ATTACHMENT FF-2

March 25, 1993

To: SEED Engineers

Subject: Escalation Rate for Estimating

The current escalation rate for estimating future expenditures is 4.5%. This rate has been in effect since August, 1992. As in the past, a different escalation rate can be used if it can be documented by a purchase contract or other means.

Frank Kofron

Frank Kofron

cc: J. Castillo
D. J. Ziebell

FJK/ZPET-6764

Attachment FF-2

WORK SHEET NAME
ENGRMHR

ESTIMATING CECo. ENGINEERING MANHOURS AND COSTS
FOR TYPICAL PROJECTS

PER GO-25, ENGINEERING FOR SUBSTATION PROJECTS = ~~14%~~ 9%
OF TOTAL CONSTRUCTION MANHOURS

TOTAL LABOR DOLLARS SHOWN IN ESTIMATING BOOK INCLUDE
A 42% BURDEN FOR OAD, SUPERVISION AND TRANSPORTATION.

THEREFORE:

$$\frac{\text{TOTAL CONSTRUCTION DOLLARS}}{\text{CURRENT LABOR RATE}} \times \frac{.09}{1.42} = \text{ENGINEERING MANHOURS}$$

AS OF JULY 10, 1992, CONSTRUCTION LABOR RATE IS $35.15 per MANHOUR.
ENGINEERING LABOR RATE IS $38.50 per MANHOUR.

$$\frac{\text{TOTAL CONSTRUCTION \$} \times .063}{\$35.15} = \text{ENGINEERING MANHOURS}$$

$$\text{ENGINEERING MANHOURS} \times \$38.50 = \text{ENGINEERING COST}$$

[illegible] 5.5 man/[illegible]
[illegible] 2.25 man/[illegible]
[illegible] 3.0 man/[illegible]

ESCALATION MULTIPLIER 4.5% per year 0.045 9-24-91

1 year	1.0450
2 years	1.0920
3 years	1.1412
4 years	1.1925
5 years	1.2462
6 years	1.3023
7 years	1.3609
8. years	1.4221
9 years	1.4861
10 years	1.5530

WORK SHEET NAME
ENGRMHR

ESTIMATING DECo. ENGINEERING MANHOURS AND COSTS
FOR TYPICAL PROJECTS

PER ID-CE. ENGINEERING FOR SUBSTATION PROJECTS = 11%
OF TOTAL CONSTRUCTION MANHOURS

TOTAL LABOR DOLLARS SHOWN IN ESTIMATING BOOK INCLUDE
A 42% BURDEN FOR OAD, SUPERVISION AND TRANSPORTATION.

THEREFORE:

$$\frac{\text{TOTAL CONSTRUCTION DOLLARS}}{\text{CURRENT LABOR RATE}} \times \frac{.09}{1.42} = \text{ENGINEERING MANHOURS}$$

AS OF JULY 10, 1992, CONSTRUCTION LABOR RATE IS $35.15 per MANHOUR.
ENGINEERING LABOR RATE IS $38.50 per MANHOUR.

$$\frac{\text{TOTAL CONSTRUCTION \$} \times .063}{\$35.15} = \text{ENGINEERING MANHOURS}$$

ENGINEERING MANHOURS X $38.50 = ENGINEERING COST

CAI

February 5. 1987

To: E. F. Burns
G. Snell
D. P. Brown

G. E. Bogdan
J. P. Rossi
L. D. Gillette

Subject: UPDATED SUBSTATION UNIT STANDARDS CATALOG

Attached is a complete copy of the current Substation Unit Standards Catalog. This catalog contains the current performance values that are to be used to calculate manhours per unit for all substation work orders. effective 1/1/87.

If you have any questions. please call me on Extension 8351.

Eric

E. J. Ruthenberg
Division Operating Services

ER/ac

Attachment

cc: A. P. Ehardt
D. J. Frasher
J. B. Gunnell
J. P. Molitor
R. A. Schrage
W. J. Specha
B. E. Willemsen
A. Wroblewski

January 12, 1987

Substation Unit Standards Catalog

The Substation Unit Standards Catalog is issued by Division Operating Services, 38FNW.

The catalog is issued to the Substation TJM Coordinators in each Division, Station Mechanical Engineering, Station Electrical Engineering and T & D Construction.

Please refer all questions about this catalog to:

Substation Construction TJM Coordinator
Division Operating Services
Extension 8351

Substation Unit Standards Catalog

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January 12, 1987

SUBSTATION UNIT STANDARDS CATALOG

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SUBSTATION UNIT STANDARDS

(CODE 2) TRANSFORMERS

Reporting Unit is Per Each Item

Transformers (Oil and Askeral Filled)
Includes Pad-Mount Type

Note: Unit value for transformers includes bushings, radiators and fans not field mounted. Does not include lightning arresters and low side cable compartment.

Unit Standards

12 KV and 34 KV KVA	Single Phase Install	Single Phase Remove	Three Phase Install	Three Phase Remove
100 - 250	4.5	2.0	9.0	4.5
333 - 750	5.5	2.5	11.0	5.5
1,000 - 2,500	6.5	3.0	12.5	6.0
3,750 - 6,250			20.0	10.0
7,500 - 10,000			25.0	12.0
12,000 - 15,000			30.0	15.0

69 KV and 138 KV[1] KVA	Install	Remove	Install	Remove
7,500 - 10,000	80.0	40.0	162.0	80.0
12,000 - 20,000	112.0	60.0	225.0	112.0
33,000 - 40,000	140.0	70.0	300.0	150.0
45,000 - 60,000	180.0	90.0	395.0	198.0
65,000 - 80,000	225.0	110.0	485.0	243.0

345 KV and 765 KV	Install	Remove
300 MVA (per Three Phase Transformer)	648.0	405.0
333 MVA (per Single Phase Transformer)	648.0	405.0
500 MVA (per Single Phase Transformer) Unit Transformer	648.0	405.0

Phase Shifters

	Install	Remove
Phase Shifter, single tank mounting	648.0	405.0
Phase Shifter, two tank mounting	950.0	405.0

Transformers (Network Type)[1 & 2]

Oil, Askarel & Silicone Filled	Install	Remove
All Sizes	13.0	5.2

1 For installation or removal in buildings-multiply unit values by 1.5.
2 See vault slab on page 30

(CODE 2) TRANSFORMERS (Continued)

Network Protector

AMP	Install	Remove
800 - 1,600	7.5	4.5
1,800 - 2,250	12.0	7.0
2,500 - 3,000	16.0	10.0
3,500 - 3,900	25.0	16.0
Protector Housing (Field Assembled)	18.0	13.0
Balancing Transformer	27.0	7.1
Network Fuse Mounts	4.5	2.0
Network Fuse Mount Cover	3.0	1.5

Portable Transformers

Portable Transformers - Includes fence and cables, installation & removal.

34Kv	30 units
138Kv - 20 MVA	75 units
- 40 MVA	125 units

Transformers (Dry Type) & Station Light and Power*

Unit Standards

KVA	Single Phase Install	Single Phase Remove	Three Phase Install	Three Phase Remove
5 - 25	2.5	1.0	3.0	1.0
35 - 100	3.0	1.5	3.5	1.5
150 - 250	4.0	1.5	5.0	1.5
300 - 500	9.0	2.5	11.0	2.5
750 - 1,000	10.0	3.0	13.0	3.0
1,500 - 2,000	11.0	3.5	15.0	5.0
2,500 - and larger	13.0	5.0	20.0	6.5

*For installations or removals in buildings - multiply unit values by 1.5.

Thermal Shorting Device (Field Installed)

	Install	Remove
Single Phase	1.0	.50
Three Phase	1.5	.50

(CODE 2) TRANSFORMERS (Continued)

Transformer Fans (Field Mounted)	Unit Standards Install	Remove
Per fan	.9	.2

Transclosure Housing for Transformer (Per Unit)	Install	Remove
Unit/Bay/Cubicle	3.5	1.5

Low Side Cable Compartment	Install	Remove
Cable Compartment-Low Side	7.0	3.5

(CODE 3) REGULATORS

Reporting Unit is Per Each Item

	Unit Standards					
	Single Phase			Three Phase		
KVA	Install	Remove	Replace	Install	Remove	Replace
24 - 36	9.0	2.0	9.0			
37 - 50	10.0	2.5	10.0			
51 - 96	13.0	3.0	13.0			
97 - 167	16.5	4.0	16.5			
168 - 375				25.0	7.5	25.0
376 - 1,000				27.5	10.0	27.5

(CODE 4) CIRCUIT BREAKERS

Reporting Unit is Per Each Item

Unit Standards

Oil- KV	Single Phase Install	Single Phase Remove	Three Phase Install	Three Phase Remove
4	8.0	5.0	20.0	10.0
12	10.5	5.5	21.0	10.5
34	21.0	10.5	42.0	21.0
69	25.0	12.5	72.0	19.0
138	59.0	30.0	118.0	60.0
345	287.5	142.5	575.0	285.0

Air (see notes:*) KV	Install	Remove	Install	Remove
.6	2.0	1.0	3.5	1.5
4	3.5	2.0	7.0	3.5
12	4.5	2.5	9.0	4.5
34	9.0	4.5	18.0	9.0

Air Blast and SF[6] KV	Install	Remove
12		
34	21	
138		
345	287.5	144.0
765	425.0	212.5

Recloser. Oil-Vacuum (Includes Frame)

KV	Install	Remove	Replace	Install	Remove	Replace
4	8.0	2.0	8.0	16.0	4.0	16.0
12	10.0	2.5	10.0	20.0	5.0	20.0
34	16.0	5.0	16.0	32.0	10.0	32.0

CIRCUIT SWITCHES KV	Install	Remove
34	7.0	3.5
138 (Per Phase)	18.0	9.0
Motor Operators	16.0	8.0

*Air circuit breakers which are a component part of the switchgear are shown on Page 6.

(CODE 6) SWITCHGEAR AND SWITCHING DEVICES

Reporting Unit is Per Each Item

Metal Clad/Metal Enclosed Switchgear	Unit Standards Install	Remove
ESS Station - Trans. Loc. - CTLY - Switchgear		
Four bay group or less including control bay	10.0	5.0
Additional manual bay (per bay on new construction)	3.5	2.0
Additional control bay (per bay on new construction)	5.0	2.5
Addition to existing switchgear (per bay)	15.0	5.0

TSS - TDC - DC Switchgear Per Bay	Install	Remove
Addition to existing switchgear	24.0	8.0
Additional bay (new construction)	15.0	5.0
Shelter or aisle switchgear (additional per bay)	4.0	2.0

Air Circuit Breakers (Component Part of Switchgear) KV	Install	Remove
.6	3.5	1.5
4	4.5	2.0
12	6.0	3.0
34	18.0	9.0

Wall Mounted Bays (Metal Clad) Minirupter	Install	Remove
Per Unit	22.0	9.0

Wall Mounted Cabinets (Benelex type material) Type	Install	Remove
All	12.0	6.0

Sectionalizer (Padmount type)	Install	Remove
Single Phase	3.0	1.0
Three Phase	5.0	2.5

Bifurcating Cabinet*	Install	Remove
Bifurcating Cabinet	10.0	5.0

*Foundation not included

(CODE 7) CURRENT LIMITING EQUIPMENT

Reporting Unit is Per Each Item

	Unit Standards	
	Install	Remove
Arrester		
KVA		
4 and under	1.0	.2
12	1.0	.3
34	1.5	.5
69	2.0	1.0
138	2.5	1.5
345	3.5	2.5
765	5.0	3.5
Inductor		
Dry		
Single Phase	7.5	2.5
Three Phase (Stacked)	23.0	7.5
Neutral Inductor	7.5	2.5
Transformer Neutral Inductor Switch Enclosure	9.0	3.0
138 KV Oil-Filled Inductor - Single Phase	275.0	150.0
138 KV Oil-Filled Inductor - Three Phase	325.0	160.0
765 KV Oil-Filled Inductor - Single Phase	648.0	405.0
Resistor		
Neutral 4/12 KV	36.0	13.0
Capacitor		
KVAR		
225 - 1,800 12 KV Sw. Assembly (C8254)	10.5	5.5
2,100 12 KV Sw. Assembly (C8254)	17.5	8.0
6,000 12 KV Met. Encl. (EM22004)	32.0	12.0
6,000 12 KV Op. Rack (EM22002)	30.0	10.0
14,400 34 KV Op. Rack (EM22001)	34.5	11.5
18,000 34 KV Op. Rack (EM22003)	40.5	13.5
Individual cell added to or removed from a rack (each)	.5	.5

(CODE 8) SWITCHBOARD, CONTROL & COMMUNICATION

Reporting Unit is Per Each Item

		Unit Standards Install	Unit Standards Remove
Relay - Includes drilling, sawing, mounting and installing			
All Aux. Relays - Surface mounted like Eagle, Clare/Telephone/ Amphenal Socket /Socket (HMA) used with Reed relay/ Wilmar relay/Durakool (includes accessory fitting)/Adlake	(each)	2.5	1.5
All other Relays	(each)	6.0	3.0
Relay Panels			
Solid state phase comparison relay panel (1' x 19" x 30")		9.0	3.0
Meter			
Ammeter, recording or indicating		5.0	1.0
Ammeter, thermal		5.0	1.0
Voltmeter, recording or indicating		5.0	1.0
Other meters		5.0	1.0
Reactive Volt/Varmeter		5.0	1.0
Watt-hour		5.5	1.0
Wattmeter - Varmeter (totalizer)		9.0	1.5
Signal Device			
Annunciator, 4 to 20 points, for each additional point, add .2		14.5	4.5
Horn or bell		2.5	.5
Indicating lamp receptacle (EM 12305)		.5	.2

(CODE B) SWITCHBOARD, CONTROL AND COMMUNICATION
(continued)

	Unit Standards Install	Remove
Switchboard - Panel - Cabinet		
A.C. Lighting Distribution Panel	9.0	2.0
Alarm Panel	9.0	2.0
Auto Transfer Cabinet	27.0	12.0
Control Switchboard	36.0	9.0
Data Acquistion Panel (control type-remote) For additional point, add .2	36.0	9.0
D.C. Distribution Panel Board	9.0	2.0
Differential Relay Cabinet	9.0	2.0
Economic Generator Control (E.G.C.)	36.0	9.0
Main A.C. Power Panel Board	15.0	5.0
Motor Control Center (includes cabinet)		
Number of breakers - 16	30.0	15.0
25	33.0	18.0
30	36.0	18.0
Auxiliary Steel Panel	18.0	5.0
Relay Panel, Hinged, Steel (Approx. 26" x 21" x 12")	9.0	2.0
Primary Metering Cabinet (Approx. 42" x 52" x 48") includes (3) 12 KV Cts and meter sockets	9.0	2.0
Telemetering Panel	36.0	9.0
Bonding Switch Cabinet	5.0	2.0
Recording Ammeter Cabinet (EM 11234)	9.0	2.0
Relay Switchboard Relay Panel	36.0	9.0
Scada RTU Data Processing Cabinet:		
one bay remote	40.0	10.0
two bay remote	50.0	12.5
three bay remote	60.0	15.0
Transformer Overload Relay Cabinet (tor)	9.0	2.0
Transformer Paralleling Cabinet	9.0	2.0
Generator Control Console (3' x 2' x 4')	18.0	5.0
Underfrequency Cabinet	9.0	2.0
SUPERVISORY-		
Master Station		
One cabinet with the capacity of four sets. Cabinet and twenty points - each additional point, add .2	10.0	4.0
Remote Station with swinging rack		
One cabinet with capacity of up to forty points. Cabinet and twenty points - each additional point, add .2	18.0	8.0
Interposing Relays	2.5	1.5

(CODE 8) SWITCHBOARD, CONTROL AND COMMUNICATION
(continued)

Notes: Western Electric Corp., Visacode, Radac and Harris Control Supervisory sets are all alike.

Master set requires - one communication cable
one A.C. cable
one D.C. cable

Remote set requires - one cable for each point installed
one communication cable
one A.C. Cable
One D.C. Cable

All supervisory sets are floor mounted

Reporting Unit is Per Each Item Special Instrument and Device	Unit Standards Install	Remove
Frequency Indicator	9.0	2.0
Oscillograph with Cabinet	36.0	9.0
Oscillograph only (Replacement)	9.0	2.0
Power Factor Indicator	9.0	2.0
Speed Indicator	9.0	2.0
Synchroscopes	9.0	2.0

Load Control Equipment	Unit Standards Install	Remove
Amplifier	6.0	2.0
Impulse Converter	6.0	2.0
Indicating Control	6.0	2.0
Power Supply	6.0	2.0
Watt Var/Transducer	2.0	1.0
Telephone Printer	4.5	1.0
Totalizer Control	9.0	3.0
Transmitter	13.5	4.5
Voltage Regulating Biasing Cabinet	9.0	3.0

Carrier Current Equipment	Unit Standards Install	Remove
Amplifier Unit (T.T. XMTR.)	3.5	1.5
Aux. Equipment Panel (Control Panel)	3.5	1.5
Carrier Current Alarm Bell	1.5	.5
DC Switch and Fuse Panel Unit	3.5	1.5
Hybrid Unit	3.5	1.5
Initiator Respond.Check Back Device	3.5	1.5
Line Tuner	3.5	1.5
Modulator Unit	3.5	1.5
Power Supply Unit	3.5	1.5
RCVR Unit	3.5	1.5
Swinging Rack Cabinet with Components	40.0	16.0
Wave Trap	22.0	11.0
XMTR/RCVR Unit	3.5	1.5

(CODE 8) SWITCHBOARD, CONTROL AND COMMUNICATION
(continued)

Audio-Tone Equipment	Unit Standards Install	Remove
Aux. Equipment Panel Unit	3.5	1.5
D.C. Switch & Fuse Panel Unit	3.5	1.5
Initiat.or Respond.Check Back Device	3.5	1.5
Modules (T.T. or D.C.R.)	3.5	1.5
Swinging Rack Cabinet with Components	40.0	16.0
Telephone Cabinet (large)	18.0	9.0
Fiber Optic Modem	.5	.2

Microwave Equipment	Unit Standards Install	Remove
8 ft. Equipment Rack	1.0	.5
4 ft. x 8 ft. Plywood for Demarcation Cabinets	1.5	.5
Wave Guide (per ft.)	.1	.1
Wave Guide Connector	1.0	.5
Wave Guide Ice Shield (per ft.)	1.0	.5

Miscellaneous	Unit Standards Install	Remove
Alarm Panel (all EM 47000 Series)	9.0	2.0
Avalanche Diode	.1	.1
Circuit Breaker (100 Amp. & Under)	1.0	.5
Circuit Breaker (over 100 Amps. to 400 Amps.)	2.0	.5
Circuit Breaker (over 400 Amps. to 600 Amps.)	3.0	1.0
Contact Making Clock	4.5	1.0
Contact Making Voltmeter	4.5	1.0
Control Switch (SBM type switch)	2.5	1.0
Current Shorting Swtich	1.5	1.0
Flexitest Switch	5.0	2.5
Fuse Block/Base	1.5	1.0
Line Drop Compensator	4.5	1.0
Motor Starter	5.5	1.0
Phasing Transformer 120 V	4.5	1.0
Push Button Station	1.0	.5
Resistor, Instrument (3600 OHM or less)	.5	.2
Resistor, Instrument (over 3600 OHM)	.8	.3
Rheostat, Potentiometer	.5	.2
Switch, test	1.5	1.0
Switch, toggle	.5	.2
Switch, knife (under 60 Amps.)	1.0	.5
Switch, knife (60 Amps. or over)	1.5	1.0
Switch, Relay "WL"	3.0	2.0
Terminal Block	1.5	1.0
Thermal Converter	5.5	2.0

(CODE 9) INSTRUMENT TRANSFORMER

Reporting Unit is Per Each Item

1. Current Transformer
2. Potential Transformer
3. Coupling Capacitor & Bushing
4. Potential Device
5. Cascade Potential Device
6. Bushing Potential Device

KV	Unit Standards Install	Unit Standards Remove
.6 (switchboard type)	2.0	1.0
4	4.0	1.5
12	4.5	1.5
34	9.0	3.0
69	10.0	3.5
138	13.5	4.5
345	17.0	6.5
765	30.0	15.0
Bushing Potential Device	8.0	4.0
Pole Mounted Primary Metering Cluster (includes Pots and Cts)	4.0	2.0

Note: Construction units are not applied when item is integral with other equipment: as in switchgear, power transformers, circuit breakers, etc.

(CODE 11) DISCONNECT SWITCH

Reporting Unit is Per Each Item

Switches (unit value per phase) KV -	Unit Standards Install	Unit Standards Remove
Under 12	1.5	.5
12	2.5	.5
34	5.0	1.0
69	10.0	5.0
138	14.5	7.0
345	29.0	14.5
765	50.0	25.0
Gas blast equipment (138/345 KV) 3 phase unit EM 16006	50.0	20.0
Hand-operated control	4.5	2.0
Motor-operated control	14.0	7.0

Fuse Mounts/Cutouts (unit value per phase) KV		
Under 12	1.5	.5
12	2.0	.5
34	4.0	1.0
69	6.0	2.5
138	8.0	3.0

Live Parts (unit per phase)		
All voltages (C 9876)	1.0	.5

(CODE 12) CONTROL/POWER CABLE, CONNECTIONS, BUS WORK

Reporting Unit is per Each Item Unless Otherwise Noted

Bus Support/Insulator/Strain KV		Unit Standards Install	Remove
4		.5	.2
12		.7	.2
34 (per stack)		1.0	.5
69 (per stack)		1.5	1.0
138 (per stack)		2.0	1.5
345 (per stack)		3.0	2.0
765 (per stack)		4.5	3.5
Lug/Connector Straight/Tee (compression type) (Smaller than 1/0 included with cable units)			
Bar taps/crimpets/ampacts		.1	-
1/0 - 500 MCM		.2	-
636 - 1,000 MCM		.4	-
1,113 - 2,338 MCM		.8	-
Bus Limiter		3.0	1.5
Cable/line limiter		.5	-
Rod, Ground		.5	-
Grid, Ground (EM 24150/1)		3.5	-
Attachment, Ground (C 750/1)		1.0	.5
Bus, Bare Copper (See Page 19 for Weights)			
Bar (unit value per pound)		.20	.10
Rod and tube (unit value per pound)		.30	.20
See attached sheets and for copper info			
Bus, Aluminum Tube (unit value per foot)			
1" to 2"		.40	.10
2 1/2" to 3 1/2"		.50	.10
4" to 5"		.60	.10
5 1/2" to 6"		.70	.10
Welded fittings (per weld)		1.0	-
Bus, Aluminum Angle (per foot)		.40	.10
Premolded Bus (C1660) (per phase)		1.5	1.0
Bus Support Expansion Coupler (Bolted)			
All sizes	each	.9	.5

(CODE 12) CONTROL/POWER CABLE, CONNECTIONS, BUS WORK
(continued)

	Unit Standards Install	Remove
Difficulty Factor (Install & Remove)	1.5 times cable units	
High Rise (Vertical Installations)	1.3 times cable units	
Generating Stations (Larger than 4/0 in Main Building Only)	1.5 times cable units	
Lead Covered Power Cables in Substations	.01	.01
Cable Pan Covers (per foot)		

Cable Reporting Unit is Per Each Foot Types of Cable	Install	Remove
Cable, Control		
One conductor	.02	.01
Multi Conductor	.03	.02
Cable, Power		
1/C 250 KCMIL & Smaller		
600 volt	.03	.02
12KV	.05	.03
1/C 266 KCMIL - 1000 KCMIL		
600 volt	.05	.03
12KV	.07	.05
34KV	.08	.06
1/C 1113 KCMIL thru 2000 KCMIL		
12KV	.10	.07
34KV	.12	.08
1/C Larger than 2000 KCMIL		
12KV	.12	.08
M/C 250 KCMIL & Smaller		
600 volt	.04	.03
12KV	.05	.03
M/C 266 KCMIL thru 1000 KCMIL		
600 volt	.07	.05
12KV	.10	.07
Cable, Bare/WR/Lead Clad		
1/C 250 KCMIL & smaller	.03	.02
1/C 260 KCMIL - 1000 KCMIL	.07	.03
1/C 1113 KCMIL thru 2000 KCMIL	.10	.05
Larger than 2000 KCMIL	.12	.06

(CODE 12) CONTROL/POWER CABLE, CONNECTIONS, BUS WORK (continued)

Cable Joints

	Unit Standards		
	Install	Remove	Break
Straight			
1/C thru 500 KCMIL			
4KV and 12KV non lead (each)	1.0	0.0	0.0
4KV and 12KV lead covered (each)	3.5	.75	1.0
1/C over 500 KCMIL			
4KV and 12KV non lead (each)	2.0	0.0	0.0
4KV and 12KV lead covered (each)	4.0	.75	1.2
M/C thru 500 KCMIL			
4KV and 12KV (each)	10.0	1.9	2.5
M/C over 500 KCMIL			
4KV and 12KV (each)	10.8	1.9	2.7
Trifurcating Joint			
Straight Thru 500 4KV and 12KV (each)	10.2	1.9	2.6
Over 500 4KV and 12KV (each)	11.0	1.9	2.8
WYE (Y) Thru 500 4KV and 12KV (each)	14.1	1.9	4.2
Over 500 4KV and 12KV (each)	15.2	1.9	4.5
Cable End Cap (insulated)			
1/C 4KV and 12KV	2.5	.75	1.0
M/C 4KV and 12KV	5.0	1.9	2.5
WYE (Y) Joint			
1/C 1/0 thru 500 KCMIL 4KV and 12KV non lead (each)	2.0	0.0	0.0
4KV and 12KV lead (each)	4.0	.75	1.2

(CODE 12) CONTROL/POWER CABLE, CONNECTIONS, BUS WORK
(continued)

WYE (Y) Joint	Unit Standards Install	Remove	Break
1/C Over 500 KCMIL			
4KV and 12KV non lead (each)	2.0	0.0	0.0
4KV and 12KV lead (each)	4.5	.75	1.4
M/C 1/0 thru 500 KCMIL			
4KV and 12KV lead (each)	12.8	1.9	3.7
M/C over 500 KCMIL			
4KV and 12KV lead (each)	13.8	1.9	4.0
Prefab Termination			
Under 500 KCMIL			
4KV and 12KV (each)	1.0	0.0	0.0
Over 500 KCMIL			
4KV and 12KV (each)	1.2	0.0	0.0
Elbow Termination	1.0	0.0	0.0
Pothead Under 34.5 KV			
Single conductor (each)	1.5	.75	0.0
Three conductor (each)	11.5	5.6	0.0

	Unit Standards Install	Remove
Switching Table		
M/C	0.0	3.0
Oil Reservoir (transformer oil - 7.5 lbs. per gal.)		
3 gal.	3.5	1.5
10 gal.	7.0	3.5
Over 10 gal.	9.0	4.5
Epoxy Resin Splice Kit (C 967)	.50	-
Load Break Cable Tap	.7	.2
Elbow Rack-Aluminum		
Single phase (C1687)	1.50	.80
Three phase (C1687)	3.0	1.50

(CODE 12) CONTROL/POWER CABLE, CONNECTIONS, BUS WORK
(continued)

		Unit Standards Install	Remove
Direct Bury Cable			
Trench and backfill	(per trench foot)	.03	-
Sand and Planking	(per trench foot)	.04	-
Hand Dig	(per trench foot)	.20	-
Trench, Ground Cable			
Trench and backfill	(per trench foot)	.03	-
Hand Dig	(per trench foot)	.10	
Miscellaneous			
Alarm, Station Entry	(each)	2.0	1.0
Cable Clamp (C5047)	(each)	.3	.0
Contactor (for heater/fan)	(each)	2.0	.5
Fan, Exhaust	(each)	2.5	.5
Fan, Vent	(each)	2.5	.5
Heater, 15KW or less	(each)	2.5	.5
Light Fixture, Indoor	(each)	1.0	.5
Outlet Receptacle	(each)	.5	.2
Safety Switch, Indoor (100A and under)	(each)	2.0	.5
Safety Switch, Indoor (101-400A)	(each)	3.5	.5
Safety Switch, Indoor (401-600A)	(each)	5.0	.8
Switch, Micro	(each)	2.0	1.0
Terminal Block Cabinet	(each)	2.0	1.0
Thermostat	(each)	2.0	.5
Time Switch, for Yard Lights	(each)	2.0	.5
Toggle Switch	(each)	.5	.2

INFORMATION SHEET

(See Page 14 For Unit Values)

COPPER THREADLESS PIPE
COPPER NO. 122
HARD DRAWN
In 20-foot Lengths

Standard Pipe Size Inches	Weight Lbs. per Lin. Ft. (Approx.)	Standard Pipe Size Inches	Weight Lbs. per Lin. Ft. (Approx.)
1/4	.376	2	1.83
3/8	.483	2 1/2	2.22
1/2	.613	3	3.45
3/4	.780	3 1/2	4.52
1	.989	4	5.72
1 1/4	1.26	5	8.73
1 1/2	1.45	6	12.40

Sizes other than listed can be furnished from Mill stocks.

WEIGHT OF BAR COPPER PER FT.

Width	Thickness 1/8"	1/4"	3/8"	1/2"
1/2"	.247	.485		
1"	.49	.97		
1 1/2"	.97	1.445		
2"		1.94	2.91	3.88
3"		2.91	4.37	5.83
4"		3.88	5.83	7.77
5"		4.85	7.27	9.70
6"		5.83	8.75	11.66
8"		7.77	11.66	15.55

To determine weight. use the following Formula for Copper Bus Bar:

Length in ft. X width/12 X thickness/12 X 560 = lbs of copper

WEIGHT OF COPPER ROD PER FT.

Diameter

1/4" - .1278 lbs. per ft.		3/8" - .426 lbs. per ft.	
1/2" - .75 lbs. per ft.			
5/8" - 1.18 lbs. per ft.			
3/4" - 1.7 lbs. per ft.		7/8" - 2.32 lbs. per ft.	
1" - 3.0 lbs. per ft.			
1 1/4" - 4.7 lbs. per ft.			
1 1/2" - 6.81 lbs. per ft.			

(CODE 14) CONDUIT AND PIPING

Reporting Unit is Per Foot Unless Otherwise Noted

Conduit, "Rigid" (Above Ground Conduit)	Unit Standards Install	Remove
1/2" to 1"	.10	.05
1 1/4" to 2"	.20	.05
2 1/2" to 3 1/2"	.30	.05
4" to 5"	.40	.07
5 1/2" to 6"	.50	.10

Conduit, Thinwall, Aluminum, Flexible, Plastic Pipe (Above Ground Conduit)

2" and Under	.10	.04
Over 2"	.20	.04

Note: Units Include Fittings, Supports, Threading, and Offsets

Conduit/Duct/Trough

Concrete Trough - All Sizes - Per Section) (Average Length 5 to 6 Feet)	1.8	.10
Control Wire Duct Wireway (Per Foot)	.20	.10
Cable Pan/Tray (Per Foot)	.14	.07
Cable Pan Covers (Per Foot)	.01	.01
Remove and Reset Concrete Covers for Cement Troughs (Per Cover) each	.20	.20

Note: Trenching, Backfill, Encasing in Concrete - SEE INFORMATION PAGES 20 and 21.

Fire Proof Fittings (EYS Bodies)

2" and under	.30	.30
Over 2"	.50	.50

Plastic - Steel (Direct Bury Duct Only)

2" and under (per foot)	.07	.04
2 1/2" and over (per foot)	.09	.04

Manufactured Bends	Unit Standards Install	Remove
2" and Under	.5	.2
Over 2"	1.0	.5

Pull/Junction Boxes - All Sizes

Jct. Box 12" x 12"	(each)	2.0	1.0
Jct. Box (over 12")	(each)	3.0	1.0

Planking

2" x 10" Treated Plank	(per foot)	.05	.02

(Units for Cable Pit/Box Only) (See pg. 18 for Sand & Planking)

EXCAVATION

(Includes Excavating, Shoring, Backfill, Removing Excess Dirt)
Figured in Number of Trench Feet

Duct Sections	Install
1 - 4	.08
6 - 9	.10
10 - 12	.15
13 - 15	.18

Setting Duct in Place (Per Foot)

Duct	Steel	Precast	Plastic
1 - 4	.12	.09	.08
6 - 9	.24	.10	.17
10 - 12	.32	.17	.23
13 - 15	.37	.21	.26

Concrete Encasement of Conduit (Per Trench Foot)

1 - 4	.04
6 - 9	.06
10 - 12	.08
13 - 15	.10

Example: Three Steel Conduits, Encased in Concrete
10 Feet long.

Trenching	.08 X 10 Feet
Setting	.12 X 10 Feet
Concrete	.04 X 10 Feet
TOTAL UNITS	.24

Miscellaneous

Seismic Bracket (Nuc. Sta.)	(Per lb.) (See Pg. 22)	.1	.01
Cable Bracket Support	(each)	.5	.15
Core Drilling (3" diameter or less)	(per ft.)	2.0	-
Core Drilling (over 3" diameter)	(per ft.)	3.0	-
Manhole Ladder	(each)	1.0	.5
Oil Sensing Unit (connects to sump pump)	(each)	3.0	1.0
Outlet Receptacle	(each)	.5	.2
Pump, Sump	(each)	2.5	.5
Unistrut	(per ft.)	.27	.10

WEIGHT OF STEEL - SEISMIC BRACKETS

PLATE STEEL

1/4" 4' X 8' = 327# - 10.2# Per Sq. Ft.
3/8" 4' X 8' = 490# - 15.3# Per Sq. Ft.
1/2" 4' X 8' = 653# - 20.4# Per Sq. Ft.
5/8" 4' X 8' = 817# - 25.5# Per Sq. Ft.
3/4" 4' X 8' = 980# - 30.6# Per Sq. Ft.
1" 4' X 8' = 1307# - 40.8# Per Sq. Ft.

TUBE STEEL

2" x 2" X 1/4" - 5.4# Per Ft.
3" X 3" X 1/4" - 8.8# Per Ft.
4" X 2" X 5/16" - 8.9# Per Ft.
4" X 4" X 3/8" - 17.3# Per Ft.
5" X 5" X 3/8" - 22.4# Per Ft.
6" X 4" X 3/8" - 22.4# Per Ft.
8" X 4" X 3/8" - 27.5# Per Ft.
5" X 3" X 3/8" - 17.3# Per Ft.

BAR STEEL

3" x 1/4" - 2.5# Per Ft.
4" X 1/4" - 3.4# Per Ft.
2" X 1/2" - 3.4# Per Ft.
4" X 1/2" - 6.8# Per Ft.

ANGLE IRON

2" X 2" X 1/4" - 3.2# Per Ft.
2" X 3" X 1/4" - 4.1# Per Ft.
2 1/2" X 2 1/2" X 1/4" - 4.1# Per Ft.
3" X 3" X 1/4" - 4.9# Per Ft.

(CODE 15) OUTDOOR STRUCTURE

Reporting Unit is as Specified

ALL BUS AND SWITCH STRUCTURE UNITS - Per Pound

Bus and Switch Structure		Unit Standards Install	Unit Standards Remove
All Structures	(per lb.)*	.01	.01
Static or Lighting Pole (40 ft. min.)	(each)	10.0	10.0

*See Page 24 of Code 15 for Additional Information.

Steel and Structure Distribution Guide
(Unit For Steel Only)

S. I. Number	C. Spec	Weight (lbs.)	Unit Standards Install	Unit Standards Remove
332858	9871.1	1300	13.0	9.7
332859	9871.2	1300	13.0	9.7
332863	9870.1	2500	25.0	18.7
332864	9870.2	3500	35.0	26.2
332875	9870.3	3750	37.5	28.1
332995	9870.3	3750	37.5	28.1
332887	9872.1	2300	23.0	17.2
332999	9872.2	3300	33.0	24.7

Wood Structure Pole		Unit Standards Install	Unit Standards Remove
25 to 40 ft.	(each)	3.5	2.1
45 to 55 ft.	(each)	4.2	2.6
60 to 75 ft.	(each)	6.0	3.5
Anchor	(each)	1.2	.2
Anchor (Guy)	(each)	1.0	.2
Arm - Cross	(each) (includes heavy duty arms)	.70	.35
Alley	(each)	.70	.35
Heavy timber	(each)	1.5	.7

Miscellaneous

Cabinet, spare fuse	(each)	.5	.25
Light Fixture, outdoor	(each)	1.8	.9
Pipe/Angle Iron Frame Work	(per ft.)	.25	.05
Safety Switch, outdoor-100 AMPS and under	(each)	1.8	.5
Safety Switch, outdoor-101 AMPS-400 AMPS	(each)	3.5	.5
Safety Swtich, outdoor-401 AMPS-600 AMPS	(each)	5.0	.8

MISCELLANEOUS STEEL STRUCTURE WEIGHTS - GUIDE

	Structure		Weight (lbs.)
138KV	Circuit Switcher High Stand	11'6" Phase Spacing	5,210
		8'0" " "	4,600
138KV	Circuit Switcher Low Stand	11'6" Phase Spacing	4,213
		8'0" " "	3,784
138KV	Disc. Switch High Stand	11'6" Phase Spacing	3,000
		8'0" " "	2,702
138KV	Disc. Switch Low Stand	11'6" Phase Spacing	2,500
		8'0" " "	2,278
138KV	Bus Support High Stand	11'6" Phase Spacing	1,603
		8'0" " "	1,447
138KV	Bus Support Low Stand	11'6" Phase Spacing	1,400
		8'0" " "	1,244
138KV	Single Phase Potential Device Str.		965
138KV	Single Phase Inductor Str.		2,585
	Three Phase Inductor Str.		8,144
138KV	Wave Trap Support Beam (each)		600
138KV	Dead End Tower	50'-55' Conductor Height	37,200
		70'-75' " "	52,800
345KV	Disc. Switch High Stand	14'0" Phase Spacing	4,750
	Low Stand	" " "	3,000
345KV	Bus Support High Stand	14'0" Phase Spacing	3,050
	Low Stand	" " "	1,730
345KV	Single Phase Potential Device Str.		1,25
345KV	Dead End Tower	50'-55' Conductor Height	41,000
		70'-75' " "	56,50
345KV	Oil Circuit Breaker Steel Plate	18" x 18" x 3/4"	7
	6" "I" Beam (per foot)		1

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(CODE 17) FOUNDATION AND YARD WORK

SPEC. #			UNITS
C-237		IBT Transf. Foundation	15.0
C-240		138 KV OCB Foundation	135.0
C-241		34.5 KV OCB Foundation 1 Ø	46.0
C-241		34.5 KV OCB Foundation 3 Ø	48.0
C-242		14.5 KV OCB Foundation	45.0
C-245		14.4 KV Recloser Foundation	45.0
C-247		40 or 60 MVA Trans. Foundation	266.0
C-250		Standard Lighting Foundation	5.0
C-270	Pg. 1	345 Bus Support w/Footing	35.0
C-270	Pg. 1	345 Bus Support w/Cylinders	18.0
C-270	Pg. 2	345 3 Ø Bus Support w/Footing	51.0
C-270	Pg. 2	345 3 Ø Bus Support w/Cylinders	25.0
C-270	Pg. 3	345 3 Ø Bus Support w/Footings	51.0
C-270	Pg. 3	345 3 Ø Bus Support w/ Cylinders	25.0
C-270	Pg. 4	345 Disconnect Fdn. w/Footings	90.0
C-270	Pg. 4	345 Disconnect Fdn. w/Cylinders	40.0
C-270	Pg. 5	345 CCPD Fdn. w/Footings	36.0
C-270	Pg. 5	345 CCPD Fdn. w/Cylinders	20.0
C-275	Pg. 1	138 1 Ø Bus Support w/Footings	36.0
C-275	Pg. 1	138 1 Ø Bus Support w/Cylinders	20.0
C-275	Pg. 2	138 Structure Fdn. w/Footings	51.0
C-275	Pg. 2	138 Structure Fdn. w/Cylinders	25.0
C-275	Pg. 3	138 Structure Fdn. w/Footings	90.0
C-275	Pg. 3	138 Structure Fdn. w/Cylinders	40.0
C-275	Pg. 4	138 CCVT Structure Fdn. w/Footings	36.0
C-275	Pg. 4	138 CCVT Structure Fdn. w/Cylinders	20.0
C-5302	Pg. 3	Poured Sectionalizer Foundation	45.0
C-5302	Pg. 4	Poured Sectionalizer Foundation	45.0
C-5302	Pg. 6	Poured Sectionalizer Foundation	45.0
C-5302	Pg. 5	Precast Sectionalizer Foundation	16.5
C-5315	Pg. 1	Outdoor Structure Fdn.	8.0
C-5315	Pg. 2	Metalclad Switchgear Fdn.	57.0
C-5315	Pg. 3	Outdoor Structures & Trans.	42.0
C-5315	Pg. 4	Power Transformer Fdn.	51.0
C-5315	Pg. 5	Steel Pole Foundations	20.0

(CODE 17) FOUNDATION AND YARD WORK
(continued)

SPEC. #			UNITS
C-5315	Pg. 6	12.5 KV Recloser Fdn.	23.0
C-5315	Pg. 7	12.5 KV Recloser (Precast) Fdn.	7.0
C-6430	Pg. 1	Pipe Cable Piers - Cylinder	32.0
C-8089	Pg. 1	Trans. Fdns. 100-7500 KVA	42.0
C-8089	Pg. 2	Trans. Fdn. 500-7500 KVA	93.0
C-8201	Pg. 1	34 KV Trans. Fdn. (Precast)	8.0
C-8201	Pg. 2	Metal Clad Switchgear Fdn.	57.0
C-8201	Pg. 3	Power Transformers (Poured)	42.0
C-8201	Pg. 5	Recloser Foundation	23.0
C-9874	Pg. 2	Cable Riser Foundation	42.0
		765 KV Trans. Footing (Per Ø)	357.0
		765 KV Trans. Fdn. (Per Ø)	200.0
		765 KV Retaining Wall (Per Ø)	250.0
		765 KV Caissons 8' and under	26.0
		765 KV Caissons 8 1/2' to 10'	30.0
		765 KV Caissons Over 10'	33.0
		765 KV Foundations (Fdn. U)	38.0
		765 KV Foundations (Fdn. W)	54.0
		765 KV Circuit Breaker Fdn.	204.0
C-5302	Pg. 5	Sectionalizer Cab. (Precast)	6.4
		Roadway Crossing Trough (25') 3.36/'	84.0
		A.B. Chance Screw Anchors	2.0
		Bifurcating Cab. Base	10.0
		12 KV Capacitor (No Piers)	47.0

Reporting Unit is as Specified

		Unit Standards Install	Remove
Miscellaneous			
Break Concrete	(cubic ft.)	-	.5
Circular Concrete Base	(each)	.8	.5
Extension Base	(each)	.3	.1
Concrete Slab (EM14920)	(each)	.5	.4
Precast Transformer Pad	(each)	1.0	.5
Spreading Yard Gravel:			
Hand Spread	(per cu. yard)	1.2	-
Machine Spread	(per cu. yard)	.15	-
Loading & Handling Rubble	(cubic ft.)	-	.05

Note: Pea gravel or bank run sand - approx. 3,000 lbs. per cu. yard.
Crushed stone, lime #8 - approx. 2,800 lbs. per cu. yard.

		Install	Remove
Foundations			
Sectionalizer Bifurcating Cabinet		7.0	1.0
Brick Work			
Install or Remove Brick Work	(cubic ft.)	2.0	.1

(CODE 18) STORAGE BATTERIES AND CHARGING SETS

Reporting Unit is Per Case - See sample below

Storage Battery	Unit Standards Install	Remove	"C" Time
200 AMP Hours or Less			
One to eight cases	8 .5	.3	.7
Nine to twenty cases	12 .3	.2	.50
Twenty-one to sixty cases	38 .1	.10	.2
Over 200 Hours			
One to eight cases	1.0	.8	1.6
Nine to twenty cases	.8	.50	1.1
Twenty-one to sixty cases	.5	.5	.9
Battery Charger (each)	7.0	2.5	.7
Under 12 AMP	4.0	2.0	
12 AMP & over	7.0	3.0	
Battery Rack (each)	3.5	1.5	
Positive or Negative Disconnect Cabinet	2.5	1.5	

Note:

A 0 to 200 AMP hour battery has more than one cell to a case.

A battery over 200 AMP hours has one single cell per case.

Sample

Install new battery (less than 200 AMP hours) - 12 cases

First eight cases 8 x .5 = 4.0
Remaining four cases 4 x .3 = 1.2

Total Units = 5.2

(CODE 19) AUXILIARY EQUIPMENT

Reporting Unit is Per Each Item	Unit Standards Install	Unit Standards Remove
Miscellaneous		
Radiation Monitor	5.0	2.5
Air Compressor (for station use)	11.0	5.5
Anode (cathodic protection)	2.7	-
Anode Terminal Box	3.5	1.5
Anode Test Station	1.3	.5
Telephone Equip. and Term. Panel (EM 47105)	9.0	2.0
Pipe Bond Cabinet	4.3	2.0
Portable Battery Light	.9	.5
Printometer	3.5	1.8
Rectifier (cathodic) EM 20705	7.0	2.0
Generator	13.5	4.5
Generator Control Console (3' x 2' x 4')	18.0	5.0
Fire Equipment		
Cabinet, External/Wall-Mounted	.5	-
House, External/On Concrete Pad	3.5	1.0
Extinguisher, Wall-Mounted	.5	.2

(CODE 28) FENCING AND VAULT SLAB

Reporting Unit is as Noted		Unit Standards Install	Unit Standards Remove
Fencing			
Including Gates and Removable Panels (linear ft.)		.2	.1
Vault Slab (each)		7.0	7.0
Oil Containment Tub			
Approx. 12.5' x 7.0' x 6.5' with cover	(each)	4.7	4.7
Excavate for Tub		18.2	
Great Lakes Liquid Level Control Cabinet		3.5	1.0
Miscellaneous			
Sheet Insulation or Barrier	(square ft.)	.10	.03
Pipe Framework	(per linear ft.)	.07	.04
Screen Guard	(per square ft.)	.12	.06