1.12 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications but shall be provided under the section specifying the associated equipment.

3.1.13 Repair of Existing Work

Repair of existing work, demolition, and modification of existing electrical distribution systems shall be performed as follows:

3.1.13.1 Workmanship

Lay out work in advance. Exercise care where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings, piping, and equipment using skilled craftsmen of trades involved.

3.1.13.2 Existing Concealed Wiring to be Removed

Existing concealed wiring to be removed shall be disconnected from its source. Remove conductors; cut conduit flush with floor, underside of floor, and through walls; and seal openings.

3.1.13.3 Removal of Existing Electrical Distribution System

Removal of existing electrical distribution system equipment shall include equipment's associated wiring, including conductors, cables, exposed

conduit, surface metal raceways, boxes, and fittings, back to equipment's power source as indicated.

3.1.14 Surge Protective Devices

Connect the surge protective devices in parallel to the power source, keeping the conductors as short and straight as practically possible.

3.2 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer 5 working days notice prior to each test.

3.2.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.2.2 600-Volt Wiring Test

Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

3.2.3 Ground-Fault Receptacle Test

Test ground-fault receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

3.2.4 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to Contracting Officer, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

-- End of Section --

SECTION 26 27 13.10 30

ELECTRIC METERS
10/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code
IEEE C37.90.1	(2013) Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
IEEE C57.13	(2016) Requirements for Instrument Transformers

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 61000-4-5	(2017) Electromagnetic Compatibility (EMC) - Part 4-5: Testing and Measurement Techniques - Surge Immunity Test
IEC 62053-22	(2003; Corr 1 2018) Electricity Metering Equipment (A.C.) - Particular Requirements - Part 22: Static Meters for Active Energy (Classes 0,2 S and 0,5 S)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.18	(2006; R 2016) Protocol Specification for ANSI Type 2 Optical Port
ANSI C12.20	(2015; E 2018) Electricity Meters - 0.1, 0.2, and 0.5 Accuracy Classes
ANSI C62.61	(1993) American National Standard for Gas Tube Surge Arresters on Wire Line Telephone Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA

17-14; TIA 17-15; TIA 17-16; TIA 17-17)
National Electrical Code

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification and on the drawings shall be as defined in IEEE 100.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

a. Maintenance manual shall provide:
   1. Condensed description of how the equipment operates.
   2. Block diagram indicating major assemblies.
   3. Troubleshooting information
   4. Preventive maintenance.
   5. Spare parts information.

b. Provide operation and maintenance manuals required by submittal item "SD-10 Operation and Maintenance Data."

SD-02 Shop Drawings

SD-03 Product Data

Power Meters;

Current Transformers;

Potential Transformer;

Communications Module;

Protocol Modules;

Data Recorder;

Submittals shall include manufacturer's information for each component, device, and accessory provided with the meter, protocol module or communications module.

SD-06 Test Reports

Acceptance Checks and Tests;

SD-10 Operation and Maintenance Data

Power Meters;

Communications Module;

Protocol Modules;

Data Recorder;

Modem;

SD-11 Closeout Submittals

System Function Verification;

1.4 QUALITY ASSURANCE

1.4.1 Installation Drawings

Drawings shall indicate but not be limited to the following:

a. Elementary diagrams and wiring diagrams with terminals identified of advanced meter, current transformers, potential transformers, protocol modules, communications modules,.

1.4.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.4.3 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.4 Material and Equipment Manufacturing Data

Products manufactured more than 2 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.5 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.6 SYSTEM DESCRIPTION

1.6.1 System Requirements

The metering and reading system, consisting of commercial, off-the-shelf meters, protocol modules, communications modules, and communication

channels, will be used to record the electricity consumption and other values as described in the sections that follow and as shown on the drawings.

1.6.2 Selection Criteria

Metering components are part of a system that includes the physical meter, data recorder function and communications () method. Every building site identified shall include sufficient metering components to measure the electrical parameters identified and to store and communicate the values as required in the following sections. Contractor shall verify and demonstrate to the government that the metering system installed on any building site is compatible with the facility-wide communication and meter-reading protocol system.

PART 2 PRODUCTS

2.1 POWER METERS

2.1.1 Physical and Common Requirements

a. Metering system components shall be installed according to the Metering System Schedule shown in the attachments..

b. Power meter shall be socket-mount design.

d. If existing meter base is usable, the meter base determines meter form factor. If a new meter is being installed, use meter and base form factor of 9S.

f. Meter shall be a Class 20, transformer rated design.

g. Meter shall be rated for use at temperature from -40 45 degrees Centigrade to +70 85 degrees Centigrade.

h. Meter shall have NEMA 3R enclosure for surface mounting.

i. Surge withstand shall conform to IEEE C37.90.1.

j. Meter shall have a standard 4 -year warranty.

k. Meter shall comply with IEC 62053-22 (Part 21: Static Meter for Active Energy, classes 0.2S and 0.5S), certified by a qualified third party test laboratory.

2.1.2 Voltage Requirements

a. Meter shall be capable of connection to the service voltage phases and magnitude being monitored. If the meter is not rated for the service voltage, provide suitable potential transformers to send an acceptable voltage to the meter.

b. Meter shall be capable of connection to the service voltage indicated in the Metering System Schedule:

c. Meter shall accept independent voltage inputs from each phase. Meter shall be auto-ranging over the full range of input voltages.

d. Voltage input shall be optically isolated to 2500 volts DC from signal and communications outputs. Components shall meet or exceed IEEE C37.90.1 (Surge Withstand Capability).

e. The Contractor shall be responsible for determining the actual voltage ratio of each potential transformer. Transformer shall conform to IEEE C57.13 and the following requirements.

1. Type: Dry type, of two-winding construction.

2. Weather: Outdoor or Indoor rated for the application.

3. Frequency: Nominal 60Hz, 50Hz for those bases that operate on 50Hz.

4. Accuracy: Plus or minus 0.3% at 60Hz or 0.3% for those systems that operate at 50Hz.

2.1.3 Current Requirements

a. Meter shall accept independent current inputs from each phase. Current transformer shall be installed with a full load rating as shown in the schedule.

b. Single ratio current transformer shall have an Accuracy Class of 0.3 with a maximum error of +/- [0.3%][0.6%][1.2%] at 5.0 amps.

c. Current transformer shall have:

1. Insulation Class: All 600 volt and below current transformers shall be rated 10 KV BIL. Current transformers for 2400 and 4160 volt service shall be rated 25 KV BIL.

2. Frequency: Nominal 60Hz, 50Hz for bases that operate on 50Hz.

3. Burden: Burden class shall be selected for the load.

4. Phase Angle Range: 0 to 60 degrees.

d. Meter shall accept current input from standard instrument transformers (5A secondary current transformers.)

e. Current inputs shall have a continuous rating in accordance with IEEE C57.13.

f. Multi-ratio current transformer where indicated shall have a top range equal to or greater than the actual load. The Contractor shall be responsible for determining the actual ratio of each transformer. Current transformer shall conform to IEEE C57.13.

2.1.4 Electrical Measurements

Power meter shall measure and report the following quantities:

a. Kilowatt-hours ("kWh" in Metering Systems Schedule) of consumption. Cumulative.

b. Kilowatts of demand ("kW" in Metering Systems Schedule). Peak average over a selectable demand interval between 5 and 60 minutes (typically 15 minutes).

d. Power factor ("PF" in Metering Systems Schedule). Measured over the same interval as the peak kW reading.

e.

f. Interval recording ("IR" in Metering Systems Schedule). Kilowatt-hours shall be recorded for each 15 minute interval and shall accumulate for 30 days. Memory for recording the interval readings shall be internal to the meter and ANSI C12.19 compliant. Meter shall provide time-stamped readings for every measured parameter.

g. Meter readings shall be true RMS.

2.1.5 Meter Accuracy

Power meter shall provide the following accuracies. Accuracies shall be measured as percent of reading at standard meter test points.

a. Power meter shall meet ANSI C12.20 for Class 0.2 and IEC 62053-22 accuracy requirements.

2.1.6 An on the Meter Display, Output and Reading Capabilities

Meter shall include the following output signals.

a. The meter will have a face display plate and shall display every electrical parameter indicated to be recorded. Meters shall not be required to indicate interval data collected in a data logger with a communications output feature. Peak values, instantaneous and cumulative values shall be displayed.

b. Meter shall include optical output port capable of 9600 to 28800 bps communication with a hand-held reading device. Optical device shall be compatible with ANSI C12.18

2.1.7 Installation Methods

a. Transformer mounted (XFMR)

1. Meter base shall be located outside on the secondary side of the pad-mounted transformer.

b. Stand-mounted adjacent to transformer ("STAND" in Metering Systems Schedule)

1. Meter base shall be mounted on a structural steel pole approximately 4 feet from the transformer pad. See detail on the drawings.

c. Building mounted ("BLDG" in Metering Systems Schedule)

1. Meter base shall be mounted on the side of the existing building near the service entrance. See detail on the drawings.

e. Common features.

1. PTs (if required for proper voltage range) and CTs shall be physically connected to the service entrance cables inside the service entrance disconnect enclosure.

2.1.8 Disconnecting Switches

a. Disconnecting wiring blocks shall be provided between the current transformer and the meter. A shorting mechanism shall be built into the wiring block to allow the current transformer wiring to be changed without removing power to the transformer. The wiring blocks shall be located where they are accessible without the necessity of disconnecting power to the transformer. For multi-ratio current transformers, provide a shorting block from each tap to the common lead.

b. Voltage-monitoring circuits shall be equipped with disconnect switches to isolate the meter base or socket from the voltage source.

2.1.9 Meter Programming

a. Power meter shall be programmable by software supplied by the meter manufacturer.

b. Software shall have a user-friendly interface consistent with existing base wide metering system.

c. Software shall operate on an operating system consistent with existing base wide metering system.

d. Software shall allow the user to configure the meter, troubleshoot meter, query and display meter parameters and configuration data and stored values.

e. Meter firmware shall be upgradeable through one of the communications ports without removing the unit from service.

2.2 COMMUNICATIONS

2.2.1 Communications Methods

2.2.1.1 Optical Port

The optical port shall communicate with a hand-held reading device according to the following requirements.

a. Communications standards

1. ANSI C12.18

2. MV90 protocol

3. ANSI C12.20

b. Read operations

1. Current kWh values

2. Demand (kW) values since last reset

3. Last reset value

4. Meter status

5. Load profile

c. Write operations

1. Meter setup

2.2.1.2 [Enter Appropriate Subpart Title Here]

2.2.1.3 [Enter Appropriate Subpart Title Here]

2.2.2 Communications Protocols and Methods

Communications protocols and methods shall be native to the meter. Provide communications module(s) as required to accomplish the following.

a. Meter shall include an IR port ("IR" in Metering Systems Schedule) for communication to external devices such as handheld readers that support a minimum speed of 9600 baud.

2.2.3 Communications Channels Surge Protection

Communications equipment shall be protected against surges induced on its communications channels. Communication interfaces to all field equipment shall be protected to meet the requirements of IEEE C37.90.1 or the requirements of IEC 61000-4-5, test level 4, while the equipment is operating. Fuses shall not be used for surge protection. Metallic cables and conductors which serve as communications channels between buildings shall have surge protection installed at equipment rated for the application installed at each end, within 3 feet of the building cable entrance. Surge protectors shall meet the requirements of the applicable extension of ANSI C62 (for example, ANSI C62.61).

2.3 METER DATA PROTOCOL

Power meters shall have communicating data protocols native or provided in supplemental modules to communicate with the communications methods that follow.

2.3.1 Open Protocol

Power meter shall support the following protocols. Contractor shall verify that the meter native protocol is consistent with the facility data recording and communication and data storage system. Contractor shall provide additional converters and modules as required for a complete

measurement, recording, communicating and data storage system.

a. Meter shall be fully supported by MV-90 software system or existing AMR software that is MV-90 compatible.

2.4 SPARE PARTS

2.4.1 Parts List

Provide spare parts as follows:

a. Power meter - two for each type used.

b. Current transformer - three for each type used.

c. Potential transformer - three for each type used.

d. Communications module - one for each type used.

e. Protocol module - one for each type used.

f. Other electronic and power components - one for each type used.

2.5 METERING SYSTEM SCHEDULE

Metering System Schedule is available at http://www.wbdg.org/FFC/NAVGRAPH/graphtoc.pdf

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

[]3.1.1 Scheduling of Work and Outages

The Contract Clauses shall govern regarding permission for power outages, scheduling of work, coordination with Government personnel, and special working conditions.

3.2 [Enter Appropriate Subpart Title Here]

]3.3 FIELD QUALITY CONTROL

3.3.1 Performance of Acceptance Checks and Tests

3.3.1.1 Meter Assembly

a. Visual and mechanical inspection

1. Compare equipment nameplate data with specification and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method.

4. Verify grounding of metering enclosure.

5. Verify the presence of surge arresters.

6. Verify that the CT ratio and the PT ratio are properly included in the meter multiplier or the programming of the meter.

b. Electrical tests

1. Calibrate watthour meters according to manufacturer's published data.

2. Verify that correct multiplier has been placed on face or meter where applicable.

3. Prior to system acceptance, the Contractor will demonstrate and confirm the meter is properly wired and is displaying correct and accurate electrical information.

3.3.1.2 Current Transformers

a. Visual and mechanical inspection

1. Compare equipment nameplate data with specification and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify correct connection.

4. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method.

5. Verify that required grounding and shorting connections provide good contact.

b. Electrical tests

1. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

2. Perform insulation-resistance test.

3. Perform a polarity test.

4. Perform a ratio-verification test.

3.3.1.3 Potential Transformers

a. Visual and mechanical inspection

1. PT's are rigidly mounted.

2. PT's are correct voltage.

3. Verify that adequate clearances exist between primary and secondary circuit.

b. Electrical tests

1. Perform a ratio-verification test.

3.3.2 Follow-Up System Function Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days' advance notice of the dates and times of checking and testing.

-- End of Section --

SECTION 26 28 21.00 40

AUTOMATIC TRANSFER SWITCHES
05/17

PART 1 GENERAL

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2014) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 10 Part 2	(2005) AC Transfer Equipment, Part 2: Static AC Transfer Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14; TIA 17-15; TIA 17-16; TIA 17-17) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1008	(2014) Transfer Switch Equipment
UL 508	(2018) UL Standard for Safety Industrial Control Equipment

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Connection Diagrams;

Fabrication Drawings;

Installation Drawings;

SD-03 Product Data

Equipment and Performance Data;

Contacts;

Indicating Lights;

Terminal Board;

Enclosures;

SD-06 Test Reports

Qualification Testing;

Operation Tests;

SD-07 Certificates

Listing of Product Installations;

SD-08 Manufacturer's Instructions

Manufacturer's Instructions

1.3 QUALITY CONTROL

1.3.1 Product Installations

Submit listing of product installations for automatic transfer switches showing the manufacturer has successfully manufactured automatic transfer switches of the size specified for a minimum period of 10 years. Include on the list, purchaser, address of installation, service organization, and date of installation.

1.3.2 Predictive Testing and Inspection Technology Requirements

This section contains systems and equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with the RCBEA GUIDE to ensure building equipment and systems have been installed properly and contain no identifiable defects that shorten the design life of a system or its components. Satisfactory completion of all acceptance requirements is necessary to obtain Government approval and acceptance of the Contractor's work.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide an automatic transfer switch with a time-delay feature that is field-adjustable from 2 to 30 minutes. The switch delays the automatic transfer back to normal power until the normal source voltage and frequency reach at least 95 percent of the rated voltage. However, if the emergency power fails and the normal source is again available at 90 percent of the rated voltage, bypass the time-delay circuitry, and transfer the load immediately back to the normal source. Provide the capability for manual

transfer in either direction. Operate sensing relays without contact chatter or false response during voltage variations between dropout and pickup.

Submit connection diagrams showing the relations and connections of contacts, indicating lights, and terminal board by showing the general physical layout of all controls and the interconnection of one system (or portion of system) with another.

Submit fabrication drawings for contacts, indicating lights, terminal board enclosures, and accessories, consisting of fabrication and assembly details to be performed in the factory.

Submit installation drawings for automatic transfer equipment in accordance with paragraph INSTALLATION.

Submit equipment and performance data for automatic transfer equipment including useful life, test, system functional flows, safety features, and mechanical automated details.

2.1.1 Performance Requirements

2.1.1.1 Application

Provide an automatic transfer switch capable of transferring the load from the normal power source to emergency power source, and from an emergency source to the normal power source. Locate the switch where indicated. Provide a switch that is solenoid-operated, mechanically held, double-throw, rated for continuous duty, capable of transferring in 100 milliseconds or less, and conforming to the applicable requirements of UL 1008 and NFPA 70, Article 700, except as herein modified.

Provide an automatic transfer switch of the two-pole type for single-phase application, and three-pole type for three-phase application. Provide a solid neutral conductor connection for neutral transfer from the normal source to the emergency source.

Ensure that the automatic transfer switch is capable of being placed in either the normal or the emergency position.

2.1.1.2 Operation

Monitor the normal source voltage across phase lines by sensing devices. If the normal source voltage in phase drops to 90 percent or less for a timed period, ensure that the automatic transfer switch starts the emergency source and transfers the load to the emergency source when voltage and frequency reach rated values; or, if the emergency source is on, verify the voltage and frequency of the alternate source and transfer the load to the alternate source. Field-adjust this time period from 1 to 30 seconds. Provide a voltage and frequency sensor relay to monitor the rated values on the emergency side to prohibit transfer until the emergency source voltage and frequency reach at least 95 percent of the required rating. Provide phase failure protection, with a 65- to 70-percent drop and a 92- to 95-percent voltage pickup rating.

2.1.1.3 Self-Test Capability

Provide an automatic transfer switch with a control-circuit self-test feature capable of verifying the proper operation of the switch control

circuit without moving the main contactor or causing discontinuity of service to the load.

2.2 COMPONENTS

2.2.1 Contacts

Provide main contacts with a wiping-action silver alloy that, when rated for operation at 50 amperes or greater, are protected against arcing. Ensure that auxiliary contacts and control transfer relay contacts have a minimum continuous-current rating of not less than 10-amperes inductive at 120 volts ac. Provide the following for auxiliary contacts:

a. Generator-control contacts, normally open, that close on undervoltage or loss of normal power as specified, remaining closed until transfer back to normal power

b. Emergency-position contacts, normally open when the switch is in the normal position, that close when the switch is in the emergency position

c. An automatic transfer switch with a switched neutral. Ensure that the switched neutral has: normal position contacts that are normally closed when the switch is in the normal position and opens when the switch is in the emergency position. Ensure that the neutral pole is fully rated and part of the main pole assembly, so that it is switched simultaneously with the main bus contacts.

Use two-pole auxiliary contacts.

Provide an automatic transfer switch with overlapping neutral transfer contacts in addition to the two- or three-pole main bus contacts. Ensure that normal and emergency neutral contacts are connected together only during the transfer and retransfer operation. Ensure contacts remain connected only until the power source contacts close/open to transfer from one source to the other. Ensure that the connection time of the overlapping neutral transfer contacts does not exceed 100 milliseconds.

2.2.2 Indicating Lights

Furnish an automatic transfer switch with two indicating lamps: one light to indicate that the switch is operating on normal power, and the other light to indicate that the switch is operating on emergency power. Fuse each indicating circuit.

2.2.3 Terminal Board

Provide a contactor automatic transfer switch terminal board for internally wired control devices, indicating lights, auxiliary contacts, and internal control devices or auxiliary switches to a common output terminal board. Wire the internal functions to facilitate remote connections or monitoring.

[2.2.4 Microprocessor Control Panel

Provide a control panel to direct the operation of the transfer switch. Connect the panel to the transfer switch with an interconnecting wiring harness. Include with the harness a disconnect plug for transfer switch routine maintenance.

Enclose the control panel with a protective cover and mount separately from the transfer switch. Provide plug-in type interfacing relays.

]2.2.5 Enclosures

Provide an automatic transfer switch enclosure with solid, code-gage, 14-gage, minimum sheet metal, NEMA 250, Type 1, with the manufacturer's standard finish.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

2.3.1 Qualification Testing

Provide test data for the furnished unit or an identical unit. Ensure tests meet the general use requirements of UL 508. Subject the complete automatic transfer switch to a test as outlined in NEMA ICS 10 Part 2. One cycle of operation tests under the UL 508 test requirements consists of a transfer of load from the normal source to the emergency source and retransfer to the normal source. Test the switch operating time and the sense relay pickup and dropout times.

PART 3 EXECUTION

3.1 INSTALLATION

Install automatic transfer switches as indicated, and in accordance with the manufacturer's instructions. Fully align and install wall-mounted enclosures at the indicated mounting height[using a minimum of six 3/8-inch bolts]. Do not use sheet metal screws or small machine screws.

3.2 FIELD QUALITY CONTROL

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Demonstrate the automatic transfer switch operates in accordance with the specification requirements in conjunction with the normal and emergency power sources.

-- End of Section --

SECTION 26 32 13

SINGLE OPERATION GENERATOR SETS

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASME INTERNATIONAL (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 975	(2002) Diesel Fuel Oils

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO UBC	(1997) Uniform Building Code

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60034-2	(1972; Sup. A 1974, Amend. 1995 & 1996)Rotating Electrical Machines Part 2: Methods for Determining Losses and Efficiency of Rotating Electrical Machinery from Tests (Excluding Machines for Traction Vehicles)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 115	(1995; R 2002) Test Procedures for Synchronous Machines Part 1 - Acceptance and Performance Testing Part II - Test Procedures and Parameter Determination for Dynamic Analysis
IEEE C2	(2002) National Electrical Safety Code (IEEE)

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 3046	(2002) Reciprocating Internal Combustion Engines - Performance
ISO 8528	(1993) Reciprocating Internal Combustion Engine Driven Alternating Current

Generating Sets

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C50.10	(1990) Rotating Electrical Machinery - Synchronous Machines
NEMA C50.12	(1982; R 1989) Salient-Pole Synchronous Generators and Generator/Motors for Hydraulic Turbine Applications
NEMA ICS 6	(1993; R 2001) Industrial Control and Systems Enclosures
NEMA MG 1	(1998; Rev. 2002) Motors and Generators

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1999) Electrical Power Distribution Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(2000) Flammable and Combustible Liquids Code
NFPA 37	(2002) Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	(2002) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 142	(2002) Steel Aboveground Tanks for Flammable and Combustible Liquids
UL 467	(1993; R 2001) Grounding and Bonding Equipment
UL 489	(2002; R 2002, Bul. 2003) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 1236	(2002) Battery Chargers For Charging Engine Starter Batteries

1.2 RELATED REQUIREMENTS

Section 26 00 00, "Basic Electrical Materials and Methods," and Section 26 08 00, "Apparatus Inspection and Testing" apply to this section except as modified herein.

1.3 SYSTEM DESCRIPTION

1.3.1 Engine-Generator Set Data

Submit data pertaining to the diesel engine-generator set and to the auxiliary equipment including but not limited to the following:

a. Make of engine.

b. Type or model of engine.

c. Gross bhp rating of engine shall be the total rated power output before deducting power requirements of electric motor-driven equipment or engine driven radiator fan.

d. Net brake power rating of engine shall include deductions for the total power requirements of electric motor-driven or engine-driven accessories as defined in ISO 3046. Net ratings shall include a deduction in power output for cooling media system power requirements including radiator fans and any other power consuming devices required to provide cooling as specified.

e. Strokes per cycle.

f. Number of cylinders.

g. Bore and stroke, inches.

h. Engine speed, rpm.

i. Piston speed, fpm.

j. kW power rating of engine-generator set as defined in the paragraph entitled "Engine-Generator Set Ratings and Performance."

k. Induction method (naturally aspirated, turbocharged).

l. Intercooler type (air-to-air or jacket water).

m. Governor type, make, and model.

n. Make and model of turbochargers.

1.3.2 Engine-Generator Set Efficiencies

Submit data pertaining to the diesel engine-generator set including but not limited to the following: Loads shall be calculated on basis of rated engine-generator set power.

a. Fuel consumption at 0.80 power factor, gallons per hr.

    1. 1/2 load

    2. 3/4 load

    3. Full load

b. Generator efficiency at 0.80 power factor (percent) in accordance with IEC 60034-2.

    1. 1/2 load

    2. 3/4 load

3. Full load

c. Radiator capacity at design conditions.

1. Coolant shall be antifreeze mixture as specified under paragraph entitled "Cooling System."

2. gpm of coolant

3. cfm of air through radiator

4. Btu per hr of heat exchange based on optimum coolant temperature to and from engine.

1.3.3 Diesel Engine Data

Submit data certified by the engine manufacturer including but not limited to the following: Loads shall be calculated on basis of rated engine-generator set power.

a. Approximate exhaust temperature degrees F at full load

1.3.4 Generator and Exciter Data

Submit data certified by the generator manufacturer including but not limited to the following:

a. Make and model number of generator

b. kW rating of generator

c. Generator reactances

1. Synchronous reactance, Xd

2. Transient reactance, X'd

3. Subtransient reactance, X"d

4. Negative sequence reactance, X2

5. Zero sequence reactance, Xo

1.3.5 Capacity Calculations for Engine-Generator Set

Calculations shall verify that the engine-generator set power rating is adequate for the load described in the paragraph entitled "Load Profile."

1.3.6 Calculations for Brake Mean Effective Pressure (BMEP)

Calculation shall verify that the diesel engine meets the specified maximum BMEP as follows:

a. kW: Minimum power rating of engine-generator set as defined in the paragraph entitled "Engine-Generator Set Ratings and Performance."

b. rpm: Engine revolutions per minute.

c. cu. in.: Total engine piston displacement in cubic inches.

d. GEN.EFF.: Generator efficiency.

e. x: Multiplication sign.

f. bhp': Brake horsepower required from diesel engine by generator loaded to full power rating.

g. bhp': kW/(GEN.EFF. x 0.746).

h. bhp": Brake horsepower required by diesel engine driven fan for cooling radiator or motor driven fan for cooling radiator.

i. bhp: bhp' + bhp".

j. BMEP psi: (792,000 x bhp) /(rpm x cu. in.).

1.3.7 Torsional Vibration Stress Analysis Computations

Torsional vibrational stresses in the crankshaft and generator shaft of assembled diesel engine and driven generator shall not exceed 5000 psi when engine is driving generator at rated speed while assembled unit is loaded to rated engine-generator set power. Computations shall be based on a mathematical model of the assembled generator set provided or based on calculations using measured values from tests on a unit identical to the one provided. Calculations based on models of, or measured data from, the unassembled engine and generator will not be acceptable. Calculations shall include:

a. A description of the system relating information pertinent to analysis such as operating speed range and identification plate data.

b. A mass elastic assembly drawing, showing the arrangement of the units in the generator set and dimensions of shafting, including minimum diameters (or section moduli) of shafting in the system.

c. A labeled line diagram of the mass elastic system indicating values of masses, stiffness, equivalent lengths, and equivalent diameters including basic assumptions and definition of terms.

d. Sample computations showing procedures used to obtain resulting stress values.

e. Computations indicating assembled engine-generator speed of 1800 rpm with assembly loaded to rated generator power and the resulting computed critical torsional stress values in the assembled engine crankshaft and generator shaft.

1.3.8 Capacity Calculations for Batteries

Calculation shall verify that the engine starting battery capacity exceeds dc power requirements.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Engine-Generator set and auxiliary equipment

SD-03 Product Data

Engine-generator set data

Engine-generator set efficiencies

Diesel engine data

Generator and exciter data

Diesel engine-generator set

Auxiliary systems and equipment

SD-05 Design Data

Capacity calculations for engine-generator set

Calculations for brake mean effective pressure

Torsional vibration stress analysis computations

Capacity calculations for batteries

SD-06 Test Reports

Acceptance checks and tests

Functional acceptance tests

Functional acceptance test procedure

SD-07 Certificates

Vibration isolation system certification

Fuel system certification

Start-up engineer qualification resume

Instructor's qualification resume

SD-09 Manufacturer's Field Reports

Engine tests

Generator tests

Assembled engine-generator set tests

SD-10 Operation and Maintenance Data

Diesel engine-generator set, Data Package 4

Auxiliary systems and equipment, Data Package 4

Preliminary assembled operation and maintenance manuals

Submit operation and maintenance manuals in accordance with Section 01 78 23, "Operation and Maintenance Data" and the paragraph entitled "Assembled Operation and Maintenance Manuals."

SD-11 Closeout Submittals

Posted operating instructions

Training plan

1.5 QUALITY ASSURANCE

1.5.1 Drawing Requirements

1.5.1.1 Engine-Generator Set and Auxiliary Equipment

Submit drawings pertaining to the engine-generator set and auxiliary equipment, including but not limited to the following:

a. Certified outline, general arrangement (setting plan), and anchor bolt details. Show total weight and center of gravity of assembled equipment on the steel subbase.

b. Detailed elementary, schematic wiring, and interconnection diagrams of the engine starting system, jacket coolant heating system, engine protective devices, engine alarm devices, engine speed governor system, generator and excitation system, and other integral devices.

c. Detailed elementary, schematic wiring; and interconnection diagrams of the diesel fuel system, starting battery system, engine-generator control panel, generator circuit breaker.

d. Dimensional drawings or catalog cuts of exhaust silencers, radiator, diesel fuel day tanks, fuel oil cooler, valves and pumps, intake filters, vibration isolators, and other auxiliary equipment not integral with the engine-generator set.

1.5.2 Vibration Isolation System Certification

Submit certification from the manufacturer that the vibration isolation system will reduce the vibration to the limits specified in the paragraph entitled "Vibration Isolation System."

1.5.3 Fuel System Certification

When the diesel fuel system requires a fuel oil cooler as described in the paragraph entitled "Fuel Oil Cooler," submit certification from the engine manufacturer that the fuel system design is satisfactory.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver equipment on pallets or blocking wrapped in heavy-duty plastic, sealed to protect parts and assemblies from moisture and dirt. Plug piping, conduit, exhaust, and air intake openings. Protect and prepare batteries for shipment as recommended by the battery manufacturer. Store auxiliary equipment at the site in covered enclosures, protected from

atmospheric moisture, dirt, and ground water.

1.7 SITE CONDITIONS

Protect the components of the engine-generator set, including cooling system components, pumps, fans, and similar auxiliaries when not operating and provide components capable of the specified outputs in the following environment:

a. Site Location: Sub-tropical, coastal area

b. Site Elevation: Mean sea level

c. Ambient Temperatures:

1. Maximum 104 degrees F dry bulb, 85 degrees F wet bulb.

2. Minimum 0 degrees F dry bulb.

d. Design Wind Velocity: 130 mph.

e. Atmospheric Conditions: Moist, dust-laden.

f. Seismic Zone: Zone 1 as defined by ICBO UBC.

1.8 MAINTENANCE

1.8.1 Extra Materials

1.8.1.1 Paint

Furnish one gallon of identical paint used on engine-generator set in manufacturer's sealed container with each engine-generator set.

1.8.1.2 Filters

Furnish four spare replacement elements in their original containers for each filter with each unit.

1.8.2 Posted Operating Instructions

Provide proposed operating instructions for the engine-generator set and auxiliary equipment laminated between matte-surface thermoplastic sheets and suitable for placement adjacent to corresponding equipment. After approval, install operating instructions where directed.

PART 2 PRODUCTS

2.1 DIESEL ENGINE-GENERATOR SET

Provide diesel engine-generator sets consisting of a water cooled diesel engine direct connected to an ac generator with a brushless excitation system and accessories. Equipment and materials shall be the manufacturer's standard products offered in catalogs for commercial or industrial use.

2.1.1 Engine-Generator Set Ratings and Performance

ISO 8528. Each engine-generator set shall have a power rating of not less than existing generator kW at 0.8 power factor and supply[208Y/120]or [480Y/277 -volt, three-phase, 60-Hz ac output. Coordinate the engine-generator set to ensure an installed rating in the environment described in paragraph entitled "Site Conditions." The power of the engine-generator set is defined as the power output available at the generator terminals excluding the electrical power absorbed by the essential independent auxiliaries. Essential independent auxiliaries are items of equipment which are essential for the continued or repeated operation of the engine which uses power supplied from a source other than the engine.

2.1.1.1 Diesel Engine Capacity

The diesel engine shall meet the specified maximum BMEP requirements at rated speed as calculated in accordance with the paragraph entitled "Calculations for BMEP." The engine capacity shall be based on the following:

a. Engine burning diesel fuel conforming to ASTM D 975, Grade 2-D, at an ambient temperature of 85 degrees F.

b. Engine cooled by a radiator fan mechanically driven by the diesel engine or remote with a motor driven fan.

c. Engine cooled by coolant mixture of water and ethylene glycol, 50 percent by volume of each.

Maximum BMEP, psi

	Naturally Aspirated	Turbocharged	Turbocharged and Intercooled
Four-cycle engines	350	350	350

Engine speed, rpm: 1800

2.1.1.2 Performance Class

The voltage and frequency behavior of the generator set shall be in accordance with ISO 8528 operating limit values for performance Class G3.

2.1.1.3 Load Profile

The diesel engine-generator set shall be of adequate capacity necessary for the load profile described on the plans.

2.1.2 Diesel Engines and Accessories

ISO 3046. Diesel engines shall be four-cycle naturally aspirated, or turbocharged, or turbocharged and intercooled; vertical in-line or vertical Vee type; designed for stationary service. Engines shall be capable of immediate acceleration from rest to normal speed without intermediate idle/warm up period or prelubrication to provide essential electrical power. Two-cycle engines are not acceptable.

2.1.2.1 Subbase Mounting

Mount each engine-generator set on a structural steel subbase sized to support the engine, generator, and necessary accessories, auxiliaries and control equipment to produce a complete self-contained unit as standard with the manufacturer. Design the structural subbase to properly support the equipment and maintain proper alignment of the engine-generator set in the specified seismic zone. In addition, provide subbase with both lifting rings and jacking pads properly located to facilitate shipping and installation of the unit. Factory align engine and generator on the subbase and securely bolt into place in accordance with the manufacturer's standard practice. Crankshaft shall have rigid coupling for connection to the generator.

2.1.2.2 Assembly

Completely shop assemble each engine-generator set on its structural steel subbase. Paint entire unit with manufacturer's standard paints and colors. After factory tests and before shipping, thoroughly clean and retouch painting as necessary to provide complete protection.

2.1.2.3 Turbocharger

If required by the manufacturer to meet the engine-generator set rating, provide turbine type driven by exhaust gas from engine cylinders, and direct connected to the blower supplying air to the engine intake manifold.

2.1.2.4 Intercooler

Provide manufacturer's standard intercooler for engine size specified.

2.1.2.5 Crankcase Protection

Provide manufacturer's standard method of preventing crankcase explosions and standard method of crankcase ventilation.

2.1.2.6 Engine Lubricating Oil System

Provide each engine with the manufacturer's standard full pressure lubricating oil system arranged to cool the pistons and to distribute oil to moving parts of the engine. Provide oil type and oil filters as recommended by the engine manufacturer.

2.1.2.7 Engine Cooling System

Provide each engine with the manufacturer's standard jacket water pump.

Provide a thermostatic control valve in the jacket coolant system for each engine-generator set to maintain a constant jacket coolant temperature to the engine.

2.1.2.8 Engine Fuel System

Provide each engine with the manufacturer's standard fuel system integral with the engine, complete with necessary piping, fittings, and valves for connecting items of equipment which are a part of the system. Provide engine manufacturer's standard hand priming pump. Provide manufacturer's standard filter for each engine, of the throwaway filter element type, consisting of shell filter elements, drains, and necessary connections and fittings.

2.1.2.9 Engine Intake Filter

Provide intake filter assemblies for each engine of the oil bath or dry type, as standard with the manufacturer. Filters shall be capable of removing a minimum of 92 percent of dirt and abrasive 3 microns and larger from intake air. Size filters to suit engine requirements at 100 percent of rated full load. Design unit for field access for maintenance purposes.

2.1.2.10 Engine Starting System

Starting shall be accomplished using an adequately sized dc starter system with a positive shift solenoid to engage the starter motor and to crank the engine continuously for 60 seconds without overheating.

2.1.2.11 Jacket Coolant Heating System

Provide a factory-installed, , jacket coolant heating system to ensure rapid starting with voltage characteristics to match existing systems. Thermostatically control heater at the temperature recommended by engine manufacturer. Include necessary equipment, piping, controls, wiring, and accessories.

2.1.2.12 Engine Protective (Shutdown) Devices

Equip each engine with devices to shut down the engine by shutting off the fuel supply to the engine via a fuel shutoff solenoid. Auxiliary contacts shall be suitable for activating a remote alarm system. Shutdown shall open the associated generator circuit breaker. Provide the following shutdown devices:

a. Overspeed device which operates when engine speed exceeds normal synchronous speed by 18 percent or as recommended by manufacturer. Device shall require manual reset.

b. Pressure switch which operates when lubricating oil pressure to engine drops below a preset value.

c. Temperature switch which operates when jacket coolant temperature exceeds a preset value.

d. Device which operates when the coolant level in the radiator drops below a preset level.

e. Other shutdown devices as recommended by the engine manufacturer.

2.1.2.13 Engine Alarm Devices

Equip each engine with alarm devices. Auxiliary contacts shall be suitable for activating a remote alarm system. Alarm devices shall have factory-fixed set points. Provide the following alarm contact devices:

a. Pressure switch which operates when lubricating oil pressure drops below a preset value.

b. Temperature switch which operates when jacket coolant temperature exceeds a preset value.

c. Temperature switch which operates when jacket coolant temperature is too low.

d. Other alarm devices as recommended by the engine manufacturer.

2.1.2.14 Miscellaneous Engine Accessories

Provide the following engine accessories where the manufacturer's standard design permits:

a. Piping on engine to inlet and outlet connections, including nonstandard companion flanges.

b. Structural steel subbase and vibration isolators, foundation bolts, nuts, and pipe sleeves.

c. Level jack screws or shims, as required.

d. Rails, chocks, and shims for installation of subbase on the foundation.

e. Removable guard, around fan. Support guard, on engine subbase, to suit manufacturer's standard.

2.1.2.15 Engine Speed Governor System

Provide a forward acting type engine speed governor system. Steady-state frequency band and frequency regulation (droop) shall be in accordance with the operating limit values of the performance class specified in the paragraph entitled "Performance Class."

2.1.3 Generator and Excitation System

2.1.3.1 Generator

Provide salient-pole type, ac, brushless-excited, revolving field, air-cooled, self-ventilated, coupled type, synchronous generator conforming to NEMA MG 1, Part 16, NEMA C50.10, and NEMA C50.12. Generator shall be rated for standby duty at 100 percent of the power rating of the engine-generator set as specified in paragraph entitled "Engine-Generator Set Ratings and Performance." Temperature rise of each of the various parts of the generator shall not exceed 130 degrees C as measured by resistance, based on a maximum ambient temperature of 40 degrees C. Winding insulation shall be Class H.

a. Stator: Stator windings shall be 2/3 pitch design, 10-12 lead reconnectable with VPI insulated coils.

b. Rotor: The rotor shall have connected amortisser windings.

c. Generator Space Heater: Provide 120 volt ac heaters. Heater capacity shall be as recommended by the generator manufacturer to aid in keeping the generator insulation dry.

d. Grounding: Provide non-corrosive steel grounding pads located at two opposite mounting legs.

e. Filters: Provide manufacturer's standard generator cooling air filter assembly.

2.1.3.2 Excitation System

Provide a brushless excitation system consisting of an exciter and rotating rectifier assembly, and permanent magnet generator integral with the generator and a voltage regulator. Insulation class for parts integral with the generator shall be as specified in paragraph entitled "Generator." System shall provide a minimum short circuit of 300 percent rated engine-generator set current for at least 10 seconds. Steady state voltage regulation shall be in accordance with the operating limit values of the performance class specified in the paragraph entitled "Performance Class."

a. Exciter and Rotating Rectifier Assembly: Rectifiers shall be provided with surge voltage protection.

b. Permanent Magnet Generator: Provide a voltage spike suppression device for permanent magnet generator (PMG) excitation systems.

c. Voltage Regulator: Voltage regulator shall be solid state or digital, automatic, three-phase sensing, volts per hertz type regulator. Regulator shall receive its input power from a PMG. Voltage variation for any 40 degree C change over the operating temperature range shall be less than plus or minus 1.0 percent. Operating temperature shall be minus 40 degree C to plus 70 degree C. Voltage adjust range shall be plus to minus 5.0 percent of nominal. Inherent regulator features shall include overexcitation shutdown.

2.2 ENGINE-GENERATOR SET AUXILIARY SYSTEMS AND EQUIPMENT

Provide auxiliary systems and equipment designed for continuous duty at 100 percent of the power rating of the engine-generator set as specified in the paragraph entitled "Engine-Generator Set Ratings and Performance."

2.2.1 Vibration Isolation System

Install the subbase on vibration isolators that are secured to a suitable concrete foundation. Provide isolators as recommended by the engine-generator set and isolator manufacturers and provide integral or external lateral support to limit lateral movement and overturning moments. The isolation system shall reduce the vibration transmitted to the adjacent floor slab to a maximum of 0.0015 inch total amplitude throughout the frequency range down to 65 Hz.

2.2.2 Exhaust System

Provide exhaust systems for each engine.

2.2.2.1 Exhaust Silencers

A critical class silencer shall be provided for each engine which will reduce the exhaust sound spectrum by the following listed values at a 75 foot radius from the outlet, with generator set loaded to rated capacity and clear weather. Inlet and outlet connections shall be flanged.

	Octave Band Center Frequency (Hertz)							
Minimum Silencer Attenuation Decibels	63	125	250	500	1000	2000	4000	8000
Critical Class	15	32	37	36	30	36	37	37

2.2.3 Cooling System

Provide the specified cooling water system. Properly size equipment to handle the flow rate and pressure losses of the coolant mixture specified in the paragraph entitled "Diesel Engine Capacity," and at the site elevation specified in the paragraph entitled "Site Conditions."

2.2.3.1 Radiators

Provide for each engine-generator set, as standard with the manufacturer.

a. Design Conditions: Each radiator unit shall have ample capacity to remove not less than the total Btu per hour of heat rejected by its respective engine at 100 percent full-rated load to the jacket water, fuel oil, and lubricating oil system, and intercooler. Radiator capacity shall be rated at optimum temperature of coolant leaving the engine and intercooler as recommended by the engine manufacturer with an ambient dry bulb air temperature outside the enclosure of 110 degrees F maximum, and 0 degrees F minimum at the site elevation specified in the paragraph entitled "Site Conditions," and with the coolant mixture specified in the paragraph entitled "Diesel Engine Capacity." Pressure drop through the radiator shall not exceed 6 psi when circulating the maximum required coolant flow. Radiator air velocity shall be a maximum of 1500 feet per minute.

b. Engine Mounted Radiator Construction: Radiator fan shall direct airflow from the engine outward through the radiator. Fan shall be V-belt driven directly from the engine crankshaft. Radiator fan shall have sufficient capacity to meet design conditions against a static restriction of 1/2 inch of water. Fan static capacity shall be

adjusted to suit the ductwork furnished. Cooling section shall have a tube and fin-type core consisting of copper or copper base alloy tubes with nonferrous fins. Select engine-driven fans for quiet vibration-free operation. Make provision for coolant expansion either by self-contained expansion tanks or separately mounted expansion tanks, as standard with the manufacturer. Provide suitable guards for each fan and drive.

c. Coolant solution shall be a mixture of clean water and ethylene glycol, 50 percent by volume each. Provide an anti-freeze solution tester suitable for the mixture.

2.2.4 Diesel Fuel System

NFPA 30 and NFPA 37 and the requirements herein.

2.2.4.1 Diesel Fuel Piping System

Factory installed piping shall conform to the engine manufacturer's standard. Provide flange connections in accordance with ASME B16.1 Class 125 flanges.

2.2.4.2 Diesel Fuel Day Tank System

Provide diesel fuel day tank system. Include necessary equipment, piping, controls, wiring, and accessories.

a. Day Tanks: UL 142. Provide integral in skid double wall (110 percent containment) diesel fuel day tanks with a minimum capacity of 72 hours of engine-generator set operation at full-rated load. Epoxy coat day tanks inside and prime and paint outside. Construct tanks of not less than 3/16 inch steel plate with welded joints and necessary stiffeners on exterior of tank. Provide a braced structural steel framework support. Weld tank top tight and provide an access opening with dustproof, removable 24 inch cover. Provide 4 1/2 inch square inspection port. Provide proper venting of both inner and outer containment.

b. Float Switches: Provide tank-top mounted or external float cage, single-pole, single-throw type designed for use on fuel oil tanks. Arrange high level float switches to close on rise of liquid level, and low level float switches to close on fall of liquid level. Mount float cage units with isolating and drain valves. Contacts shall be suitable for the station battery voltage.

1. Critical low level float switch which shall activate at 5 percent of normal liquid level shall shut engine off.

2. Low-low level float switch which shall activate alarm at 30 percent of normal liquid level.

3. Low level float switch which shall open the fuel oil solenoid valve and start the fuel transfer pump at 75 percent of normal liquid level.

4. High level float switch which shall close the fuel oil solenoid valve and stop the fuel transfer pump at 90 percent of normal

liquid level.

5. Critical high level float switch which shall activate alarm at 95 percent of normal liquid level.

c. Leak Detector Switch: Actuates when fuel is detected in containment basin, stops fuel transfer pump, and closes the fuel oil solenoid valve.

d. Generator Control Panel shall display the following alarms: Provide NEMA ICS 6, Type3R, enclosed control panel for each day tank. Control panel shall include the following accessories.

1. Power available LED (green).

2. Critical low fuel alarm contacts for shut down of engine.

3. Low-low level fuel alarm LED.

4. Low-low level fuel alarm contacts for remote annunciator.

5. Critical high level fuel alarm LED.

6. Leak detecting alarm LED.

7. Alarm horn.

e. Tank Gages: Provide buoyant force type gages for diesel fuel day tanks with dial indicator not less than 4 inches in size and arranged for top mounting. Calibrate each reading dial or scale for its specific tank to read from empty to full, with intermediate points of 1/4, 1/2, and 3/4.

2.2.4.3 Fuel Oil Cooler

Provide an air cooled fuel oil cooler if the temperature of the fuel returned to the tank from the engine will cause overheating of the tank fuel above the maximum fuel temperature allowed by the engine manufacturer when operating at maximum rated generator power output and low fuel level in the tank. The fuel oil cooler shall be furnished by the engine manufacturer for the application and the installation shall be complete including piping and power requirements.

2.2.5 Starting Battery System

Provide a 24-volt dc starting battery installation for starting of each engine-generator set utilizing an electric cranking system.

2.2.5.1 Engine Starting Battery

Provide maintenance free, sealed, lead-acid, SAE Type D diesel engine starting batteries. Batteries shall have sufficient capacity to provide 60 seconds of continuous cranking of the engine in an ambient temperature of 95 degrees F.

2.2.5.2 Starting Battery Charger

UL 1236. Provide 120 volt ac, enclosed, automatic equalizing, dual-rate, solid-state, constant voltage type battery charger with automatic ac line compensation. Dc output shall be voltage regulated and current limited. Charger shall have two ranges, float and equalize, and shall provide continuous taper charging. The charger shall have a continuous output rating of not less than 10 amperes and shall be sized to recharge the engine starting batteries in a minimum of 8 hours while providing the control power needs of the engine-generator set. Enclosure shall be NEMA ICS 6, Type12. The following accessories shall be included:

a. Dc ammeter

b. Dc voltmeter

c. Equalize light

d. Ac on light

e. Low voltage light

f. High voltage light

g. Equalize test button/switch

h. Ac circuit breaker

i. Low dc voltage alarm relay

j. High dc voltage alarm relay

k. Current failure relay

l. Ac power failure relay

2.2.6 Engine-Generator Control Panel

Provide NEMA ICS 6, Type12, enclosed control panel mounted on the engine-generator set with vibration isolators. Provide the following control panel mounted devices and control features.

2.2.6.1 Control Panel Mounted Devices

a. Engine Control Switch (ECS): Provide a three position control switch with "MANUAL START" - "OFF/RESET" - "AUTO START" positions.

b. Emergency Stop Push Button (ESPB): Provide a red, mushroom head, twist-to-reset, maintained contact type push button.

c. Generator Metering: Provide ac metering package that displays ac voltage, current, and frequency of one phase of the generator output simultaneously. Metering package shall include a voltmeter/ammeter phase selector switch to allow viewing of each phase.

d. Generator Voltage Adjust Potentiometer (VAP): Provide a potentiometer, locking screwdriver type, to adjust generator voltage.

e. Engine Instrumentation: Provide instrumentation package that displays

the following engine information:

1. Engine oil pressure

2. Engine coolant temperature

3. Engine speed (rpm)

4. Engine running hours

f. Indicating Lamps: Provide LED type indicating lamps and a lamp test switch. Lamps shall indicate the following alarm and shutdown conditions:

1. Low engine lubricating oil pressure alarm

2. Low engine lubricating oil pressure shutdown

3. High engine coolant temperature alarm

4. High engine coolant temperature shutdown

5. Engine overcrank shutdown

6. Engine overspeed shutdown

7. Emergency stop shutdown

8. Starting battery system trouble alarm

9. Day tank low fuel shutdown

10. Low engine coolant temperature alarm

11. Low coolant level shutdown

g. Alarm Horn: Provide an alarm horn and a horn silence switch.

h. Panel Lamp: Provide a panel lamp and lamp "ON-OFF" switch.

2.2.6.2 Crank Cycle/Terminate Relay

Provide crank cycle/terminate relay with adjustable crank/rest periods of 1 to 60 seconds (initially set for 15 seconds) and adjustable total crank time of 30 seconds to 10 minutes (initially set for 75 seconds).

2.2.6.3 Engine Cooldown Relay

Provide cooldown relay with adjustable cool down time of 0 to 30 minutes (initially set at engine manufacturer's recommended time).

2.2.7 Generator Circuit Breaker

UL 489, molded case, adjustable thermal magnetic trip type circuit breaker. The circuit breaker continuous current rating shall be adequate for the power rating of the engine-generator set and the circuit breaker shall be rated to withstand the short circuit current provided by the generator set. Provide circuit breaker in a NEMA ICS 6, Type 1 enclosure mounted on the engine-generator set.

2.2.8 Electrical Support Equipment

Furnish with respective pieces of equipment. Motors, controllers, contactors, and disconnects shall conform to Section 26 20 00, "Interior Distribution System." Provide electrical connections under Section 26 20 00, "Interior Distribution System." Provide controllers and contactors with maximum of 120-volt control circuits, and auxiliary contacts for use with controls furnished. When motors and equipment furnished are larger than size indicated, the cost of providing additional electrical service and related work shall be included under this section.

2.2.9 Weatherproof Enclosure

Provide for each engine-generator set and fabricate from marine grade almuminum in accordance with the manufacturer's standard design. Provide a complete, weatherproof enclosure for the engine, generator, and auxiliary systems and equipment. Support exhaust piping and silencer so that the turbocharger is not subjected to exhaust system weight or lateral forces generated in connecting piping that exceed the engine manufacturer's maximum allowed forces and moments. The housing shall have sufficient louvered openings to allow entrance of outside air for engine and generator cooling at full load. Design louvered openings to exclude driving rain and snow. Provide properly arranged and sized, hinged panels in the enclosure to allow convenient access to the engine, generator, and control equipment for maintenance and operational procedures. Provide hinged panels with spring type latches which shall hold the panels closed securely and will not allow them to vibrate. Brace the housing internally to prevent excessive vibration when the set is in operation.

2.3 SPECIAL WRENCHES AND TOOLS

Wrenches and tools specifically designed and required to work on the new equipment, which are not commercially available as standard mechanic's tools, shall be furnished to the Contracting Officer.

2.4 IDENTIFICATION OF EQUIPMENT

Provide plates and tags sized so that inscription is readily legible to operating or maintenance personnel and securely mounted to or attached in proximity of their identified controls or equipment. Lettering shall be normal block lettering, a minimum of 0.25 inch high.

2.4.1 Materials

Construct ID plates and tags of 16 gage minimum thickness bronze or stainless steel sheet metal engraved or stamped with inscription. Construct plates and tags not exposed to the weather or high operational temperature of the diesel engine of laminated plastic, 0.125 inch thick, matte white finish with black center core, with lettering accurately aligned and engraved into the core.

2.4.2 Control Devices and Operation Indicators

Provide ID plates or tags for control devices and operation indicators, including valves, off-on switches, visual alarm annunciators, gages and thermometers, that are required for operation and maintenance of provided mechanical systems. Plates or tags shall be minimum of 0.5 inch high and 2 inches long and shall indicate component system and component function.

2.4.3 Equipment

Provide ID plates of a minimum size of 3 inches high and 5 inches long on provided equipment indicating the following information:

a. Manufacturer's name, address, type and model number, and serial number;

b. Contract number and accepted date;

c. Capacity or size;

d. System in which installed; and

e. System which it controls.

2.5 ASSEMBLED OPERATION AND MAINTENANCE MANUALS

The contents of the assembled operation and maintenance manuals shall include the manufacturer's O&M information required by the paragraph entitled "SD-10, Operation and Maintenance Data" and the manufacturer's O&M information specified in Section 26 36 23.00 20, "Automatic Transfer Switches."

a. Manuals shall be in separate books or volumes, assembled and bound securely in durable, hard covered, water resistant binder, and indexed by major assembly and components in sequential order.

b. A table of contents (index) shall be made part of the assembled O&M. The manual shall be assembled in the order noted in table of contents.

c. The cover sheet or binder on each volume of the manuals shall be identified and marked with the words, "Operation and Maintenance Manual."

2.6 SOURCE QUALITY CONTROL

Perform and report on factory tests and inspections prior to shipment. Provide certified copies of manufacturer's test data and results. Test procedures shall conform to ASME, IEEE, and ANSI standards, and to ISO requirements on testing, as appropriate and applicable. The manufacturer performing the tests shall provide equipment, labor, and consumables necessary for tests and measuring and indicating devices shall be certified to be within calibration. Tests shall indicate satisfactory operation and attainment of specified performance. If satisfactory, equipment tested will be given a tentative approval. Equipment shall not be shipped before approval of the factory test reports for the following tests.

2.6.1 Engine Tests

Perform customary commercial factory tests in accordance with ISO 3046 on each engine and associated engine protective device, including, but not limited to the following:

a. Perform dynamometer test at rated power. Record horsepower at rated speed and nominal characteristics such as lubricating oil pressure, jacket water temperature, and ambient temperature.

b. Test and record the values that the low oil pressure alarm and protective shutdown devices actuate prior to assembly on the engine.

c. Test and record values that the high jacket water temperature alarm and protective shutdown devices actuate prior to assembly on the engine.

2.6.2 Generator Tests

Tests shall be performed on the complete factory assembled generator prior to shipment. Conduct tests in accordance with IEEE Std 115, NEMA C50.10, and NEMA MG 1.

2.6.2.1 Routine Tests

Perform the following routine tests on the generators and their exciters:

a. Resistance of armature and field windings

b. Mechanical balance

c. Phases sequence

d. Open circuit saturation curve and phase (voltage) balance test

e. Insulation resistance of armature and field windings

f. High potential test

2.6.2.2 Design Tests

Submit the following design tests made on prototype machines that are physically and electrically identical to the generators specified.

a. Temperature rise test

b. Short circuit saturation curve and current balance test

2.6.3 Assembled Engine-Generator Set Tests

Perform the following tests on the assembled engine-generator set.

2.6.3.1 Initial Stabilization Readings

Operate the engine-generator set and allow the set to stabilize at rated kW at rated power factor, rated voltage, and rated frequency. During this period record instrument readings for output power (kW), terminal voltage, line current, power factor, frequency (rpm) generator (exciter) field voltage and current, lubricating oil pressure, jacket water temperature, and ambient temperature at minimum intervals of 15 minutes. Adjust the load, voltage, and frequency to maintain rated load at rated voltage and frequency. Adjustments to load, voltage, or frequency controls shall be recorded on the data sheet at the time of adjustment. Stabilization shall be considered to have occurred when four consecutive voltage and current recorded readings of the generator (or exciter) field either remain

unchanged or have only minor variations about an equilibrium condition with no evident continued increase or decrease in value after the last adjustment to the load, voltage, or frequency has been made.

2.6.3.2 Regulator Range Test

Remove load and record instrument readings (after transients have subsided). Adjust voltage to the maximum attainable value or to a value just prior to actuation of the overvoltage protection device. Apply rated load and adjust voltage to the minimum attainable value or a value just prior to activation of the undervoltage protection device. The data sheets shall indicate the voltage regulation as a percent of rated voltage and the maximum and minimum voltages attainable. Voltage regulation shall be defined as follows:

$$\text{Percent Regulation} = \frac{((\text{No-Load Voltage}) - (\text{Rated-Load Voltage})) \times 100}{(\text{Rated-Load Voltage})}$$

2.6.3.3 Frequency Range Test

Adjust the engine-generator set frequency for the maximum attainable frequency at rated load. Record instrument readings. Adjust the engine-generator set frequency for the specified minimum attainable frequency at rated load. Record instrument readings. Reduce the load to zero and adjust the engine-generator set frequency for the maximum attainable frequency. Record instrument readings. Adjust the engine-generator set frequency for the minimum attainable frequency. Record instrument readings. The data sheet shall show the maximum and minimum frequencies attained at rated load, and at no load.

2.6.3.4 Transient Response Test

Drop the load to no load and re-apply rated load three times to ensure that the no load and rated load voltage and frequency values are repeatable and that the frequency and voltage regulation is within the limits specified. Record generator terminal voltage and frequency using a high speed strip chart recorder. The data sheet shall show the following results:

a. Frequency

1. Stability bandwidth or deviation in percent of rated frequency.

2. Recovery time.

3. Overshoot and undershoot.

b. Voltage

1. Stability bandwidth or deviation in percent of rated voltage.

2. Recovery time.

3. Overshoot and undershoot.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall conform to the applicable requirements of IEEE C2 NFPA 30,

NFPA 37, and NFPA 70.

3.2 GROUNDING

NFPA 70 and IEEE C2, except that grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02, "Underground Transmission and Distribution". Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Engine-Generator Set Grounding

Provide separate copper grounding conductors and connect them to the ground system as indicated.

3.2.3 Connections

Make joints in grounding conductors by exothermic weld or compression connector. Exothermic welds and compression connectors shall be installed as specified in Section 33 71 02, "Underground Transmission and Distribution," paragraph entitled "Grounding."

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 START-UP ENGINEER

Provide the services of a qualified factory trained start-up engineer, regularly employed by the engine-generator set manufacturer. The start-up services shall include conducting preliminary operations and functional acceptance tests. The start-up engineer shall be present at the engine generator set installation site, full-time, while preliminary operations and functional acceptance tests are being conducted.

3.4 PREREQUISITES FOR FUNCTIONAL ACCEPTANCE TESTING

Completion of the following requirements is mandatory prior to scheduling functional acceptance tests for the engine-generator set and auxiliary equipment.

3.4.1 Performance of Acceptance Checks and Tests

The acceptance checks and tests shall be accomplished by the testing organization as described in Section 26 08 00, "Apparatus Inspection and Testing."

3.4.1.1 Generator Sets

Complete as specified in the paragraph entitled "Acceptance Checks and Tests."

3.4.1.2 Automatic Transfer Switches

Complete acceptance checks and tests as specified in Section 26 36 23.00 20, Automatic Transfer Switches."

3.4.2 Preliminary Operations

The start-up engineer shall conduct manufacturer recommended start-up procedures and tests to verify that the engine-generator set and auxiliary equipment are ready for functional acceptance tests. Give the Contracting Officer 15 days' advance notice that preliminary operations will be conducted. After preliminary operation has been successfully conducted, the start-up engineer will notify the Contracting Officer in writing stating the engine-generator set and auxiliary equipment are ready for functional acceptance tests.

3.4.3 Preliminary Assembled Operation and Maintenance Manuals

Preliminary assembled operation and maintenance manuals shall have been submitted to and approved by the Contracting Officer. Manuals shall be prepared as specified in the paragraph entitled "Assembled Operation and Maintenance Manuals."

3.4.4 Functional Acceptance Test Procedure

Test procedure shall be prepared by the start-up engineer specifically for the engine-generator set and auxiliary equipment. The test agenda shall cover the requirements specified in the paragraph entitled "Functional Acceptance Tests." The test procedure shall indicate in detail how tests are to be conducted. A statement of the tests that are to be performed without indicating how the tests are to be performed is not acceptable. Indicate what work is planned on each workday and identify the calendar dates of the planned workdays. Specify what additional technical support personnel is needed such as factory representatives for major equipment. Specify on which testing workday each technical support personnel is needed. Data recording forms to be used to document test results are to be submitted with the proposed test procedure. A list of test equipment and instruments shall also be included in the test procedure.

3.4.5 Test Equipment

Test equipment and instruments shall be on hand prior to scheduling field tests or, subject to Contracting Officer approval, evidence shall be provided to show that arrangements have been made to have the necessary equipment and instruments on site prior to field testing.

3.5 FIELD QUALITY CONTROL

Give Contracting Officer 15 days notice of dates and times scheduled for tests which require the presence of the Contracting Officer. The Contracting Officer will coordinate with the using activity and schedule a time that will eliminate or minimize interruptions and interference with the activity operations. The Contractor shall be responsible for costs associated with conducting tests outside of normal working hours and with incorporating special arrangements and procedures, including temporary power conditions. The Contractor shall provide labor, equipment, diesel fuel, test load, and consumables required for the specified tests. The test load shall be a cataloged product. Calibration of measuring devices and indicating devices shall be certified. Refer to Section 26 00 00,

"Basic Electrical Materials and Methods," for requirements for a cataloged product. Perform the following field tests.

3.5.1 Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.5.1.1 Circuit Breakers - Low Voltage Insulated Case/Molded Case

a. Visual and mechanical inspection

1. Compare nameplate data with specifications and approved shop drawings.

2. Inspect circuit breaker for correct mounting.

3. Operate circuit breaker to ensure smooth operation.

4. Inspect case for cracks or other defects.

5. Verify tightness of accessible bolted connections and cable connections by calibrated torque-wrench method. Thermographic survey is not required.

6. Inspect mechanism contacts and arc chutes in unsealed units.

b. Electrical Tests

1. Perform contact-resistance tests.

2. Perform insulation-resistance tests.

3. Adjust Breaker(s) for final settings in accordance with engine-generator set manufacturer's requirements.

3.5.1.2 Current Transformers

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify correct connection.

4. Verify that adequate clearances exist between primary and secondary circuit.

5. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Thermographic survey is not required.

6. Verify that all required grounding and shorting connections provide good contact.

b. Electrical Tests

1. Perform insulation-resistance tests.

2. Perform polarity tests.

3. Perform ratio-verification tests.

3.5.1.3 Metering and Instrumentation

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify tightness of electrical connections.

b. Electrical Tests

1. Determine accuracy of meters at 25, 50, 75, and 100 percent of full scale.

2. Calibrate watthour meters according to manufacturer's published data.

3. Verify all instrument multipliers.

4. Electrically confirm that current transformer secondary circuits are intact.

3.5.1.4 Battery Systems

a. Visual and mechanical inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Thermographic survey is not required.

4. Measure electrolyte specific gravity and temperature and visually check fill level.

5. Verify adequacy of battery support racks, mounting, anchorage, and clearances.

b. Electrical tests

1. Set charger float and equalizing voltage levels.

2. Verify all charger functions and alarms.

3. Measure each cell voltage and total battery voltage with charger energized and in float mode of operation.

4. Perform a capacity load test.

3.5.1.5 Engine-Generator Set

a. Visual and mechanical inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Inspect for correct anchorage and grounding.

b. Electrical and mechanical tests

1. Perform an insulation-resistance test on generator winding with respect to ground. Calculate polarization index.

2. Perform phase rotation test to determine compatibility with load requirements.

3.5.1.6 Grounding System

a. Visual and mechanical inspection

1. Inspect ground system for compliance with contract plans and specifications.

3.5.2 Functional Acceptance Tests

The tests shall be performed by the start-up engineer. Upon successful test completion, the start-up engineer shall provide the Contracting Officer with a written test report within 15 calendar days showing the tests performed and the results of each test. The report shall include the completed approved test data forms and certification from the start-up engineer that the test results fall within the manufacturer's recommended limits and meet the specified requirements performance. The report shall be dated and signed by the start-up engineer, and submitted for approval by the Contracting Officer. The Contracting Officer will witness final acceptance tests. Testing shall include but not be limited to:

a. Verify proper functioning of each engine protective shutdown device and pre-shutdown alarm device. Testing of the devices shall be accomplished by simulating device actuation and observing proper alarm and engine shutdown operation.

b. Verify proper functioning of the engine overspeed trip device. Testing of the overspeed trip device shall be accomplished by raising the speed of the engine-generator set until an overspeed trip is experienced.

c. Verify proper functioning of the crank cycle/terminate relay. Testing of the relay shall be accomplished by engaging the starter motor with the engine being prevented from running. Observe the complete crank/rest cycle as described in the paragraph entitled "Crank Cycle/Terminate Relay."

d. Verify proper functioning of the following automatic and manual operations. Testing shall include but not be limited to:

   1. Loss of Utility: Initiate a normal power failure with connected test load of rated kW at 1.0 power factor. Record time delay on start, cranking time until engine starts and runs, time to come up to operating speed, voltage and frequency overshoot, and time to achieve steady state conditions with all switches transferred to emergency position.

   2. Return of Utility: Return normal power and record time delay on retransfer for each automatic transfer switch, and time delay on engine cooldown and shutdown.

   3. Manual starting

   4. Emergency stop

e. Operate the engine-generator set at rated current (amperes) until the jacket water temperature stabilizes. Stabilization will be considered to have occurred when three consecutive temperature readings remain unchanged. Continue to operate the generator set for an additional 2 hours. Record instrument readings for terminal voltage, line current, frequency (Hz), engine speed rpm, lubricating oil pressure, jacket water temperature, and ambient temperature at 5 minute intervals for first 15 minutes and at 15 minute intervals thereafter.

3.6 DEMONSTRATION

Upon completion of the work and at a time approved by the Contracting Officer, the Contractor shall provide instructions by a qualified instructor to the Government personnel in the proper operation and maintenance of the equipment. Eight (8) Government personnel shall receive training comparable to the equipment manufacturer's factory training. The duration of instruction shall be for not less than one 8 hour working day for instruction of operating personnel and not less than one 8 hour working day for instruction of maintenance personnel.

3.6.1 Instructor's Qualification Resume

Instructors shall be regular employees of the engine-generator set manufacturer. The instruction personnel provided to satisfy the requirements above shall be factory certified by the related equipment manufacturer to provide instruction services. Submit the name and qualification resume of instructor to the Contracting Officer for approval.

3.6.2 Training Plan

Submit training plan 30 calendar days prior to training sessions. Training plan shall include scheduling, content, outline, and training material (handouts). Content shall include but not limited to the following:

3.6.2.1 Operating Personnel Training

This instruction includes operating the engine-generator set, auxiliary equipment including automatic transfer switches in all modes, and the use of all functions and features specified.

3.6.2.2 Maintenance Personnel Training

Shall include mechanical, hydraulic, electrical, and electronic instructions for the engine-generator set and auxiliary equipment including automatic transfer switches.

a. Mechanical Training: Shall include at least the following:

1. A review of mechanical diagrams and drawings.

2. Component location and functions.

3. Troubleshooting procedures and techniques.

4. Repair procedures.

5. Assembly/disassembly procedures.

6. Adjustments (how, when, and where).

7. Preventive maintenance procedures.

8. Review of flow diagram.

9. Valve locations and function.

10. Valve and hydraulic equipment adjustment and maintenance procedures.

11. Hydraulic system maintenance and servicing.

12. Lubrication points, type, and recommended procedures and frequency.

b. Electrical and Electronic Maintenance Training: Shall include at least the following:

1. A review of electrical and electronic systems including wiring diagrams and drawings.

2. Troubleshooting procedures for the machine and control systems.

3. Electrical and electronic equipment servicing and care.

4. Use of diagnostics to locate the causes of malfunction.

5. Procedures for adjustments (locating components, adjustments to be made, values to be measured, and equipment required for making adjustments).

6. Maintenance and troubleshooting procedures for microprocessor or minicomputer where applicable.

7. Circuit board repair procedures where applicable (with schematics provided).

8. Use of diagnostic tapes.

9. Recommended maintenance servicing and repair for motors, switches, relays, solenoids, and other auxiliary equipment and devices.

-- End of Section --

SECTION 26 36 23.00 20

AUTOMATIC TRANSFER SWITCHES
04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2013) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2017) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1008	(2014) Transfer Switch Equipment
UL 508	(1999; Reprint Oct 2013) Industrial Control Equipment

1.2 RELATED REQUIREMENTS

Section 26 00 00 BASIC ELECTRICAL MATERIALS AND METHODS, and Section 26 08 00 APPARATUS INSPECTION AND TESTING, apply to this section, with the additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Automatic Transfer Switch Drawings

SD-03 Product Data

Automatic Transfer Switches

SD-06 Test Reports

Acceptance Checks and Tests

Functional Acceptance Tests

SD-07 Certificates

Proof of Listing

SD-10 Operation and Maintenance Data

Automatic Transfer Switches, Data Package 5

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 QUALITY ASSURANCE

1.4.1 Proof of Listing

Submit proof of listing by UL 1008.

1.4.2 Automatic Transfer Switch Drawings

Drawings shall include outline, arrangement, and detail drawings. Detail drawings shall include manufacturer's name and catalog number, electrical ratings, total system transfer statement, reduced normal supply voltage at which transfer to the alternate supply is initiated, transfer delay times, short-circuit current rating, wiring diagram, description of interconnections, testing instructions, acceptable conductor type for terminals, tightening torque for each wire connector, and other required UL 1008 markings.

PART 2 PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCHES

Provide four-pole, automatic transfer switches for use in emergency systems in accordance with UL 1008. Each automatic transfer switch shall be rated for total system transfer and have the current and voltage ratings as indicated. The rating of the switch shall be adequate for withstanding the effects of the indicated RMS symmetrical fault current when protected by the indicated overcurrent device without contact welding. The switch operating mechanism shall be electrically operated from the source to which it is transferring, shall have quick-make, quick-break, load break contacts, and shall be mechanically held in both positions. Non-fire pump service transfer switches shall have manual operating means provided for maintenance and servicing accessible only by opening the enclosure. The manual operating means shall affect the opening and closing of the switch contacts at the same rate of speed as that caused by the automatic operation of the switch. The switch enclosure shall comply with UL 508, NEMA Type 3R, and shall be equipped with an equipment ground lug.

2.1.1 Automatic Transfer Switch Controls

2.1.1.1 Controls for Utility-Generator Automatic Transfer Switch

Provide all necessary controls to start the generator set upon loss of the normal (utility) source, transfer the load to the generator set upon reaching rated voltage and frequency, re-transfer the load when the normal (utility) source returns, and stop the generator set.

The switch shall include the following control features.

a. Three-phase normal source voltage sensing circuit with adjustable dropout, 75-93 percent of nominal, and pickup, 85-100 percent of nominal.

b. Engine starting control contacts with adjustable commit-to-start delay circuit, 0.5-6.0 seconds.

c. Voltage/frequency sensing circuit, set for 80 percent of nominal, for enabling load transfer to emergency source.

d. Re-transfer to normal source time delay, adjustable 1-30 minutes.

e. Programmable exerciser to allow automatic starting of the generator set and subsequent load transfer. Exercise periods shall be selectable for 1 to 24 hours per day for 0 to 7 days a week.

2.1.2 Front Panel Devices

Provide devices mounted on cabinet front consisting of:

a. Mode selector switch with the following positions and associated functions;

1. TEST - Simulates loss of normal/preferred source system operation.

2. NORMAL - Transfers system to normal/preferred source bypassing re-transfer time delay.

b. Lamps for indicating connected source and normal/preferred source is available.

c. Auxiliary contacts for indicating connected source and normal/preferred source available.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall conform to the requirements of NFPA 70 and manufacturer's recommendation.

3.2 PREREQUISITES FOR FUNCTIONAL ACCEPTANCE TESTING

Completion of the following requirements is mandatory prior to scheduling functional acceptance tests for the automatic transfer switch.

3.2.1 Performance of Acceptance Checks and tests

Complete as specified in paragraph entitled "Acceptance Checks and Tests". The Acceptance Checks and Tests shall be accomplished by the Testing organization as described in Section 26 08 00 APPARATUS INSPECTION AND TESTING.

3.2.2 Manufacturers O&M Information

The manufacturers O&M information required by the paragraph entitled "SD-10 Operation and Maintenance Data", shall have been submitted to and approved by the Contracting Officer.

3.2.3 Test Equipment

All test equipment and instruments shall be on hand prior to scheduling

field tests, or subject to Contracting Officer's approval, evidence shall be provided to show that arrangements have been made to have the necessary equipment and instruments on site prior to field testing.

3.3 FIELD QUALITY CONTROL

Give Contracting Officer 15 days notice of dates and times scheduled for tests which require the presence of the Contracting Officer. The Contracting Officer will coordinate with the using activity and schedule a time that will eliminate or minimize interruptions and interference with the activity operations. The contractor shall be responsible for costs associated with conducting tests outside of normal working hours and with incorporating special arrangements and procedures, including temporary power conditions. The contractor shall provide labor, equipment, apparatus, including test load, and consumables required for the specified tests. Calibration of all measuring devices and indicating devices shall be certified. The test load shall be a cataloged product in accordance with Section 26 00 00 BASIC ELECTRICAL MATERIALS AND METHODS. Perform the following field tests in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.3.1 Automatic Transfer Switch Acceptance Checks and Tests

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Confirm correct application of manufacturer's recommended lubricants.

4. Verify that manual transfer warnings are attached and visible.

5. Verify tightness of all control connections.

6. Verify tightness of accessible bolted connections by calibrated torque-wrench method. Thermographic survey is not required.

7. Perform manual transfer operation.

8. Verify positive mechanical interlocking between normal and alternate sources.

b. Electrical Tests

1. Measure contact-resistance.

2. Perform insulation-resistance on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole for one minute. Perform tests in both source positions.

3. Verify settings and operations of control devices.

4. Calibrate and set all relays and timers.

3.3.2 Functional Acceptance Tests

Functional Acceptance Tests shall be coordinated with Section 26 32 13 SINGLE OPERATION GENERATOR SETS and shall include simulating power failure and demonstrating the following operations for each automatic transfer switch. Contractor shall show by demonstration in service that the automatic transfer switches are in good operating condition, and function not less than five times.

a. Perform automatic transfer tests:

    1. Simulate loss of normal/preferred power.

    2. Return to normal/preferred power.

    3. Simulate loss of emergency power.

    4. Simulate all forms of single-phase conditions.

b. Verify correct operation and timing of the following functions:

    1. Normal source voltage-sensing relays.

    2. Engine start sequence.

    3. Time delay upon transfer.

    4. Alternate source voltage-sensing relays.

    5. Automatic transfer operation.

    6. Interlocks and limit switch function.

    7. Time delay and retransfer upon normal power restoration.

-- End of Section --

SECTION 31 23 00.00 20

EXCAVATION AND FILL
02/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C33/C33M	(2013) Standard Specification for Concrete Aggregates
ASTM D1140	(2014) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D1557	(2012) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D2487	(2011) Soils for Engineering Purposes (Unified Soil Classification System)

1.2 DEFINITIONS

1.2.1 Degree of Compaction

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557, for general soil types, abbreviated as percent laboratory maximum density.

1.2.2 Hard Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.3 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Submit 15 days prior to starting work.

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

1.4 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

1.5 CRITERIA FOR BIDDING

f. Hard materials will not be encountered in 50 percent of the excavations at 3 feet below existing surface elevations.

h. Blasting will not be permitted. Remove material in an approved manner.

1.6 QUALITY ASSURANCE

1.6.1 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

2.1.1 Satisfactory Materials

Any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and frozen, deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials. Unsatisfactory materials also include man-made fills, trash,

refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 3 inches. The Contracting Officer shall be notified of any contaminated materials.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM, GP-GM, GW-GM, SW-SM, SP-SM, and SM shall be identified as cohesionless only when the fines are nonplastic (plasticity index equals zero). Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

2.2 POROUS FILL FOR CAPILLARY WATER BARRIER

ASTM C33/C33M fine aggregate grading with a maximum of 3 percent by weight passing ASTM D1140, No. 200 sieve, or or coarse aggregate Size 57 and conforming to the general soil material requirements specified in paragraph entitled "Satisfactory Materials."

2.3 2.3.1 Porous FillBackfill material consisting of clean crushed rock or gravel having a gradation conforming to the requirements of gradation #57 for coarse aggregate in ASTM C33/C33M.2.4

PART 3 EXECUTION

3.1 SURFACE PREPARATION

3.1.1 Stripping

Strip suitable soil from the site where excavation or grading is indicated and stockpile separately from other excavated material. Material unsuitable for use as topsoil shall be wasted . Locate topsoil so that the material can be used readily for the finished grading. Where sufficient existing topsoil conforming to the material requirements is not available on site, provide borrow materials suitable for use as topsoil. Protect topsoil and keep in segregated piles until needed.

3.1.2 Unsuitable Material

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and rubbish underneath paved areas or concrete slabs.

3.2 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed. Refill with porous fill and compact to 95 percent of ASTM D1557 maximum density. Unless specified otherwise, refill excavations cut below indicated depth with porous fill and compact to 95 percent of ASTM D1557 maximum density.

Satisfactory material removed below the depths indicated, without specific direction of the Contracting Officer, shall be replaced with satisfactory materials to the indicated excavation grade; except as specified for spread footings. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

3.2.1 Structures With Spread Footings

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement. Fill over excavations with concrete during foundation placement.

3.2.2 Excavated Materials

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Paragraph "DISPOSITION OF SURPLUS MATERIAL."

3.2.3 Final Grade of Surfaces to Support Concrete

Excavation to final grade shall not be made until just before concrete is to be placed. Only excavation methods that will leave the foundation rock in a solid and unshattered condition shall be used. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond. Shales shall be protected from slaking and all surfaces shall be protected from erosion resulting from ponding or flow of water.

3.3 SUBGRADE PREPARATION

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Contracting Officer. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified herein.

3.4 COMPACTION

Determine in-place density of existing subgrade; if required density exists, no compaction of existing subgrade will be required. Density requirements specified herein are for cohesionless materials. When cohesive materials are encountered or used, density requirements may be

reduced by 5 percent.

3.4.1 General Site

3.4.2 Structures, Spread Footings, and Concrete Slabs

Compact top 12 inches of subgrades to 95 percent of ASTM D1557.

3.5 FINISH OPERATIONS

3.5.1 Grading

Finish grades as indicated within one-tenth of one foot. Grade areas to drain water away from structures. Maintain areas free of trash and debris. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.5.2 Protection of Surfaces

Protect newly backfilled, graded, and topsoiled areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.6 DISPOSITION OF SURPLUS MATERIAL

Waste in Government disposal landfill.

3.7 FIELD QUALITY CONTROL

3.7.1 Sampling

Take the number and size of samples required to perform the following tests.

3.7.2 Testing

Perform one of each of the following tests for each material used. Provide additional tests for each source change.

-- End of Section --

SECTION 33 12 33.00 30

WATER METERS
11/11

PART 1 GENERAL

1.1 DEFINITIONS

Unless otherwise specified or indicated, water terms used in this specification and on the drawings shall be as defined in AWWA C700.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. The latest version is required when applied to this specification.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C700	(2015) Cold-Water Meters - Displacement Type, Metal Alloy Main Case
AWWA C701	(2015) Cold-Water Meters - Turbine Type for Customer Service
AWWA C702	(2015) Cold-Water Meters - Compound Type
AWWA C707	(2010; R 2016) Encoder-Type Remote-Registration Systems for Cold-Water Meters

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(2013) Pipe Threads, General Purpose (Inch)
ASME B16.1	(2015) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code
IEEE C37.90.1	(2013) Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 9001	(2008; Corr 1 2009) Quality Management Systems- Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2;

TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14; TIA 17-15; TIA 17-16; TIA 17-17)
National Electrical Code

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings;

SD-03 Product Data

Protocol Modules;

Communications Modules;

Data Recorder;

Water Meters;

Spare Parts

SD-06 Test Reports

Acceptance Checks and Tests

SD-10 Operation and Maintenance Data

Operation And Maintenance Manuals;

1.4 QUALITY ASSURANCE

1.4.1 Installation Drawings

Drawings shall indicate, but not be limited to, the following:

a. Elementary diagrams and wiring diagrams with terminals identified of[protocol modules,][communications modules,][Ethernet connections,][telephone lines]. [For each meter installation, provide a diagram identified by the building number.]

b. One-line diagram, including meters,[protocol modules,][communications modules,][Ethernet connections,][telephone outlets,][and fuses]. [For each meter installation, provide a diagram identified by the building number.]

1.4.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for five years prior to bid opening. The five-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have

been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the five-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section. All meters provided shall be manufactured by a registered ISO 9001 quality standard facility. All specifications shall meet or exceed the latest revision of AWWA C702.

1.4.3 Alternative Qualifications

Products having less than a five-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 10,000 hours, exclusive of the manufacturer's factory or laboratory tests, is provided.

1.4.4 Material and Equipment Manufacturing Data

Products manufactured more than two years prior to date of delivery to the site shall not be used, unless specified otherwise.

1.5 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract. All meters shall carry the following published warranties:

a. Meters shall be guaranteed to be free from defective materials and workmanship and meet AWWA New Meter Accuracy Standards for a period of five years from the date of installation. At the expiration of this period, meters shall be guaranteed to meet AWWA Repaired Meter Accuracy Standards for the following time periods:

   (1) 5/8 inch to 1 inch: 5 to 15 years from the date of shipment.

   (2) 1-1/2 inch and larger: 5 to 10 years from the date of shipment.

b. All registers are guaranteed for a ten-year period from the date of purchase. Any defective register will be replaced at no cost to the Government.

c. All brass maincases are guaranteed for life by the manufacturer. Any defective maincase will be replaced at no cost to the Government.

1.6 SYSTEM DESCRIPTION

1.6.1 System Requirements

The metering and reading system, consisting of commercial, off-the-shelf meters, protocol modules and communications modules, and communication channels, will be used to record the water consumption and other values as described in the sections that follow and as shown on the drawings.

1.6.2 Selection Criteria

Metering components are part of a system that includes the physical meter, data recorder function, and communications method. Every building site

identified shall include sufficient metering components to measure the water parameters identified and to store and communicate the values as required in the following sections. The Contractor shall verify that the metering system installed on any building site is compatible with the facility-wide communication and meter-reading protocol system.

1.6.3 Submittal Data

Submittals shall include manufacturer's information for each component, device, and accessory provided with the meters, protocol modules or communications modules.

PART 2 PRODUCTS

2.1 WATER METERS

2.1.1 Physical and Common Requirements

a. Metering system components shall be installed according to the Metering System Schedule shown in the attachment

b. Meter shall be rated for use at temperatures from -40 degrees Centigrade to +70 degrees Centigrade.

c. Surge withstand shall conform to IEEE C37.90.1.

2.1.1.1 Cold-Water Meters - Displacement Type 5/8-inch x 3/4-inch, 1-inch, 1-1/2-inch, 2-inch Size

Small meters shall be as follows or shall be approved equivalents: Positive displacement meters provided hereunder shall be full-size nutating-disc, magnetic drive, sealed register, cold water meters and shall fully comply with the requirements of AWWA C700 unless otherwise specified hereunder. No oscillating-piston style meters will be accepted.

a. Materials

(1) Cases 5/8-Inch x 3/4-Inch, 1-Inch, 1-1/2-Inch: The main case of the meter shall be cast all-bronze, bottom caps shall be cast all-bronze, excepting register boxes and register box lids which shall be bronze or an approved plastic material as specified in AWWA C700. Meter cases constructed of plastic will not be accepted.

(2) Cases 2-Inch: The main case of the meter shall be cast all-bronze, including bottom caps, excepting register boxes and register box lids which shall be bronze or an approved plastic material. Meter cases constructed of plastic will not be accepted.

(3) Register Box Rings and Lids: Register box rings and lids shall be made of a copper alloy containing not less than 57 percent copper, or all bronze, or an approved suitable synthetic polymer.

(4) Measuring Chambers: Measuring chambers shall be made of a copper alloy containing not less than 85 percent copper and suitable amounts of tin, lead, and zinc or of a suitable synthetic polymer.

(5) Discs: Discs shall be made of vulcanized hard rubber or a suitable synthetic polymer with specific gravity approximately equal to that of water. They shall have sufficient dimensional stability to

retain operating clearances at working temperatures of up to +27 degrees Centigrade and not warp or deform when exposed to operating temperatures of +37 degrees Centigrade.

(6) Measuring Chamber Diaphragms: Measuring chamber diaphragms shall be made of phosphor bronze, stainless steel, hard rubber, or a suitable synthetic polymer.

(7) Spindles, Thrust Rollers, and Thrust-Roller Bearing Plates: Spindles, thrust rollers and thrust-roller bearing plates shall be made of phosphor bronze, stainless steel, hard rubber, or a suitable synthetic polymer.

(8) Intermediate Gear Trains: Frames, gears, and pinions shall be made of a suitable copper alloy, other suitable non-corrosive metals, or other suitable materials.

(9) External Fasteners (Casing Bolts, Studs, Nuts, Screws, and Washers): External fasteners shall be made of a copper alloy containing not less than 57 percent copper, stainless steel, or steel treated to resist corrosion by a process approved by the Government. Fasteners for no-pressure assemblies may be made of a suitable synthetic polymer. All external case closures, such as rings, clamps, screws, bolts, cap bolts, nuts and washers, shall be designed for easy removal following lengthy service.

(10) Water Meter Coupling - 5/8-Inch x 3/4-Inch: A water coupling shall be composed of one meter coupling nut, one meter coupling tail piece (straight), and one rubber-type washer for meter coupling. The meter coupling tailpiece and nut shall be a copper alloy containing not less than 57 percent copper. The coupling nut shall have internal straight pipe threads conforming to ASME B1.20.1. Pitch diameter shall be that shown on AWWA C700. The coupling tailpiece shall have external taper pipe threads conforming to ASME B1.20.1 and an internal diameter approximately equal to the nominal thread size of the tailpiece. Lengths and thread sizes shall be those listed in AWWA C700. One water meter coupling and one additional rubber-type washer for meter coupling (total of two rubber-type washers) shall be provided with each meter.

(11) Companion Flanges - 1-1/2-Inch and 2-Inch: Companion flanges shall be made of cast iron.

b. General Design

(1) Pressure Requirements: Meters supplied under this specification shall operate without leakage or damage to any part at a working pressure of 150 psi.

(2) Accessibility: All 1-1/2-inch and 2-inch meters shall be designed for easy removal of all interior parts without disturbing the connections to the pipeline.

c. Detail Design

(1) Cases: All meters shall have an outer case with separate, removable measuring chambers. Cases shall not be repaired in any manner. The inlet and outlet shall have a common axis. A meter

case shall include the top case and bottom case, or main case and bottom plate, whichever is applicable. Connection flanges shall be parallel.

(2) Connections: Meter case connections for 5/8-inch x 3/4-inch and 1-inch meters shall be meter casing spuds on both ends. Spuds shall have external straight threads conforming to ASME B1.20.1 as far as the specifications apply. Pitch diameters shall be those shown in AWWA C700. Main case connections for 1-1/2-inch and 2-inch meters shall be oval-flanged on both ends. Flanges shall be faced and drilled and shall be the oval type. The drilling shall be on a horizontal axis; the number of bolt holes and the diameters of the bolt holes and bolt circle shall be as listed in AWWA C700. Two oval companion flanges, gaskets, bolts and nuts shall be provided with each meter. Companion flanges shall be faced, drilled, and tapped in conformance with ASME B1.20.1. Dimensions shall be those listed in AWWA C700. Companion flanges shall be cast iron.

(3) Registers: Registers shall be straight-reading and shall read in 1000-gallon increments. The register shall be equipped with a center-sweep test hand with the test circle located on the periphery of the register and graduated in 100 equal parts, with each tenth graduation being numbered. Register construction shall conform to all applicable requirements of AWWA C700.

(4) Register Boxes: The lid shall be recessed and shall overlap the register box in order to protect the lens. The lens shall be held securely in place.

(5) Intermediate Gear Trains: Intermediate gear trains may be mounted on the measuring chamber, in the upper main casing, or when not exposed to water, combined with or adjacent to the register gearing.

(a) Oil-enclosed type - Gear trains exposed to water shall be of the oil-enclosed type, shall have a separate housing or form housing with the main casing or measuring chamber, and shall operate in a suitable lubricant.

(b) Magnetic coupled drives - When intermediate gear trains are located in the water compartment of the meter, the revolutions of the train output spindles shall be transmitted to the registers by means of magnetic couplings through the meter cases. When the intermediate gear trains are located in the register compartments, the disc nutations shall be transmitted by magnetic couplings.

(6) Measuring Chambers: The measuring chambers shall be self-contained units, smoothly finished, firmly seated, and easily removed from the main cases, and shall not be cast as part of the main cases. The measuring chambers shall be so secured in the main cases that the accuracy of the meter will not be affected by any distortion of the cases that might occur when operating with a pressure less than 150 psi.

(7) Discs: Discs shall be smoothly finished, disc plated, whether flat or conical, shall be either reinforced or equipped with thrust rollers. Discs may be one piece or composed of a plate with two half balls. The disc spindles shall be fastened securely. The disc

nutations shall not exceed the quantities listed in AWWA C700.

(8) Strainers: All meters shall be provided with strainer screens installed in the meter. Strainer screens shall be rigid, fit snugly, be easy to remove, and have an effective straining area at least double that of the main case inlet.

(9) Seal Wire Holes: Register box screws and inlet and outlet coupling nuts, if provided, shall be drilled for seal wires. Seal wire holes shall not be less than 3/32 inch in diameter.

(10) Registration Accuracy: Meters shall meet the following requirements for accuracy with water of a temperature of less than +27 degrees Centigrade.

(a) Normal Flow Limits - At any rate of flow within the normal test flow limits specified on AWWA C700, the meter shall not register less than 98.5 percent and not more than 101.5 percent of the water that actually passes through it.

(b) Minimum Test Flow - At the minimum test flow rate specified in AWWA C700, the meter shall not register less than 95 percent and not more than 101 percent of the water that actually passes through it.

(11) Markings: The size, model, and direction of flow through the meter shall be marked permanently on the outer case of all meters. All meters shall have the manufacturer's serial numbers stamped on the meter main case and top of the reading lid.

(12) Register Boxes: The name of the manufacturer shall be marked permanently on the lid of the register box. The serial number of the meter shall be imprinted on the lid and the main case.

2.1.1.2 Cold-Water Meters - Compound Type 2-Inch, 3-Inch, 4-Inch, and 6-Inch Size

Compound meters shall consist of a combination of a main-line meter of the turbine type for measuring high rates of flow and a meter of appropriate size for measuring low rates of flow. The compound meter shall have an automatic valve mechanism for diverting low rates of flow through the bypass meter. Both metering devices with registers shall be contained in the same case. The operating and physical characteristics shall conform to those specified within AWWA C702.

a. Materials

(1) Cases: The main case of the meter shall be made of a copper alloy containing not less than 75 percent copper.

(2) Register Box Rings and Lids: Register box rings and lids shall be made of a cast copper alloy containing not less than 75 percent copper, forged or die-cast copper alloy containing not less than 57 percent copper or a suitable synthetic polymer.

(3) Measuring Cages or Chambers: Measuring cages or chambers shall be made of a copper alloy containing not less than 84 percent copper and suitable amounts of tin, lead, and zinc or of a suitable synthetic polymer.

(4) Measuring Turbines, Pistons and Discs: Turbines, pistons and discs shall be made of vulcanized hard rubber or a suitable synthetic polymer with specific gravity approximately equal to that of water. They shall have sufficient dimensional stability to retain operating clearances at working temperatures of up to +27 degrees Centigrade and not warp or deform when exposed to operating temperatures of +37 degrees Centigrade.

(5) Disc and Turbine Spindles: Measuring chamber spindles shall be made of phosphor bronze, stainless steel, ceramic, or suitable synthetic polymer.

(6) Intermediate Gear Trains: Frames, gears and pinions of intermediate gear trains exposed to water shall be made of copper alloy containing not less than 85 percent copper and suitable amounts of tin, lead, and zinc, or suitable synthetic polymer. When not exposed to water, intermediate gear trains may be made of a suitable synthetic polymer.

(7) External Fasteners (Casing Bolts, Studs, Nuts, Screws, and Washers): External fasteners shall be made of a copper alloy containing not less than 57 percent copper, stainless steel, or steel treated to resist corrosion by a process approved by the Government. Fasteners for no-pressure assemblies may be made of a suitable synthetic polymer. All external case closures, such as rings, clamps, screws, bolts, cap bolts, nuts and washers, shall be designed for easy removal following lengthy service.

(8) Companion Flanges: Companion flanges shall be made of cast iron.

(9) Automatic Valves: The valve weights shall be lead, or a copper alloy containing not less than 75 percent copper, or a copper alloy shell loaded with lead. The valve and supplemental hinge pins or spindles shall be a copper alloy containing not less than 75 percent copper, or stainless steel, and all valve and supplemental weight hinge bearings shall be bushed with hard rubber or bronze or other suitable bushing material. If the valve contains a clapper, it shall be faced with a removable semi-hard seat. Valve seats shall be made of a copper alloy containing not less than 75 percent copper and suitable amounts of tin, lead, and zinc.

b. General Design

(1) Pressure Requirements: Meters supplied under this specification shall operate without leakage or damage to any part at a working pressure of 150 psi.

(2) Accessibility: All compound meters shall be designed for easy removal of all interior parts without disturbing the connections to the pipeline.

(3) Registration Accuracy: Meters shall meet the following requirements for accuracy with water of a temperature of less than +27 degrees Centigrade.

(a) Normal Flow Limits - The meter shall not register less than 97 percent and not more than 103 percent of the water actually passed

through it at any rate of flow within the normal test flow limits specified in AWWA C702, except in the registration of flows within the changeover from bypass meter to main meter.

(b) Changeover Flow - The beginning of the changeover is when the accuracy of registration falls below 97 percent due to the operation of the automatic valve mechanism, and the end of changeover is when accuracy of registration again reaches 97 percent. The registration of these changeover rates of flow shall not be less than 90 percent and not more than 103 percent. The difference in the rate of flow at the beginning and at the end of the changeover shall not exceed the figures listed in AWWA C702.

(c) Minimum Test Flow - There shall not be less than 95 percent of actual flow recorded when a test is made at the minimum test flow shown in AWWA C702.

(4) Markings: The size, model, and direction of flow through the meter shall be cast or stamped in the outer case of all meters.

(a) Register Boxes - The name of the manufacturer shall be permanently impressed on the lid of the register box. The serial number of the meter shall be imprinted on the lid.

c. Detail Design

(1) Main Case: All meters shall have an outer case with separate, removable measuring chambers. Cases shall not be repaired in any manner. The inlet and outlet shall have a common axis. Connection flanges shall be parallel.

(2) External Case Screw, Bolts, Nuts and Washers: All external screws, bolts, cap bolts, nuts and washers shall be designed for easy removal after lengthy service.

(3) Main Case Connections: All main case connections shall be flanged. The bolt holes shall comply with AWWA C702.

(a) 2-Inch Meters - The flanges for 2-inch meters shall be oval. The drilling of oval flanges shall be on the horizontal axis.

(b) Meters Larger than 2-Inch - The flanges for 3-inch, 4-inch, and 6-inch meters shall be the round type, faced and drilled, and shall conform to ASME B16.1 for bronze pipe flange, Class 125.

(4) Companion Flanges: Companion flanges of the same size and type as the meter flanges shall be provided, and gaskets, nuts, and bolts shall be provided. Round companion flanges shall be faced, drilled, and tapped in accordance with ASME B1.20.1 and shall conform to ASME B16.1 for cast-iron pipe flange, Class 125. All companion flanges shall comply with AWWA C702 for drilling, diameter, and thickness specifications.

(5) Tapped Bosses: All meters shall be provided with tapped bosses in the top of the case near the outlet for field testing purposes.

(6) Registers: Registers shall be straight reading and shall read in cubic feet (cu.ft.). Except for those instances when test conditions require the use of a different register, the register

provided with the meter shall be the same register that was on the meter when it was tested for accuracy. The register lock and side gears shall be fastened securely to the number wheel discs and hubs. The tumbler pins shall mesh accurately at the turnover points with the lock and side gears of the adjacent number wheels. Both main and pinion shafts shall be so secured in the register frame and/or register plates that they cannot get out of position. The pinion shaft shall be so designed that there is no possibility of its bending and allowing the pinion to skip the turnover point. The numerals on the number wheels shall not be less than 3/16 inch in height and should be readable at a 45-degree angle from vertical. Registers that are hermetically sealed shall have gears and pinion which shall run free on fixed shafts or be fixed on shafts that run free in the register frame and/or register plates and shall be constructed so that they cannot be unmeshed. The registers shall have a center-sweep test hand with a test circle located on the periphery of the register and graduated in 100 equal parts, each tenth graduation numbered. The maximum quantity indicated by a single revolution of the test hand and the minimum capacity of the register shall be as listed in AWWA C702. The maximum indication on the test circle and the minimum register capacity of the bypass unit shall be in accordance with the approved AWWA Standard for the type of meter used as the bypass unit.

(a) Coordinator Registers - The meter may be equipped with a coordinator so that the readings of both sections can record on a single register. The register construction shall conform to previously mentioned requirements, and the maximum quantity indicated by a single revolution of the test hand and the minimum capacity of the register shall conform to AWWA C702.

(7) Register Boxes: The lid shall be recessed and shall overlap the register box to protect the lens.

(8) Intermediate Gear Trains: Intermediate gear trains may be mounted on the measuring chamber or cage or in the main casings. When not exposed to water, they may also be combined with or adjacent to the register gearing. Gear trains exposed to water shall be the oil-enclosed type, shall have separate housings or shall form housings with the main casings or measuring chambers, and shall operate in a suitable lubricant. Gear trains made of non-corrosive metals or synthetic polymers may be exposed to water.

(9) Measuring Chambers or Cages: The main-line section chambers or cages shall be self-contained units firmly seated and easily detached and removed from the main case. Chambers or cages with turbines that have revolving spindles shall have removable bearings for such spindles. Chambers or cages with stationary spindles on which the turbines revolve shall provide rigid, centrally located fastenings for the spindles. The spindles shall be removable. The main-line section chambers or cages shall be interchangeable in all meters of the same size, make, and model.

(a) Bypass Chamber - The bypass chamber shall be a type covered by an approved AWWA Standard. The chamber shall be a self-contained unit, firmly seated and easily removed from the case, and shall not be cast as part of the outer case. The chamber shall be secured in position in the outer case so that any slight

distortion of the case which might occur under 150 psi pressure will not affect the accuracy of the meter.

(10) Measuring Turbines and Discs: Measuring turbines that have revolving spindles shall rotate on spindles supported by bushings or replaceable bearings. Turbines that rotate on stationary spindles shall also have bushings or replaceable bearings. The plates of disc pistons, whether flat or conical, shall have metal reinforcements or shall be equipped with thrust rollers.

(11) Magnetic Coupled Drives: When intermediate gear trains are located in the water compartment of the main or bypass section of the meter, the revolutions of the train output spindles shall be transmitted to the registers by means of magnetic couplings through the meter case. When intermediate gear trains are located in the register compartments, the revolutions shall be transmitted by magnetic coupling.

(12) Automatic Valves: The automatic valve shall be of a type suitable for such purpose. It shall close by force. The weight of the valve and any supplemental force imposed on it shall offer sufficient resistance to the incoming water to divert all small rates of flow through the bypass meter until such time as the rate of flow through the meter is great enough to ensure efficient operation of the main measuring section. Valve hinge pins or spindles shall be bushed. Valve sets shall be bronze or other corrosion-resistant material, shall have a satisfactory width of face, and shall be held firmly in place. A clapper or swing-type valve shall be provided with a removable semi-hard seat.

(13) Bypass Meter: The physical and operating characteristics and dimensions of the bypass meter shall be in accordance with the approved AWWA Standard for the type of meter used as the bypass.

(14) Strainers: Strainers, if provided, shall be rigid, shall be easily removed and shall have an effective straining area at least double that of the water main-case inlet.

(15) Seal Wire Holes: Register box screws shall be drilled for seal wires. Seal wire holes shall be not less than 3/32 inch in diameter.

2.1.1.3 Cold-Water Meter - Turbine Type 2-Inch Size

Turbine meters provided hereunder shall be Class II, in-line, horizontal-axis, high-velocity type and shall fully conform to the requirements of AWWA C701, except as otherwise specified herein. The 2-inch turbine meter shall have oval flanged ends and shall be supplied with one companion flange, gaskets, and with bolts and nuts as specified herein.

a. Materials

(1) Cases: All turbine main cases shall be bronze. No exceptions will be allowed.

(2) Register Box Rings and Lids: Register box rings and lids shall be made of a cast copper alloy containing not less than 75 percent copper, forged or die-cast copper alloy containing not less than 57 percent copper or a suitable synthetic polymer.

(3) Measuring Cages or Chambers: Measuring cages or chambers shall be made of a copper alloy containing not less than 84 percent copper and suitable amounts of tin, lead, and zinc or of a suitable synthetic polymer.

(4) Measuring Turbines, Pistons and Discs: Turbines, pistons and discs shall be made of vulcanized hard rubber or a suitable synthetic polymer with specific gravity approximately equal to that of water. They shall have sufficient dimensional stability to retain operating clearances at working temperatures of up to +27 degrees Centigrade and not warp or deform when exposed to operating temperatures of +37 degrees Centigrade.

(5) Disc and Turbine Spindles: Measuring chamber spindles shall be made of phosphor bronze, stainless steel, ceramic, or suitable synthetic polymer.

(6) Intermediate Gear Trains: Frames, gears and pinions of intermediate gear trains exposed to water shall be made of copper alloy containing not less than 85 percent copper and suitable amounts of tin, lead, and zinc, or suitable synthetic polymer. When not exposed to water, intermediate gear trains may be made of a suitable synthetic polymer.

(7) External Fasteners: (casing bolts, studs, nuts, screws, and washers). External fasteners shall be made of a copper alloy containing not less than 57 percent copper, stainless steel, or steel treated to resist corrosion by a process to be approved by the Government. Fasteners for no-pressure assemblies may be made of a suitable synthetic polymer. All external case closures, such as rings, clamps, screws, bolts, cap bolts, nuts and washers, shall be designed for easy removal following lengthy service.

(8) Companion Flanges: Companion flanges shall be made of cast iron.

b. General Design

(1) Pressure Requirements: Meters supplied under this specification shall operate without leakage or damage to any part at a working pressure of 150 psi. Pressure drop through turbine meters and strainers, when operated within specified normal flow limits, shall not exceed the characteristics outlined in AWWA C701.

(2) Accessibility: All turbine meters shall be designed for easy removal of all interior parts without disturbing the connections to the pipeline. Turbine meters shall have readily accessible change gears, adjustable vanes or other approved means to adjust meter registration. Such adjustment feature shall be an integral part of the removable rotor/register assembly and not of the main or bottom case of the meter.

(3) Registration Accuracy: Meters shall meet the following requirements for accuracy with water of a temperature of less than +27 degrees Centigrade.

(a) Normal Flow Limits - The meter shall not register less than 97 percent and not more than 103 percent of the water actually passed through it at any rate of flow within the normal test flow limits

specified in AWWA C702, except in the registration of flows within the changeover from bypass meter to main meter. Turbine meters shall be designed to allow prolonged operation at or near the upper limit of the specified normal flow range without premature degradation of registration accuracy or other evidence of undue wear. Meters shall also be capable of accepting sudden increases in flow at high rates of flow without decoupling the register.

2.1.1.4 Cold-Water Meter Strainers 2-Inch, 3-Inch, 4-Inch and 6-Inch Size

General: All strainers provided shall have top access. Cases for 2-inch, 3-inch, 4-inch and 6-inch strainers shall be bronze. Strainer plates for all sizes shall be 18-8 stainless steel or bronze. All strainers shall conform to AWWA C702.

NOTE: SeBiLOY is an acceptable substitute for bronze.

2.1.2 Meter Programming

N/A

[2.1.3 Register Requirements for Remote Registration

a. Meters must have encoder-type remote-registration conforming to the latest version of AWWA C707. Registers using generator pulses or low voltage conversions are not permitted. Power requirement for data transmission must be supplied by an interrogation device. Registers must be compatible with various brands of interrogation equipment. The register must provide at least six-digit visual registration at the meter. The units, the month and year of manufacture, and other identification information must clearly be printed on the face of the register. The register must also have a full test sweep hand or dial. The register must, in a digital format, simultaneously encode at least six significant digits of the meter reading for transmission through the remotely located receptacle. A meter identification number must also be provided with each reading.

b. All registers shall be easily upgraded to Automatic Meter Reading (AMR), which includes telephone, radio, cable, Energy Management and Control System (EMCS), Direct Digital Control (DDC), and Supervisory, Control and Data Acquisition (SCADA), with the substitution of the remote receptacle with a Meter Interface Unit (MIU). Data transmission shall be instantaneous and supplied in ASCII format without conversion or modification. The register must operate reliably down to at least 3.0 volts. Color-coded wire terminals (red, green and black) shall be provided; however, only the red and black terminals will be utilized for a two-wire connection to the interface ScanPad. The green terminal shall only be utilized to convert to AMR via the use of a MIU. A suitable wire terminal cover shall be provided and be factory potted when ordered for underground pit installations.

c. All registers must be removable without disassembly of the meter or depressurizing the service line. The register must be free of openings to protect the internal electronics of the register. Lens covers shall be made of polycarbonate or other suitable engineering polymer for indoor installations and mineral glass for underground pit installations. All other register assembly and material requirements stated herein shall also apply.

]2.2 COMMUNICATIONS

2.2.1 Energy Monitoring and Control (EMCS) or Automatic Meter Reading Interfaces

a. Water meters shall be capable of interfacing (output signal equivalent to flow rate) with the existing Automatic Meter Reading systems for data gathering in units of GPM.

b. Meters shall not require power to function and deliver data. Output signal shall be either a voltage or amperage signal which can be converted to a flow rate specification.

c. Communication protocols used must be OPC-compliant, such as MODUBUS, LonWorks, and BACnet. System must be nonproprietary open architecture and able to interface with third-party vendor software.

d. Meter shall be equipped with one pulse output channel ("Pulse" in Metering Systems Schedule) that can be configured for operation.

2.3 SPARE PARTS

2.3.1 Parts List

Provide spare parts as follows:

a. Water meters - one for every 20 installed.

b. Communications modules - one for every 20 used.

c. Protocol modules - one for every 20 used.

d. Other electronic and power components - one for each type used.

2.4 METERING SYSTEM SCHEDULE

METERING SYSTEM SCHEDULE				
1	2	3	4	5
Bldg #	Type of Meter	Communication	Meter Location	Remarks
101	1 inch displacement	IR RS232	Bldg	Small building. Consumption reimbursable billing only.
102	2 inch turbine	BaseT, 56K	Bldg	Interval recording
103	3/4 inch displacement	Local	Bldg	

Metering System Schedule Notes by column position:

PART 3 EXECUTION

3.1 INSTALLATION

Water meter installations shall conform to AWWA C700, AWWA C701 and AWWA C702. Electrical installations shall conform to IEEE C2, NFPA 70 (National Electrical Code), and to the requirements specified herein. Provide new equipment and materials unless otherwise indicated or specified.

3.1.1 [Enter Appropriate Subpart Title Here]

3.1.2 Scheduling of Work and Outages

The Contract clauses shall govern regarding permission for water/power outages, scheduling of work, coordination with Government personnel, and special working conditions.

3.2 [Enter Appropriate Subpart Title Here]
]3.3 FIELD QUALITY CONTROL

3.3.1 Performance of Acceptance Checks and Tests

a. Meter Assembly

(1) Visual and mechanical inspection

(a) Compare equipment nameplate data with specification and approved shop drawings.

(b) Inspect physical and mechanical condition.

(c) Verify grounding of metering enclosure, if required.

(d) Verify the presence of surge arresters.

(2) Electrical tests

(a) Verify that correct multiplier has been placed on face or meter, where applicable.

(b) Prior to system acceptance, the Contractor will demonstrate and confirm the meter is properly wired and is displaying correct and accurate water information.

3.3.2 Follow-up Verification

Upon completion of acceptance checks and tests, show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the Contract, the Contracting Officer shall be given five working days' advance notice of the dates and times of checking and testing.

3.3.3 [Enter Appropriate Subpart Title Here]

3.4 MAINTENANCE

3.4.1 Operation and Maintenance Manuals

Provide operation and maintenance manuals for each of the following: Water

Meters, Communications Modules, Protocol Modules, and Data Recorder.

3.4.2 Maintenance Manuals

Provide the following in the Maintenance Manuals:

a. Condensed description of how the equipment operates.

b. Block diagram indicating major assemblies.

c. Troubleshooting information.

d. Preventive maintenance.

e. Spare parts information.

-- End of Section --

SECTION 33 71 01

OVERHEAD TRANSMISSION AND DISTRIBUTION

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS O5.1	(2002) Wood Products - Specifications and Dimensions

ASME INTERNATIONAL (ASME)

ASME B16.11	(2002) Forged Fittings, Socket-Welding and Threaded

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53/A 53M	(2002) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 153/A 153M	(2001; Rev. A) Zinc Coating (Hot-Dip) on Iron and Steel Hardware - AASHTO No.: M232
ASTM A 475	(1998) Zinc-Coated Steel Wire Strand
ASTM B 1	(2001) Hard-Drawn Copper Wire
ASTM B 2	(2000) Medium-Hard-Drawn Copper Wire
ASTM B 3	(2001) Soft or Annealed Copper Wire
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 231/B 231M	(1999) Concentric-Lay-Stranded Aluminum 1350 Conductors
ASTM B 397	(1985; R 1999) Concentric-Lay-Stranded Aluminum-Alloy 5005-H19 Conductors
ASTM B 399/B 399M	(1999) Concentric-Lay-Stranded Aluminum-Alloy 6201-T81 Conductors

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C1	(2000) All Timber Products - Preservative Treatment by Pressure Processes

AWPA C4	(1995) Poles - Preservative Treatment by Pressure Processes
AWPA C25	(1995) Sawn Crossarms, - Preservative Treatment by Pressure Processes

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2002) National Electrical Safety Code (ANSI/IEEE)
IEEE C62.11	(1999) Metal-Oxide Surge Arresters for AC Power Circuits (= 1 kV) (ANSI/IEEE)
IEEE C135.22	(1988) Zinc-Coated Ferrous Pole-Top Insulator Pins with Lead Threads for Overhead Line Construction

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C29.5	(1984; R 2002) Wet-Process Porcelain Insulators - Low- and Medium-Voltage Types
NEMA C37.42	(1996) High Voltage Expulsion Type Distribution Class Fuses, Cutouts, Fuse Disconnecting Switches and Fuse Links

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1999) Electrical Power Distribution Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS 202-1	(2001; Supp. 2002) List of Materials Acceptable for Use on Systems of RUS Electrification Borrowers
RUS 1728F-700	(1993) Wood Poles, Stubs, and Anchor Logs

UNDERWRITERS LABORATORIES (UL)

UL 6	(2000; Bul. 2001, 2002) Rigid Metal Conduit - Steel
UL 510	(1994; R 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape

1.2 RELATED REQUIREMENTS

Section 26 00 00, "Basic Electrical Materials and Methods" and Section 26 08 00, "Apparatus Inspection and Testing" apply to this section with additions and modifications specified herein.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Public Works (Code 404), Building 1005 Michael Road, Camp Lejeune, North Carolina will review and approve transformer submittals. As an exception to this paragraph, transformers manufactured by ABB in Athens, GA; by Cooper Power Systems in Waukesha, WI or Nacogdoches, TX; or by Howard Industries in Laurel, MS need not meet the submittal requirements of this contract. Instead, the following shall be submitted.

a. A certification, from the manufacturer, that the technical requirements of this specification shall be met.

b. Routine and other tests (paragraph entitled "Routine and Other Tests, shall be conducted by the manufacturer and may be witnessed by the Government (paragraph entitled "Source Quality Control"). Provide certified copies of the tests.

c. Provide field test reports (paragraph entitled "Field Quality Control").

SD-03 Product Data

Conductors

Insulators

Wood Poles

Cutouts

Transformer

Surge arresters

Guy strand

Anchors

SD-06 Test Reports

Field Test Plan

Field Quality Control

Ground resistance test reports

Submit report of the acceptance test results as specified by paragraph entitled "Field Quality Control"

SD-07 Certificates

Wood poles

Composite crossarms

1.4 QUALITY ASSURANCE

1.4.1 Ground Resistance Test Reports

Submit the measured ground resistance of grounding system. When testing grounding electrodes and grounding systems, identify each grounding electrode and each grounding system for testing. Include the test method and test setup (i.e. pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

1.4.2 Field Test Plan

Provide a proposed field test plan 20 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

1.5 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Consider materials specified herein or shown on contract drawings which are identical to materials listed in RUS 202-1 as conforming to requirements.

2.2 POLES

Poles shall be of lengths and classes indicated.

2.2.1 Wood Poles

Wood poles machine trimmed by turning, Southern Yellow Pine conforming to ATIS O5.1 and RUS 1728F-700. Gain, bore and roof poles before treatment. Should additional gains be required subsequent to treatment, metal gain plates shall be provided. Pressure treat poles with chromated copper arsenate (CCA), except that Douglas Fir and Western Larch poles shall not be treated with CCA in accordance with AWPA C1 and AWPA C4 as referenced in RUS 1728F-700. The quality of each pole shall be ensured with "WQC" (wood quality control) brand on each piece, or by an approved inspection agency report.

2.3 CROSSARMS

2.3.1 Composite Crossarms

2.3.2 Crossarm Braces

Provide steel angle as indicated. Provide braces with 38 inch span for 8 foot crossarms and 60 inch span for 10 foot crossarms.

2.3.3 Armless Construction

Pole mounting brackets for line-post or pin insulators and eye bolts for suspension insulators shall be as shown. Brackets shall be attached to poles with a minimum of two bolts. Brackets may be either provided integrally as part of an insulator or attached to an insulator with a suitable stud. Bracket mounting surface shall be suitable for the shape of the pole. Brackets for wood poles shall have wood gripping members. Horizontal offset brackets shall have a 5-degree uplift angle. Pole top brackets shall conform to IEEE C135.22, except for modifications necessary to provide support for a line-post insulator. Brackets shall provide a strength exceeding that of the required insulator strength, but in no case less than a 2800 pound cantilever strength.

2.4 HARDWARE

Hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M.

2.5 INSULATORS

Provide wet-process porcelain insulators which are radio interference free.

a. Pin insulators: NEMA C29.5, Class 55-5.

2.6 OVERHEAD CONDUCTORS

Conductors of bare copper and aluminum alloy (AAAC) of sizes and types indicated.

2.6.1 Solid Copper

ASTM B 1, ASTM B 2, and ASTM B 3, hard-drawn, medium-hard-drawn, and soft-drawn, respectively. ASTM B 8, stranded.

2.6.2 Aluminum

ASTM B 231/B 231M.

2.6.2.1 Aluminum Alloy

ASTM B 397 or ASTM B 399/B 399M.

2.7 GUY STRAND

ASTM A 475, high-strength, Class A or B, galvanized strand steel cable. Guy strand shall be 3/8 inch in diameter with a minimum breaking strength of 12,000 pounds. Provide guy terminations designed for use with the particular strand and developing at least the ultimate breaking strength of

the strand.

2.8 ROUND GUY GUARDS

Vinyl or PVC material, yellow colored, 8 feet long and shatter resistant at sub-zero temperatures.

2.8.1 Guy Attachment

Thimble eye guy attachment.

2.9 ANCHORS AND ANCHOR RODS

Anchors shall be screw anchors presenting holding area indicated on drawings as a minimum. Anchor rods shall be triple thimble-eye, 3/4 inch diameter by 8 feet long. Anchors and anchor rods shall be hot dip galvanized.

2.9.1 Screw Anchors

Screw type anchors having a manufacturer's rating of not less than 6,000 pounds in loose to medium sand/clay soil, Class 6 and extra heavy pipe rods conforming to ASTM A 53/A 53M, Schedule 80, and couplings conforming to ASME B16.11.

2.10 GROUND RODS

Copper clad steel ground rods at least 3/4 inch in diameter and 10 feet long. Die-stamp each near top with name or trademark of manufacturer and length of rod in feet. Rods shall have a hard, clean, smooth, continuous, surface throughout length of rod.

2.10.1 Ground Wire

Provide soft drawn copper wire ground conductors a minimum No. 4 AWG. Ground wire protectors may be either PVC or half round wood molding. Wood molding shall be fir, pressure treated in accordance with AWPA C25, or shall be cypress or cedar.

2.11 SURGE ARRESTERS

IEEE C62.11, metal oxide, porcelain housed, surge arresters arranged for crossarm mounting. RMS voltage rating shall be 10 kV. Arresters shall be Distribution class.

2.12 FUSED CUTOUTS

Open type fused cutouts rated [100] [200] amperes and 12,000 amperes symmetrical interrupting current at 7.8 kV ungrounded, conforming to NEMA C37.42. Type K fuses conforming to NEMA C37.42 with ampere ratings equal to 150 percent of the transformer full load rating. Open link type fuse cutouts are not acceptable.

2.13 CONDUIT RISERS AND CONDUCTORS

The riser shield shall be PVC containing a PVC back plate and PVC extension shield or a rigid galvanized steel conduit, as indicated, and conforming to UL 6. Provide conductors and terminations as specified in Section 33 71 02 "Underground Transmission and Distribution."

2.14 ELECTRICAL TAPES

Tapes shall be UL listed for electrical insulation and other purposes in wire and cable splices. Terminations, repairs and miscellaneous purposes, electrical tapes shall comply with UL 510.

2.15 CALKING COMPOUND

Compound for sealing of conduit risers shall be of a puttylike consistency workable with hands at temperatures as low as 35 degrees F, shall not slump at a temperature of 300 degrees F, and shall not harden materially when exposed to air. Compound shall readily calk or adhere to clean surfaces of the materials with which it is designed to be used. Compound shall have no injurious effects upon the workmen or upon the materials.

PART 3 EXECUTION

3.1 INSTALLATION

Provide overhead pole line installation conforming to requirements of IEEE C2 for Grade B construction of overhead lines in medium loading districts and NFPA 70 for overhead services. Provide material required to make connections into existing system and perform excavating, backfilling, and other incidental labor. Consider street, alleys, roads and drives "public." Pole configuration shall be as indicated.

3.1.1 Wood Pole Installation

Provide pole holes at least as large at the top as at the bottom and large enough to provide 4 inch clearance between the pole and side of the hole. Provide a 6 inch band of soil around and down to the base of the pole treated with 2 to 3 gallons of a one percent dursban TC termiticide solution.

3.1.1.1 Setting Depth of Pole

Pole setting depths shall be as follows:

Length of Pole (feet)	Setting in Soil (feet)	Setting in Solid Rock (feet)
20	5.0	3.0
25	5.5	3.5
30	5.5	3.5
35	6.0	4.0
40	6.0	4.0
45	6.5	4.5
50	7.0	4.5
55	7.5	5.0
60	8.0	5.0

Length of Pole (feet)	Setting in Soil (feet)	Setting in Solid Rock (feet)

3.1.1.2 Setting in Soil, Sand, and Gravel

"Setting in Soil" depths, as specified in paragraph entitled "Setting Depth of Pole," apply where the following occurs:

a. Where pole holes are in soil, sand, or gravel or any combination of these;

b. Where soil layer over solid rock is more than 2 feet deep;

c. Where hole in solid rock is not substantially vertical; or

d. Where diameter of hole at surface of rock exceeds twice the diameter of pole at same level. At corners, dead ends and other points of extra strain, poles 40 feet or more long shall be set 6 inches deeper.

3.1.1.3 Setting in Solid Rock

"Setting in Solid Rock," as specified in paragraph entitled "Setting Depth of Pole," applies where poles are to be set in solid rock and where hole is substantially vertical, approximately uniform in diameter and large enough to permit use of tamping bars the full depth of hole.

3.1.1.4 Setting With Soil Over Solid Rock

Where a layer of soil 2 feet or less in depth over solid rock exists, depth of hole shall be depth of soil in addition to depth specified under "Setting in Solid Rock" in paragraph entitled "Setting Depth of Pole," provided, however, that such depth shall not exceed depth specified under "Setting in Soil."

3.1.1.5 Setting on Sloping Ground

On sloping ground, always measure hole depth from low side of hole.

3.1.1.6 Backfill

Thoroughly tamp pole backfill for full depth of the hole and mound excess fill around the pole.

3.1.1.7 Setting Poles

Set poles so that alternate crossarm gains face in opposite directions, except at terminals and dead ends where gains of last two poles shall be on side facing terminal or dead end. On unusually long spans, set poles so that crossarm comes on side of pole away from long span. Where pole top pins are used, they shall be on opposite side of pole from gain, with flat side against pole.

3.1.1.8 Alignment of Poles

Set poles in alignment and plumb except at corners, terminals, angles, junctions, or other points of strain, where they shall be set and raked against the strain. Set not less than 2 inches for each 10 feet of pole

length above grade, nor more than 4 inches for each 10 feet of pole length after conductors are installed at required tension. When average ground run is level, consecutive poles shall not vary more than 5 feet in height. When ground is uneven, poles differing in length shall be kept to a minimum by locating poles to avoid the highest and lowest ground points. If it becomes necessary to shorten a pole, a piece shall be sawed off the top. Holes shall be dug large enough to permit the proper use of tampers to full depth of hole.

3.1.2 Anchors and Guys

Place anchors in line with strain. The length of the guy lead (distance from base of pole to the top of the anchor rod) shall be as indicated.

3.1.2.1 Setting Anchors

Set anchors in place with anchor rod aligned with, and pointing directly at, guy attachment on the pole with the anchor rod projecting 6 to 9 inches out of ground to prevent burial of rod eye.

3.1.2.2 Screw Anchors

Install screw anchors by torquing with boring machine.

3.1.2.3 Swamp Anchors

Install swamp anchors by torquing with boring machine or wrenches, adding sections of pipe as required until anchor helix is fully engaged in firm soil.

3.1.2.4 Setting Guy Strands

Complete anchor and guy installation, dead end to dead end, and tighten guy before wire stringing and sagging is begun on that line section. Provide strain insulators at a point on guy strand 8 feet minimum from the ground and 6 feet minimum from the surface of pole.

3.1.3 Hardware

Provide hardware with washer against wood and with nuts and lock nuts applied wrench tight. Provide locknuts on threaded hardware connections. Locknuts shall be M-F style and not palnut style.

3.1.4 Grounding

Unless otherwise indicated, grounding shall conform to IEEE C2. Pole grounding electrodes shall have a resistance to ground not exceeding 25 ohms. When work in addition to that indicated or specified is directed in order to obtain specified ground resistance, provisions of the contract covering changes shall apply.

3.1.4.1 Ground Rod Connections

Make ground rod connections on pole lines by exothermic weld or by using a compression connector for ground wire or wire to rod connections. Make exothermic welds strictly in accordance with manufacturer's written recommendations. Welds which have puffed up or which show convex surfaces

indicating improper cleaning, are not acceptable. No mechanical connectors are required at exothermic weldments. Compression connectors shall be type that uses a hydraulic compression tool to provide correct pressure. Provide tools and dies recommended by compression connector manufacturer. An embossing die code or similar method shall provide visible indication that a connector has been fully compressed on ground wire.

3.1.4.2 Grounding and Grounded Connections

a. Where no primary or common neutral exists, surge arresters and frames of equipment operating at over 750 volts shall be bonded together and connected to a dedicated primary grounding electrode.

b. Where no primary or common neutral exists, transformer secondary neutral bushing, secondary neutral conductor, and frames of equipment operating at under 750 volts shall be bonded together and connected to a dedicated secondary grounding electrode.

c. When a primary or common neutral exists, connect all grounding and grounded conductors to a common grounding electrode.

3.1.4.3 Protective Molding

Protect grounding conductors which are run on surface of wood poles by wood molding extending from ground line throughout communication and transformer spaces.

3.1.5 CONDUCTOR INSTALLATION

3.1.5.1 Line Conductors

Conductors shall be handled with care necessary to prevent nicking, kinking, gouging, abrasions, sharp bends, cuts, flattening, or otherwise deforming or weakening conductor or any damage to insulation or impairing its conductivity. Remove damaged sections of conductor and splice conductor. Conductors shall be paid out with the free end of conductors fixed and cable reels portable, except where terrain or obstructions make this method unfeasible. Bend radius for any insulated conductor shall not be less than the applicable NEMA specification recommendation. Conductors shall not be drawn over rough or rocky ground, nor around sharp bends.

3.1.5.2 Connectors and Splices

Conductor splices, as installed, shall exceed ultimate rated strength of conductor and shall be of type recommended by conductor manufacturer. No splice shall be permitted within 10 feet of a support. Connectors and splices shall be mechanically and electrically secure under tension and shall be of the nonbolted compression type. The tensile strength of any splice shall be not less than the rated breaking strength of the conductor. Splice materials, sleeves, fittings, and connectors shall be noncorrosive and shall not adversely affect conductors. Aluminum-composition conductors shall be wire brushed and an oxide inhibitor applied before making a compression connection. Connectors which are factory-filled with an inhibitor are acceptable. Inhibitors and compression tools shall be of types recommended by the connector manufacturer. Primary line apparatus taps shall be by means of hot line clamps attached to compression type bail clamps (stirrups). Low-voltage connectors for copper conductors shall be of the solderless pressure type. Noninsulated connectors shall be smoothly taped to provide a waterproof

insulation equivalent to the original insulation, when installed on insulated conductors. On overhead connections of aluminum and copper, the aluminum shall be installed above the copper.

3.1.5.3 Conductor-To-Insulator Attachments

Conductors shall be attached to insulators by means of clamps, shoes or tie wires, in accordance with the type of insulator. For insulators requiring conductor tie-wire attachments, tie-wire sizes shall be as indicated in TABLE II.

TABLE II

TIE-WIRE REQUIREMENTS

CONDUCTOR Copper (AWG)	TIE WIRE Soft-Drawn Copper (AWG)
6	8
4 and 2	6
1 through 3/0	4
4/0 and larger	2
AAC, AAAC, or ACSR (AWG)	AAAC OR AAC (AWG)
Any size	6 or 4

3.1.5.4 Armor Rods

Armor rods shall be provided for AAC and AAAC. Armor rods shall be installed at supports, except armor rods will not be required at primary dead-end assemblies if aluminum or aluminum-lined zinc-coated steel clamps are used. Lengths and methods of fastening armor rods shall be in accordance with the manufacturer's recommendations. For span lengths of less than 200 feet, flat aluminum armor rods may be used. Flat armor rods, not less than 0.03 by 0.25 inch shall be used on No. 1 AWG AAC and AAAC and smaller conductors and on No. 5 AWG ACSR and smaller conductors. On larger sizes, flat armor rods shall be not less than 0.05 by 0.30 inches. For span lengths of 200 feet or more, preformed round armor rods shall be used.

3.1.5.5 Ties

Provide ties on pin insulators tight against conductor and insulator and ends turned down flat against conductor so that no wire ends project.

3.1.5.6 Reinstalling Conductors

Existing conductors to be reinstalled or resagged shall be strung to "final" sag table values indicated for the particular conductor type and size involved.

3.1.5.7 New Conductor Installation

String new conductors to "initial" sag table values recommended by the

manufacturer for conductor type and size of conductor and ruling span indicated.

3.1.5.8 Fittings

Dead end fittings, clamp or compression type, shall conform to written recommendations of conductor manufacturer and shall develop full ultimate strength of conductor.

3.1.5.9 Aluminum Connections

Make aluminum connections to copper or other material using only splices, connectors, lugs, or fittings designed for that specific purpose. Keep a copy of manufacturer's instructions for applying these fittings at job site for use of the inspector.

3.1.6 Risers

Secure galvanized steel conduits on poles by two hole galvanized steel pipe straps spaced as indicated and within 3 feet of any outlet or termination. Ground metallic conduits.

3.2 FIELD QUALITY CONTROL

3.2.1 General

The Contractor shall notify the Contracting Officer 14 days prior to conducting tests. The Contractor shall furnish materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field reports will be signed and dated by the Contractor.

3.2.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.2.3 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.2.3.1 Current Transformers

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify correct connection.

(4) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

(5) Verify that all required grounding and shorting connections provide good contact.

b. Electrical Tests

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter

(2) Perform insulation-resistance tests.

(3) Perform polarity tests.

(4) Perform ratio-verification tests.

3.2.3.2 Metering

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify tightness of electrical connections.

b. Electrical Tests

(1) Verify accuracy of meters at 25 percent, 50 percent, 75 percent, and 100 percent of full scale.

(2) Calibrate watthour meters according to manufacturer's published data.

(3) Verify all instrument multipliers.

3.2.3.3 Grounding System

a. Visual and mechanical inspection

(1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

(1) Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

3.2.4 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least three times, demonstrating satisfactory operation each time.

3.2.5 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

SECTION 33 71 02

UNDERGROUND ELECTRICAL DISTRIBUTION

12/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS8	(2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

ASTM INTERNATIONAL (ASTM)

ASTM B 1	(2001; R 2007) Standard Specification for Hard-Drawn Copper Wire
ASTM B 3	(2001; R 2007) Standard Specification for Soft or Annealed Copper Wire
ASTM B 8	(2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM F 512	(2006) Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2007; Errata 2006 & 2007; INT 44-56 2007; INT 47, 49, 50, 52-56 2008; INT 57, 58, 51, 48, 59 2009) National Electrical Safety Code
IEEE Std 100	(2000) The Authoritative Dictionary of IEEE Standards Terms
IEEE Std 386	(2006) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE Std 400.2	(2004) Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)
IEEE Std 404	(2006) Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V Through 500 000 V

IEEE Std 48	(2009) Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)Normal Measurements

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2009) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C119.1	(2006) Sealed Insulated Underground Connector Systems Rated 600 Volts
NEMA RN 1	(2005) Standard for Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 6 & 8	(2003) Standard for Polyvinyl Chloride PVC Plastic Utilities Duct for Underground Installations
NEMA TC 9	(2004) Standard for Fittings for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation
NEMA WC 71	(1999) Standard for Nonshielded Cables Rated 2001-5000 Volts for use in the Distribution of Electric Energy
NEMA WC 74	(2006) Standard for 5-46 kV Shielded Power Cable for use in the Transmission and Distribution of Electric Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2008; AMD 1 2008) National Electrical Code - 2008 Edition

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-758-A	(2004) Customer-Owned Outside Plant Telecommunications Cabling Standard

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS Bull 1751F-644	(2002) Underground Plant Construction

UNDERWRITERS LABORATORIES (UL)

UL 1072	(2006; Rev thru Sep 2007) Medium-Voltage

	Power Cables
UL 1242	(2006; Rev thru Jul 2007) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 44	(2005; Rev thru Nov 2005) Thermoset-Insulated Wires and Cables
UL 467	(2007) Standard for Grounding and Bonding Equipment
UL 486A-486B	(2003; Rev thru Apr 2009) Standard for Wire Connectors
UL 510	(2005; Rev thru Aug 2005) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(2004; Rev thru Oct 2009) Standard for Metallic Outlet Boxes
UL 514B	(2004; Rev thru Nov 2009) Standard for Conduit, Tubing and Cable Fittings
UL 6	(2007) Standard for Electrical Rigid Metal Conduit-Steel
UL 651	(2005; Rev thru May 2007) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL 83	(20086) Standard for Thermoplastic-Insulated Wires and Cables
UL 854	(2004; Rev thru Oct 2007) Service-Entrance Cables

1.2 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

b. In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.

c. In the text of this section, "medium voltage cable splices," and "medium voltage cable joints" are used interchangeably and have the same meaning.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

SD-03 Product Data

Medium voltage cable

Medium voltage cable joints

Medium voltage cable terminations

Precast concrete structures

SD-06 Test Reports

Arc-proofing test for cable fireproofing materials

Medium voltage cable qualification and production tests

Field Acceptance Checks and Tests

Arc-proofing test for cable fireproofing tape

Cable Installation Plan and Procedure

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

a. Site layout drawing with cable pulls numerically identified.

b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.

c. The cable manufacturer and type of cable.

d. The dates of cable pulls, time of day, and ambient temperature.

e. The length of cable pull and calculated cable pulling tensions.

f. The actual cable pulling tensions encountered during pull.

SD-07 Certificates

Cable splicer/terminator

Cable Installer Qualifications

1.4 QUALITY ASSURANCE

1.4.1 Certificate of Competency for Cable Splicer/Terminator

Certification of the qualification of the cable splicer/terminator shall be submitted, for approval, 30 days before splices or terminations are to be made in medium voltage (5 kV to 35 kV) cables. The certification shall include the training, and experience of the individual on the specific type and classification of cable to be provided under this contract. The certification shall indicate that the individual has had three or more

years recent experience splicing and terminating medium voltage cables. The certification shall also list a minimum of three splices/terminations that have been in operation for more than one year. In addition, the individual may be required to perform a dummy or practice splice/termination in the presence of the Contracting Officer, before being approved as a qualified cable splicer. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice/termination kit, and detailed manufacturer's instructions for the cable to be spliced. The Contracting Officer reserves the right to require additional proof of competency or to reject the individual and call for certification of an alternate cable splicer.

1.4.2 Cable Installer Qualifications

Provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. Provide a resume showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.

1.4.3 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.4.4 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.4.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

PART 2 PRODUCTS

2.1 CONDUIT, DUCTS, AND FITTINGS

2.1.1 Rigid Metal Conduit

UL 6, galvanized steel, threaded type.

2.1.1.1 Rigid Metallic Conduit, PVC Coated

UL 6, galvanized steel, threaded type, coat with polyvinyl chloride (PVC) sheath bonded to galvanized exterior surface, nominal 40 mil thick conforming to NEMA RN 1, Type A40, except that hardness shall be nominal 85 Shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, and tensile strength shall be minimum 3500 psi and aging shall be minimum 1000 hours in an Atlas Weatherometer.

2.1.2 Intermediate Metal Conduit

UL 1242, galvanized steel, threaded type..

2.1.2.1 Intermediate Metal Conduit, PVC Coated

UL 1242, galvanized steel, threaded type, coated with polyvinyl chloride (PVC) sheth bonded to the galvanized exterior surface, nomimal 40 mil think, conforming to NEMA RN 1, Type A40, except that hardness shall be nominal 85 Shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, and tensile strength shall be minimum 3500 psi and aging shall be minimum 1000 hours in an Atlas Weatherometer.

2.1.3 Plastic Conduit for Direct Burial

UL 651,Schedule 40.

2.1.4 Plastic Duct for Concrete Encasement

NEMA TC 6 & 8 and ASTM F 512, UL 651, EPC-40-PVC.

2.1.5 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall neither slump at a temperature of 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials. Inflatable bladders may be used as an option.

2.1.6 Fittings

2.1.6.1 Metal Fittings

UL 514B, threaded type.

2.1.6.2 PVC Conduit Fittings

UL 514B, UL 651.

2.1.6.3 PVC Duct Fittings

NEMA TC 9.

2.1.6.4 Outlet Boxes for Steel Conduit

Outlet boxes for use with rigid or flexible steel conduit shall be cast-metal cadmium or zinc-coated if of ferrous metal with gasketed closures and shall conform to UL 514A.

2.2 LOW VOLTAGE INSULATED CONDUCTORS AND CABLES

Insulated conductors shall be rated 600 volts and conform to the requirements of NFPA 70, including listing requirements. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be accepted. Service entrance conductors shall conform to UL 854, type USE.

2.2.1 Conductor Types

Cable and duct sizes indicated are for copper conductors and THHN/THWN unless otherwise noted. Conductors No. 10 AWG and smaller shall be solid copper. Conductors No. 8 AWG and larger shall be stranded copper. All conductors shall be copper.

2.2.2 Conductor Material

Unless specified or indicated otherwise or required by NFPA 70, wires in conduit, other than service entrance, shall be 600-volt, Type THWN/THHN conforming to UL 83 or Type XHHW or RHW conforming to UL 44. Copper conductors shall be annealed copper complying with ASTM B 3 and ASTM B 8.

2.2.3 Jackets

Multiconductor cables shall have an overall PVC outer jacket.

2.2.4 Cable Marking

Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout the cable length.

Each cable shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

Conductors shall be color coded. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Conductor identification shall be by color-coded insulated conductors, plastic-coated self-sticking printed markers, colored nylon cable ties and plates, heat shrink type sleeves,or colored electrical tape. Control circuit terminations shall be properly identified. Color shall be green for grounding conductors and white for neutrals; except where

neutrals of more than one system are installed in same raceway or box, other neutrals shall be white with a different colored (not green) stripe for each. Color of ungrounded conductors in different voltage systems shall be as follows

a. 208/120 volt, three-phase

(1) Phase A - black

(2) Phase B - red

(3) Phase C - blue

b. 480/277 volt, three-phase

(1) Phase A - brown

(2) Phase B - orange

(3) Phase C - yellow

c. 120/240 volt, single phase: Black and red

[d. On three-phase, four-wire delta system, high leg shall be orange, as required by NFPA 70.]

2.3 LOW VOLTAGE WIRE CONNECTORS AND TERMINALS

Shall provide a uniform compression over the entire conductor contact surface. Use solderless terminal lugs on stranded conductors.

a. For use with copper conductors: UL 486A-486B.

2.4 LOW VOLTAGE SPLICES

Provide splices in conductors with a compression connector on the conductor and by insulating and waterproofing using one of the following methods which are suitable for continuous submersion in water and comply NEMA C119.1.

2.4.1 Heat Shrinkable Splice

Provide heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material which shall be applied in accordance with the manufacturer's written instructions.

2.4.2 Cold Shrink Rubber Splice

Provide a cold-shrink rubber splice which consists of EPDM rubber tube which has been factory stretched onto a spiraled core which is removed during splice installation. The installation shall not require heat or flame, or any additional materials such as covering or adhesive. It shall be designed for use with inline compression type connectors, or indoor, outdoor, direct-burial or submerged locations.

2.5 MEDIUM VOLTAGE CABLE

Cable (conductor) sizes are designated by American Wire Gauge (AWG) and Thousand Circular Mils (Kcmil). Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Insulated conductors shall

have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout cable length. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be accepted. Provide single conductor type cables unless otherwise indicated.

2.5.1 Cable Configuration

Provide Type MV cable, conforming to NEMA WC 74 and UL 1072 . Provide cables manufactured for use in duct applications . Cable shall be rated 15 kV with [133] percent insulation level.

2.5.2 Conductor Material

Provide concentric-lay-stranded, Class B conductors. Provide soft drawn copper cables complying with ASTM B 3 and ASTM B 8 for regular concentric and compressed stranding.

2.5.3 Insulation

Provide ethylene-propylene-rubber (EPR) insulation conforming to the requirements of NEMA WC 71 and AEIC CS8.

2.5.4 Shielding

Cables rated for 2 kV and above shall have a semiconducting conductor shield, a semiconducting insulation shield, and an overall copper tape shield for each phase.

2.5.5 Neutrals

Neutral conductors of shall be copper, employing the same insulation and jacket materials as phase conductors, except that a 600-volt insulation rating is acceptable.

2.5.6 Jackets

Cables shall be provided with a PVC jacket. Direct buried cables shall be rated for direct burial. Provide PVC jackets with a separator that prevents contact when underlying semiconducting insulating shield.

2.6 MEDIUM VOLTAGE CABLE TERMINATIONS

IEEE Std 48 Class 1; of the molded elastomer, prestretched elastomer, or heat-shrinkable elastomer. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, or armor. Terminations shall be provided in a kit, including: skirts, stress control terminator, ground clamp, connectors, lugs, and complete instructions for assembly and installation. Terminations shall be the product of one manufacturer, suitable for the type, diameter, insulation class and level, and materials of the cable terminated. Do not use separate parts of copper or copper alloy in contact with aluminum alloy parts in the construction or installation of the terminator.

2.6.1 Cold-Shrink Type

Terminator shall be a one-piece design, utilizing the manufacturer's latest technology, where high-dielectric constant (capacitive) stress control is integrated within a skirted insulator made of silicone rubber. Termination shall not require heat or flame for installation. Termination kit shall contain all necessary materials (except for the lugs). Termination shall be designed for installation in low or highly contaminated indoor and outdoor locations and shall resist ultraviolet rays and oxidative decomposition.

2.6.2 Separable Insulated Connector Type

IEEE Std 386. Provide connector with steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material. Provide connectors of the loadbreak or deadbreak type as indicated, of suitable construction for the application and the type of cable connected, and that include cable shield adaptors. Provide external clamping points and test points.

a. 200 Ampere loadbreak connector ratings: Voltage: 15 kV, 95 kV BIL. Short time rating: 10,000 rms symmetrical amperes.

2.7 MEDIUM VOLTAGE CABLE JOINTS

Provide joints (splices) in accordance with IEEE Std 404 suitable for the rated voltage, insulation level, insulation type, and construction of the cable. Joints shall be certified by the manufacturer for waterproof, submersible applications. Upon request, supply manufacturer's design qualification test report in accordance with IEEE Std 404. Connectors for joint shall be tin-plated electrolytic copper, having ends tapered and having center stops to equalize cable insertion.

2.7.1 Cold-Shrink Rubber-Type Joint

Joint shall be of a cold shrink design that does not require any heat source for its installation. Splice insulation and jacket shall be of a one-piece factory formed cold shrink sleeve made of black EPDM rubber. Splice shall be packaged three splices per kit, including complete installation instructions.

2.8 TAPE

2.8.1 Insulating Tape

UL 510, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

2.8.2 Buried Warning and Identification Tape

Provide metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inches minimum width, Red in color for electrica and Orange for telecommunications for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Provide permanent color and printing, unaffected by

moisture or soil.

2.8.3 Fireproofing Tape

Provide tape composed of a flexible conformable unsupported intumescent elastomer. Tape shall be not less than .030 inch thick, noncorrosive to cable sheath, self-extinguishing, noncombustible, and shall not deteriorate when subjected to oil, water, gases, salt water, sewage, and fungus.

2.9 PULL ROPE

Shall be plastic or flat pull line (bull line) having a minimum tensile strength of 200 pounds. Leave a minimum of 24 inches of slack at each end of the pull wires.

2.10 GROUNDING AND BONDING

2.10.1 Driven Ground Rods

Provide copper-clad steel ground rods conforming to UL 467 not less than 3/4 inch in diameter by 10 feet in length. Sectional type rods may be used for rods 20 feet or longer.

2.10.2 Grounding Conductors

Stranded-bare copper conductors shall conform to ASTM B 8, Class B, soft-drawn unless otherwise indicated. Solid-bare copper conductors shall conform to ASTM B 1 for sizes No. 8 and smaller. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Aluminum is not acceptable.

2.11 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE. In addition, provide concrete for encasement of underground ducts with 3000 psi minimum 28-day compressive strength. Concrete associated with electrical work for other than encasement of underground ducts shall be 4000 psi minimum 28-day compressive strength unless specified otherwise.

2.12 Precast concrete structures

Provide precast concrete support pad for transformer.

2.12.1 Precast Concrete Transformer Support (Pad)

In lieu of cast-in-place, Contractors, shall provide precast concrete structures designed for transformer support and subject to the requirements specified below. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes.

2.12.1.1 General

Precast concrete structures shall have the same accessories and facilities as required for cast-in-place structures. Likewise, precast structures shall have plan area and clear heights not less than those of cast-in-place structures. Concrete materials and methods of construction shall be the

same as for cast-in-place concrete construction, as modified herein. Concrete for precast work shall have a 28-day compressive strength of not less than 4000 psi. Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.

2.13 SOURCE QUALITY CONTROL

2.13.1 Arc-Proofing Test for Cable Fireproofing Tape

Manufacturer shall test one sample assembly consisting of a straight lead tube 12 inches long with a 2 1/2 inch outside diameter, and a 1/8 inch thick wall, and covered with one-half lap layer of arc and fireproofing material per manufacturer's instructions. The arc and fireproofing tape shall withstand extreme temperature of a high-current fault arc 13,000 degrees K for 70 cycles as determined by using an argon directed plasma jet capable of constantly producing and maintaining an arc temperature of 13,000 degrees K. Temperature (13,000 degrees K) of the ignited arc between the cathode and anode shall be obtained from a dc power source of 305 (plus or minus 5) amperes and 20 (plus or minus 1) volts. The arc shall be directed toward the sample assembly accurately positioned 5 (plus or minus 1) millimeters downstream in the plasma from the anode orifice by fixed flow rate of argon gas (0.18 g per second). Each sample assembly shall be tested at three unrelated points. Start time for tests shall be taken from recorded peak current when the specimen is exposed to the full test temperature. Surface heat on the specimen prior to that time shall be minimal. The end point is established when the plasma or conductive arc penetrates the protective tape and strikes the lead tube. Submittals for arc-proofing tape shall indicate that the test has been performed and passed by the manufacturer.

2.13.2 Medium Voltage Cable Qualification and Production Tests

Results of AEIC CS8 qualification and production tests as applicable for each type of medium voltage cable.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment and devices in accordance with the manufacturer's published instructions and with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable. In addition to these requirements, install telecommunications in accordance with TIA-758-A and RUS Bull 1751F-644.

3.2 CABLE INSPECTION

Prior to installation, each cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable prior to installation in accordance with the cable manufacturer's recommendations.

3.3 CABLE INSTALLATION PLAN AND PROCEDURE

The Contractor shall obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature limits for installation, lubricants, coefficient of friction, conduit cleaning,

storage procedures, moisture seals, testing for and purging moisture, maximum allowable pulling tension, and maximum allowable sidewall bearing pressure. The Contractor shall then perform pulling calculations and prepare a pulling plan which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS. Cable shall be installed strictly in accordance with the cable manufacturer's recommendations and the approved installation plan.

Calculations and pulling plan shall include:

a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.

b. List of cable installation equipment.

c. Lubricant manufacturer's application instructions.

d. Procedure for resealing cable ends to prevent moisture from entering cable.

e. Cable pulling tension calculations of all cable pulls.

f. Cable percentage conduit fill.

g. Cable sidewall bearing pressure.

h. Cable minimum bend radius and minimum diameter of pulling wheels used.

i. Cable jam ratio.

j. Maximum allowable pulling tension on each different type and size of conductor.

k. Maximum allowable pulling tension on pulling device.

3.4 UNDERGROUND FEEDERS SUPPLYING BUILDINGS

Terminate underground feeders supplying building at a point 5 feet outside the building and projections thereof, except that conductors shall be continuous to the terminating point indicated. Coordinate connections of the feeders to the service entrance equipment with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Conduit shall be PVC, Type schedule-40 from the supply equipment to a point 5 feet outside the building and projections thereof. Protect ends of underground conduit with plastic plugs until connections are made.

3.5 UNDERGROUND CONDUIT AND DUCT SYSTEMS

3.5.1 Requirements

Depths to top of the conduit shall be in accordance with NFPA 70. Run conduit in straight lines except where a change of direction is necessary. Numbers and sizes of ducts shall be as indicated. Ducts shall have a continuous slope downward toward underground structures and away from buildings, laid with a minimum slope of 3 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment

risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in structures.

3.5.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.5.3 Conduit Cleaning

As each conduit run is completed, for conduit sizes 3 inches and larger, draw a flexible testing mandrel approximately 12 inches long with a diameter less than the inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs. For conduit sizes less than 3 inches, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs.

3.5.4 Jacking and Drilling Under Roads and Structures

Conduits to be installed under existing paved areas which are not to be disturbed, and under roads and railroad tracks, shall be zinc-coated, rigid steel, jacked into place.Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 50 feet in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers. Hydraulic jet method shall not be used.

3.5.5 Galvanized Conduit Concrete Penetrations

Galvanized conduits which penetrate concrete (slabs, pavement, and walls) in wet locations shall be PVC coated and shall extend from at least 2 inches within the concrete to the first coupling or fitting outside the concrete (minimum of 6 inches from penetration).

3.5.6 Multiple Conduits

Separate multiple conduits by a minimum distance of 2 1/2 inches, except that light and power conduits shall be separated from control, signal, and telephone conduits by a minimum distance of 12 inches. Stagger the joints

of the conduits by rows (horizontally) and layers (vertically) to strengthen the conduit assembly. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers, ties, and locking device on top to provide a completely enclosed and locked-in conduit assembly. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of conduit assembly.

3.5.7 Conduit Plugs and Pull Rope

New conduit indicated as being unused or empty shall be provided with plugs on each end. Plugs shall contain a weephole or screen to allow water drainage. Provide a plastic pull rope having 3 feet of slack at each end of unused or empty conduits.

3.5.8 Conduit and Duct Without Concrete Encasement

Provide not less than 3 inches clearance from the conduit to each side of the trench. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level with original bottom with sand or earth free from particles, that would be retained on a 1/4 inch sieve. The first 6 inch layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in3 to 6 inch layers. Provide color, type and depth of warning tape as specified above.

3.5.8.1 Encasement Under Roads and Structures

Under roads, paved areas, and railroad tracks, install conduits in concrete encasement of rectangular cross-section providing a minimum of 3 inch concrete cover around ducts. Concrete encasement shall extend at least 5 feet beyond the edges of paved areas and roads, and 12 feet beyond the rails on each side of railroad tracks.

3.5.9 Duct Encased in Concrete

Construct underground duct lines of individual conduits encased in concrete. Do not mix different kinds of conduit in any one duct bank. Concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 2 1/2 inches, except separate light and power conduits from control, signal, and telecommunications conduits by a minimum concrete thickness of 3 inches. Before pouring concrete, anchor duct bank assemblies to prevent the assemblies from floating during concrete pouring. Anchoring shall be done by driving reinforcing rods adjacent to duct spacer assemblies and attaching the rods to the spacer assembly. Provide color, type and depth of warning tape as specified above.

3.6 CABLE PULLING

Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into switches, transformers, switchgear, switchboards, and other enclosures. Cable with tape shield shall have a bending radius not less than 12 times the overall diameter of the completed cable. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.6.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables.

3.7 LOW VOLTAGE CABLE SPLICING AND TERMINATING

Make terminations and splices with materials and methods as indicated or specified herein and as designated by the written instructions of the manufacturer. Do not allow the cables to be moved until after the splicing material has completely set. Make splices in underground distribution systems only in accessible locations such as manholes,handholes, or aboveground termination cabinets.

3.8 MEDIUM VOLTAGE CABLE TERMINATIONS

Make terminations in accordance with the written instruction of the termination kit manufacturer.

3.9 MEDIUM VOLTAGE CABLE JOINTS

Provide power cable joints (splices) suitable for continuous immersion in water. Make joints only in accessible locations in manholes or handholes by using materials and methods in accordance with the written instructions of the joint kit manufacturer.

3.9.1 Joints in Shielded Cables

Cover the joined area with metallic tape, or material like the original cable shield and connect it to the cable shield on each side of the splice. Provide a bare copper ground connection brought out in a watertight manner and grounded to the manhole grounding loop as part of the splice installation. Ground conductors, connections, and rods shall be as specified elsewhere in this section. Wire shall be trained to the sides of the enclosure to prevent interference with the working area.

3.10 CABLE END CAPS

Cable ends shall be sealed at all times with coated heat shrinkable end caps. Cables ends shall be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps shall remain in place until the cable is spliced or terminated. Sealing compounds and tape are not acceptable substitutes for heat shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

3.11 FIREPROOFING OF CABLES IN UNDERGROUND STRUCTURES

Fireproof (arc proof) wire and cables which will carry current at 2200 volts or more in underground structures.

3.11.1 Fireproofing Tape

Tightly wrap strips of fireproofing tape around each cable spirally in half-lapped wrapping. Install tape in accordance with manufacturer's instructions.

3.11.2 Tape-Wrap

Tape-wrap metallic-sheathed or metallic armored cables without a nonmetallic protective covering over the sheath or armor prior to application of fireproofing. Wrap shall be in the form of two tightly applied half-lapped layers of a pressure-sensitive 10 mil thick plastic tape, and shall extend not less than one inch into the duct. Even out irregularities of the cable, such as at splices, with insulation putty before applying tape.

3.12 GROUNDING SYSTEMS

Provide grounding system as indicated, in accordance with NFPA 70 and IEEE C2, and as specified herein.

Noncurrent-carrying metallic parts associated with electrical equipment shall have a maximum resistance to solid earth ground not exceeding the following values:

Pad-mounted transformers without protective fences	5 ohms
Ground in manholes	5 ohms
Grounding other metal enclosures of primary voltage electrical and electrically-operated equipment	5 ohms

3.12.1 Grounding Electrodes

Provide cone pointed driven ground rods driven full depth plus 6 inches, installed to provide an earth ground of the appropriate value for the particular equipment being grounded.
If the specified ground resistance is not met, an additional ground rod shall be provided in accordance with the requirements of NFPA 70 (placed not less than 6 feet from the first rod). Should the resultant (combined) resistance exceed the specified resistance, measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

3.12.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.12.3 Grounding Conductors

Provide bare grounding conductors, except where installed in conduit with associated phase conductors. Ground cable sheaths, cable shields, conduit, and equipment with No. 6 AWG. Ground other noncurrent-carrying metal parts and equipment frames of metal-enclosed equipment. Ground metallic frames and covers of handholes and pull boxes with a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.12.4 Ground Cable Crossing Expansion Joints

Protect ground cables crossing expansion joints or similar separations in structures and pavements by use of approved devices or methods of installation which provide the necessary slack in the cable across the joint to permit movement. Use stranded or other approved flexible copper cable across such separations.

3.13 EXCAVATING, BACKFILLING, AND COMPACTING

Provide in accordance with NFPA 70 and Section 31 23 00.00 20 EXCAVATION AND FILL.

3.13.1 Reconditioning of Surfaces

3.13.1.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct . Preserve sod and topsoil removed during excavation and reinstall after backfilling is completed. Replace sod that is damaged by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding, and provide topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.

3.13.1.2 Paving Repairs

Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists , restore such surface treatment or pavement the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces.

3.14 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.14.1 Concrete Slabs for Equipment

Unless otherwise indicated, the slab shall be at least 8 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh, placed uniformly 4 inches from the top of the slab. Slab shall be placed on a 6 inch thick, well-compacted gravel base. Top of concrete slab shall be approximately 4 inches above finished grade with gradual slope for drainage. Edges above grade shall have 1/2 inch chamfer. Slab shall be of adequate size to project at least 8 inches beyond the equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training

areas.

3.14.2 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.15 FIELD QUALITY CONTROL

3.15.1 Performance of Field Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.15.1.1 Medium Voltage Cables

Perform tests after installation of cable, splices, and terminators and before terminating to equipment or splicing to existing circuits.

a. Visual and Mechanical Inspection

(1) Inspect exposed cable sections for physical damage.

(2) Verify that cable is supplied and connected in accordance with contract plans and specifications.

(3) Inspect for proper shield grounding, cable support, and cable termination.

(4) Verify that cable bends are not less than ICEA or manufacturer's minimum allowable bending radius.

(5) Inspect for proper fireproofing.

(6) Visually inspect jacket and insulation condition.

(7) Inspect for proper phase identification and arrangement.

b. Electrical Tests

(1) Perform a shield continuity test on each power cable by ohmmeter method. Record ohmic value, resistance values in excess of 10 ohms per 1000 feet of cable must be investigated and justified.

(2) Perform acceptance test on new cables before the new cables are connected to existing cables and placed into service, including terminations and joints. Perform maintenance test on complete cable system after the new cables are connected to existing cables and placed into service, including existing cable, terminations, and joints. Tests shall be very low frequency (VLF) alternating voltage withstand tests in accordance with IEEE Std 400.2. VLF test frequency shall be 0.05 Hz minimum for a duration of 60 minutes using a sinusoidal waveform. Test voltages shall be as follows:

CABLE RATING	AC TEST VOLTAGE for ACCEPTANCE TESTING
5 kV	10kV rms(peak)
8 kV	13kV rms(peak)
15 kV	20kV rms(peak)
25 kV	31kV rms(peak)
35 kV	44kV rms(peak)

CABLE RATING	AC TEST VOLTAGE for MAINTENANCE TESTING
5 kV	7kV rms(peak)
8 kV	10kV rms(peak)
15 kV	16kV rms(peak)
25 kV	23kV rms(peak)
35 kV	33kV rms(peak)

3.15.1.2 Grounding System

a. Visual and mechanical inspection

Inspect ground system for compliance with contract plans and specifications

b. Electrical tests

Perform ground-impedance measurements utilizing the fall-of-potential method in accordance with IEEE Std 81. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable megohmmeter tester in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

3.15.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

SECTION 33 77 36.00 40

MEDIUM-VOLTAGE UTILITY FUSES
05/17

PART 1 GENERAL

[Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

]1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 242	(2001; Errata 2003) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems - Buff Book
IEEE 399	(1997) Brown Book IEEE Recommended Practice for Power Systems Analysis
IEEE C37.40	(2003; Errata 2003; R 2009) Service Conditions & Definitions for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, & Accessories
IEEE C37.41	(2016; Corr 2017) Design Tests for High-Voltage (>1000 V) Fuses and Accessories
IEEE C37.42	(2016) Specifications for High-Voltage (> 1000 V) Fuses and Accessories
IEEE C37.46	(2010) Standard for High Voltage Expulsion and Current-Limiting Type Power Class Fuses and Fuse Disconnecting Switches
IEEE C37.47	(2011) Standard for High Voltage Distribution Class Current-Limiting Type Fuses and Fuse Disconnecting Switches

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 3	(2005; R 2010) Medium-Voltage Controllers Rated 2001 to 7200 V AC
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2;

TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14; TIA 17-15; TIA 17-16; TIA 17-17)
National Electrical Code

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings;

Installation Drawings;

SD-03 Product Data

Distribution Fuse Cutouts;

SD-07 Certificates

Testing Certificates

SD-08 Manufacturer's Instructions

Fuse Cutouts

Manufacturer's Installation Instructions

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Submit fabrication drawings for fuse cutouts consisting of fabrication and assembly details to be performed in the factory.

Submit equipment and performance data for distribution fuse cutouts including life, testing certificates verifying conformance to referenced standards, system functional flows, safety features, and mechanical automated details.

2.2 EQUIPMENT

2.2.1 Standards

Ensure distribution fuse cutouts conform to the following standards:

a. IEEE C37.40

b. IEEE C37.41

c. IEEE C37.42

d. IEEE C37.46

e. IEEE C37.47

f. IEEE 242

g. IEEE 399

h. NEMA ICS 3

i. NEMA ICS 6

k. NFPA 70

2.2.2 Fuse Cutouts

Submit manufacturer's instructions for fuse cutouts, including special provisions required to install equipment components and system packages. Include special notices detailing impedances, hazards, and safety precautions.

Ensure that distribution fuse cutouts are self-contained, enclosed, dropout type, or open type when required for higher voltage or interrupting rating. Install loadbreak cutouts only if specifically indicated.

Ensure the interrupting capacity is sufficient to break the maximum system fault current to which the cutout will be subjected. The minimum interrupting capacity is 16,000 amperes (A) root mean square (rms) asymmetric.

Provide that heavy-duty or extra-heavy-duty classification cutouts. Ensure cutouts installed on three-phase, 13.2 kilovolt (kV) or 13.8 kV systems that are rated at 15 kV. The installation of cutouts rated at 7.8 kV on these systems is not allowed.

Provide fuse links with a continuous rating equal to approximately 150 percent of the full-load line current when used for transformer protection, and approximately 110 percent of the conductor-rated capacity when used for circuit protection. Ensure that the 15 kV cutout has a wet withstand, 10-second voltage rating of 37 kV, with a 95 kV basic impulse level (BIL). Provide a continuous current rating of 100 A unless otherwise indicated. Provide fuse disconnects rated not less than 100 amperes, having attachments to permit manual operation of the disconnect under load without external arcing.

Where indicated, combine lightning arresters and fuse cutouts.

PART 3 EXECUTION

3.1 INSTALLATION

Install distribution fuse cutouts in accordance with installation drawings and with the manufacturer's installation instructions.

-- End of Section --

ENVIRONMENTAL:

** REFER TO TYPICAL ENVIRONMENTAL DOCUMENTS PREPARED FOR ALL ECC PROJECTS. **