PUC 4-1

Request:

Please recalculate the revenue requirement for each Narragansett Electric and Narragansett Gas that results from the changes to the tax code made in H.R.-1 The Tax Cuts & Jobs Act. If the companies are still working through all of the Act to determine all of the impacts, at a minimum, please recalculate the revenue requirement to reflect the change in the corporate tax rate from 35% to 21% and supplement the response after full analysis has been completed.

Response:

As suggested by the question, adjustments to the Company's proposed revenue requirements for Narragansett Electric and Narragansett Gas are appropriate to account for revisions to the corporate tax rate modified by the federal Tax Cuts and Jobs Act (Tax Act). There are several ramifications that flow from the change in the corporate tax rate and some of these ramifications will take time to evaluate and quantify. National Grid is fully engaged in the process of identifying the cost reductions that will flow to customers of all of its regulated utility operations. It is clear that the change in tax rate will have an impact on both annual income-tax expense and balances of Accumulated Deferred Income Tax and Excess Deferred Federal Income Tax. Also, it is clear that it will be necessary to align the Company's proposed revenue requirements with the specifications of the Tax Act by the time that rates go into effect for this proceeding.

The Company has not yet had sufficient time to rerun all of the revenue requirement models to determine the precise reduction that would flow through the Company's entire revenue requirement proposals for this proceeding as a result of the change in corporate tax rate. Although it is a relatively straightforward calculation for the first year revenue requirement, flowing the change through the future years is a more involved exercise. For the first year impact, the Company estimates a reduction to the revenue requirements of approximately $19.3 million in total for Rhode Island customers, which is a $9.7 million reduction for Narragansett Electric and a $9.6 million reduction for Narragansett Gas. Please refer to Attachment PUC 4-1 for summary revenue requirement schedules reflecting this reduction.

The Company will supplement this response as soon as reasonably possible to provide a more detailed analysis.

Prepared by or under the supervision of: Melissa Little

Rate Year Ending August 31, 2019

		Total Company		Electric			Gas		
		$	%	Source	$	%	Source	$	%
	REVENUE								
1	Base revenue increase submitted	$71,617,451	100.0%	Schedule MAL-1-ELEC Page 1 of 4 Row 1 Column (f)	$41,294,907	100.0%	Schedule MAL-1-GAS Page 1 of 4 Row 1 Column (f)	$30,322,543	100.0%
2	MACRS correction	($5,238,450)	-7.3%	DIV 2-20	($2,903,788)	-7.0%	DIV 2-28	($2,334,662)	-7.7%
3	Five Quarter Average Correction	($1,492,613)	-2.1%	DIV 2-14	($1,492,613)	-3.6%		$0	0.0%
4	Tax reform impact	($19,309,751)	-27.0%		($9,660,639)	-23.4%		($9,649,112)	-31.8%
5	Base revenue increase with revised tax plan	$45,576,637	63.6%	Page 2 of 5 Row 1 Column (f)	$27,237,867	66.0%	Page 3 of 5 Row 1 Column (f)	$18,338,769	60.5%

The Narragansett Electric Company d/b/a National Grid
Illustrative Statement of Electric Operations Income and Revenue Deficiency Summary
For the Test Year Ended June 30, 2017 and the Rate Year Ending August 31, 2019

		Schedule Reference	Test Year Ended June 30, 2017 (a)	Normalizing Adjustments (b)	Test Year Ended June 30, 2017 Adjusted (c) = (a) + (b)	Proforma Adjustments (d)	Rate Year Ending August 31, 2019 (e) = (c) + (d)	Base Revenue Increase Required (f)	Rate Year Ending August 31, 2019 with Base Revenue Requirement (g) = (e) + (f)
1	Revenues	Schedule MAL 2-ELEC	$906,848,280	($627,513,858)	$279,334,422	($141,992)	$279,192,430	$27,237,867	$306,430,297
2									
3	Purchased Power & Other Reconciling Expense	Schedule MAL-3	$304,255,398	($304,255,398)	$0	$0	$0	$0	$0
4									
5	Net Distribution Revenues		$602,592,882	($323,258,459)	$279,334,422	($141,992)	$279,192,430	$27,237,867	$306,430,297
6									
7	Operation & Maintenance Expenses	Schedule MAL-3	$304,575,180	($160,473,649)	$144,101,530	$10,581,073	$154,682,603	$0	$154,682,603
8									
9	Amortization of Regulatory Deferrals	Schedule MAL-4-ELEC	$8,454	($8,454)	$0	$332,482	$332,482	$0	$332,482
10									
11	Amortization of Utility Plant	Schedule MAL-5-ELEC	$62,962	($62,962)	$0	$0	$0	$0	$0
12									
13	Depreciation	Schedule MAL-6-ELEC	$69,031,187	($19,869,812)	$49,161,375	$1,770,914	$50,932,289	$0	$50,932,289
14									
15	Municipal Taxes	Schedule MAL-7-ELEC	$49,702,787	($20,023,313)	$29,679,474	$850,784	$30,530,258	$0	$30,530,258
16									
17	Payroll Taxes	Schedule MAL-8	$8,148,712	($4,420,053)	$3,728,658	$470,837	$4,199,496	$0	$4,199,496
18									
19	Gross Receipts Taxes	Schedule MAL-9	$32,568,650	($32,568,650)	$0	$0	$0	$0	$0
20									
21	Other Taxes	Schedule MAL-9	$434,298	$0	$434,298	$20,108	$454,406	$0	$454,406
22									
23	Interest on Customer Deposits	Workpaper MAL-2-ELEC	$0	$0	$0	132,127	$132,127	$0	$132,127
24									
25	Total Operating Revenue Deductions		$464,532,229	($237,426,894)	$227,105,336	$14,158,325	$241,263,661	$0	$241,263,661
26									
27	Operating Income Before Income Taxes		$138,060,652	($85,831,566)	$52,229,086	($14,300,317)	$37,928,769	$27,237,867	$65,166,637
28									
29	Income Taxes	Schedule MAL-10-ELEC					$5,191,972	$5,645,427	$10,837,399
30									
31	Operating Income After Income Taxes						$32,736,797	$21,592,440	$54,329,238
32									
33	Rate Base	Schedule MAL-11-ELEC					$726,438,184		$726,438,184
34									
35	Rate of Return						4.51%	Line 31(e) / Line 33(e)	
36									
37									

38	Revenue Deficiency		
39	Earned Rate of Return	4.51%	Line 35 (e)
40	Rate Year Required Rate of Return	7.43%	Page 4, Line 9 (c)
41	Rate of Return Deficiency	2.92%	Line 40 - Line 39
42	Rate Base	$726,438,184	Line 33 (e)
43	Net Operating Income Deficiency	$21,237,560	
44	Gross Revenue Conversion Factor	1.282533	Line 53
45	**Revenue Deficiency**	$27,237,867	Line 43 / Line 44
46			
47	Gross Revenue Conversion Factor		
48	Gross Revenue	1.000000	
49	Uncollectible expense	(0.013029)	Schedule MAL-22, Page 6, Line 15
50	Revenue net of Uncollectibles	0.986971	
51	Composite income tax rate	(0.20726)	Line 50 x (- 0.21%)
52	Net income effect of 1.000 Revenue	0.779707	Line 50 + Line 51
53	Gross Revenue Conversion Factor	1.2825328	1 / Line 52

The Narragansett Electric Company d/b/a National Grid
Illustrative Statement of Gas Operations Income and Revenue Deficiency Summary
For the Test Year Ended June 30, 2017 and the Rate Year Ending August 31, 2019

		Schedule Reference	Test Year Ended June 30, 2017 (a)	Normalizing Adjustments (b)	Test Year Ended June 30, 2017 Adjusted (c) = (a) + (b)	Proforma Adjustments (d)	Rate Year Ending August 31, 2019 (e) = (c) + (d)	Base Revenue Increase Required (f)	Rate Year Ending August 31, 2019 with Base Revenue Requirement (g) = (e) + (f)
1	Revenues	Schedule MAL-2-GAS	$377,158,225	($199,762,322)	$177,395,903	$37,127,687	$214,523,590	$18,338,769	$232,862,359
2									
3	Purchased Power & Other Reconciling Expense	Schedule MAL-3	$136,269,302	($136,269,302)	$0	$0	$0	$0	$0
4									
5	Net Distribution Revenues		$240,888,923	($63,493,020)	$177,395,903	$37,127,687	$214,523,590	$18,338,769	$232,862,360
6									
7	Operation & Maintenance Expenses	Schedule MAL-3	$115,479,365	($26,277,921)	$89,201,444	$848,387	$90,049,831	$0	$90,049,831
8									
9	Amortization of Regulatory Deferrals	Schedule MAL-4-GAS	$705,953	$1,309,738	$2,015,691	($495,085)	$1,520,606	$0	$1,520,606
10									
11	Amortization of Utility Plant	Schedule MAL-5-GAS	$1,874,224	$106,546	$1,980,770	($1,554,586)	$426,184	$0	$426,184
12									
13	Depreciation	Schedule MAL-6-GAS	$33,311,851	($15,649)	$33,296,202	$7,919,753	$41,215,955	$0	$41,215,955
14									
15	Municipal Taxes	Schedule MAL-7-GAS	$22,091,730	($2,696)	$22,089,035	$4,780,420	$26,869,455	$0	$26,869,455
16									
17	Payroll Taxes	Schedule MAL-8	($1,294,241)	$3,763,829	$2,469,588	$292,724	$2,762,312	$0	$2,762,312
18									
19	Gross Receipts Taxes	Schedule MAL-9	$11,166,309	($11,166,309)	$0	$0	$0	$0	$0
20									
21	Other Taxes	Schedule MAL-9	$217,464	$0	$217,464	$10,069	$227,533	$0	$227,533
22									
23	Interest on Customer Deposits	Workpaper MAL-2-GAS	$0	$0	$0	$35,184	$35,184	$0	$35,184
24									
25	Total Operating Revenue Deductions		$183,552,655	($32,282,462)	$151,270,194	$11,836,866	$163,107,060	$0	$163,107,060
26									
27	Operating Income Before Income Taxes		$57,336,268	($31,210,558)	$26,125,709	$25,290,821	$51,416,531	$18,338,769	$69,755,300
28									
29	Income Taxes	Schedule MAL-10-GAS					$6,760,679	$3,770,979	$10,531,658
30									
31	Operating Income After Income Taxes						$44,655,852	$14,567,790	$59,223,642
32									
33	Rate Base	Schedule MAL-11-GAS					$767,169,688		$767,169,688
34									
35	Rate of Return						5.82%	Line 31(e) / Line 33(e)	
36									
37									
38						Revenue Deficiency			
39						Earned Rate of Return	5.82%	Line 35 (e)	
40						Rate Year Required Rate of Return	7.67%	Page 4, Line 9 (c)	
41						Rate of Return Deficiency	1.85%	Line 40 - Line 39	
42						Rate Base	$767,169,688	Line 33 (e)	
43						Net Operating Income Deficiency	$14,186,063		
44						Gross Revenue Conversion Factor	1.292731	Line 53	
45						**Revenue Deficiency**	$18,338,769	Line 43 / Line 44	
46									
47						Gross Revenue Conversion Factor			
48						Gross Revenue	1.000000		
49						Uncollectible expense	(0.020815)	Schedule MAL-22, Page 7, Line 15	
50						Revenue net of Uncollectibles	0.979185		
51						Composite income tax rate	(0.20563)	Line 50 x (- 0.21%)	
52						Net income effect of 1.000 Revenue	0.773556	Line 50 + Line 51	
53						Gross Revenue Conversion Factor	1.2927314	1 / Line 52	

The Narragansett Electric Company d/b/a National Grid
Cost of Capital - Electric
For the Test Year Ended June 30, 2017 and the Data Year 2 Ending August 31, 2021

	Description	Capital Structure (a)	Cost Rate (b)	Weighted Return (c) = (a) x (b)	Taxes (d)	Pre-tax Return (e) = (c)+(d)
1	Short Term Debt	0.45%	1.76%	0.01%		0.01%
2						
3	Long Term Debt	48.47%	4.69% (1)	2.27%		2.27%
4						
5	Preferred Stock	0.11%	4.50%	0.00%		0.00%
6						
7	Total Common Equity	50.97%	10.10%	5.15%	1.37% (2)	6.52%
8						
9	Total Capitalization	100.00%		7.43%	1.37%	8.80%

Notes
(1) Company's Effective Cost of Long Term Debt
(2) Line 3(c) / (1-21%) - Line 3(c)

Column Notes
(a) As referenced in Pre-filed Direct Testimony of Robert B. Hevert, page 2 of 2 Lines 14 through 18

Line Notes
1(b) As referenced in Pre-filed Direct Testimony of Robert B. Hevert,, page 78 of 93 Line 13
3(b) As referenced in Pre-filed Direct Testimony of Robert B. Hevert,, page 78 of 93 Line 4
5(b) As referenced in Pre-filed Direct Testimony of Robert B. Hevert,, page 78 of 93 Line 10
7(b) As referenced in Pre-filed Direct Testimony of Robert B. Hevert,, page 83 of 93 Line 13

The Narragansett Electric Company d/b/a National Grid
Cost of Capital
For the Test Year Ended June 30, 2017 and the Rate Year Ending August 31, 2019

	Description	Capital Structure (a)	Cost Rate (b)	Weighted Return (c) = (a) x (b)	Taxes (d)	Pre-tax Return (e) = (c)+(d)
1	Short Term Debt	0.45%	1.76%	0.01%		
2						
3	Long Term Debt	48.47%	5.18% (1)	2.51%		2.51%
4						
5	Preferred Stock	0.11%	4.50%	0.00%		
6						
7	Total Common Equity	50.97%	10.10%	5.15%	1.37% (2)	6.52%
8						
9	Total Capitalization	100.00%		7.67%	1.37%	9.03%

Notes
(1) Company's Effective Cost of Long Term Debt
(2) Line 3(c) / (1-21%) - Line 3(c)

Column Notes
(a) As referenced in Pre-filed Direct Testimony of Robert B. Hevert, page 2 of 2 Lines 14 through 18

Line Notes
1(b) As referenced in Pre-filed Direct Testimony of Robert B. Hevert,, page 78 of 93 Line 13
3(b) As referenced in Pre-filed Direct Testimony of Robert B. Hevert,, page 78 of 93 Line 4
5(b) As referenced in Pre-filed Direct Testimony of Robert B. Hevert,, page 78 of 93 Line 10
7(b) As referenced in Pre-filed Direct Testimony of Robert B. Hevert,, page 83 of 93 Line 13

PUC 4-2

Request:

Please refile the revenue requirement schedules for Narragansett Electric and Narragansett Gas to reflect the impact of H.R.-1 The Tax Cuts & Jobs Act.

Response:

Please see the Company's response to PUC-4-1 for the requested information. The Company is working to develop revised revenue requirement schedules to reflect the impact of the federal Tax Cuts and Jobs Act. The Company has provided a high-level estimate of the value of the reduction for federal income tax expense. This estimate is exclusive of the impact for the flow back of Excess Deferred Federal Income Taxes. Additional estimates and revised schedules will be provided as soon as reasonably possible.

Prepared by or under the supervision of: Melissa Little

PUC 4-3

Request:

If the Company is still assessing the Tax Cuts and Jobs Act to determine all of the tax implications, at a minimum, please file revised revenue requirement schedules to reflect the change in the corporate tax rate from 35% to 21%.

Response:

Please see the Company's responses to PUC 4-1 and PUC 4-2 for the requested information. The Company appreciates the fact that this is an important, unique opportunity to reduce costs for customers and to offset the impact of the pending rate increase. Therefore, the Company agrees that it is vital that the Public Utilities Commission has the information necessary to flow benefits through to customers. The Company will submit the requested information as soon as reasonably possible.

Prepared by or under the supervision of: Melissa Little

PUC 4-4

Request:

Please refile any other schedules that were impacted by H.R.-1 The Tax Cuts & Jobs Act, including the bill impact schedules.

Response:

Please see the Company's responses to PUC 4-1 and 4-2 for the requested information. The federal Tax Cuts and Jobs Act will affect numerous schedules in the Company's initial filing. The Company is preparing revised schedules for submission in this docket.

Prepared by or under the supervision of: Melissa Little

PUC 4-5

Request:

Please indicate how the reduction in the corporate tax rate from 35% to 21% is anticipated to affect the net operating loss position currently being addressed in the annual Infrastructure, Safety & Reliability filings.

Response:

The reduction in the corporate tax rate from 35 percent to 21 percent will have an impact on the net operating loss position currently factoring into the annual Company's annual Infrastructure, Safety, and Reliability filings. The Company has not yet had sufficient time to complete its evaluation and review of this impact. The Company will submitted revised schedules and computations once more information is available as to the impact for Rhode Island customers.

Prepared by or under the supervision of: Melissa Little

PUC 4-6

Request:

For the Rate Year and each Data Year, please provide the overall revenue impact of the request in this docket plus the request in Docket No. 4780.

Response:

The Company plans to file its revised testimony and revenue requirement in Docket No. 4780 with the Public Utilities Commission on January 12, 2018. The Company will supplement this response at that time.

Prepared by or under the supervision of: Melissa Little

PUC 4-7

Request:

Assuming the requested revenue requirement were approved in this docket, what is the increase that customers will be paying as compared to the revenue requirement that was approved in Docket No. 4323.

Response:

Before performing the comparison described in this request, the Company must first adjust, or normalize, the approved revenue requirement from Docket 4323 for specifically known changes to the Company's cost of providing service after the PUC's approval in Docket 4323. This request is asking for the comparison of two revenue requirements calculated at two points in time, and not considering such changes of meaningful significance would not result in a comparison acknowledging these incremental costs for which the Company has been receiving incremental revenue outside of base distribution rates and has now reflected these costs, as well as the additional revenue, in its Docket 4770 revenue requirement. Therefore, the Docket 4323 revenue requirement should, essentially, be restated to a level that would put it on a comparable basis, to the greatest extent possible, to the rate year revenue requirement in this general rate case. Two main drivers of such adjustments to the Docket 4323 revenue requirement are the revenue requirement associated with the Infrastructure, Safety, and Reliability (ISR) Plan and the increase in Narragansett Gas's customer base (i.e., Gas Growth).

The capital investment associated with the ISR Plans after January 2014, the rate year in Docket 4323, is not reflected in the Docket 4323 revenue requirement. However, it is reflected in the Docket 4770 revenue requirement. To compare the two revenue requirements without consideration for this difference is not an appropriate comparison. It is necessary to adjust up the Docket 4323 revenue requirement by the estimated rate year ending August 2019 revenue requirement on cumulative ISR Plan capital investment since February 2014. The Company has been recovering the revenue requirement on this cumulative capital investment through the ISR tariff provisions in effect for Narragansett Electric and Narragansett Gas, any by not adjusting the Docket 4323 revenue requirement for the ISR Plan revenue requirement would be overstating the increase in distribution cost recovery associated with this rate case by only comparing the two rate cases' revenue requirements in isolation.

Gas Growth results in incremental distribution costs, both capital investment and operation and maintenance (O&M) and customer service and billing expenses. Such costs are accompanied by incremental revenue from the new customers interconnected to Narragansett Gas's distribution system. Similar to the ISR Plans' revenue requirements and their recovery outside of base distribution rates until new distribution rates take effect as a result of this rate case, the same concept applies to Gas Growth as well. The costs associated with Gas Growth after January

2014 are reflected in the Docket 4770 revenue requirement, and to not consider these costs and that they are being recovered through the revenue generated by new gas customers would also be overstating the increase in distribution cost recovery associated with this rate case by only comparing the two rate cases' revenue requirements in isolation.

Please see Attachment PUC 4-7 for an illustration of the increase resulting from the comparison of the Docket 4770 revenue requirement and the Docket 4323 revenue requirement as adjusted by the ISR Plan revenue requirement and, for Narragansett Gas, Gas Growth. The comparison results in increases that are consistent with the increases requested in this general rate case.

Prepared by or under the supervision of: Melissa Little

		Elec (a)	Gas (b)
(1)	Docket 4323 Compliance Revenue Requirement	$259,948,386	$166,765,895
(2)	Normalized for ISR Revenue Requirement for Docket 4770's Rate Year	$19,489,298	$38,889,954
(3)	Normalized for Gas Customer Growth through Docket 4770's Rate Year	n/a	$10,249,900
(4)	Normalized Docket 4323 Revenue Requirement for Docket 4770 Rate Year	$279,437,684	$215,905,749
(5)	Docket 4770 Requested Rate Year Revenue Requirement	$320,487,337	$244,846,133
(6)	Docket 4770 Increase Compared to Normalized Docket 4323 Revenue Requirement	$41,049,653	$28,940,384
(7)	Docket 4770 Requested Increase	$41,294,908	$30,322,543

(1) (a): January 24, 2013 Compliance Filing, Docket 4323, Compliance Attachment 1, Page 1, Line 5, Column (g)
(b): January 24, 2013 Compliance Filing, Docket 4323, Compliance Attachment 6, Page 1, Line 5, Column (g)

(2) (a): Workpaper MAL-12-ELEC, Line 14, Column (g)
(b): Workpaper MAL-12-GAS, Line 14, Column (g)

(3) August 1, 2014 RDM Filing, Docket 4514, Schedule MAL-1, Page 1, Column D for Residential, Small C&I, Medium C&I
January 24, 2013 Compliance Filing, Docket 4323, Compliance Attachment 8C, Page 4, Column (U),
Lines 82 + 87 + 92 + 97 for Large and Extra Large C&I

Divided by:

August 1, 2014 RDM Filing, Docket 4514, Schedule MAL-1, Page 1, Column E for Residential, Small C&I, Medium C&I
January 24, 2013 Compliance Filing, Docket 4323, Compliance Attachment 8C, Page 3, Column (B),
Line (82 + 87 + 92 + 97) ÷ 12, for Large and Extra Large C&I

Multiplied by the difference between:

August 1, 2014 RDM Filing, Docket 4514, Schedule MAL-1, Page 1, Column E for Residential, Small C&I, Medium C&I
January 24, 2013 Compliance Filing, Docket 4323, Compliance Attachment 8C, Page 3, Column (B),
Line (82 + 87 + 92 + 97) ÷ 12, for Large and Extra Large C&I

and

Schedule PMN-9, Page 28 of 136, Column (m)

(4) Sum of Lines (1) through (3)

(5) (a): Schedule MAL-1-ELEC, Page 1, Line 5, Column (g)
(b): Schedule MAL-1-GAS, Page 1, Line 5, Column (g)

PUC 4-8

Request:

Referencing the Line Extension Policy on page 210 of Book 16, please provide a copy of the Specifications for Electrical Installations booklet.

Response:

The Specifications for Electrical Installations booklet is a multi-jurisdictional document provided in Attachment PUC 4-8-1 that is supplemented from time to time. The currently effective supplements are provided as Attachment PUC 4-8-2 through Attachment PUC 4-8-12. Please note that certain supplements to the booklet may be jurisdiction-specific. For example, Attachment PUC 4-8-4 is a supplement to the Specifications for Electrical Installations booklet specific to the Company's Upstate New York affiliate, Niagara Mohawk Power Corporation.

- Attachment PUC 4-8-1: Specifications for Electrical Installations 2010 Covering National Grid's Service Areas in MA, NH, NY, and RI;
- Attachment PUC 4-8-2: Supplement to Specifications for Electrical Installations, Errata and Revisions for the Electric System Bulletin 750 Series (January 2015);
- Attachment PUC 4-8-3: Supplement to Specifications for Electrical Installations, General Requirements Above 600-Volt Service, Electric System Bulletin No. 751 (June 2014);
- Attachment PUC 4-8-4: Supplement to Specifications for Electrical Installations, Service Above 15,000 Volts, Electric System Bulletin No. 752 (October 1994, 2nd Printing April 2002);
- Attachment PUC 4-8-5: Supplement to Specifications for Electrical Installations, Primary Meter Pole, Electric System Bulletin No. 753 (June 1993, 2nd Printing April 2002);
- Attachment PUC 4-8-6: Supplement to Specifications for Electrical Installations, Outdoor Padmounted or Vault Enclosed Three Phase Transformer, Electric System Bulletin No. 754/759 (October 2007);

Prepared by or under the supervision of: Raymond Rosario

- Attachment PUC 4-8-7: Supplement to Specifications for Electrical Installations, Operation & Maintenance Requirements for Services Above 600 Volts, Electric System Bulletin No. 755 (June 2003);

- Attachment PUC 4-8-8: Supplement to Specifications for Electrical Installations, Requirements for Parallel Generation Connected to a National Grid Owned EPS, Electric System Bulletin No. 756 (June 2017, Version 3.0);

- Attachment PUC 4-8-9: Supplement to Specifications for Electrical Installations, Requirements for Services Supplied from National Grid's Secondary Networks, Electric System Bulletin No. 757 (September 2016);

- Attachment PUC 4-8-10: Supplement to Specifications for Electrical Installations, Primary Service to Metal Enclosed Gear, Electric System Bulletin #758 (January 1985);

- Attachment PUC 4-8-11: Supplement to Specifications for Electrical Installations, Underground Residential Distribution (URD) Installation and Responsibility Guide, Electric System Bulletin No. 759A (July 2010); and

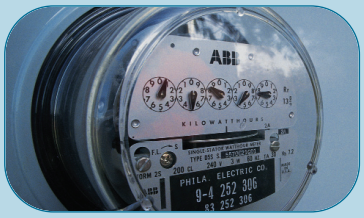
- Attachment PUC 4-8-12: Supplement to Specifications for Electrical Installations, Underground Commercial Distribution (UCD) Installation and Responsibility Guide, Electric System Bulletin No. 759B (July 2010).

Prepared by or under the supervision of: Raymond Rosario

Specifications for Electrical Installations

2010

Covering National Grid's Service Areas in
MA, NH, NY, and RI



nationalgrid

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While you're planning electrical and mechanical systems for your next project, our representatives will work closely with you and your clients.

We'll provide detailed analysis or supplemental data on all types of electrical installations.

We'll give you valuable aid before final plans are made on heating, cooling, wiring and lighting. And most important, we will suggest ways to conserve energy.

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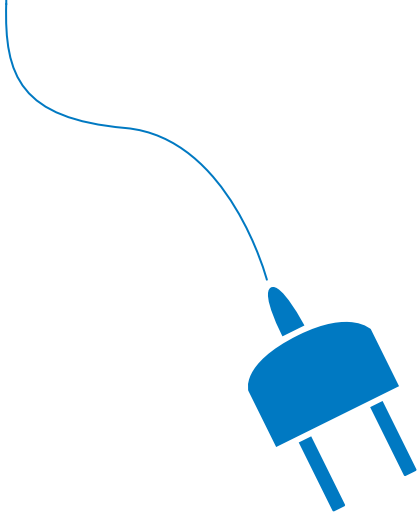
	New York	Massachusetts	New Hampshire	Rhode Island
Customer Service Center	1-800-642-4272 24 hours/7 days	1-800-322-3223 Mon-Fri 7:00a.m. - 7:00p.m. Saturday 7:00a.m. - 5:00p.m.		
Fax	1-315-460-9270 (for new service applications only)	1-508-357-4730		
Mail Address	National Grid Customer Service Center 300 Erie Boulevard W. Syracuse, NY 13202-4250	National Grid Customer Service Center PO Box 960 Northborough, MA 01532-0960		
Non-English Speaking Customers Para clients que hablan Espanol	1-800-561-6672	1-800-322-3223		
Hearing/Speech-Impaired Customers	711			
Specialized Commercial & Industrial Business Group	1-800-664-6729 Mon-Fri 8:00a.m.-5:00p.m.	Not Applicable		
Emergency Numbers - does not replace 911 emergency medical services				
Life-Threatening Electric Emergency	1-800-892-2345	1-800-465-1212		
Life-Threatening Gas Emergency		1-800-233-5325		1-800-640-1595
Power Outages	1-800-867-5222 Automated OnCall℠	1-800-465-1212		
New Construction & Service Upgrades To initiate a request for new or upgraded electric service				
By Phone	1-800-642-4272 24 hours/7 days	1-800-375-7405 Mon-Fri 8:00a.m.-4:30p.m.		
Contractor Service	1-800-664-6729 Mon-Fri 8:00a.m.-5:00p.m.	Not Applicable		
By Fax	1-800-882-0322 Using Electric Service Request Form	1-888-266-8094		
Online by Internet	www.nationalgridus.com Then, select the appropriate state. Go to the section "For Technical and Construction Professionals			
For assistance with pending electric service requests, contact Customer Order Fullfillment	1-800-260-0054			
For electric inspectors, to release a municipal wiring inspection	1-888-932-0301 24 hr.automated system only for single meter service requests	1-800-375-7405 Mon-Fri 8:00a.m.-4:30p.m. (24 hr. automated system forthcoming in mid-2010 only for single meter service requests)		
New Residential or Commercial Developments - To e-mail AutoCAD or MicroStation drawings	OrderFulfillment@us.ngrid.com			
Dig Safe Requests	1-800-962-7962 Dig Safely NY	1-888-DIGSAFE (1-888-344-7233) Dig Safe System Inc.		
	811 is the nation wide number; see http://www.call811.com/state-specific.aspx			
Hazard Identification Hotline When working near power lines or high voltage lines	1-800-642-4272	1-888-625-3723		

Also, check the following Web site for this and other National Grid information: **https://www.nationalgridus.com**

Specifications for Electrical Installations

2010

Covering National Grid's Service Areas in
MA, NH, NY, and RI



For the latest authorized version, please refer to the company's website at **http://www.nationalgridus.com/electricalspecifications**.

PREFACE

This April 2010 edition of the Specifications for Electrical Installations is effective as of June 2010. These specifications consolidate and replace both the "Electric System Bulletin No. 750" and "Information and Requirements for Electric Service—Green Book" and are in effect for the following National Grid companies:

Granite State Electric Company

Massachusetts Electric Company

Nantucket Electric Company

The Narragansett Electric Company

Niagara Mohawk Power Corporation

These specifications, which protect the mutual interests of the Customer and Company, may be revised or amended from time to time in keeping with developments and progress of the industry. For the latest official version of this document please visit the Company's web site address at: **http://www.nationalgridus.com/electricalspecifications**. Printed copies of these specifications are not document controlled and may be obtained from the Company by contacting the applicable Customer Service Center in Massachusetts for New England or Upstate New York. Therefore, the on-line version will always prevail over any uncontrolled printed documents.

Where referenced in tariffs by the National Grid companies, this new edition is synonymous with the designations as "ESB 750 Book" or "Information and Requirements Book" and meets the same requirements.

TABLE OF CONTENTS

PROCESS AND INFORMATION

Obtaining Electric Service

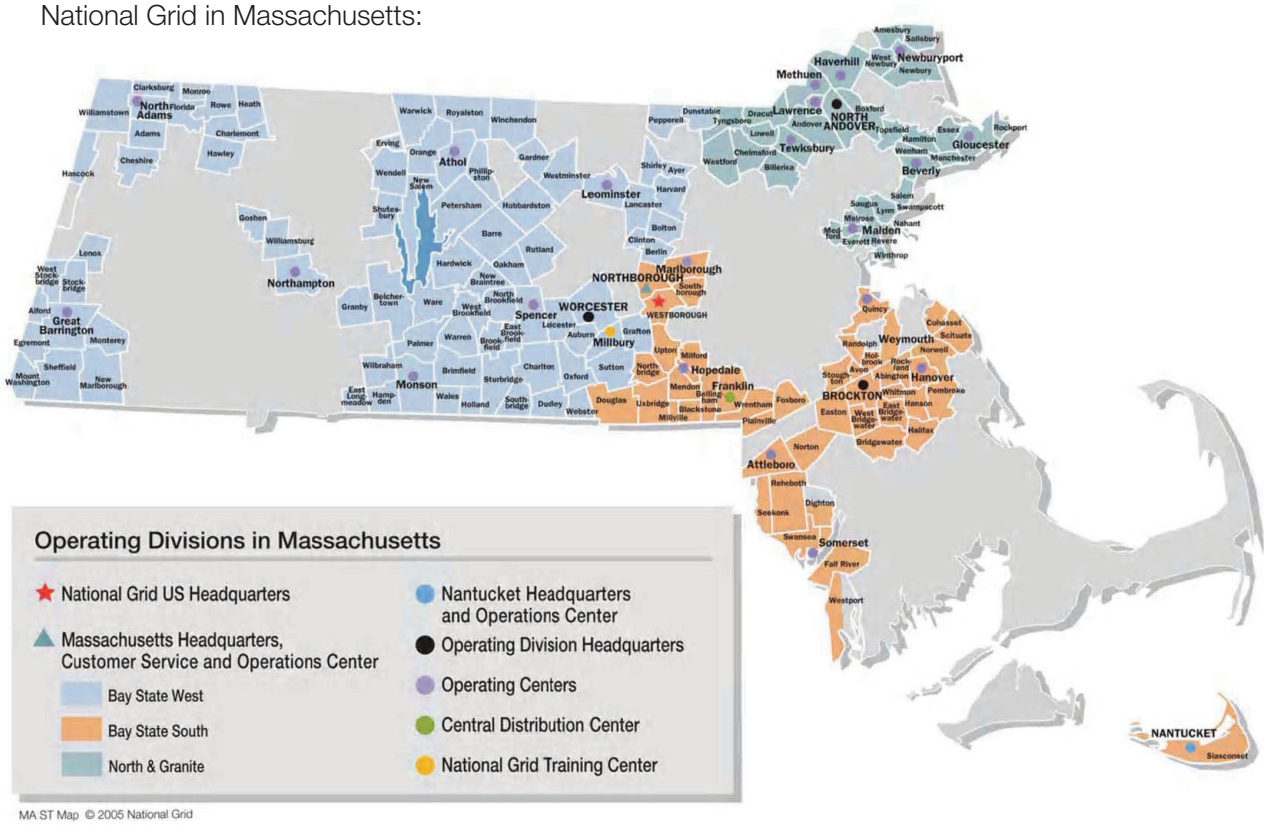
Please refer to the inside front cover of this book for Company contact information by phone, facsimile, mail, or internet.

How to Obtain Electric Service (less than 600 volts)	
(Applicants and Existing Customers**)**	
Pre-Plan Step 1	✓ Review the **Service Territory Map** in the following pages of this book to determine the availability of electric service where application is made. ✓ Determine the **amperage size** and **voltage of service** needed; see the latest National Electrical Code. ✓ Determine the **type of service** desired as permitted. ✓ If heating with electricity, determine the total square footage of the area to be heated. ✓ Determine the **desired date electric service is to be energized** (provide for applicable planning, material order, and construction schedules). A Customer Order Fulfillment representative will make contact to confirm if the desired date can be met by the Company.
Request Step 2	✓ For Applicants for a **new electric service**: ▪ The individual or entity who will be responsible for the electric bill must apply for service by contacting the Company's state-applicable Customer Service Center. ▪ Applicants may be required to submit written application and provide a security deposit according to the applicable Company tariff, which will be conveyed at the time the Applicant contacts the Company to request a new service in their name. ▪ The Applicant or their designated representative may **initiate the service order** by mail, facsimile, internet or telephone. When applying by mail or facsimile, an **electric service request form** is available from the Company's state-applicable Customer Service Center. Fill out the form providing the following information: ✓ Customer name, mailing address, phone number and daytime contact information ✓ The address where electric service is to be delivered and specific directions, including the nearest intersection ✓ The name, address and telephone number of the electrical contractor, if one will be used ✓ The specifics about type and size of service as defined above ✓ The proposed date for electric service (may require re-negotiation once Company work scope is defined) When applying by internet, navigate to the **new service order form for Electricity** by going to the website for the applicable state and selecting the topic "**For Technical and Construction Professionals.**" Click on the link for "**Electric Service**" to open the online form. When applying by telephone, be prepared to provide the information provided on the electric service request form. ✓ To request an **upgrade, relocation or rewire of an existing electric service**, the Customer or their designated licensed electrical contractor may initiate the request by mail, facsimile, internet or telephone. Contact the Company's state-applicable Customer Service Center. For residential single-phase services, information which will assist in potentially expediting the request includes: the service location, service pole, and meter location if the service remains at the same location and if there are no clearance violations caused by pools, additions, garages, or decks. Where there is a clearance issue or if the attachment is inaccessible by ladder from the ground, the Company designates the service location. ✓ To request a **temporary service**, the request should be made by the individual or entity responsible for payment of charges associated with the temporary service. Payment is required in advance of scheduling the installation of a temporary service according to the applicable Company tariff. ✓ If an easement is required, the Applicant or Customer completes an **Easement Application Form.**

How to Obtain Electric Service (cont'd) (less than 600 volts)	
(Applicants and Existing Customers**)**	
Plan Step 3	✓ **Consult the Company** regarding the type of service available and typical scheduling **before** plans are completed, the equipment is purchased, and construction is started. ▪ For residential developments, commercial, and industrial applications, an AutoCAD or Microstation (if available) electronic copy of the **site plan**, with grades and curb cuts may be e-mailed to the Company. ▪ For 400-ampere services and larger and distributed generation and standby generator proposed installations, a **one-line diagram** must be submitted to the Company indicating service voltage; size of main switch or sub-mains if more than one; number, size, and type of conductors; number, size, and material of conduits, number of meters, their location and whether they are self-contained or transformer rated. The diagram must include information from the service attachment point to the main disconnect switch and overcurrent device (**i.e.** service equipment). ✓ Secure appropriate **property rights** (easements, licenses, permits, etc.) prior to the installation of any electrical service. ✓ **Contribute to the cost** of the service installation and connection to the Company's distribution system if the line on private property exceeds the allowance as provided in the Company's applicable tariff.
Installation Step 4	✓ The Company's work can be scheduled only after the Company has received all documents and payment toward construction, if required. ✓ **Complete the electrical wiring.** ✓ Obtain any required **electrical permits** and arrange electrical inspection. ✓ Provide a completed "**Certificate of Electrical Inspection**" to the Company. ✓ Follow the Company's disconnect/reconnect policy for rewires/upgrades for less than 200-ampere single-phase overhead residential services only. **Note:** Licensed electricians or qualified electrical contractors have several options to perform this work, providing they are using the same Point of Attachment. Contact the Company's Customer Order Fulfillment for a representative to review the details for the available policy in your area. ✓ Provide a completed "**Certificate of Compliance to Minimum Insulation Standards**" to the Company if an existing home is converted to electric heat. ✓ Provide appropriate **property rights** for the Company's facilities, as required. ✓ **Pay any charges** that might be required by the Company according to its applicable tariff.

Electric Service Areas

National Grid in Massachusetts:



SERVING THESE COMMUNITIES:

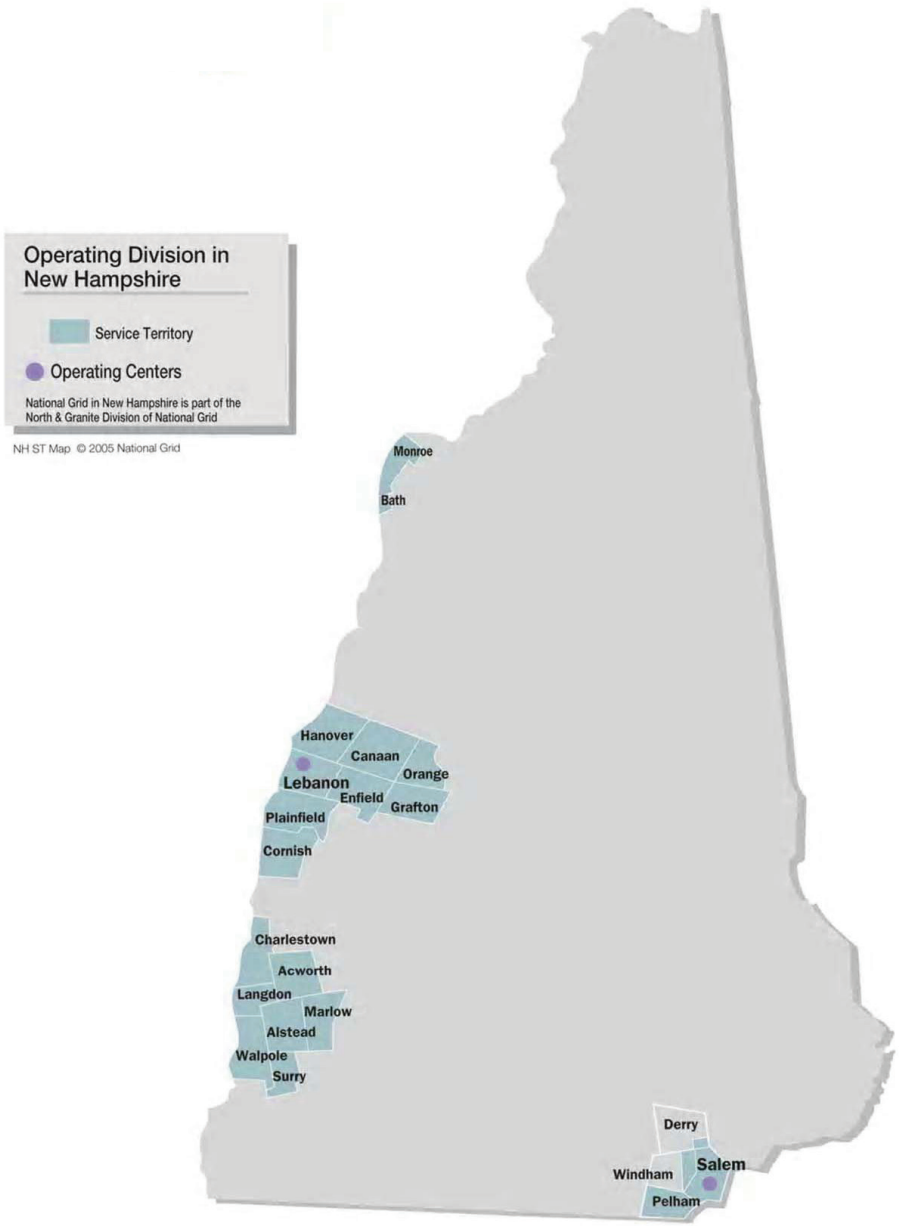
Abington
Adams
Alford
Amesbury
Andover
Annisquam
Asbury Grove
Ashley Falls
Athol
Attleboro
Auburn
Avon
Ayer
Ballard Hill
Ballardvale
Barre
Barrowsville
Belchertown
*Bellingham
Berlin
Beverly
Beverly Farms
Billerica
Blackington
Blackstone
Bolton
Bondsville
Boxford
Bradford
Bramanville
Bridgewater
Briggsville
Brimfield
Brockton
Brookfield
Byfield
Carryville
Charlemont
Charlton
Chartley
Chaseville
Chelmsford
Cherry Valley
Cheshire
Chockalog
Clarksburg
Clayton
Clinton
Cohasset
Coldbrook Springs
Collinsville
Cominsville
Cordaville
Dighton
Dodge
Douglas
Dracut
Drury
Dudley
Dunstable
East Bridgewater
East Brookfield
East Longmeadow
Easton
Egremont
Erving
Essex
Everett
Fall River
Farley
Farnams
Farnumsville
Fayville
Fisherville
Fiskdale
Florence
Florida
Foxboro
Franklin
Furnace
Gardner
Gibbs Crossing
Gilbertsville
Glendale
Gloucester
Goshen
Grafton
Granby
Great Barrington
Greendale

Halifax
Hamilton
Hampden
Hancock
Hanover
Hanson
Hardwick
Hartsville
Harvard
Haverhill
Hawley
Haydenville
Heath
Hebronville
Hillsville
Hingham
Holbrook
Holland
Hopedale
Hoosac Tunnel
Housatonic
Hubbardston
Indian Orchard
Interlaken
Ironstone
Kittville
Lake Buel
Lancaster
Lanesville
Leeds
Lawrence
Leicester
Lenox
Leominster
Linwood
Lowell
Lunnenburg
Lynn
Magnolia
Malden
Manchaug
Manchester
Marlborough
Medford
Melrose
Mendon
Methuen
Midland
Milford
Millbury
Mill River
Millers Falls
Millville
Monroe
Monroe Bridge
Monson
Monterey
Mt Washington
Nahant
New Braintree
New Marlboro
New Salem
Newbury
Newburyport
North Adams
North Andover
North Brookfield
Northampton
Northborough
Northbridge
Norton
Norwell
Nuttings Lake
Oakham
Old Furnace
Orange
Oxford
Palmer
Pembroke
Pepperell
Perryville
Petersham
Phillipston
Pigeon Cove
Pinehurst
Pitcherville
Plainville
Podunk
Prides Crossing
Quincy
Rakeville
Randolph
Rehoboth
Revere
Riverdale
Rochdale - Leicester
Rochdale - Oxford
Rockdale
Rockland
Rockport
Rowe
Royalston
Rutland
Salem
Salisbury
Sandersdale
Saugus
Saundersvjlle
Scituate
Seekonk
Shaker Village
Sharon
Sheffield
Sheldonville
Shirley
Shutesbury
Somerset
Southborough
Southbridge
South Easton
Southfield
Southville
Spencer
Spindleville
Still River
Stockbridge
Stoneville
Stoughton
Sturbridge
Sutton
Swampscott
Swansea
Tasseltop
Tewksbury
Texas
Thorndike
Three Rivers
Topsfield
Tully
Tyngsboro
Upton
Unionville
Uxbridge
Wadsworth
Wales
Ward Hill
Ware
Warren
Warwick
Waterville
Webster
Wendell
Wendell Depot
Wenham
Westborough
West Bridgewater
West Brookfield
West Newbury
West Stockbridge
Westford
Westminster
Westport
Westville
Weymouth
Wheelockville
Wheelwright
White City
Whitinsville
Whitman
Whitmanville
Wilbraham
Wilkinsonville
Williamsburg
Williamstown
Williamsville
Winchendon
Winchendon Springs
Winthrop
Wollaston
Worcester
Wrentham

Nantucket Area Communities:
Airport - Nantucket
Brant Point
Cisco
Cliff
Dionis
Hummock Pond
Madaket
Monomoy
Nantucket
Pocomo
Polpis
Quaise
Quidnet
Shimmo
Siaconset
Smiths Point
Surfside
Tom Nevers
Town
Wauwinet

*Served in part

National Grid in New Hampshire:



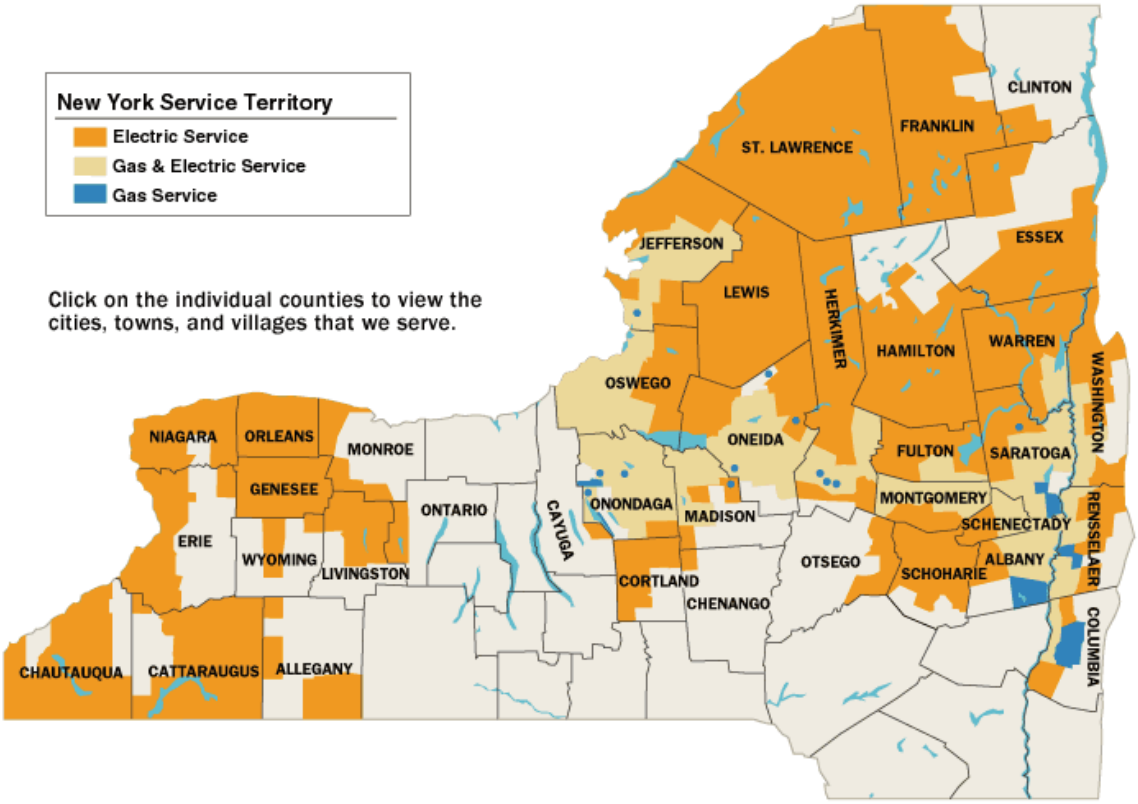
https://www.nationalgridus.com/non_html/shared_about_svcmap_gseco.pdf

SERVING THESE COMMUNITIES:

*Acworth
*Alstead
*Bath
*Canaan
*Charlestown
*Cornish
*Derry
*Enfield
*Grafton
*Hanover
*Langdon
*Lebanon
*Marlow
*Monroe
*Orange
*Pelham
*Plainfield
Salem
*Surry
Walpole
*Windham

*Served in part

National Grid in Upstate New York:



https://www.nationalgridus.com/niagaramohawk/about_us/serviceterr_map.asp

SERVING THESE COMMUNITIES:
(See the following pages for NY's Western, Central, and Eastern divisions.)

* Only part of town or village served by Company.

NY Western Division Service Area Cities, Towns, and Villages by County

Allegany
T Alma
T Andover*
T Centerville
T Cuba
T Independence
T New Hudson
T Scio
T Wellsville*
T Willing
V Cuba

Cattaraugus
C Olean
T Allegany
T Ashford
T Carrollton
T Cold Spring
T East Otto
T Ellicottville
T Farmersville
T Franklinville
T Freedom*
T Great Valley*
T Hinsdale
T Humphrey
T Ischua
T Little Valley*
T Lyndon
T Machias
T Mansfield
T Olean
T Otto
T Perrysburg*
T Portville
T Randolph*
T Redhouse
T South Valley
T Yorkshire*
V Allegany
V Cattaraugus
V Delevan
V Franklinville
V Limestone
V Portville

Chautauqua
C Dunkirk
T Arkwright
T Busti
T Carroll
T Charlotte
T Chautaugua*
T Clymer
T Dunkirk
T Ellery
T Ellicott
T French Creek
T Gerry
T Harmony
T Kaintone
T Mina
T North Harmony
T Poland
T Pomfret
T Portland*
T Ripley
T Sheridan
T Sherman
T Stockton
V Bemus Point
V Brocton*
V Cassadaga
V Celeron
V Falconer*
V Fredonia
V Lakewood
V Panama
V Sherman
V Sinclairville-Charlotte
V Sinclairville-Gerry
V Westfield*

Erie
C Buffalo
C Lackawanna
C Tonawanda
T Amherst*
T Brant
T Cheektowaga*
T Collins
T Eden
T Evans
T Grand Island
T Hamburg*
T Newstead*
T North Collins
T Tonawanda
T West Seneca*
V Angola
V Blasdell
V Depew-Cheektowaga*
V Depew-Lancaster*
V Ellicottville
V Farnham
V Kenmore
V Lancaster*
V North Collins
V Sloan-Cheektowaga*
V Williamsville-Amherst

Genesee
C Batavia
T Alabama
T Alexander
T Batavia
T Bergen*
T Bethany
T Byron
T Darien
T Elba
T LeRoy
T Oakfield
T Pavilion
T Pembroke
T Stafford
V Alexander
V Attica - Alexander
V Attica - Attica
V Corfu
V Elba
V LeRoy
V Oakfield

Livingston
T Avon
T Caledonia
T Conesus
T Geneseo*
T Groveland
T Lima
T Livonia
T York
V Avon
V Caledonia
V Lima
V Livonia

Monroe
T Clarkson
T Hamlin
T Mendon*
T Riga*
T Rush
T Sweden
V Brockport - Sweden
V Honeoye Falls
V Scottsville

Niagara
C Niagara Falls
C North Tonawanda
T Cambria
T Hartland
T Lewiston
T Lockport*
T Newfane
T Niagara
T Pendleton
T Porter
T Royalton
T Somerset
T Wheatfield
T Wilson
V Lewiston
V Middleport-Hartland
V Middleport-Royalton
V Wilson
V Youngstown

Ontario
T Canadice
T Richmond
T West Bloomfield
Orleans
T Albion
T Barre
T Carlton
T Clarendon
T Gaines
T Kendall
T Murray*
T Ridgeway
T Shelby
T Yates
V Albion - Albion
V Albion - Gaines
V Barker
V Holley
V Lyndonville
V Medina – Ridgeway
V Medina - Shelby

Wyoming
T Attica
T Covington
T Orangeville
T Wethersfield

NY Central Division Service Area Cities, Towns, and Villages by County

Cayuga
T Niles
Chenango
T Lincklaen
Clinton
T Black Brook
T Saranac*
Cortland
C Cortland
T Cortlandville
T Cuyler
T Homer
T Preble
T Scott
T Solon
T Truxton
T Virgil*
V Homer
V Homer-Cortlandville
V McGraw
Essex
T North Elba*
T St. Armand
V Bloomingdale
V Lake Placid - N Elba*
V Saranac Lake - N Elba
V Saranac Lk-St Armand
Franklin
T Altamont
T Bangor
T Belmont*
T Bombay
T Brandon
T Brighton
T Constable*
T Dickinson
T Duane
T Fort Covington
T Franklin
T Harrietstown
T Malone
T Moira
T Santa Clara
T Waverly
T Westville
V Brushton
V Fort Covington
V Malone
V Saranac Lake-Harr'town
V Tupper Lk-Altamont*
Fulton
T Oppenheim
T Stratford
T Malone
T Moira
T Santa Clara
T Waverly
T Westville
V Brushton
V Fort Covington
V Malone
V Saranac Lake-Harr'town
V Tupper Lk-Altamont*
Fulton
T Oppenheim
T Stratford
V Dolgeville*
Hamilton
T Arietta
T Inlet
T Long Lake*
T Morehouse
Herkimer
C Little Falls
T Columbia*
T Danube
T Fairfield
T Frankfort
T German Flatts
T Herkimer
T Litchfield*
T Little Falls
T Manheim
T Newport
T Norway
T Ohio
T Russia
T Salisbury
T Schuyler
T Webb
V Cold Brook
V Dolgeville - Manhiem
V Frankfort*
V Herkimer
V Ilion*
V Middleville-Fairfield
V Middleville-Newport
V Mohawk*
V Newport
V Poland - Newport
V Poland - Russia
Jefferson
C Watertown
T Adams
T Alexandria
T Antwerp
T Brownville
T Cape Vincent
T Champion
T Clayton
T Ellisburg
T Henderson
T Hounsfield
T LeRay
T Lorraine
T Lyme
T Orleans
T Pamelia
T Philadelphia*
T Rodman
T Rutland
T Theresa
T Watertown
T Wilna
T Worth
V Adams
V Alexandria Bay
V Antwerp
V Black River-LeRay
V Black River-Rutland
V Brownville
V Cape Vincent
V Carthage
V Chaumont
V Clayton
V Deferiet
V Dexter
V Ellisburg
V Evans Mills
V Glen Park - Brownville
V Glen Park - Pamelia
V Herrings
V Mannsville
V Philadelphia*
V Sackets Harbor
V Theresa*
V West Carthage
Lewis
T Constableville
T Croghan
T Denmark
T Diana
T Greig
T Harrisburg
T High Market
T Lewis
T Leyden
T Lowville
T Lyonsdale
T Martinsburg
T Montague
T New Bremen*
T Osceola
T Pinckney
T Turin
T Watson
T West Turin
V Castorland
V Constableville
V Copenhagen
V Croghan
V Croghan - New Bremen
V Harrisville
V Lowville
V Lyons Falls
V Lyons Falls - Lyonsdale
V Port Leyden
V Port Leyden-Lyonsdale
V Turin
Madison
C Oneida - Inside
C Oneida - Outside
T Cazenovia
T DeRuyter
T Fenner
T Lenox
T Lincoln
T Nelson
T Stockbridge
T Sullivan
V Canastota
V Cazenovia
V Chittenango
V DeRuyter
V Munnsville
V Wampsville
Oneida
C Rome Inside
C Rome Outside
C Utica
T Annsville
T Ava*
T Boonville*
T Camden
T Deerfield
T Florence
T Floyd
T Forestport
T Kirkland
T Lee
T Marcy
T New Hartford
T Paris

NY Central Division Service Area (Cont'd)

Oneida (cont'd)
T Remsen
T Steuben
T Trenton
T Vernon
T Verona
T Vienna
V Sherrill*
T Western
T Westmoreland
T Whitestown
V Boonville*
V Camden
V Sherrill*
V Clayville
V Clinton
V Holland Patent
V N Y Mills - Whitestown
V New Hartford
V NY Mills-New Hartford
V Oneida Castle
V Oriskany
V Prospect
V Remsen
V Remsen - Trenton
V Sylvan Beach
V Trenton
V Vernon
V Whitesboro
V Yorkville

Onondaga
C Syracuse
T Camillus
T Cicero
T Clay
T Dewitt
T Elbridge*
T Fabius
T Geddes*
T Lafayette
T Lysander
T Manlius
T Onondaga
T Otisco*
T Pompey
T Salina
T Skaneateles*
T Tully
T Van Buren*
V Baldwinsville-Lysander
V Baldwinsville-Van Buren
V Camillus
V E Syracuse
V Fabius
V Fayetteville
V Liverpool
V Manlius
V Minoa
V North Syracuse-Cicero
V North Syracuse-Clay
V Skaneateles*
V Solvay*
V Tully

Oswego
C Fulton
C Oswego
T Albion
T Amboy
T Boylston
T Constantia
T Granby
T Hannibal
T Hastings
T Mexico
T Minetto
T New Haven
T Orwell
T Oswego
T Palermo
T Parish
V Phoenix
T Redfield
T Richland
T Sandy Creek
T Schroeppel
T Scriba
T Volney
T West Monroe
T Williamstown
V Altmar
V Central Square
V Cleveland
V Hannibal
V Lacona
V Mexico
V Parish
V Pulaski
V Sandy Creek

St. Lawrence
C Ogdensburg
T Brasher*
T Canton
T Clare
T Clifton
T Colton
T DeKalb
T DePeyster
T Edwards
T Fine
T Fowler
T Gouverneur
T Hammond
T Hermon
T Hopkinton
T Lawrence
T Lisbon
T Louisville*
T Macomb
T Madrid
T Massena*
T Morristown
T Norfolk*
T Oswegatchie
T Parishville
T Piercefield
T Pierrepont
T Pitcairn
T Potsdam
T Rossie
T Russell
T Stockholm*
T Waddington
V Canton
V Edwards
V Gouverneur
V Hammond
V Hermon
V Heuvelton
V Massena*
V Morristown
V Norwood - Norfolk
V Norwood - Potsdam
V Potsdam
V Rensselaer Falls
V Richville
V Waddington

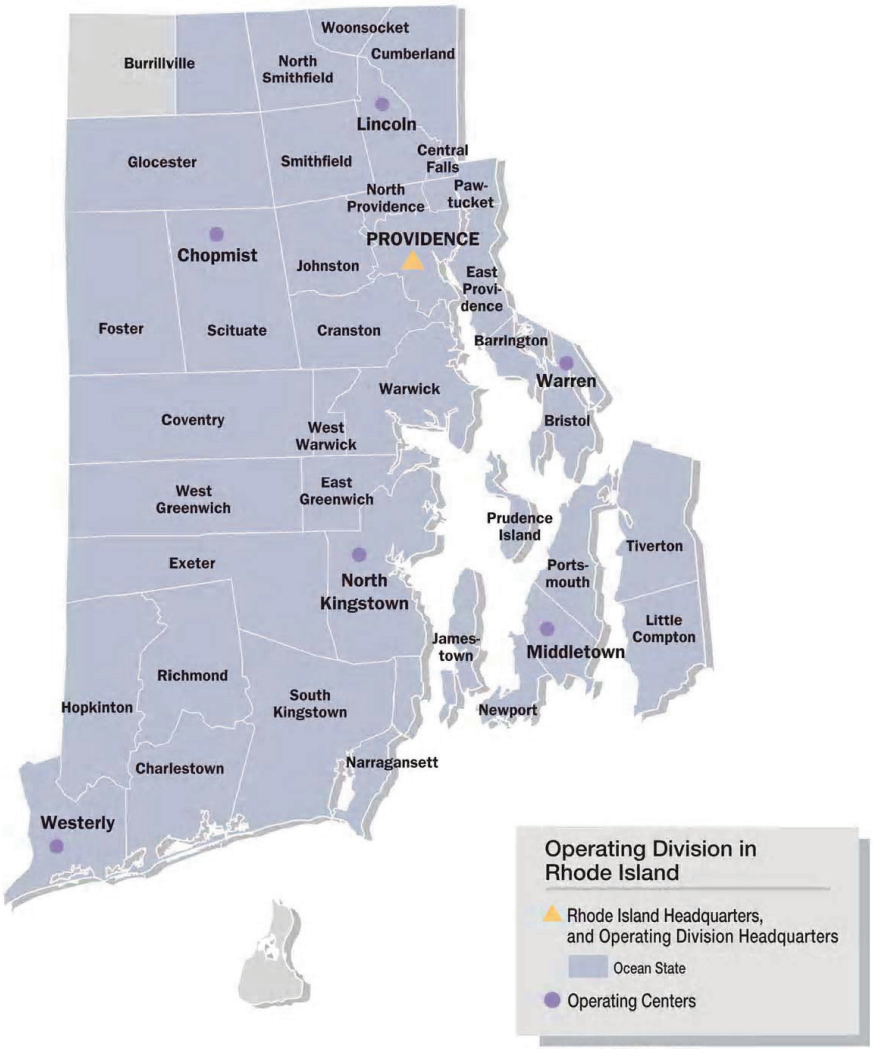
NY Eastern Division Service Area Cities, Towns, and Villages by County

Albany
C Albany
C Cohoes
C Watervliet
T Berne
T Bethlehem
T Coeymans*
T Colonie
T Guilderland
T Knox
T New Scotland
V Altamont
V Colonie
V Green Island
V Menands
V Voorheesville
Columbia
C Hudson
T Chatham*
T Claverack*
T Clermont
T Gallatin*
T Germantown
T Ghent
T Greenport
T Kinderhook
T Livingston
T Stockport
T Stuyvesant
T Taghkanic*
V Kinderhook
V Valatie
Essex
T Crown Point
T Minerva
T Moriah
T North Hudson
T Schroon
T Ticonderoga
T Westport
V Port Henry
V Ticonderoga
V Westport
Fulton
C Gloversville
C Johnstown
T Bleecker
T Broadalbin
T Caroga
T Ephratah
T Johnstown
T Mayfield
T Northampton
T Oppenheim
T Perth
T Stratford
V Broadalbin
V Mayfield
V Northville
Hamilton
T Arietta
T Benson
T Hope
T Indian Lake*
T Lake Pleasant
T Wells
V Speculator
Herkimer
T Danube
T Manheim
T Stark
Montgomery
C Amsterdam
T Amsterdam
T Canajoharie
T Charleston
T Florida
T Glen
T Minden
T Mohawk
T Palatine
T Root
T St. Johnsville
V Ames
V Canajoharie
V Fonda
V Fort Johnson
V Fort Plain – T Canajoharie
V Fort Plain – T Minden
V Fort Plain – T Palantine
V Fultonville
V Hagaman
V Nelliston
V Palatine Bridge
Otsego
T Cherry Valley
T Decatur
T Maryland
T Roseboom
T Worcester
V Cherry Valley
V Schenevus
Rensselaer
C Rensselaer
C Troy
T Brunswick
T E Greenbush
T Grafton
T Hoosick
T Nassau
T North Greenbush*
T Pittstown
T Poestenkill
T Sand Lake*
T Schaghticoke*
T Schodack
V Castleton
V Hoosick Falls
V Nassau – T Nassau
V Nassau – T Schodack
V Schaghticoke
V Valley Falls – T Pittstown
V Valley Falls – T Schaghticoke
Saratoga
C Saratoga Springs
T Ballston
T Charlton
V St. Johnsville
T Corinth
T Day
T Edinburgh
T Galway
T Greenfield
T Hadley
T Half Moon*
T Malta*
T Milton
T Moreau
T Northumberland
T Providence
T Saratoga
T Stillwater*
T Waterford
T Wilton
V Ballston Spa - T Ballston
V Ballston Spa - T Milton
V Corinth
V Galway
V Schuylerville
V So. Glens Falls
V Victory Mills
V Waterford
Schenectady
C Schenectady
T Duanesburg
T Glenville
T Niskayuna
T Princetown
T Rotterdam
V Delanson
V Scotia
Schoharie
T Blenheim
T Broome
T Carlisle
T Cobleskill
T Esperance
T Fulton
T Middleburg
T Richmondville*
T Schoharie
T Seward
T Sharon
T Summit
T Wright
V Cobleskill
V Esperance
V Middleburg
V Schoharie
V Sharon Springs
Warren
C Glens Falls
T Bolton
T Chester
T Hague
T Horicon
T Johnsburg
T Lake George
T Lake Luzerne
T Queensbury
T Stony Creek
T Thurman
T Warrensburg
V Lake George
Washington
T Argyle

NY Eastern Division Service Area (Cont'd)

T Cambridge
T Dresden
T Easton
T Fort Ann
T Fort Edward
T Greenwich
T Hampton
T Hartford
T Jackson*
T Kingsbury
T Putnam
T White Creek
T Whitehall
V Argyle
V Cambridge – T Cambridge
V Cambridge – T White
Creek
V Fort Ann
V Fort Edward
V Greenwich – T Easton
V Greenwich – T Greenwich
V Hudson Falls
V Whitehall
V Broadalbin
V Mayfield
V Northville

National Grid in Rhode Island:



https://www.nationalgridus.com/non_html/shared_about_svcmap_neco.pdf

SERVING THESE COMMUNITIES:

Adamsville
Albion
Allenton
Alton – Hopkinton
Alton – Richmond
Anthony
Apponaug
Arcadia – Exeter
Arcadia – Richmond
Arctic
Ashaway
Auburn
Avondale
Barrington
Belleville
Bonnett Shores
Boone Lake
Bradford – Hopkinton
Bradford – Westerly
Branch Village
Bristol
Browning Beach
Burrillville
Carolina – Charlestown
Carolina – Richmond
Centerdale
Central Falls
Centerville
Chepachet
Charlestown
Chopmist
Clayville – Scituate
Clayville – Foster
Conninicut
Cononchet
Coventry
Cowessett
Cranston
Crompton
Crossmills
Cumberland
Davisville
East Greenwich
East Providence
Edgewood
Escoheag – Exeter
Escoheag – West Greenwich
Esmond
Exeter
Fiskeville
Forestdale
Foster

Foster Center
Galilee
Glendale
Glocester
Great Island
Greene
Greenville
Greenwich Center
Georgiaville
Greystone
Hamilton
Harmony
Haversham
Hope - Cranston
Hope - Scituate
Hope - Coventry
Hope Valley
Hopkinton
Jamestown
Jerusalem
Johnston
Kenyon
Kingston
Lafayette
Lincoln
Lippitt
Little Compton
Lymansville
Manton
Manville
Mapleville
Marieville
Matunuck
Middletown
Misquamicut
Mohegan
Moores Field
Moosup Valley
Narragansett
Nasonville
Natick
Newport
North Kingstown
North Providence
North Scituate
North Smithfield
North Tiverton
Norwood
Oakland
Ocean Ridge
Pawtucket
Peacedale
Perryville
Pettasquamscutt
Point Judith
Pontiac
Portsmouth
Potter Hill
Providence
Prudence Island
Potowomot
Quonochontaug
Quonset
Rockland
Richmond
Rockville
Rumford
Saunderstown
Scituate
Shannock - Charlestown
Shannock - Richmond
Shawomut
Shelter Harbour
Slatersville
Slocum - Exeter
Slocum – North Kingstown
Smithfield
Snug Harbour
South Kingstown
Still Water
Thornton
Tiverton
Tucker Town
Union Village
Wakefield
Warren
Warwick
Washington
Watch Hill
Weekapaug
West Barrington
Westerly
West Glocester
West Greenwich
West Kingston
West Warwick
White Rock
Wickford
Wood River Jct
Woodville - Hopkinton
Woodville - Richmond
Woonsocket
Wyoming

Safety Information

National Grid is committed to the pursuit of safety excellence through compliance with all OSHA, State, and Regulatory requirements. We encourage the Customer or its Contractor to comply with the same requirements and for safe trenching.

811 is the nationwide number for utility locate requests before trenching; see:
http://www.call811.com/state-specific.aspx

In the New England states:

Dig Safe System, Inc.
1-888-DIG-SAFE or 811 MA - ME - NH - RI - VT

http://www.digsafe.com/
For Utility Locate Requests call: **1-888-DIGSAFE (344-7233)** or Apply Online

In Upstate New York:

Dig Safely. New York

Dig Safely and Dig Safely. New York are used under license from Dig Safe System, Inc.

http://www.digsafelynewyork.com/
Call center operators at Dig Safely New York are available 24 hours a day, seven days a week to receive and process calls to the toll-free phone number (**1-800-962-7962**).

The Electrical Safety Foundation International (ESFI):

ESFi

http://esfi.org/

For worker safety precautions as applicable for the installation, please refer to:

- NESC ANSI C2,
- NFPA 70E,
- OSHA, and
- any state and local requirements.

Contacting the Company

Please refer to the inside front cover for important phone numbers and our Internet Web sites for National Grid information in the USA.

Part A – "General Information"

Note: *The information provided in Part A contains common general conditions of electric service based upon state laws and regulations that govern the authority of utilities to provide electric service under applicable tariffs. While each utility's requirements may vary from state-to-state, most states have adopted some form of the National Electrical Safety Code (NESC). The NESC is an adoptable code promulgated by IEEE through the ANSI standards-making process.*

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to provide National Grid's general electric service rules for basic requirements essential for maintaining satisfactory service or interconnection compatible with National Grid's electric power system (EPS). In addition, these rules are intended to properly protect the safety and interests of National Grid's customers and others served by the electric power system (EPS) operated by the utility. Where the term "Company" is used, it refers to the applicable serving utility within National Grid's service territories. These basic rules are supplemented by the applicable tariffs in effect in each of the Company's service territories, as such tariffs may be amended from time to time.

1.2 SCOPE

These electric service requirements cover conductors and equipment connecting the Company's EPS at the Customer's service point. These also include other topics associated with the supply of electricity that are of mutual interest to the Company, customers, design professionals, and qualified installers. It should be noted that this is not a complete set of rules governing the electrical premises wiring and equipment.

1.3 RATE SCHEDULE

Electric tariffs and associated rules and regulations are on file with the applicable state regulatory agencies and are also available for download from the Company's website for each state. The following are the associated National Grid tariffs for these specifications, as such tariffs may be amended from time to time:

- In Massachusetts, "Terms and Conditions for Distribution Service"
- In New Hampshire, "Tariff for Retail Delivery Service"
- In New York, P.S.C. No. 220, "Schedule for Electric Service"
- In Rhode Island, "Terms and Conditions for Distribution Service"

1.4 COOPERATION AND TIME REQUIREMENTS

The Customer, its authorized agent and/or design professional is responsible for cooperating with the Company and permitting a thorough and proper technical review by the Company for acceptance and timely delivery of the Company's services. Preliminary information leading to new or increased electric service requirements shall be submitted to the Company early in the planning stages. This will insure proper design and scheduling coordination of the work associated with the service connection.

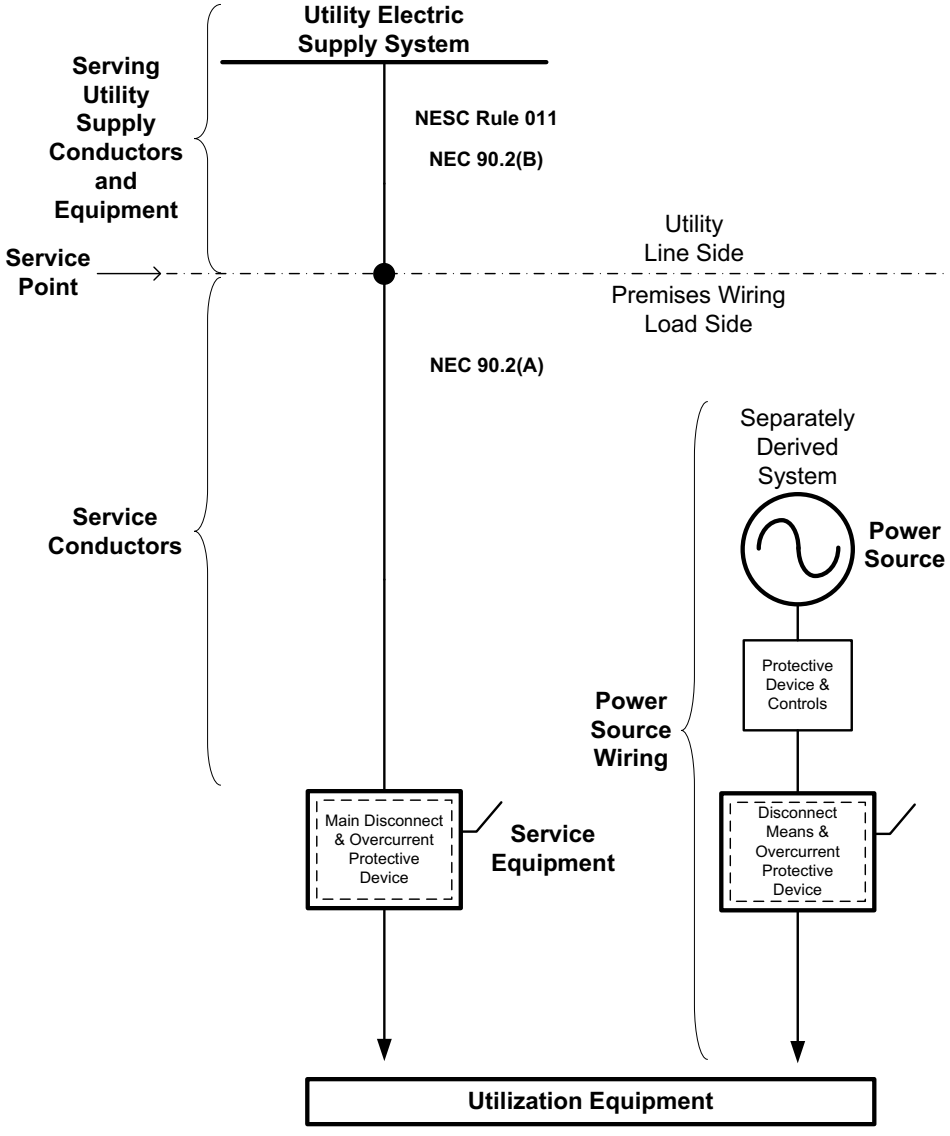
1.5 CODES, STANDARDS, AND REFERENCES

These rules supplement, and may exceed standards of safety regarding the Customer's electrical installation set forth in the National Electrical Code (NEC) and the National Electrical Safety Code (NESC) and other applicable codes. These rules are not a substitute for the NEC, NESC, municipal codes, or any other authority having jurisdiction.

The Company requires that the Customer's premises wiring installations be made in accordance with all applicable codes and these rules. Service shall be denied if these codes and the Company's rules are not met. The Company accepts no liability for direct or indirect damages resulting from the Company's refusal to energize a service or the Company's termination of a service that does not meet these rules and all other applicable codes.

The following is a general illustration of where the Company's electric supply and the Customer's premises wiring meet for what is covered and what is not covered by the NEC as described in NEC Section 90.2. Local conditions of service may permit the Company's metering to be installed at any point on either side of the service point; see 90.2(B)(5) in the NEC. Conditions of electric service are based on governmental laws or regulations that determine the Company's authority to provide electric service under their tariffs. These conditions of electric service affect the location of the service point and facilities under the Company's exclusive control.

FIGURE 1.5-1 – ILLUSTRATION UTILITY ELECTRIC SUPPLY AND PREMISES WIRING



1.5.1 References

NFPA 70	National Electrical Code
NFPA 70B	Recommended Practice for Electrical Equipment Maintenance
NFPA 70E	Standard for Electrical Safety in the Workplace
ANSI/IEEE C2	National Electrical Safety Code
Building Code	States of MA, NH, NY, and RI
Massachusetts General Laws:	Chapter 82, Section 40A Chapter 164, Section 127 & 127A Chapter 166, Sections 21A-21G Chapter 266, Section 30 Chapter 266, Section 127
New Hampshire Revised Statutes:	Chapter 374, Sections 48-56 Chapter 539, Section 7
New York State Laws	Public Service Law, Chapter 48 of the Consolidated Laws High Voltage Proximity Act, contained in Labor Law, Chapter 31 of the Consolidated Laws, Section 202-h 16 NYCRR, Rules and Regulations of the Department of Public Service
General Laws of Rhode Island:	Chapter 35, Sections 11-35-4, 11-35-5, 11-35-6, 11-35-7, 11-41-1, 11-41-5, 11-41-6 Chapter 39-1.2, Sections 1-14
Federal Occupational Safety and Health Administration (OSHA)	29 CFR 1926.550(a)(15) 29 CFR 1926.651 (a) 29 CFR 1910.333 (c)
Excavation Notification Requirements - Dig Safe	In MA, NH, RI: 1-888-DIGSAFE (344-7233) In NY: 1-800-962-7962 811 is the nationwide number; see http://www.call811.com/state-specific.aspx

1.5.2 Supplemental Company Specifications

ESB No. 751	General Requirements Above 600-volt Service
ESB No. 752	Service above 15,000 volts
ESB No. 753	Primary Meter Pole
ESB No. 754	Outdoor Pad Mounted or Vault Enclosed Three Phase Transformer
ESB No. 754A	Single Phase Outdoor Pad Mounted Transformer
ESB No. 755	Operation & Maintenance Requirements for Service Above 600 volts
ESB No. 756	General Requirements for Parallel Generation Connected to a National Grid Owned EPS
- Appendix A	Requirements for Parallel Generation Connected to National Grid Facilities in NY
- Appendix B	Requirements for DG Connected to National Grid's Radial Distribution per the NYS SIR
- Appendix C	Requirements for Parallel Generation Connected to National Grid Facilities in Massachusetts
- Appendix D	Requirements for Parallel Generation Connected to National Grid Facilities in Rhode Island
- Appendix E	Requirements for Parallel Generation Connected to National Grid Facilities in New Hampshire
ESB No. 757	Network Services
ESB No. 758	Primary Service to Metal Enclosed Gear
ESB No. 759	Underground Distribution Guidelines
ESB No. 759A	Underground Residential Distribution Guideline
ESB No. 759B	Underground Commercial Distribution Guideline

See these Electric System Bulletins at **http://www.nationalgridus.com/electricalspecifications**

1.6 REQUESTS FOR INFORMATION

The Company invites inquiries and will assist the Customer with the application of these rules. Refer to the "Process and Information" section in the beginning of this book.

1.7 CUSTOMER'S RESPONSIBILITY

1.7.1 All Customers

The Customer shall provide the service entrance, in accordance with the Company's requirements, and all premises wiring on the load side of the service point. At all times, the Customer is responsible for ensuring that its electrical interconnection facilities attached to the Company's EPS are designed, installed, operated, and maintained in accordance with all applicable codes, standards, rules, regulations, statutes, governmental ordinances, and third party permits (collectively referred to as all applicable requirements). The Customer is responsible for contacting all third parties and obtaining all applicable permits (including environmental if required), approvals and inspections, and underground facility locating services for its premises wiring installation. Documentation substantiating the completion of such activities shall be furnished to the Company upon request.

The Customer shall assume or delegate, to an authorized representative, the primary responsibility for approval and acceptance of its equipment and the timing of its installation. The Company cannot accept any responsibility for the condition of the Customer's premises wiring and equipment. The Customer is responsible for and the cost of on-going compliance with all applicable requirements noted above as well as any and all system design and operating changes to its installation.

1.7.2 Customers served at voltages above 600 volts

1.7.2.1 Design Acceptance

The planning and design of electric service equipment at voltages above 600 volts requires skilled application of engineering principles and data to ensure proper interconnection and functionality with the utility electric supply system and to ensure safe operation and maintenance of the equipment following installation. Therefore a Professional Engineer, licensed in the state where service is made, shall prepare all documents submitted to the Company in connection with all electric service equipment above 600 volts. This requirement applies to new installations and alterations to existing installations. Designs involving alterations to existing electric service equipment shall include retrospective review of the original design to ensure the alteration will function properly.

This requirement is described in ESB 751 and applies to all submittals detailed in ESB's 752, 753, 756 and 758, at all stages of a project, from initial conceptual planning through the final for-construction design that is accepted by the Company. All drawings shall be prepared in conformance with ANSI Y32.2, IEEE 141, and IEEE 446 symbol and drafting nomenclature.

Signature, license number, seal, or letterhead with return address, as appropriate, will suffice as evidence of preparation by a licensed PE. Documents not evidencing preparation by a licensed PE will be returned to the submitter without comment for resubmittal to the Company.

1.7.2.2 Operation and Maintenance

Customers owning electric service equipment above 600 volts shall operate and maintain such equipment in accordance with Company supplied operating instructions and specifically ESB 755, "Operation and Maintenance Requirements for Services above 600 volts."

1.8 COMPANY'S RESPONSIBILITIES

The electric supply and service installation provisions and costs shall be in accordance with the Company's filed tariffs.

These specifications are subject to revision without notice. They may be revised or amended as the Company shall determine, or as required by developments of the industry to protect the mutual interests of the Customer and Company. The latest revision shall be used. Additional copies of these specifications and any errata can be obtained from the Company; also see Section 1.5 for Company supplemental specifications.

1.9 INSPECTION, WIRING ADEQUACY, AND ENFORCEMENT

The Company requires the Customer to furnish satisfactory evidence of the safe condition of its wiring before any service is connected. This will be in the form of an electrical inspection approval certificate from the authority having jurisdiction (AHJ) or an inspection agency approved by the AHJ and the Company. Inspections shall confirm compliance with the National Electrical Code, any applicable municipal codes, and any specific utility service rules that are in addition to the aforementioned codes. The Company and its accepted inspection organizations have the authority for enforcement of these rules.

To re-energize a service that has been disconnected for an unsafe condition by any AHJ mandate or by the Company, the Customer must provide an electrical inspection certificate from an approved inspection agency to the Company prior to reconnection.

The Company requires certificates of inspection:

- On all new services and
- To re-energize any existing service that has been de-energized by any disconnect method (cutting service lateral conductors at pole or weatherhead, meter removal, etc.) for any of the reasons or durations listed below:

    1. an emergency,
    2. theft of service,
    3. duration exceeding twelve months,
    4. following 36 months of service inactivity, and
    5. when premises wiring (system) is replaced, altered or extended.

1.10 DISCLAIMER

1.10.1 Company Approval

The Company's approval of the Customer's installation constitutes the Company's acceptance of the Customer's proposed arrangement and equipment as meeting the Company's minimum requirements under these rules and does not relieve the Customer from the obligation of complying with all applicable codes, statutes, rules or regulations.

1.10.2 Use of Electricity

The Company shall not be liable for damage to the person or property of the Customer or any other persons resulting from the use of electricity or the presence of the Company's equipment on the Customer's premises. Relative to any information supplied by the Company in connection with a customer, it must be understood that the Company's EPS is a dynamic system that changes from moment to moment as demands are made to the system. Furthermore, permanent changes to the system are common which will change the information provided to Customers or their Agents. Although the Company makes every reasonable effort to obtain reliable information and proper calculations, the Company provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of data furnished to Customers or their Agents. National Grid reserves the right to make improvements, upgrades or other changes to the electric system without notice. Such changes may invalidate any information provided.

1.10.3 Condition of Service

The Company shall not be liable for, or in any way in respect of, any interruption, abnormal voltage, discontinuance, or reversal of its service, due to causes beyond its immediate control whether accident, labor difficulties, condition of fuel supply, the decision of any public authority, or failure to receive any electricity for which in any manner it has contracted, or due to the operation in accordance with good utility practice of any emergency load reduction program by the Company or one with whom it has contracted for a supply of electricity, or inability for any other reason to maintain uninterrupted and continuous service; provided, however, that under the terms of the Company's applicable tariff if the Company is unable for any of the causes enumerated above to supply electricity for a continuous period of two (2) days or more, then upon request of the Customer, the Demand Charge, if any, shall be suspended for the duration of such inability.

1.10.4 Company Warranty Statement

For all voltages and services, the Company will cooperate with its customers or their representatives. However, neither by inspection, nor by the rendering of advisory service, nor in any other way, does the Company give any warranty, expressed or implied, as to the adequacy, safety, or other characteristics of any equipment, wires, appliances, or devices owned, used, or maintained by Customers.

1.11 ENFORCEMENT OF COMPANY REQUIREMENTS

1.11.1 Enforcement Criteria

The Company and the local AHJ have the authority to enforce these specifications. The Company's Specifications for Electrical Installations Committee has the responsibility for: making interpretations of the rules, deciding upon the approval* of equipment and materials, and granting the special permissions contemplated in a number of the rules.

Alternative construction methods not covered in these specifications must be submitted to the Company in writing and be approved* by the Company prior to purchase and/or installation of equipment. The Company shall only grant deviations from these specifications in writing.

Exceptions from the NEC or other codes shall only be granted in writing by the local code authority exercising jurisdiction and filed with the Company.

***Note:** See Section 2 for the definition of the term "Company approval". The Company does not "approve" all aspects of the Customer's equipment or premises wiring installation.*

1.11.2 Diversion of Electrical Energy

A diversion of electrical energy is any method or device used by any person that prevents an electric meter from duly registering the quantity of electricity supplied by the Company and/or the taking of any electrical current without the Company's consent.

Where there is evidence of meter tampering or theft of electrical energy, the responsible person or persons shall be liable for prosecution under penalty of law.

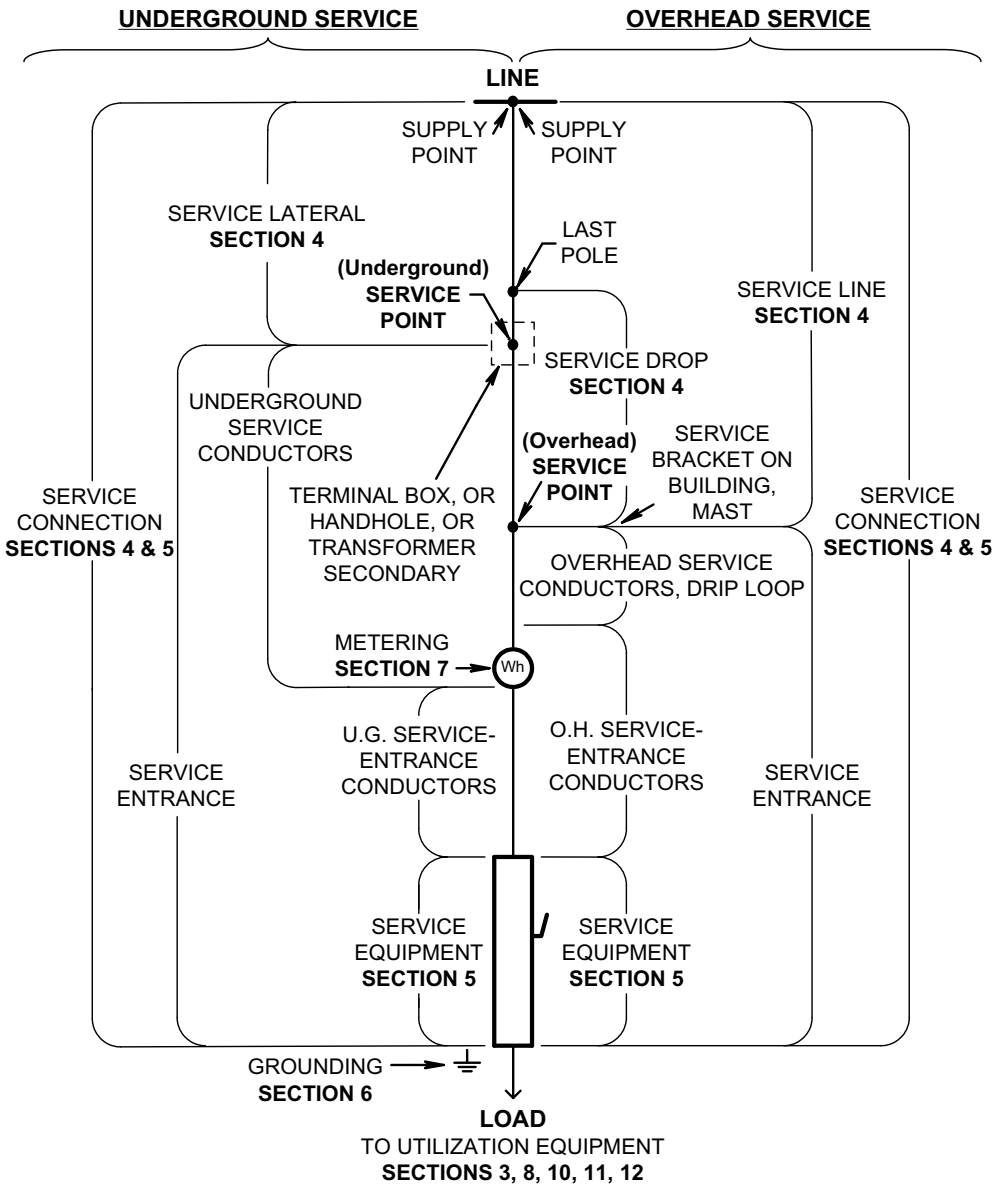
2.0 DEFINITIONS

Notes:

(1) The following are terms defined as used in this publication.

(2) For graphical relationship of defined components and section references in this book, see Figure 2-1.

Figure 2-1: Typical Service Installation Diagram Below 600 volts – Excluding Network



Applicant: Any entity (individual, firm, partnership, corporation, association, municipality, or governmental body) requesting a new service from the Company for their own use and not for resale or delivery to others.

Note: The Company must be consulted for specific Applicant rules as they apply in the Company's applicable tariff.

Area Lighting (Utility): A utility lighting distribution system that provides lumens on public or private property. (See NEC 90.2(A) where area lighting is not under the exclusive control of utilities and see the NESC for information that covers area lighting under the exclusive control of utilities.)

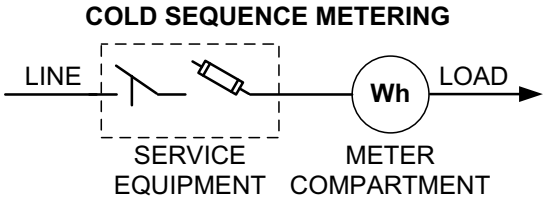
Authority Having Jurisdiction (AHJ): Governmental bodies or their Agent exercising legal jurisdiction over applicable codes.

Back-up Service: A service type provided during an unscheduled outage of the Customer's facility, up to the portion of Customer's electrical requirements supplied by the Customer's facility.

Building: A structure which stands alone or which is cut off from adjoining structures by approved fire walls with all openings therein protected by approved fire doors.

Clearance: Required separation mandated by codes or the Company.

Cold Sequence metering: Metering equipment located on the Customer's side of the service equipment.



Company: The electric utility companies doing business as National Grid to which these requirements apply are:

- Granite State Electric Company
- Massachusetts Electric Company
- The Narragansett Electric Company
- Nantucket Electric Company
- Niagara Mohawk Power Corporation

Company Approval: Acceptance for the minimum requirements of National Grid exclusive of the Customer's obligation of complying with all applicable codes, statutes, rules or regulations. (See 1.10.1.)

Customer: An existing user of recurring electric service. (A contractor or developer performing work on behalf of a Customer is considered an agent of the Customer.)

Seasonal Customer: A Customer who applied for and receives the Company's service periodically each year, intermittently during the year, or at other irregular intervals.

Design Professional: A Professional Engineer (PE) licensed to practice in the state where service is being installed and who is directly retained by the Customer for that purpose. (If the state licensed PE is representing a multi-member design firm, the firm shall have state certification to practice professional engineering and a copy of such license must be provided to the Company upon request. Any Company requested design professional certification proof must be submitted to the Company in writing upon initial design submission.)

Distribution Line: A distribution line is an electric line, either overhead or underground, including the necessary and ancillary accessories to distribute electric energy, which may provide service to more than one customer. A distribution line may be located (1) in a street, highway, alley, or (2) on private right-of-way when used or useful to supply two or more customers at separate premises.

Drip Loop: Individual conductors formed to prevent the entrance of moisture, and which provide adequate length to meet the Company's and applicable code requirements.

Electrical Inspector: Inspectors external to the Company who are approved by the municipality in which they are working and recognized by the Company. Electrical Inspectors are responsible for ensuring that the installation complies with all applicable codes and Company requirements, service equipment, material, installations, and/or procedures.

Electric Service: Maintenance by the Company of the appropriate voltage and frequency at the point of delivery shall constitute the delivery of electric service to the Customer. (See Service.) Emergency: An unplanned natural or accidental event that affects existing electric service.

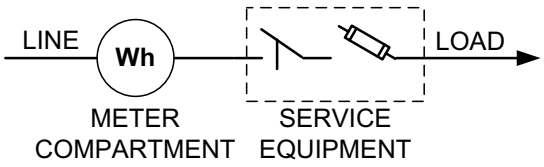
Emergency Power System: A system legally required and classed as emergency by codes or any governmental agency having jurisdiction that automatically provides an independent reserve source of electricity, upon failure or outage of the normal power source, to elements of a power system essential to the safety of human life.

Exclusive Control: Generally covers installation, ownership, restricted access, operation, and maintenance by qualified and authorized persons.

Fire Wall: A wall separating buildings or subdividing a building to prevent the spread of fire and having a fire resistance rating and structural stability as determined and approved in writing by the AHJ.

Hot Sequence metering: Metering equipment located on the Company's side of the service equipment.

HOT SEQUENCE METERING



Line: A system of poles, conduit, wires, cables, transformers, fixtures and accessory equipment used for the distribution of electricity to the public. A line may be located: (1) in a street, highway, alley; or (2) on a private right-of-way when used or useful to supply two or more customers at separate premises.

Maintenance Service: A scheduled service for the Company to perform maintenance on the Customer's equipment, during a Customer's planned outage. Such service shall be pursuant to written agreement and, normally, scheduled at least one month in advance with the Company. Manufactured Home: A factory assembled structure or structures transportable and designed to be used as a dwelling unit with a permanent foundation acceptable to the local AHJ.

Mobile Home: A factory assembled structure or structures transportable on their own running gear and designed to be used as a dwelling unit(s) without a permanent foundation.

Multiple Residential Occupancy Building: A structure, including row houses, enclosed within exterior walls or fire walls, which is built, erected and framed of component structural parts and is designed to contain four or more individual dwelling units for permanent residential occupancy.

Point of Attachment: The location of the service drop conductors to a building or structure provided by the Customer and installed to maintain clearances specified by the NEC (Article 230) and by the Company's requirements. (Service conductors are supported by mechanical attachment to the building or structure.)

Premise: A premise is a unified, undivided parcel of real property under the Customer or Applicant's control through ownership or lease which is not separated by a public road, right of way, or property belonging to another entity. A premise may or may not contain buildings or structures within the real property.

Premises: The land and buildings of the Customer located on the Customer's side of the service point.

Primary: The Company's distribution systems typically operating over 600 volts.

Recreational Vehicle: A vehicular type unit primarily designed as temporary living quarters for recreational, camping, or travel use, which either has its own motive power or is mounted on or drawn by another vehicle. These include: travel trailer, camping trailer, truck camper, and motor home.

Recreational Vehicle Park: Sometimes called "Trailer Park", is an accommodation for Recreational Vehicles where individual site occupancy is normally of short duration. Restricted Access by the Company. Areas where exclusive control by the Company is maintained.

Secondary: The Company's distribution systems typically operating at 600 volts or below.

Separately Derived System: A premises wiring system whose power is derived from another source of electricity and that has no direct electrical connection, including a solidly connected grounded circuit conductor, to the service.

Service: The conductors and equipment for delivering energy from the Company's distribution line to the wiring system of the Customer served. (*See Electric Service.*)

> **Residential Service:** Service to one or more dwelling unit(s) providing complete and independent living facilities for one or more persons and which include permanent provisions for sleeping, cooking, and sanitation.
>
> **Non-Residential Service:** All service types other than residential.

Service conductors: The conductors from the service point to the service equipment of the Customer supplied by the Company.

> **Overhead Service Conductors:** The overhead conductors between the service point and the first point of connection to the service-entrance conductors at the building or other structure.
>
> **Underground Service Conductors:** The underground conductors between the service point and the first point of connection to the service-entrance conductors in a terminal box, meter, or other enclosure, inside or outside the building wall. (Where there is no terminal box, meter, or other enclosure, the point of connection is considered to be the point of entrance of the service conductors into the building. Underground service conductors are not supplied by the Company.)

Service connection: One service lateral or service line and its associated service entrance. Service drop: The overhead conductors between the last pole or other aerial support of the Company's electric supply line up to and including the splices connecting to the service point's service entrance conductors at the building or other structure.

Service entrance: That part of the Customer's wiring from the point of attachment or termination of the service lateral or service line to and including the service equipment.

Service entrance conductors: The wires or cables between the service conductors and the service equipment.

> **Overhead System Service-Entrance Conductors:** The service conductors between the terminals of the service equipment and a point usually outside the building, clear of building walls, where joined by tap or splice to the service drop or overhead service conductors.
>
> **Underground System Service-Entrance Conductors:** The service conductors between the terminals of the service equipment and the point of connection to the service lateral or underground service conductors. (Where service equipment is located outside the building walls, there may be no service-entrance conductors or they may be entirely outside the building.)

Service equipment: The Customer's necessary disconnecting and protective equipment intended to constitute the main control and cutoff of the supply from the service point. This consists of a circuit breaker(s) or switch(es) and fuse(s) and their accessories connected to the load end of service conductors. The service overcurrent device shall be an integral part of the service disconnecting means or shall be located immediately adjacent thereto.

Service Head: For cable in conduit risers, a service head is one that is raintight and listed for the purpose for preventing water from entering service entrance conductors, raceway, or equipment.

Service line or lateral: The Company's electric line including the necessary and ancillary accessories to connect a distribution line to an individual customer's meter or point of attachment. (A service line or service lateral, at the Company's discretion, may be connected to two or more meters at a single premise. Wiring along the outside of the Customer's house or building shall not be included in the service line or service lateral.)

> **Service line:** The overhead conductors between the utility electric supply system and the service point. (A service line does include a service drop.)
> **Service lateral:** The underground conductors between the utility electric supply system and the service point.

Service Point: The point of connection between the facilities of the Company and the Customer's premises wiring. (The service point can be described as the point of demarcation between where the serving utility ends and the premises wiring begins. The serving utility generally specifies the location of the service point based on their conditions of service. Refer to Figures 1.5-1 and 2-1.)

Service Riser Mast: A rigid metal conduit containing service entrance conductors that supports the service drop to maintain required vertical clearance.

Service Riser Pole: The Company's pole where the Customer's underground service conductors emerge to connect to the Company's overhead distribution line or transformer.

Short-term service: A service that is recurrently required only for short periods each time, either periodically each year, intermittently during the year, or at other irregular intervals.

Standby Power System: An alternate source of electricity incorporating necessary transfer equipment intended to supply power to selected loads upon loss of the normal power supply.

Supervised Installation: Conditions of maintenance and supervision ensure that only qualified persons monitor and service the system continuously provided by a single building management.

Supplemental Service: A service type provided to meet the Customer's electrical requirements in excess of on-site generation.

Supply Point: The point of connection of the Company's service lateral or service line and the facilities of the Company.

Temporary Service: A non-recurring service intended to be used for a short time only, not to exceed one year for residential or two years for commercial applications. (Temporary service can be to a non-permanent structure or personal property, or to a building or structure which is non-permanent in that it may be readily removed or relocated, or as a preliminary connection toward the establishment of permanent service.)

Underground Commercial Distribution (UCD): An underground electrical supply system using at-grade transformers and switchgear to serve commercial or industrial customers.

Underground Residential Distribution (URD): An underground electrical supply system using at-grade transformers and switchgear to serve five or more residential customers.

Utilization Equipment: An electrical installation that uses electric or light energy for electronic, electromechanical, chemical, heating, lighting, testing, communication, signaling, or similar purposes on the premises wiring side of the service point. (Performed under the NEC.)

Weatherhead: A weatherhead for service entrance cable installations is a manufactured raintight service head listed for the purpose as permitted according to the NEC.

3.0 GENERAL SERVICE CONNECTION REQUIREMENTS

3.1 APPLICATION FOR SERVICE

3.1.1 Application

Application for a new or changed service may ordinarily be made by mail, facsimile, telephone call to the Company, or by means of the Company's Internet Web site. Refer to the "Process and Information" section at the beginning of this book. Written application will be required when a service is taken from a line extension or when otherwise mandated by the provisions of the applicable tariff.

An applicant must make a separate application for each point of delivery and metering point, and for each class of service desired. That is, for each separate residence, apartment, business, building, structure, or premise where electric service is desired, a separate application is required. The Company will extend facilities to "premises" specifically identified on municipal tax maps.

Application should be made as far as possible in advance of the date the new or changed service is required to assure time for engineering, ordering of material, and construction. Delivery of equipment, depending on size and voltage rating, may take considerable time. A plot plan designating the location of buildings or additions should be provided with new electric load data.

3.1.2 Public grants and special permits

In many cases, public grants or special permits must be obtained by the Company from the local governmental authority where it is required that a service be run over, under, or along a public way. In some instances these grants and permits can be obtained only after public hearings are held. In such cases, delays in service connections can be avoided or curtailed by applying to the Company for service at the earliest possible date.

3.1.3 Easements

As a condition of service, the Applicant or Customer must provide the Company with an easement(s), properly executed by all owners of record drafted by the Company, for all Company owned facilities located on private property (to include User or Private Roads (NY) and Private Ways (MA, NH, RI)), whether or not such private property is owned by the Customer. The Applicant or Customer will provide such easement(s) prior to the start of the Company's construction and at no cost to the Company. The Applicant or Customer shall provide a copy of its mortgage and deed, together with a copy of the survey and/or plan of record, for the Company's use in preparation of the easement(s) as well as any other documents necessary for the Company to prepare such easement(s).

3.2 NUMBER OF SERVICES

3.2.1 With Respect to Building and Premise

One alternating current service will normally be installed to a building or structure on a premise.

3.2.2 Electricity Delivered Through More Than One Meter

Where electricity is delivered through more than one meter, the cost of service delivered through each meter will be computed separately.

3.2.3 Multiple Service Requests

Multiple service requests, by their nature, often impose complex issues with respect to state laws and the Company's obligations. For these requests the concepts of premise, building, and necessity, need to be evaluated individually. These key considerations require a prospective Customer contemplating such a multiple service request to contact the Company prior to proceeding with either a formal electric service request or project plans assuming such an arrangement. Even if approved by the AHJ, the Company will make the final determination as to whether multiple services will be permitted. To aid in the assessment of the above items, the Customer shall provide written documentation from the local AHJ over building and electrical codes indicating that the building or structure under consideration is approved by the AHJ for a multiple electric service arrangement. At a minimum, the AHJ's written approval shall state suitability in accordance with all provisions in effect of the applicable Fire Prevention and Building Code and National Electrical Code including local ordinances.

When the above documentation has been received and the Company approves of a multiple electric service arrangement, the Company will provide specific requirements for each service point. The Company recommends the Customer consult its building insurance carrier regarding the potential liabilities associated with specific multiple service point proposals.

In addition, as required by the Company's applicable tariff, the Customer shall reimburse the Company for any distribution facilities requested for the Customer's convenience that the Company deems to be over and beyond what is necessary in order to provide service to the Customer. The Company is under no obligation, however, to provide such facilities. Mutual agreement is required between the Customer and the Company. The Company will provide estimates for any cost contribution required for providing additional service(s) in accordance with its applicable tariff. A construction advance may be required. If a Customer desires more than one service in order to separately meter another building on the same premise, and if this building could otherwise be supplied through the one meter and if the Company allows such additional service, the Customer shall pay the entire cost of installing the additional service according to the Company's applicable tariff.

3.3 TEMPORARY SERVICE

3.3.1 Company Facilities

Temporary service facilities may include a line extension, a service lateral, installation of transformers, meter facilities, and other work by the Company. Examples of temporary service are those supplied to non-permanent structures, during the construction of permanent structures or projects, or for short-term service to carnivals, exhibits, decorative lighting, etc. Customer installations considered unsafe by the Company will not be energized.

3.3.2 Location

The temporary structure shall, whenever possible, be located adjacent to the permanent building so that the service may be transferred to the point of permanent attachment when the construction is completed. Typical overhead and underground temporary services are shown in Section 4.

3.3.3 Equipment

Service entrance, meter and other wiring on temporary installations are to be installed in the same manner as required for permanent installation with respect to service-drop clearances, metering, grounding, and safety. Service entrance equipment shall be installed on a structure; see Sections 4 and 5. Inspections and approval by an authorized inspection organization shall be required prior to the Company making the service connection. The Customer shall be required to provide a substantial and adequate support, guyed if necessary.

3.3.4 Duration

Temporary service shall be permitted for holiday decorative lighting, carnivals, and for similar purposes for the ninety (90) day period permitted by the NEC. Temporary service for residential home construction shall be permitted for a period not to exceed one (1) year or two (2) years for commercial construction depending upon the applicable Company tariff.

When temporary service is a result of an emergency, the permanent service shall be re-certified according to these specifications by an authorized NEC inspector within five (5) business days.

3.3.5 Cost

In accordance with the Company's applicable tariff, the Customer may be required to pay in advance the estimated cost of installing and removing the temporary service. Estimates of the cost for temporary service to commercial and industrial installations may be obtained from the Company's Customer Order Fulfillment (or the Account Manager, if applicable). If any such installation presents unusual difficulties as to metering the service supplied, the Company may estimate consumption for purposes of applying the rates as set forth in the applicable Company tariff.

3.4 ACCESS

In accepting service, the Customer grants to identified Company employees and agents the right of personnel, vehicle, and equipment access to the Customer's premises at all reasonable times for such purposes as the reading of meters, inspection of meters, and installing, operating, maintaining, disconnecting and removing, any or all of the property belonging to the Company. Such access shall be suitable for its intended purpose.

When the Company's conductors supply a building or structure, these conductors shall not pass beneath or through the interior of another building or structure. Any Customer building or structure shall not encroach on the Company's line conductors and line equipment, except where transformer vaults are installed within the building served.

The Company may discontinue service after reasonable notice, if access to its meters or other equipment is unreasonably refused, obstructed, or hazardous. The Customer may also be assessed a charge if access is prevented or hindered.

3.5 IDENTIFICATION OF EMPLOYEES

Employees of the Company, or its agents, authorized to visit the premises of its Customers, are furnished with photographic Company identification, which they will show upon request.

3.6 CHARACTER OF SERVICE

The Customer shall inquire of the Company as to the type of service to be supplied prior to the purchase of electrical equipment or before proceeding with its wiring installation. In response to such inquiry, the Company will designate the type of service and delivery voltage based on the location of the Customer and the size and character of its proposed load. Special consideration will be given to the selection of the type of service to supply electric motors, furnaces, welders, x-ray apparatus and other loads, which may interfere with satisfactory service to other customers. Normally only one service is provided to a premise. For multiple services to a building see Section 3.2.

3.7 VOLTAGES AVAILABLE

3.7.1 Available Services

All new services will be 60 Hertz, single phase or three phase alternating current designated by the Company. The following types of service in Table 3.7.1-1 are generally standard but not all types are available at all locations. To find which are available, please consult the Company. This must be done before any wiring is installed or equipment purchased.

To serve residential, commercial and industrial loads, one of the voltage services 600 volts and less, listed in Table 3.7.1-1, will be supplied at the Company's designation.

Table 3.7.1-1 - Available Services Below 600 volts

Phases	Wires	Company's Delivery Voltage (volts)	Company's Typical Voltage Delivery Levels		Note
			Minimum Customer Load (kVA)	Maximum Customer Load (kVA)	
1	3	120/240	None	100	1.
1	3	120/208	None	20	2.
1	3	277/480	None	50	3.
3	4	208 wye/120	None	300	4.

Phases	Wires	Company's Delivery Voltage (volts)	Company's Typical Voltage Delivery Levels		Note
			Minimum Customer Load (kVA)	Maximum Customer Load (kVA)	
3	4	208 wye/120	None	1000	
3	4	480 wye/277	None	500	4.
3	4	480 wye/277	None	2500	5.

Notes to Table 3.7.1-1:

1. Single-phase, 120/240 volt service is limited to 50 kVA maximum where utilization equipment includes individual motors not over 6-1/2 HP. Self-contained meter socket applications are limited to 72kW demand.
2. Where the present service is three phase, 4 wire, 208 wye/120 volts. Exception: In Network areas where standard service voltage is three-phase, 4 wire, 208 wye/120 volts, demand for single-phase service 120/208 volts is not to exceed either (a) 60 kVA for the Upstate New York area or (b) 20 kVA for the areas in Massachusetts, New Hampshire, and Rhode Island.
3. Where the present service is three phase, 4 wire, 480 wye/277 volts. Three-phase, 4 wire, 480 wye/277 volts is Commercial and Industrial use only.
4. Where supplied by cluster mounted overhead transformers at the Company's discretion; see Section 9.2.1. Demand of 150kVA or more is generally preferred to be supplied by a pad mounted transformer service. Three-phase service normally will not be made available for a residence.
5. With the exception of network service, transformer vault services are limited to 1500 kVA at 480 wye/277 volts.

For both new applicants and existing customers, the Applicant or Customer shall submit a written request that includes its proposed in-service date, connected load, diversified demand, and load factor information. Refer to the "Process and Information" section at the beginning of this book. Customers having the potential to exceed 75 kVA of transformer capacity may be required to supply space for electrical equipment on private property in accordance with the Company's Terms and Conditions; see Sections 4 and 9. Where three-phase secondary service is requested and available and the minimum Customer load is less than 50 kVA, the Customer may be required to contribute to the supply facilities' installation cost according to the Company's tariff in the specific service area.

For service above 600 volts, the Company will solely designate the type of service based on the location of the Applicant or Customer and the size and character of the proposed load. Please consult the Company early in the planning process to determine the specified delivery voltage. In Upstate NY, maximum demand can be limited by specific supply circuit conditions under the Company's tariff, PSC No. 220. An Applicant or existing Customer in Upstate NY with large quantifiable needs on a distribution system greater than the Company's specified limit will require a service of higher voltage characteristics offered in PSC No. 220 to efficiently and effectively manage the load supplied by the utility electric system meeting the public needs of more than one customer. Evaluation according to Rules 4.4 and 44 in PSC No. 220 permits the Company to determine and specify the delivery voltage to the Applicant or Customer in Upstate NY. In addition, see Section 3.8 for services no longer standard.

3.7.2 New Customers (Applicants)

The delivery voltage for service to a new Customer is determined based on engineering considerations such as system loading, location of electric supplies, reliability, circuit protection and coordination, planning, operation and maintenance.

3.7.3 Existing Customers

3.7.3.1 Customer Expansion

The new delivery voltage for service to an existing Customer contemplating an expansion that will result in a maximum customer peak demand greater than the limit specified in Table 3.7.1-1, is determined based

on engineering considerations such as system loading, location of electric supplies, reliability, circuit protection and coordination, planning, operation and maintenance. The Customer shall reimburse the Company as set forth in the applicable Company tariff.

3.7.3.2 Voltage Migration at Customer's Request

Voltage migration may be permitted upon written request to the Company, provided: (1) such increase in delivery voltage shall be allowed only when in the Company's sole judgment, system or facility loading, reliability and safety will not be jeopardized; and (2) the provisions of the Company's applicable tariff shall apply to any such increase in delivery voltage requested by the Customer.

3.7.3.3 Voltage Migration at Company's Request

When, in the Company's sole judgment, and consistent with the Company's applicable tariffs, the Company determines that changes in delivery voltage are necessary to alleviate system or facility loading, reliability or safety problems, the Company will make such changes and will be responsible for the associated costs.

3.8 SERVICES NO LONGER STANDARD

Non-standard services include, but are not limited to: 25 Hertz, 2 phase systems, 2 wire 120 volts, 240 volts delta, 460 volts wye, 480 volts delta, 600 volts delta, 2400 volts, 4160 volts or 4800 volts services. While 2400 volts, 4160 volts, or 4800 volts are no longer standard, they may still be available at certain locations; consult the Company.

Customers now receiving non-standard service shall not expand the use of such service, except in very limited circumstances at the sole discretion of the Company.

Customers with an existing non-standard service requesting a service change shall consult with the Company to obtain a standard single or three phase 60 Hertz service at an appropriate delivery voltage.

3.9 LOAD BALANCE

The Customer, in taking electric service, shall connect its lighting and other loads so as to maintain as nearly as is reasonably possible, equal current in each of the line conductors at the point of delivery. Voltage unbalance resulting from unbalanced currents shall not exceed 2% or shall not cause objectionable effects upon or interference with the operation of the Company's facilities and service to others. The Company may require the Customer to install any necessary operating and safety equipment in accordance with the requirements and specifications of the Company, provided such installation does not conflict with applicable electrical codes, federal, state or municipal law. The Customer is responsible for bearing the cost of any changes necessary to correct an unbalanced load condition.

3.10 INCREASE IN SERVICE

Company facilities are normally designed to meet the Customer's initial electric demand requirements at the time service is installed. The Customer shall provide the Company reasonable advance written notice of any proposed increase in service required. This notice shall include the amount and character of the proposed increased service, including the timing, frequency, and duration of the peak load, as well as the date the increased load will be required. Load increases requiring changes to the supply facilities (other than metering equipment) for the sole use of the Customer may require a contribution to the Company in accordance with the Company's applicable tariff. See previous Section 3.7. The Customer shall not make additions unless the Company has notified the Customer that it can supply the increased load.

3.11 UNAUTHORIZED ATTACHMENTS

The Company forbids any unauthorized attachments to its poles and towers, such as banners, signs, clothes lines, antennas, basketball hoops, lighting fixtures, etc. It forbids the use of any of its facilities for placards or other advertising materials. The Company will remove any such unauthorized attachments without notice and may prosecute such trespassing.

The Company forbids any work by contractors on or in any of its facilities without prior written authorization by the Company.

The attachment of antenna systems to Customer-owned electric service masts or poles carrying the Company's conductors is strictly prohibited due to the possibility of serious results from accidental contacts. Such attachments will be removed immediately upon discovery by the Company, and the removal will be at the Customer's expense.

3.12 DISCONTINUANCE OF SERVICE

The Company may discontinue service where the Customer's equipment or its operation is deemed to be unsafe or results in objectionable effects on the operation of the Company's facilities or its other customers, consistent with the procedures set forth in the Company's applicable tariff. Reconnection of service will occur after the Customer has made the required corrections at its cost. See also Section 10.

Part B – "Electric Service Requirements"

4.0 SERVICE CONNECTIONS

4.1 GENERAL

Types of Service Connections

The Company offers the following service connections, depending on the Customer's location, character of service, and expected electrical demand:

- Overhead Secondary Voltage Service Connection (Under 600V)
- Overhead Primary Voltage Service Connection (from 2.4kV to 34.5kV inclusive)
- Overhead Transmission Voltage Service Connection
- Underground Secondary Voltage Service Connection (Under 600V)
- Underground Primary Voltage Service Connection (from 2.4kV to 34.5kV inclusive)
- Underground Transmission Voltage Service Connection

Definitions to be familiar with from Section 2:

Line	Primary
Emergency System	Service Point
Multiple Residential Occupancy Building	Supply Point
Service Connection	Service Equipment
Service Drop	Temporary Service
Service Lateral	URD
Service Line	UCD

4.1.1 Rights-of-Way, Easements

See Section 3.1.3 for property rights as a condition of service.

In UCD, URD, or multiple occupancy building applications, the Customer shall provide the Company with two copies of the approved development map, certified as final by a design professional or licensed land surveyor, which the plan shall have been recorded or filed with the Registry of Deeds. The map shall indicate lot lines, building setback lines, grade lines, sidewalk, roadway, sewer, water, drainage, and other facilities. The map shall also include the identification and, where appropriate, delineation of sensitive environmental resources including, but not limited to, wetlands, streams, archaeologically sensitive areas, and hazardous waste disposal areas, etc. In addition to this base information, this map shall clearly indicate the easement strips dedicated to the Company and the location of the lots (units) for which electric service is requested. The governmental authority having control over land use shall approve this map. In addition, when electronic maps are used, the Customer must consult the Company for submittal.

Rights-of-way and easements must be cleared of any obstructions at no charge to the Company. The applicant shall grade the right-of-way or easement to within six inches (150 mm) of final grade before the Company commences construction. The applicant must maintain the Company's clearance and grading requirements.

4.1.2 Number, Routing and Location of Service Laterals or Service Lines

The Company will designate the number of service laterals or service lines required to provide service to a Customer. Normally, the Company runs only one service lateral or service line to a Customer. Service l aterals or service lines will not be run from building to building. The Company will designate the location from which the service will be taken, the type of construction to be employed, the routing of the service lateral or service line, and the service point location. The Company will consider appearance, accessibility, available right-of-way, and the desires of the Customer in making this decision.

4.1.3 Relocation of Service Laterals

When electric service relocation is at the request of the Customer, all costs associated with the relocation of the service lateral on both private and public land shall be borne by the Customer.

When the service lateral relocation is the result of an order by a public authority, the Customer shall pay for that portion of the cost associated with the service lateral movement on private property. In some instances, the public authority may compensate the Customer for this expense.

When the pole from which a customer-owned underground service lateral originates must be replaced it is the Customer's responsibility to move its service lateral to the new pole location at its sole expense. For a customer-owned electric service lateral needing relocation, it is the Customer's responsibility to arrange with its contractor to move its service lateral. This responsibility includes coordination of this relocation with the Company and inspection of the newly relocated service lateral by an authorized electrical inspector.

Company-owned facilities involved with any relocation will be the responsibility of the Company.

4.1.4 Allowable Voltage Drop

The Company recommends that the Customer's conductors from the service point to the main service equipment (see Figure 2-1) be sized to limit voltage drop to 1%. Normally, the Company's voltage range measured at the service point for service below 600 volts is between 114 volts and 123 volts on a 120-volt AC base within the Company's Upstate NY service territory, and between 114 volts and 126 volts within the Company's MA, NH, and RI service territories. It is the Customer's responsibility to maintain adequate voltage beyond the service point.

4.1.5 Minimum Size-Single Phase Service Connections

A new single-phase service connection for an installation of one meter shall have a current carrying capacity of not less than 100 amperes, and for an installation of more than one meter not less than 150 amperes. The Company, in its sole discretion may also allow non-dwelling type installations such as, but not limited to CATV equipment, signs, and service to traffic control systems to be a minimum of 30 amperes. The Company may grant an exception in writing if the Company determines adequate service facilities are assured. The Company recommends ampere capacities greater than the National Electrical Code's required minimum, when significant future load increases are expected.

4.1.6 Service Conductor Splicing

Service conductors may be spliced in accordance with the National Electrical Code (NEC) except for the following situations:

- above grade on Company pole unless in the supply space at transformer by Company,
- within meter socket enclosure,
- within conduits on pole, and
- inside of a building unless approved by the NEC.

Where extensions within a secondary transformer compartment or within a Customer vault are necessary, splicing is done by either the Company or the Customer depending on the application: for single-phase pad-mounted transformers, splicing is done by the Company; for three-phase pad-mounted transformers and vault installations, splicing is done by the Customer.

4.1.7 Routing of Metered and Unmetered Conductors

Metered and unmetered conductors of any voltage shall not be installed in the same raceway, auxiliary gutters and/or pull boxes. Where unmetered conductors are run through the Customer's premises, they shall be enclosed in a continuous run of (threaded) rigid metal conduit with no conduit bodies, or in service busway, or in concrete-encased ductline (which may be required by the AHJ for certain situations). The installation of pull boxes or other similar devices is only permitted on unmetered raceways on the Customer's premises with the Company's written approval.

Where unmetered plug-in type armor-clad busway is used to serve customers in the same building, all plug-in access openings shall be provided with a steel hasp assembly for the Company's padlocking of the hinged hood in the closed position.

The sealing of unmetered raceways with lead-wire or padlock type meter seals is not permitted by the Company.

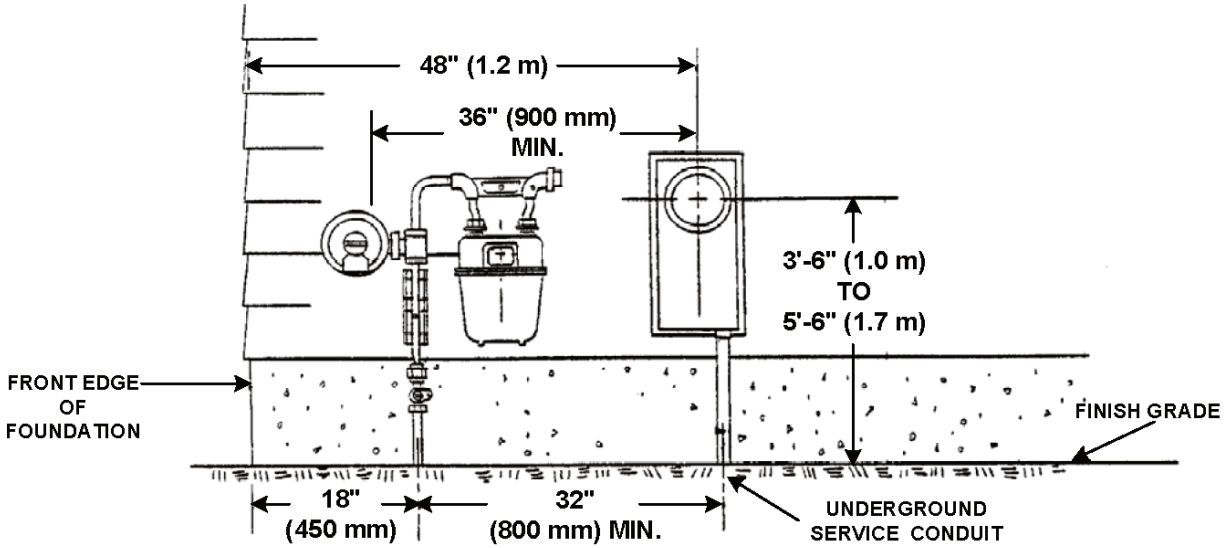
4.1.8 Inhibiting Grease

Caution: Inhibiting grease shall not be applied on meter socket jaws or meter blades.

4.1.9 Electric and Gas Meter Clearances

Electric meters for newly installed services shall be located outdoors, unless permitted by the Company in certain limited circumstances. Electric meters shall not be located above or below gas regulating vents and must maintain a minimum 36" horizontal distance from a gas regulating vent. In all cases, the Gas Service Provider shall be consulted regarding the location of gas meters near electric meters or electrical equipment.

Figure 4.1.9-1 Electric Meter to Gas Meter Clearances

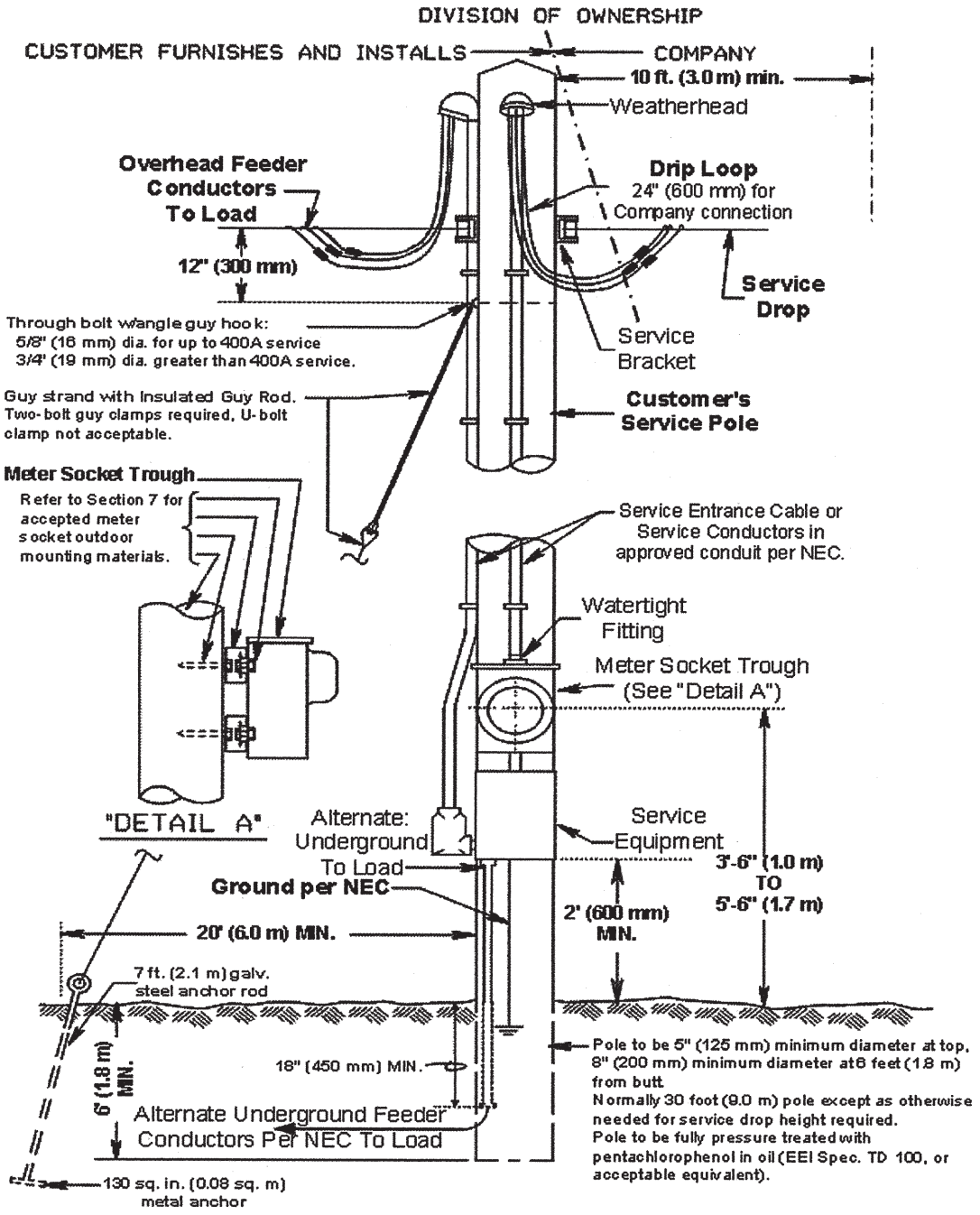


4.1.10 Temporary Service

Temporary service may include the installation of a line extension, service lateral or service line, setting meters or other extra work by the Company. The Customer may be required to pay, in advance, the entire cost of the temporary service including removal of the temporary service; see Section 3.3. Temporary service is generally provided as an overhead secondary service voltage connection. The Customer will provide, as the point of attachment, either:

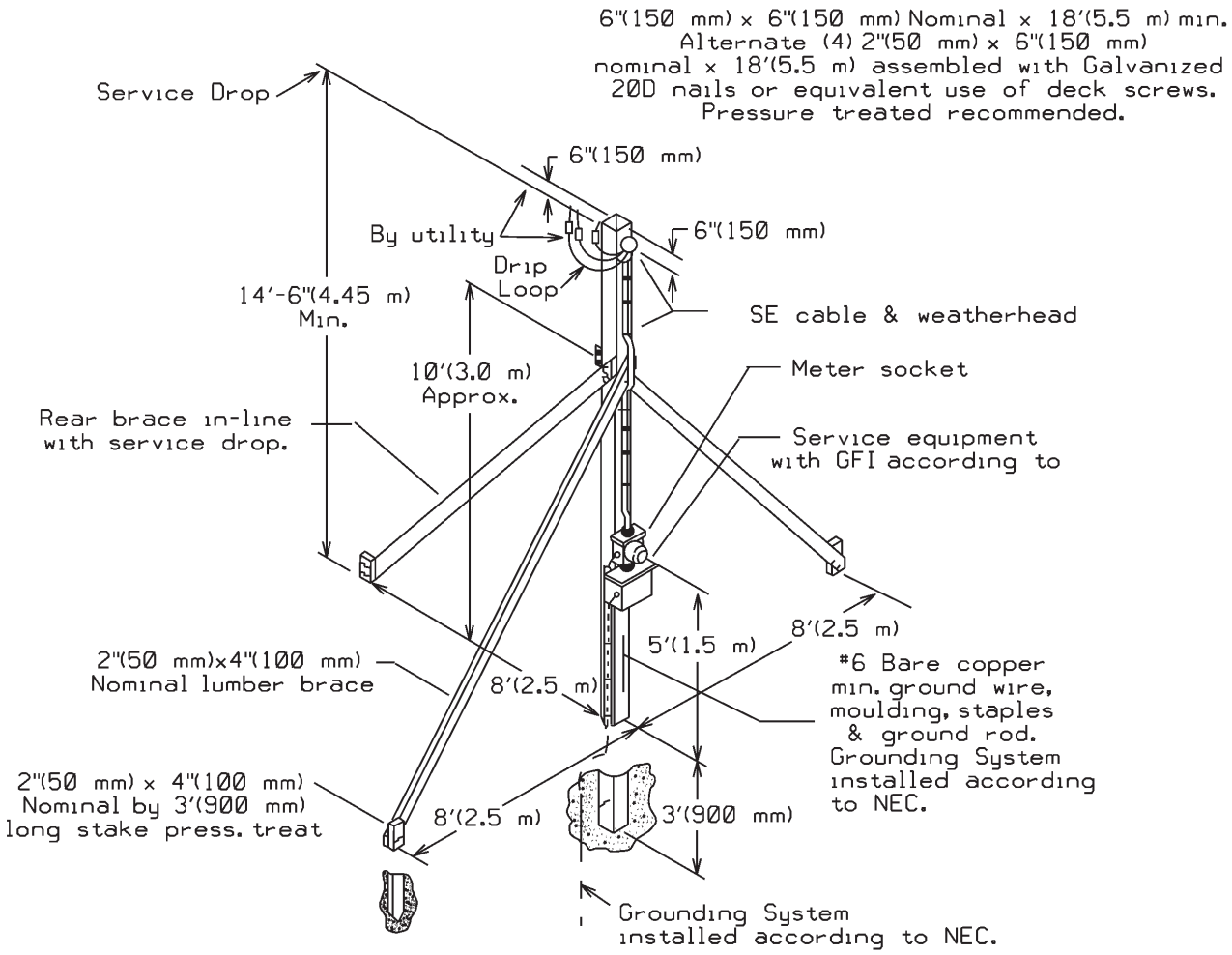
- A properly guyed wood pole or a building on which the service bracket can be attached. The wood pole shall be ANSI Class 7 minimum, pressure treated and of sufficient height to provide proper ground clearance for conductors. This installed pole shall be safe for climbing. Where a 25 ft. (7.5 m) pole is permitted, a 5 ft. (1.5 m) minimum burial depth is required. Installations determined to be unsafe by the Company shall not be energized. The span for the service drop shall not exceed 150 feet (45 m). Temporary service drops shall not be attached to construction trailers. This arrangement is shown in Figure 4.1.10-1 below.

Figure 4.1.10-1 Typical Overhead Service Pole for Permanent or Temporary Service Below 600V



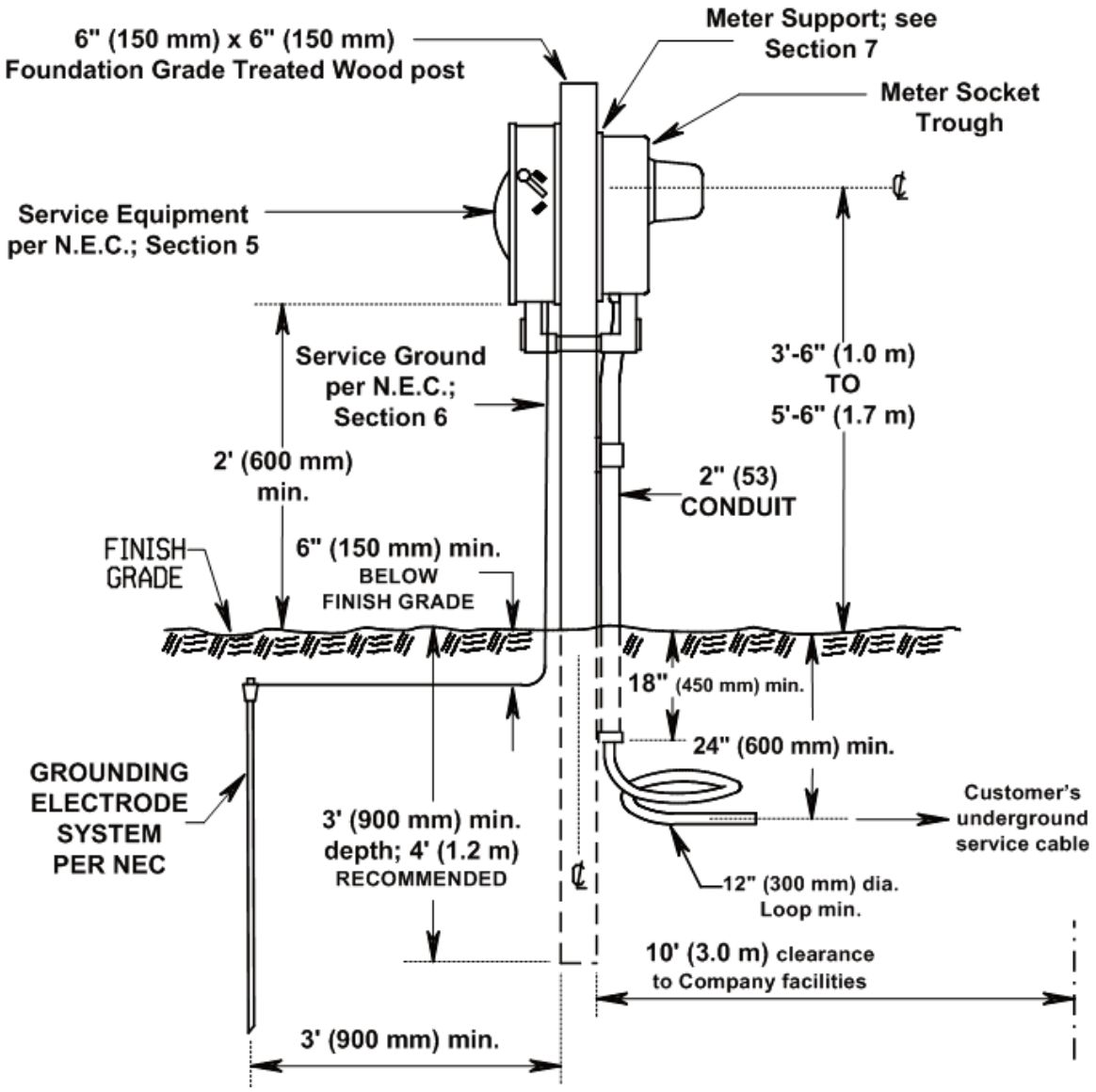
- For an alternate temporary overhead service arrangement, a 6” (150 mm) X 6” (150 mm) foundation grade treated post with cross bracing as shown in Figure 4.1.10-2 below may be permitted.

Figure 4.1.10-2 Temporary Overhead Service Below 600 volts



- Where conditions permit, an underground temporary service may also be obtained as shown in Figure 4.1.10-3 Temporary Underground Service Below 600 voltsFigure 4.1.10-3 below.

Figure 4.1.10-3 Temporary Underground Service Below 600 volts



4.1.11 Fire Alarm and Emergency Systems

4.1.11.1 Fire Alarms

All fire alarm circuits shall be metered. If the authority having jurisdiction requires that the fire alarm service connection be ahead of the normal metering, then a second meter for the fire alarm shall be installed. Where self-contained meter sockets are applied, the meter socket provided by the Customer shall be equipped with a lever bypass. The Customer shall pay the entire cost of metering the fire alarm service.

4.1.11.2 Emergency Systems

Emergency systems may be served through the building's main service equipment or through separate main service equipment and separate metering, tapped ahead of the building's main service equipment. Due to NEC requirements for the continuous duty of emergency systems, these systems shall be instrument transformer metered only, and shall not be metered by self-contained meters. The Customer shall consult with the AHJ regarding specific requirements for emergency systems. The Customer shall pay the entire cost of separately metering the emergency system service.

4.1.12 Service to Manufactured and Mobile Homes, Mobile Home Parks, and Recreational Vehicle Parks

The provision of electric service to these types of structures present challenges to the Company and the Customer because general service drops and underground service laterals cannot be placed directly on the structure itself, but rather, must be metered and served through a remote meter assembly (meter pedestal or Customer service pole) and service equipment.

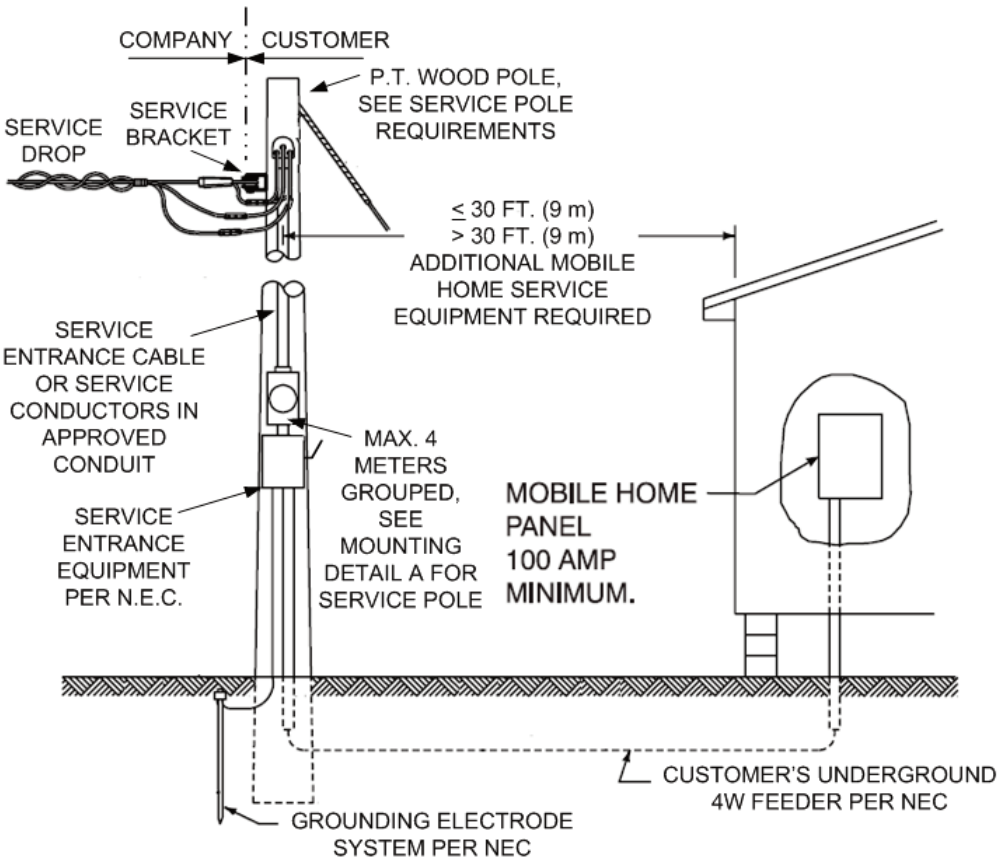
4.1.12.1 Service to Manufactured and Mobile Homes and Mobile Home Parks

Mobile home parks of certain sizes (number of lots) and within various locations may require the Company to comply with Underground Residential Development (URD) rules. These rules may differ by state. The Customer or Developer is urged to contact the Company prior to planning electric service to a new or expanding mobile home park to discuss the specific arrangements necessary to provide electric service consistent with the Company's applicable tariff.

When the Company determines that overhead service shall serve a single manufactured or mobile home, the Customer shall install a Customer service pole, as shown in Figure 4.1.10-1. When the Company determines that underground service shall serve a single manufactured or mobile home, the Customer shall install a service post shown in Figure 4.1.10-3 or meter pedestal as shown in Figure 7.3-8.

Depending on the arrangement and number of manufactured or mobile homes to be served, a meter board may be installed as shown in Figure 4.1.12.1-1 below and in Figure 7.3-10. This arrangement allows a number of metered manufactured/mobile homes to be served from the same service point, and to be metered in the same location. The Customer/Developer is cautioned to comply with the necessary load calculations as described within the National Electrical Code and to comply with the requirements as set forth by the local AHJ.

Figure 4.1.12.1-1 Typical Overhead Service Installation for Mobile Home Park



4.1.12.2 Service to Recreational Vehicle Parks

Electric service to Recreational Vehicle Parks shall be provided through one single service lateral or service line and one or more meters at a single location. Individual lots shall not be separately metered. The Customer/Developer shall comply with the NEC requirements regarding the distribution of its own electric service throughout the park. The Customer/Developer shall contact the Company regarding "Seasonal", "Temporary" or "Permanent" service types. See Section 2 for definitions and Section 3.3 for short-term and temporary service requirements.

4.2 OVERHEAD SECONDARY VOLTAGE SERVICE CONNECTION (UNDER 600V)

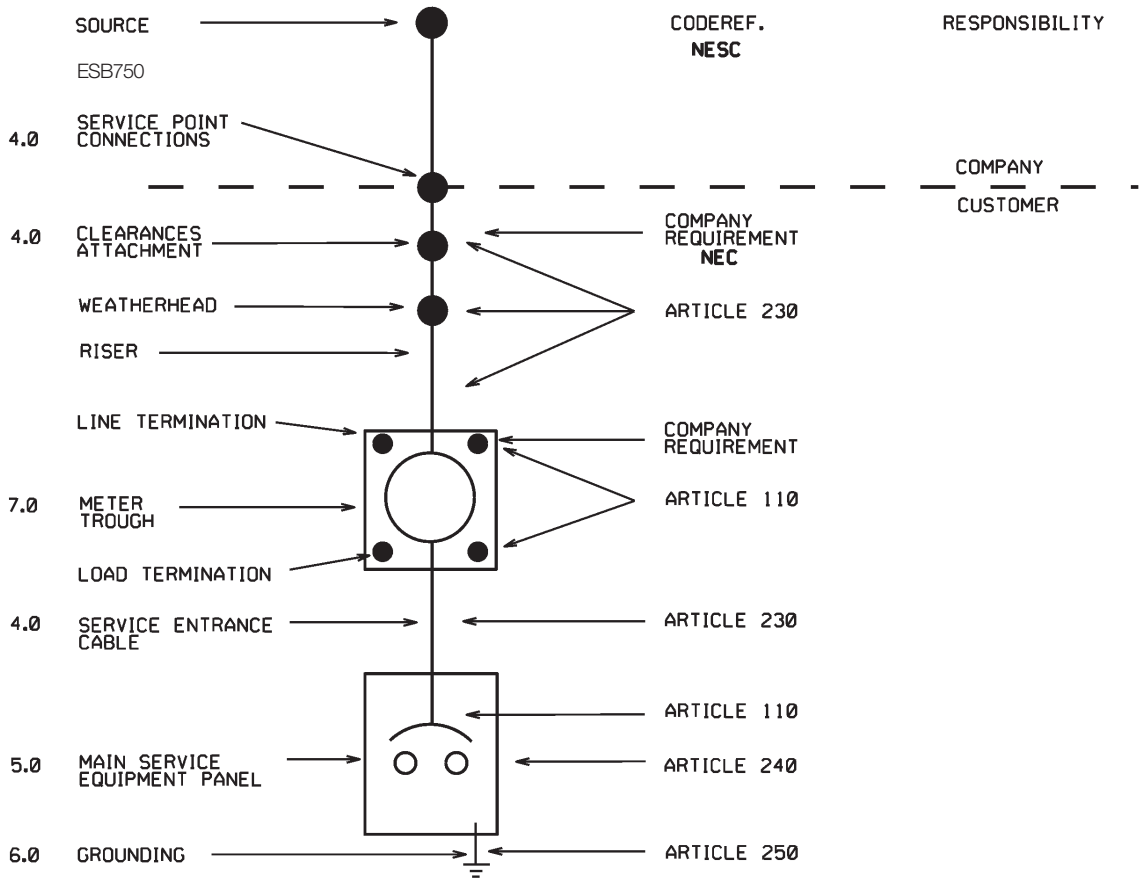
4.2.1 General

An example of a typical Company-provided secondary voltage overhead service is shown in Figure 4.2.1-1 below. The Company will construct, own and maintain all overhead service lines, that is, that portion of the supply circuit between the Company's secondary distribution line serving other customers and the service point in accordance with the Company's applicable tariff. Refer to Section 2 for the definition of the term service line.

An overhead service drop may be provided to supply services rated 800 amperes or less. No more than two sets of service entrance conductors, with their end terminations grouped at one location shall be connected to a service drop.

At single-phase installations where the anticipated demand as determined by the Company does not exceed 72 kVA, a self-contained meter shall be used; see Section 7. Where the anticipated single-phase demand exceeds 72 kVA, a current transformer installation shall be provided by the Company as indicated in Section 7. Where the anticipated demand exceeds 100 kVA, three-phase service is required.

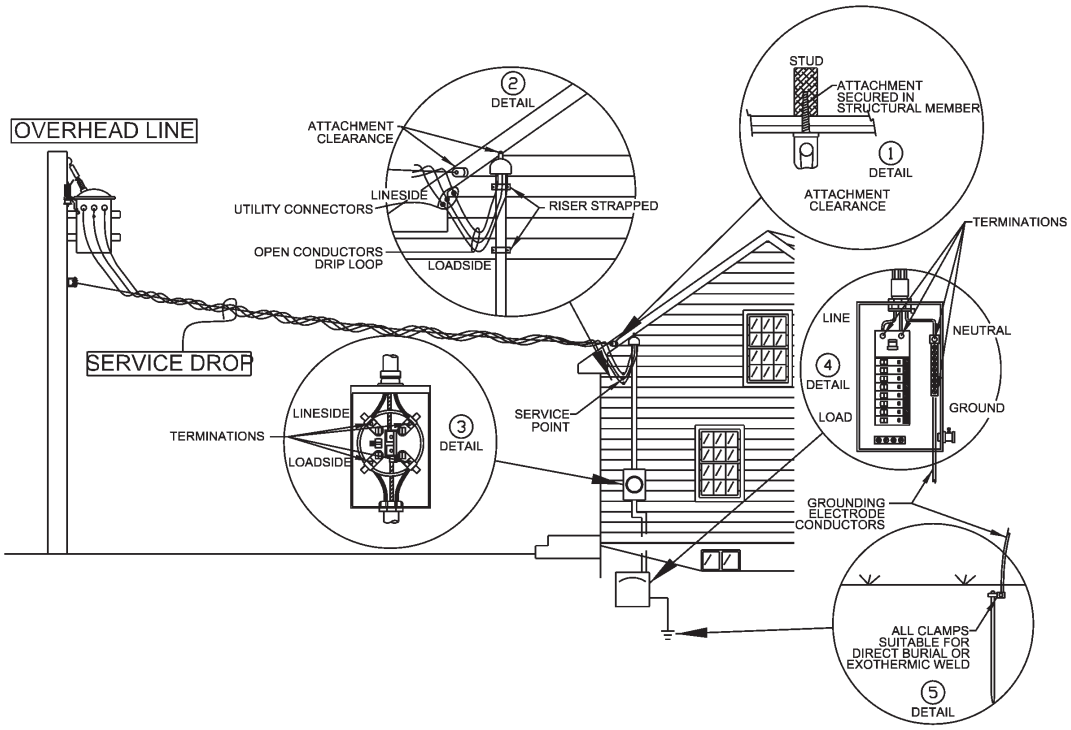
Figure 4.2.1-1 Typical Overhead Service Installation under 600V



4.2.2 Service Attachment, Location

The Customer shall furnish, own, and install a 600 volt insulated service bracket assembly to which the Company's service drop will be attached; see Appendix 1. This assembly shall be properly affixed to a structural member of the supporting building, service pole, or riser mast, and capable of withstanding the tension shown in Table 4.2.4.3-1 for the size of the service being installed. Attachments to chimneys are not permitted. The service bracket shall be positioned below the service entrance conductor weather-head as shown in Figure 4.2.2-1.

Figure 4.2.2-1 Typical Residential Overhead Service under 300 volts and 400 amperes



Notes to Figure 4.2.2-1:

1. **Point of Attachment –** 600 volt insulator installed at proper clearance. See Sections 4.2.4.1 and 4.2.4.2 and NEC Sections 230.24 and 230.26.
2. **Drip Loop –**
   - **A.** To prevent the entrance of moisture drip loops shall be formed on individual conductors. See Section 4 and NEC 230.54.
   - **B.** Open conductors' clearances from openings – See Section 4.2.4.1 and NEC 230.9.

3. **Meter Socket Trough –**
   - **A.** Location, Mounting, and Work Space – See Section 7 and NEC 110.26.
   - **B.** Independent Test Laboratory Certification – See Section 7.2 and NEC 110.3.
   - **C.** Service conductors connected in terminals – See Sections 7.2 and 7.3 and NEC Sections 110.14 and 312.5.

4. **Service Equipment (Main Disconnecting Means and Overcurrent Protection) –**
   - **A.** Main means to disconnect and protect from overcurrent all premises wiring conductors. See Section 5 and NEC Sections 230.70, 230.71, 230.72, 230.90, and 230.91.
   - **B.** Service conductors shall be connected to the service disconnecting means. See Sections 4 and 5 and NEC 230.81.

5. **Grounding and Bonding –** The service equipment shall be grounded. See Sections 5 and 6 and NEC Sections 250.4 and 250.24.
6. **Electrical Inspection by the AHJ –** Final inspection through inspector field verification and approval. See Section 1.9 and NEC Sections 90.4, 90.7, 110.2, and 110.3.

   A. Inspection approval sticker on right side of meter socket trough. See Section 1.9 and NEC 110.2.

   B. For third party inspection agencies, see utility agreement for electrical inspection agencies (in Upstate NY) and NFPA Electrical Inspection Manual. For other references see NFPA standards 73, 70B, and 70E.

4.2.3 Customer-owned Service Pole

On farms, or other locations, where several buildings or structures are under one ownership; and, where a single electric service point and billing meter are feasible (service rating, 800 ampere, maximum), a Customer furnished, installed, owned and maintained service pole, complete with billing meter and service equipment, may be permitted. A service pole shall be installed according to the requirements noted in the Figure 4.1.10-1. All materials and methods used shall not be less than those specified in the applicable figures. For a service drop greater than 30 feet (9.0 m), guying of the pole is required. The Company shall be consulted in each case to determine installation requirements.

4.2.4 Overhead Service Line Clearances

National Grid's overhead service line conductors must comply with the clearance requirements of the National Electrical Safety Code and National Grid's Overhead Construction Standards. The Customer's service bracket, located near the point of attachment, must be installed in such a location to allow for minimum clearance of overhead service line conductors to be met. Placement of swimming pools under existing overhead service line conductors is prohibited. Should a new service require placement over an existing swimming pool, the Company must be consulted to insure that minimum clearance requirements can be met. In all cases, the Company shall determine the location of the point of attachment.

4.2.4.1 General Overhead Service Line Clearances

The following general clearances are in effect for National Grid's overhead service line conductors:

Clearance Requirement	Effectively Grounded Neutral, Grounded Guys and Ungrounded Guys Exposed to 0 to 300V		0 to 750V Multiplex Supply Cables	
	(ft.)	(m)	(ft.)	(m)
Vertical clearance above roads, streets, alleys, parking lots, driveways and other areas subject to truck traffic.	17.0	5.2	17.5	5.4
Spaces and ways subject to pedestrians or restricted traffic only.	11.0	3.4	13.5	4.2
Vertical or diagonal clearances over or under roofs or projections not readily accessible to pedestrians.	4.5	1.4	5.0	1.6
Vertical or diagonal clearances over or under balconies or roofs readily accessible to pedestrians.	12.0	3.7	12.5	3.9
Maximum vertical height above ground to service drop drip loop from finished grade.	25.0	7.7	25.0	7.7
Any direction from eavestrough or downspout.	0.5	0.2	0.5	0.2
Clearance in any direction to unguarded windows or doors.	4.5	1.4	5.0	1.6
Vertical above window top and around non-opening windows (with no sag adders).	1.0	0.4	1.0	0.4

4.2.4.2 Clearances to Swimming Pools

Customers with noted clearance violations caused by the placement of an above ground or in-ground swimming pool will be responsible for the relocation of the swimming pool or the cost of relocation of overhead conductors to meet the Company's minimum clearance standards. Electric service will be discontinued if correction cannot be made within a reasonable time frame as determined by the Company, see Section 3.12.

Service lines within 25' (7.6 m) of the edge of the water surface of the swimming pool must meet the minimum requirements as described in the table below, otherwise, the standard clearance requirements above must be adhered to.

Clearance Requirement	Effectively Grounded Neutral, Grounded Guys and Ungrounded Guys Exposed to 0 to 300V		0 to 750V Multiplex Supply Cables	
	(ft.)	(m)	(ft.)	(m)
Clearance in any direction from the water level, edge of pool, base of diving platform, or anchored raft.	23.5	7.2	24.0	7.4
Clearance in any direction to the diving platform, tower, water slide or other fixed pool-related structures.	15.5	4.8	16.0	4.9

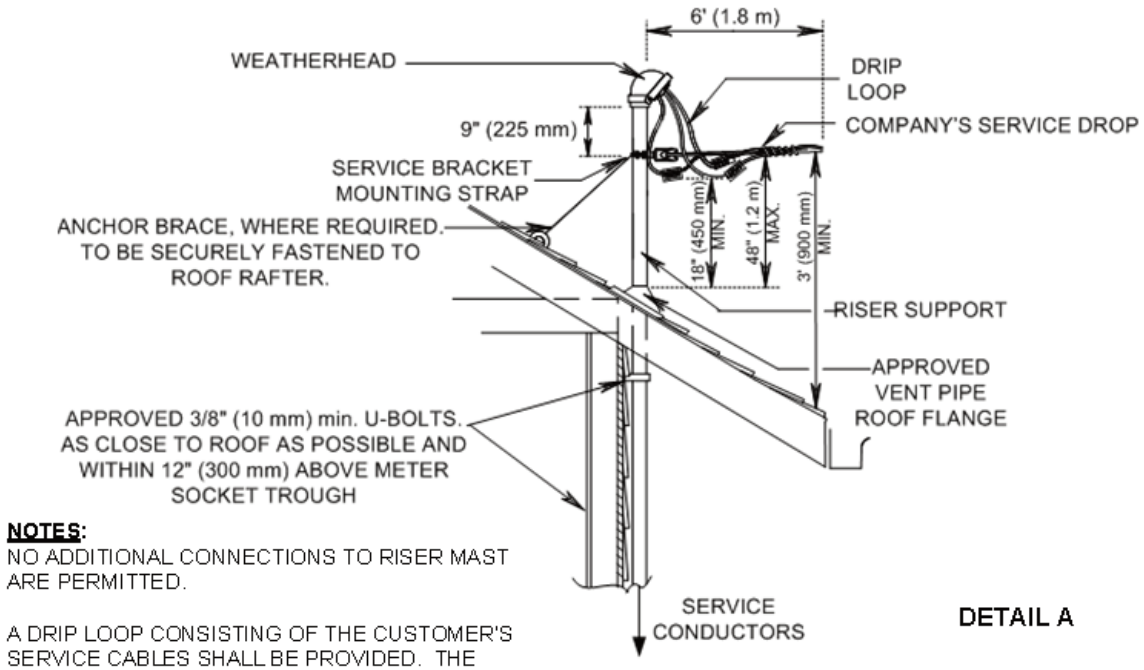
4.2.4.3 Service to Low Buildings

Where the Customer's building or structure is too low to serve as the attachment point for the service bracket, and clearances described by Section 4.2.4 cannot be met, the Company shall be consulted. When National Electrical Code and National Electrical Safety Code standards permit, the Customer can submit the matter to the Company which may approve the installation of the service bracket at an alternate point. As another alternative, the Customer may install a service "riser" to mount the service bracket at the required height. This service "riser" shall be galvanized rigid steel conduit or a galvanized structural steel member similar to the design shown in Figure 4.2.4.3-1. This service riser shall be capable of withstanding the service drop tensions in Table 4.2.4.3-1. The conduit for service riser masts shall be at least 2-1/2 inches (63). Where mast heights exceed the maximum heights allowed by Table 4.2.4.3-1, an anchor may be installed to resist the bending moment imposed by the wire as shown in the bottom of the table. Where clearance remains a problem, the Company recommends the Customer install an underground service lateral and service conductors as described in Section 4.5.

Table 4.2.4.3-1 - Galvanized Riser Mast Bracing Requirements

Galvanized Steel Riser Mast								
Maximum Unbraced Height From Roof to Attachment Bracket								
See Details in Figure 4.2.4.3-1.	Service Rating							
	1 Phase 200A & Below		3 Phase 150A		1 or 3 Phase 400A		3 Phase 800A	
	lb.	kN	lb.	kN	lb.	kN	lb.	kN
Service Cable Tension →	650	2.9	680	3.0	1000	4.4	2000	8.9
Riser Material:	**in.**	**cm**	**in.**	**cm**	**in.**	**cm**	**in.**	**cm**
Angle Size								
3" (75 mm) x 3" (75 mm) x 1/4" (6mm)	30	80	30	80	N/A	N/A	N/A	N/A
3" (75 mm) x 3" (75 mm) x 3/8" (10 mm)	42	110	42	110	24	60	2 @ 24 ea.	2 @ 60 ea.
3-1/2" (90 mm) x 3-1/2" (90 mm) x 3/8" (10 mm)	48	120	48	120	42	110	2 @ 42 ea.	2 @ 110 ea.
Channel Size								
6" (150 mm) x 2" (50 mm) - 8.2 lb (3.7 kg)	24	60	24	60	N/A	N/A	N/A	N/A
8" (200 mm) x 2-1/4" (57 mm) - 11.5 lb (5.2 kg)	42	110	36	90	24	60	2 @ 24 ea.	2 @ 60 ea.
9" (225 mm) x 2-1/2" (65 mm) - 13.4 lb (6.1 kg)	48	120	48	120	30	80	2 @ 30 ea.	2 @ 80 ea.
I-Beam Size (Detail B)								
4" (100 mm) x 2-5/8" (66 mm) - 7.7 lb (3.5 kg)	36	90	30	80	N/A	N/A	N/A	N/A
5" (125 mm) x 3" (75 mm) - 10.0 lb (4.5 kg)	48	120	48	120	36	90	2 @ 36 ea.	2 @ 90 ea.
6" (150 mm) x 3-3/8" (85 mm) - 12.5 lb (5.7 kg)	48	120	48	120	42	110	2 @ 42 ea.	2 @ 110 ea.
Nom. Diameter Steel Conduit (Detail A)								
2.5 inch (63)	36	90	30	80	24	60	2 @ 24 ea.	2 @ 60 ea.
3 inch (78)	48	120	48	120	36	90	2 @ 36 ea.	2 @ 90 ea.
3.5 inch (91)	48	120	48	120	48	120	2 @ 48 ea.	2 @ 120 ea.
4 inch (103)	48	120	48	120	48	120	2 @ 48 ea.	2 @ 120 ea.
Minimum Guy Wire Bracing	5/16" (8mm)		5/16" (8mm)		3/8" (10mm)		1/2" (13mm)	

Figure 4.2.4.3-1 Overhead Service Attachment and Riser Mast Requirements



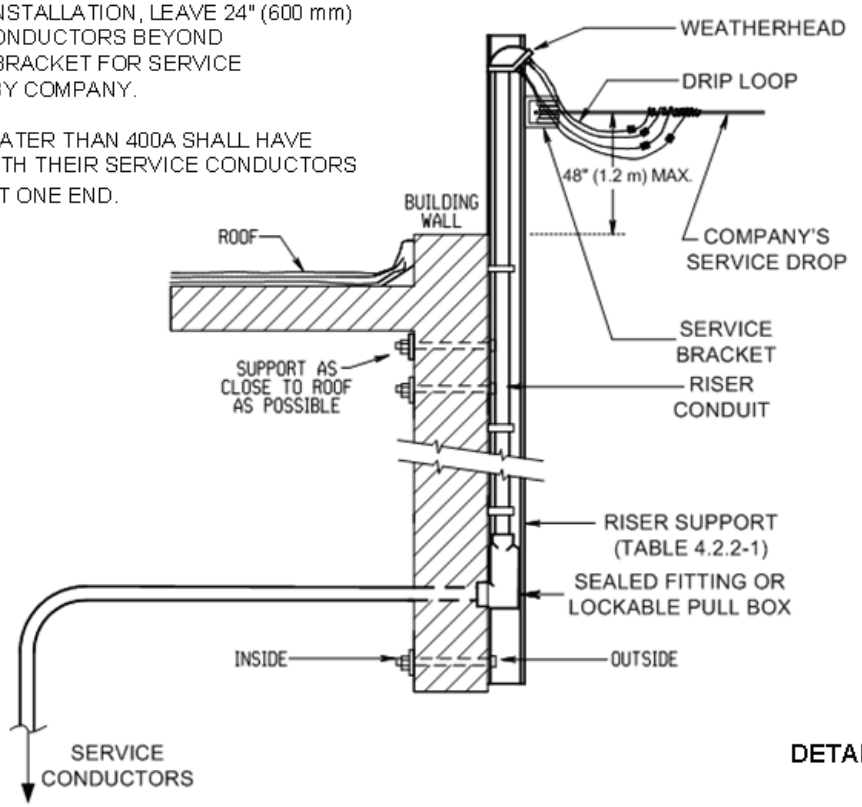
NOTES:

NO ADDITIONAL CONNECTIONS TO RISER MAST ARE PERMITTED.

A DRIP LOOP CONSISTING OF THE CUSTOMER'S SERVICE CABLES SHALL BE PROVIDED. THE LOOP SHALL MAINTAIN CLEARANCES SHOWN ABOVE THE ROOF AND SHALL BE INSTALLED WITHIN 6' (1.8 m) OF MAST.

UPON INITIAL INSTALLATION, LEAVE 24" (600 mm) OF SERVICE CONDUCTORS BEYOND ATTACHMENT BRACKET FOR SERVICE CONNECTION BY COMPANY.

SERVICES GREATER THAN 400A SHALL HAVE TWO MASTS WITH THEIR SERVICE CONDUCTORS PARALLELED AT ONE END.



4.2.5 Service Drop and Connection to Service Conductors

The Customer shall furnish, install, own and maintain all service entrance conductors. The Company shall make all connections, permanent or temporary, between the overhead service drop and these entrance conductors. The Company will not permit this connection to be made by others, unless as specifically described in Section 4.2.6 below.

At least twenty-four inches (600 mm) of each service entrance conductor shall project beyond the weatherhead or termination of the service entrance cable for connection to the service drop conductors. Manufactured weatherheads shall be mounted vertically and filled with duct seal to inhibit water penetration.

The service entrance cable itself, or the conduit, or wireway containing the service entrance conductors, shall be exposed from the connection at the service drop conductors to the meter location, except where this service entrance directly passes through a roof or building wall. These openings shall be weatherproofed to prevent the entrance of water and protect the service conductors from physical damage up to the service equipment.

4.2.6 Residential Overhead Service Upgrade

The Company has a program where available for only licensed electricians (as determined by the AHJ) to have the option to disconnect and permanently reconnect a residential overhead service in lieu of scheduling multiple appointments for the Company to perform the work. To do this, the following conditions must be met:

- Residential single-phase overhead service of 200 amperes or less.
- There is no change in the point of service location.
- Service drop maintains minimum clearances according to Section 4.2.4 and the NEC.

The licensed electrician must make arrangements first by contacting the Company for the program available in accordance with the Company's applicable tariff. See the "Process and Information" section on obtaining electric service and the inside front cover of this book.

4.3 OVERHEAD PRIMARY VOLTAGE SERVICE CONNECTION (2.4kV TO 46kV INCLUSIVE)

Refer to the Company's Electric System Bulletin's 751, 752, and 753 for installations within National Grid's New York Service Territory Only.

Primary service, by its nature, provides more opportunity for a given primary Customer to directly affect other electric system customers. Primary customers are responsible for obtaining and maintaining their own equipment.

The Company provides a number of services of this type. Normally, such services are three phase. Depending upon site location, actual service voltage, and use characteristics, certain load restrictions may apply. Customers within National Grid's New York Service Territory who require service at 34.5kV are required to provide a substation, which is reviewed and approved by the Company prior to energization. The Customer is urged to contact the Company prior to planning for an overhead primary voltage service. For more detailed requirements, see ESB 753 "Primary Meter Pole" for 2.4kV to 15kV class installations and ESB 752 for those 23kV to 46kV primary metering installations.

The Company constructs, owns and maintains all overhead primary service lines in the voltage range from 2,400 volts and above. Where intermediate support is required, or an extension of the primary service lateral or line is necessary, the Customer may be required to contribute to the cost of that portion of the service lateral or service line, in accordance with the Company's filed tariffs.

When the service lateral terminates in a building or vault, the section between the last pole and the building or vault shall be cable.

4.4 OVERHEAD TRANSMISSION VOLTAGE SERVICE CONNECTION

Refer to the Company's Electric System Bulletins 751 and 752.

Customers within National Grid's New York Service Territory may accept transmission level voltage service (69kV and above) and shall consult with the Company so that all details concerning the design and installation of the service lateral or service line may be worked out to the mutual satisfaction of both the Customer and the Company. Refer to the Company's ESB 752 for details regarding this service type.

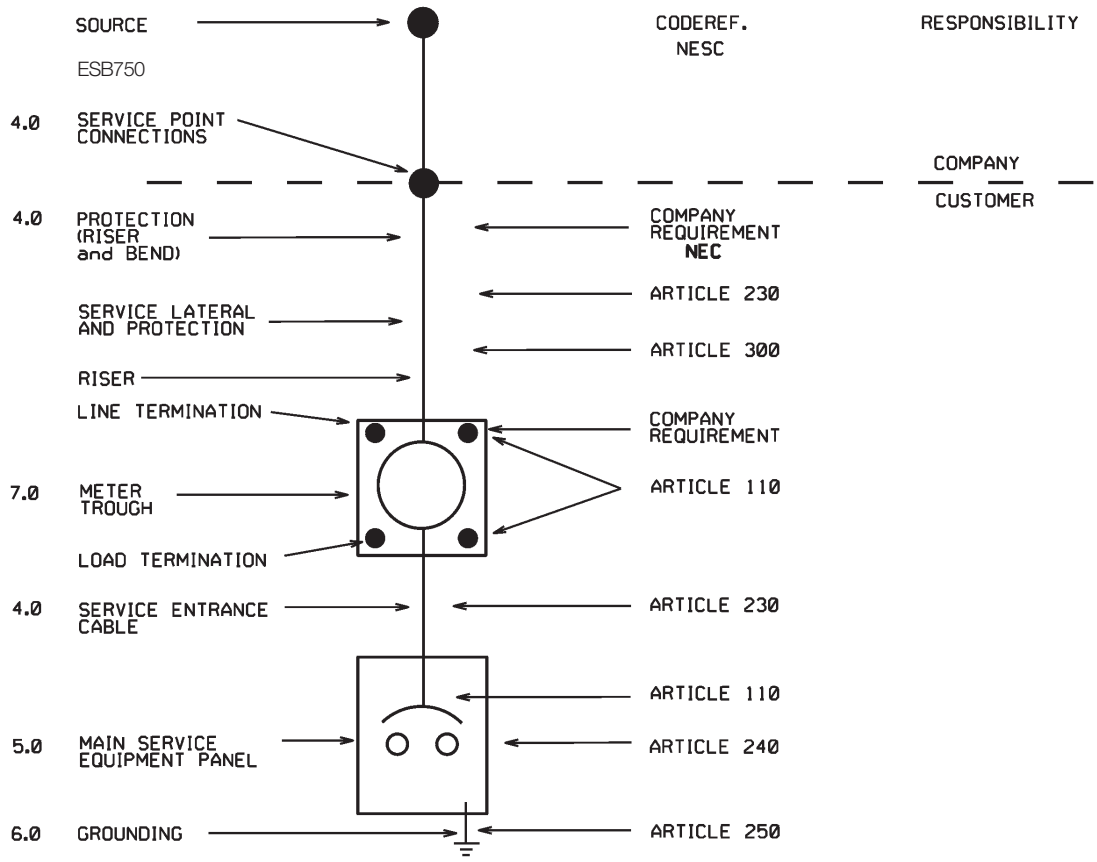
4.5 UNDERGROUND SECONDARY SERVICE VOLTAGE CONNECTION (UNDER 600V)

4.5.1 General

The Company will provide an underground secondary service connection by one of the following methods:

- Underground secondary service connection from the Company's overhead distribution supply line (see Figure 4.5.4.2-1)
- Underground secondary service connection from the Company's underground supply line, including network service
  - Figures 4.5.5.3.1-1; 4.5.5.3.2-1; 4.5.5.3.3-1; and 4.5.5.3.4-1 – Underground secondary service connection from a Company Network or Radial Underground Line
  - Figure 4.5.6-1 – Underground secondary service connection from a Company pad-mount trans former or handhole within a URD
  - See ESB's 751 and 754 – Underground secondary service connection from a Company owned primary underground service lateral and pad-mount transformer

Figure 4.5.1-1 Typical Underground Service Installation under 600V (Excluding Network Services)



4.5.2 Facilities in Shared Trench

The Customer's underground electric service lateral may be installed in the same trench as facilities providing other utility services in accordance with the National Electrical Code and the National Electrical Safety Code. The Customer should contact the owners of these other utility facilities for their requirements on the use of shared trench. The Company shall be consulted for its requirements when its underground distribution line or service lateral cable is involved with trench shared with other underground facilities.

The use of a common trench for Customer owned underground facilities and Company distribution lines is not permitted; however, a perpendicular crossing may be allowed after approval by the Company.

4.5.3 Conduit System

Certain conduit construction techniques are essential to maintain the integrity of an electric service over its lifetime. For services less than 600 volts, Company conduit requirements are minimal, covering only situations where both the Company and the Customer have a mutual interest; however, the Customer's conduit installation shall meet the National Electrical Code. The Company requires that all conduits on the line side of the revenue metering be installed in a secure manner. No conduit body fittings (condulets) or unlocked access panels are permitted. For network services and services above 600 volts, where the Company furnishes, installs, and thereafter maintains the cable, there are more requirements as noted in this book and National Grid's ESB No. 754.

Where conduit installations are made, it is especially important where future placement of conduit will be awkward, time consuming, and costly that a spare conduit be provided. Spare conduit is required for primary service laterals and all network services. Where the underground secondary voltage service cable terminates on the outside of a building in a meter socket or trough, the cable shall be protected by conduit. Where the underground secondary voltage service cable terminates in a building, the cable through the wall shall be protected by conduit.

For services supplied from radial underground systems, the Customer shall seal conduits where they enter the building to limit water ingress from either around or within the service conduits. For services supplied from the secondary network, the Customer shall install a fire-stop conduit seal to limit ingress of water, smoke, fire, and hazardous gases from either around or within the service conduits. The Customer is responsible for meeting the NEC and any other code requirements as necessary for sealing of underground conduits.

4.5.4 Underground Secondary Service Connection from the Company's Overhead Distribution Supply Line

4.5.4.1 Customer-owned Underground Secondary Service Conductors

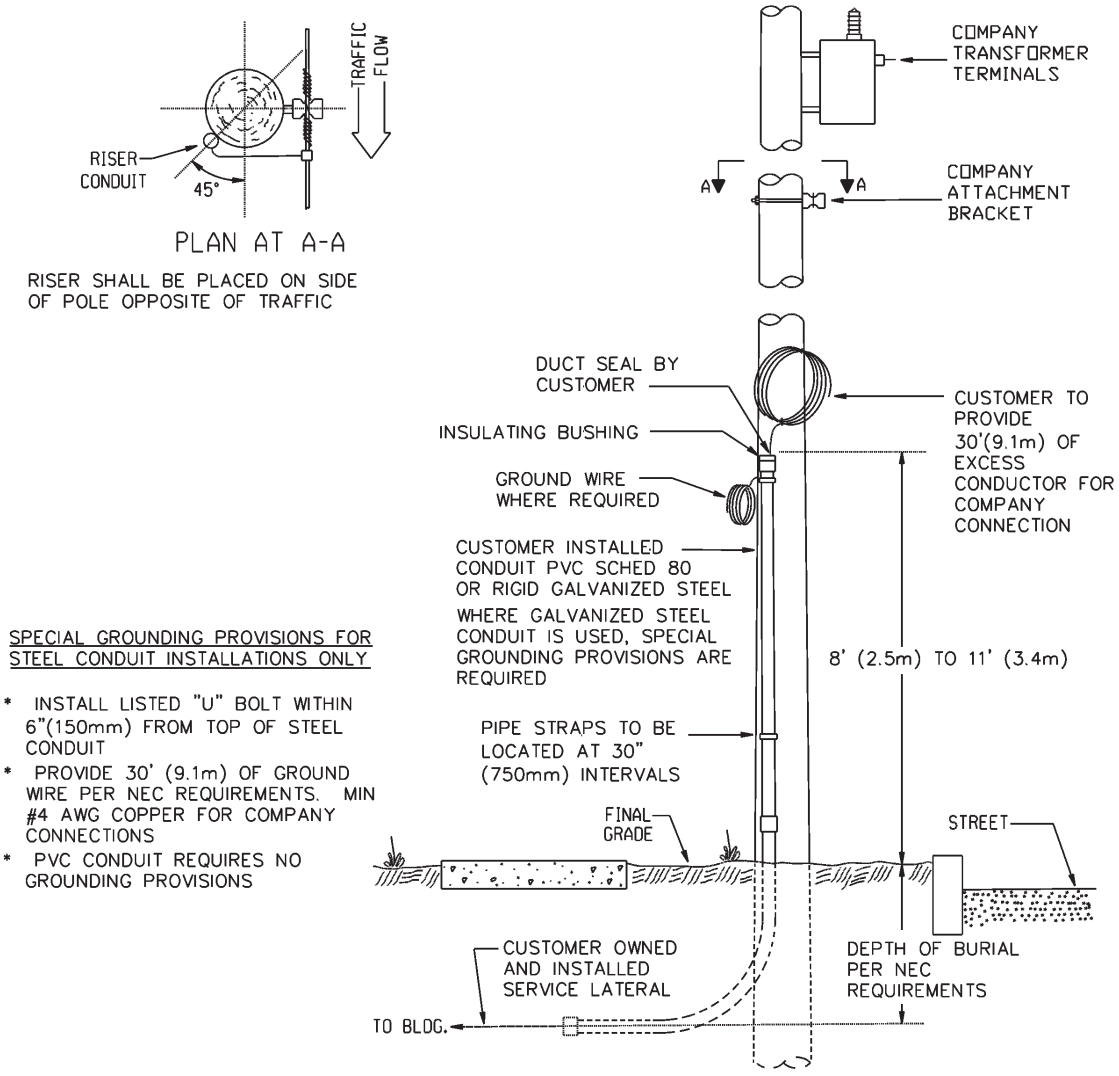
Where the Company elects to provide service from its overhead distribution supply line, the Customer shall own, operate, and maintain the underground service conductors from the service point at the Company's supply line to the service equipment. The Customer's underground service conductors installed in the public way shall be as permitted by the Company's applicable tariff. The Customer shall also be responsible for the conduit, fasteners and trenching required to attach to the Company's distribution pole. The conduit for underground service risers shall have an inside diameter of at least 2 inches (50 mm).

Where the Company's pole is not located on the same side of the road as the proposed underground service, the Customer shall contact the Company to discuss the necessary arrangements. In some instances and in some roadway jurisdictions, the Customer may be allowed to install their own conduit and underground service cable across the road. Otherwise, the Company may be required to install an additional distribution pole to provide this type of service. In these instances, as is the case with all customer riser pole installations, the Company requires an inspection of the installation, including the riser pole location, fastening and grounding only after the Company has set the required pole and all work in association with the electric service has been completed. Note, depending on the roadway jurisdiction and if service is in the public way, a petition to the roadway jurisdiction may be required.

4.5.4.2 Company Riser Pole Attachments

The Company will permit the use of PVC Schedule 80 conduit on secondary voltage service riser poles. The conduit shall be placed, in a location on the pole away from traffic. Primary voltage services must be installed within galvanized rigid steel conduit, see Electric System Bulletin 754. See Figure 4.5.4.2-1 as follows for requirements.

Figure 4.5.4.2-1 Underground Secondary Service Riser Pole Detail



4.5.5 Underground Secondary Service Connection from the Company's Underground Supply Lines

4.5.5.1 General

Services of this type are normally found in urban areas, network areas and underground residential developments (URD). Special considerations apply to each category. For the most part, except for URD, all require cable-in-conduit construction, with the conduit encased in concrete (3-inch (75 mm) envelope). Network services, because of the high fault currents available in such systems, require more attention.

All direct connections to Company-owned cable shall be made by the Company. The Customer shall provide the Company with a compression type splice, listed for the application. All cable sections shall be taped by the Company and secured to the satisfaction of the Company. The Company will not make direct connections to the Customer's main switch or fuse box.

4.5.5.2 Radial fed underground secondary services

For urban areas, where radial underground service is provided, and where the Company's secondary termination point is inside the Customer's premise, termination boxes of the following size shall be used.

- For a single set of conductors up to and including 500 kcmil, the minimum sized service box shall be 24" (600 mm) x 24" (600 mm) x 12" (300 mm). Note that customers will have to use 600 kcmil conductors to meet NEC requirements for 400A services.
- An alternate smaller service box may be permitted for a single set of conductors up to #4/0 AWG if there is a space limitation for the 24" (600 mm) x 24" (600 mm) x 12" (300 mm) box. This alternate service box is 18" (450 mm) x 18" (450 mm) x 10" (250 mm).
- For a parallel set of conductors up to and including 600 kcmil, the minimum sized service box shall be 24" (600 mm) x 32" (800 mm) x 12" (300 mm).

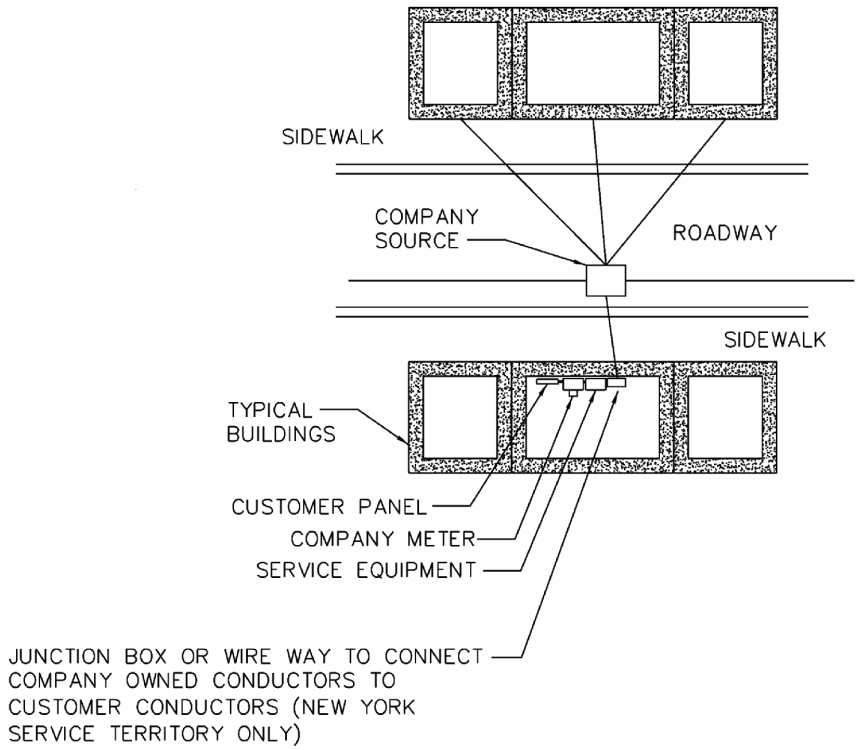
4.5.5.3 Network Areas and Underground Lines

4.5.5.3.1 General

In certain urban areas within the Company's service territory, Customers may be served by the Company's "general" network, or "spot" network. The network system has redundant facilities that is the most reliable power supply for large loads in a dense urban area. Customers may receive a "general" network service, at 120/208V, either single or three phase. Customers having larger loads, may receive service through the Company's "spot" network at either 120/208V or 277/480V.

Due to the various locations where the Company provides network services and the differences in operational and design requirements for the various networks, Customers must contact and coordinate the requirements of network services with the Company.

Figure 4.5.5.3.1-1 Typical Service from Network or Underground Line

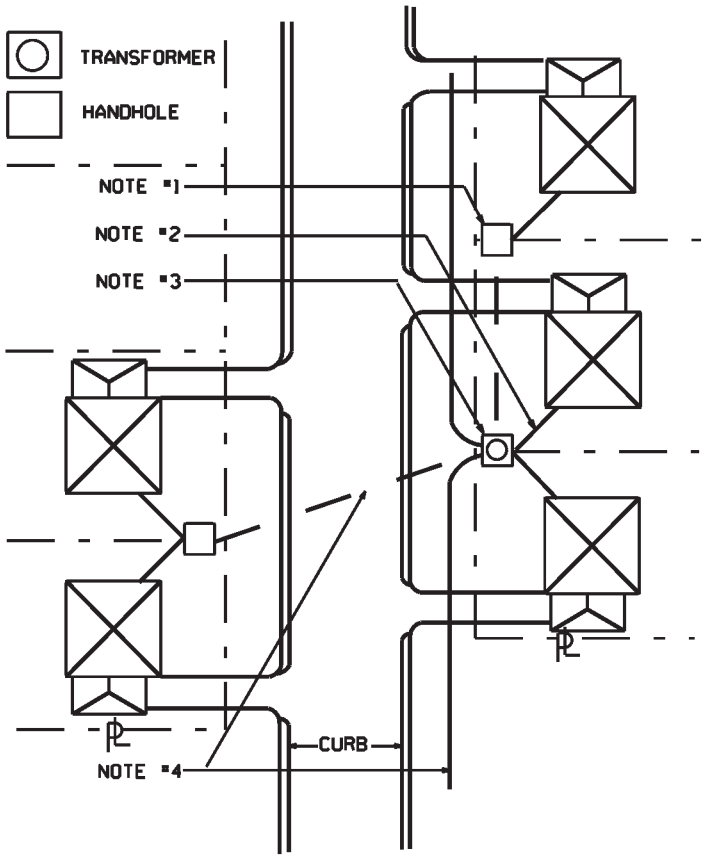


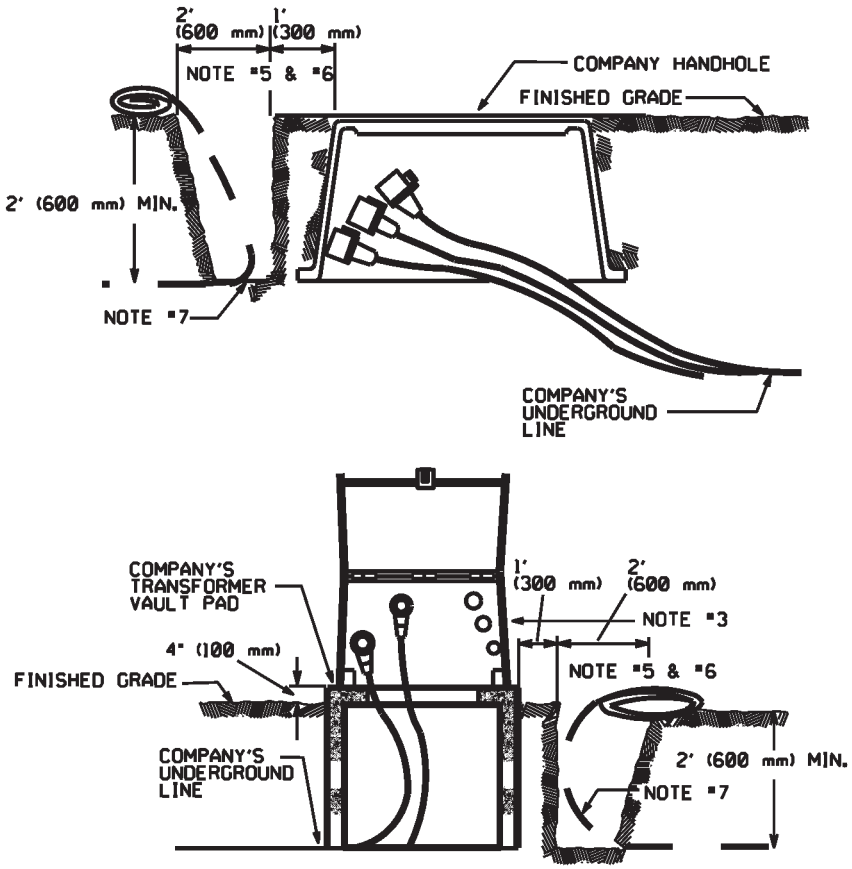
4.5.6 Underground Residential Distribution (URD) Areas

Service within an Underground Residential Distribution Area shall be taken from the Company's transformer, or, the Company's handhole.

The Customer shall furnish, install, own and maintain the underground secondary service conductors between the Company's underground system supply point (in this instance, the supply point and service point are the same) and the Customer's service equipment. The Customer shall install approved underground secondary service conductors and shall tightly seal conductor ends to prevent entrance of moisture. (See Figure 4.5.6-1.) The Company may refuse to energize the service if conductor ends are not moisture sealed. The Customer shall dig to approximately 1 ft. (300 mm) from the Company's transformer base or service handhole, and leave a coil of cable of at least 6 ft. (1.8 m). After inspection agency approval, the underground service conductors shall be backfilled prior to the Company energizing the service.

Figure 4.5.6-1 Underground Residential Distribution (URD)



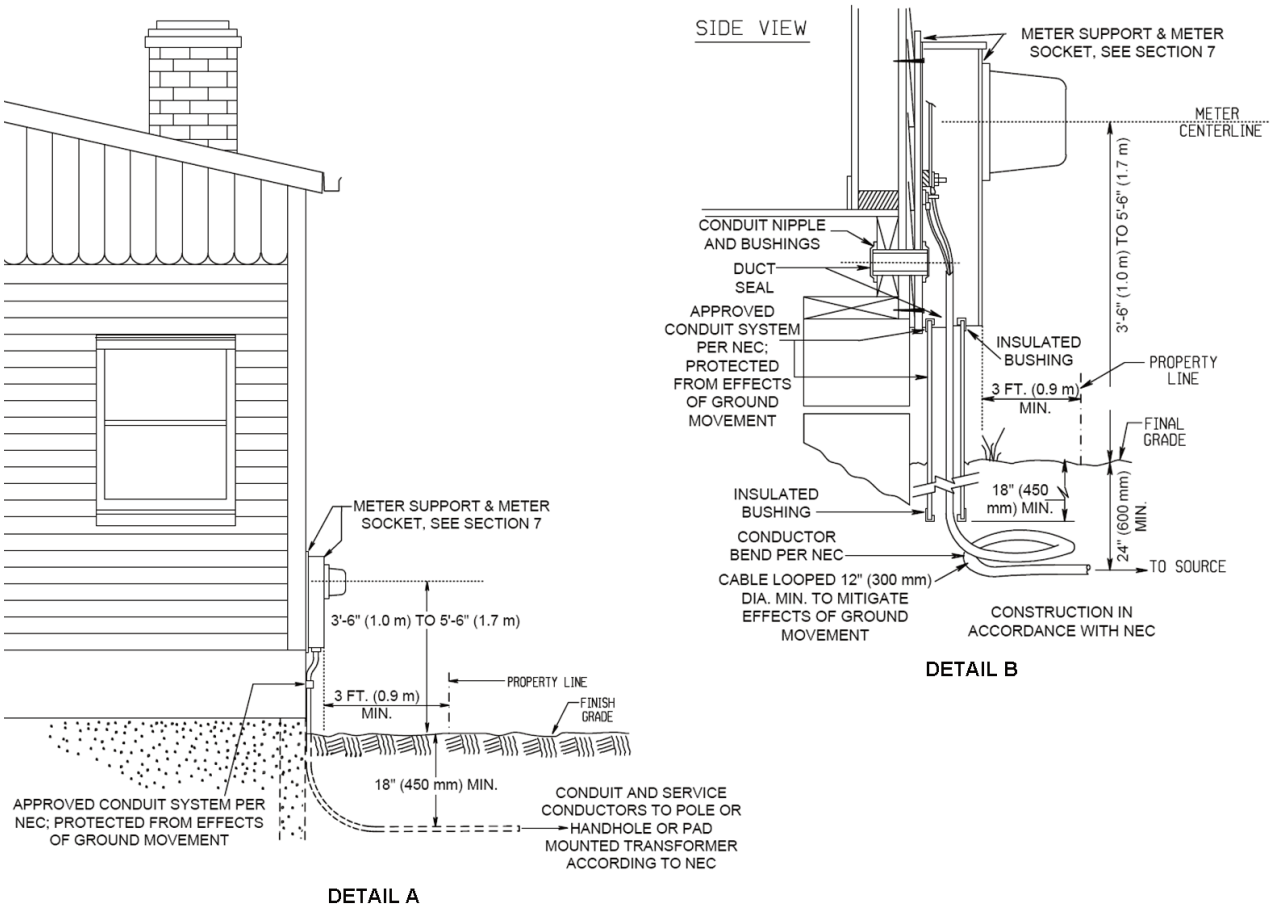


PAD MOUNTED TRANSFORMER

Notes to Figure 4.5.6-1:

NOTE #1	Handhole by Company.
NOTE #2	Customer underground service conductors.
NOTE #3	Single phase transformer by Company.
NOTE #4	Company's underground line.
NOTE #5	200 A service -- not more than one set of service conductors, maximum size 350 kcmil.
NOTE #6	400 A service -- not more than two sets of service conductors, maximum size 350 kcmil (one set of 500 kcmil maximum copper service conductors is acceptable).
NOTE #7	Customer to seal cable ends to prevent entrance of moisture during installation
NOTE #8	Customer to trench to within one foot (300 mm) of handhole or transformer pad and leave 2 ft. (600 mm) of trench open. Customer to leave adequate length of sealed service conductors for connection by Company. Length for: handhole – 5 ft. (1.5 m), transformer –10 ft. (3.0 m).
NOTE #9	The Company is committed to the pursuit of safety excellence through compliance with all OSHA, State, and Regulatory requirements. The Company advises the Customer or their Contractor to comply with the same requirements for safe trenching.

Figure 4.5.6-2 Underground Secondary Service Residential Meter Connection – Conduit or Direct Buried



4.5.7 Underground Secondary Service Connection

4.5.7.1 From a Company-owned Primary Underground Service Lateral

Depending on the nature of service and/or the distance to the nearest Company supply point, the Company may be required to extend primary service lateral conductors and a Company-owned transformer, on private property. As outlined below and in the Company's ESB 754, the Customer is responsibile for installing a suitable trench, with conduit when necessary, and provisions for a pad-mount transformer. Individual service connection requirements are provided within these Bulletins.

4.5.7.2 From an Outdoor Single Phase Pad Mounted Transformer

Refer to ESB 751 for the underground primary service lateral and to Section 9 and ESB 754 for the single-phase pad mounted transformer provisions.

4.5.7.3 From an Outdoor Three Phase Pad Mounted Transformer

Refer to ESB 751 for the underground primary service lateral and to Section 9 and ESB 754 for the three-phase pad mounted transformer provisions.

4.5.7.4 Service to Multiple Occupancy Buildings

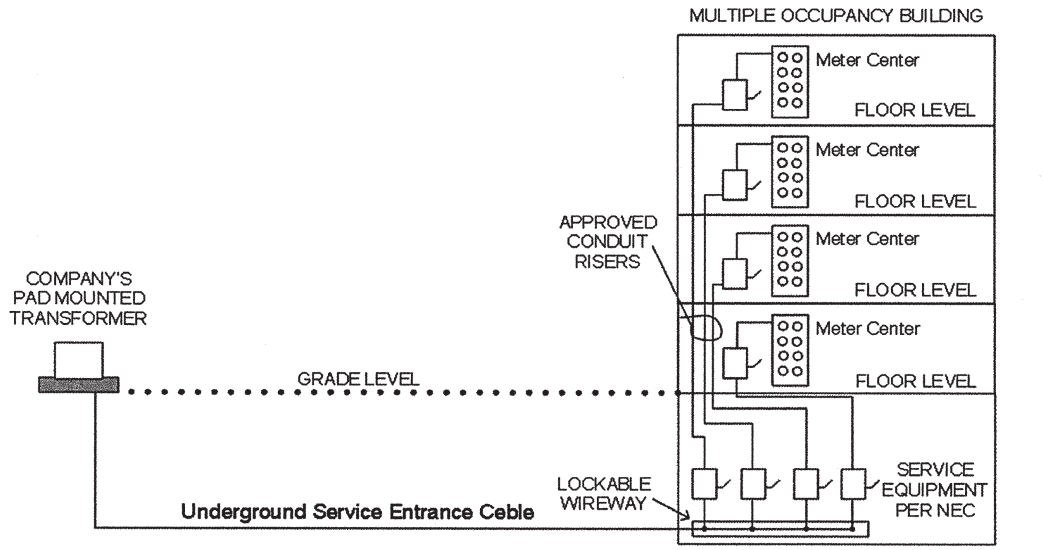
These services, even on a small scale, present many unique challenges and often require extensive off-site and on-site electrical system work by the Company. The initial goal for services of this type is the submittal of an approved plot plan complete with electrical facilities shown. Be sure to refer to the requirements in Sections 3.1, 3.4, and 4.1.1 in particular. The appropriate Company representative will outline the service connection requirements necessary to provide electric service to the building and its tenants. The following criteria apply to the service conductors and unmetered risers.

- Feeder bus duct risers may be installed between the service equipment and the meter centers.
- Tap boxes or provisions for plug-in units between meter centers are not permitted.
- The proposed unmetered risers shall meet the minimum voltage drop provisions in accordance with the National Electrical Code, Article 215. (See Section 4.1.4.)
- If the proposed unmetered risers are considered inadequate by the Company, then a single meter room will be required adjacent to the service point.

Unless otherwise exempt by the Company's tariff, the Company will provide underground distribution to a residential multiple occupancy building and the Customer will provide the necessary facilities for the padmounted transformer installation as noted in ESB No. 754. Primary underground lines installed to serve these buildings are considered underground residential or commercial distribution extensions. For services above 600 volts consult the Company.

Where there is an inquiry for supplying service to individual tenants within a building, the Customer shall install and maintain feeders from a Company designated service entrance location to connect each such tenant. The Customer shall provide transformation required for other utilization voltages within the building on the load side of the meter.

Figure 4.5.7.4-1 Typical Service to Multiple Occupancy Building



4.6 UNDERGROUND PRIMARY VOLTAGE SERVICE CONNECTION (FROM 2.4kV TO 35kV INCLUSIVE)

Refer to the Company's Electric System Bulletins 751 and 758 and consult with the Company so that all details concerning the design and installation of the primary service lateral may be worked out to the mutual satisfaction of both the Customer and the Company. Also, see Section 7 for metering requirements.

4.7 UNDERGROUND TRANSMISSION VOLTAGE SERVICE CONNECTION (ABOVE 15kV)

Refer to the Company's Electric System Bulletins 751, 752, and 758.

The Customer shall consult with the Company in every case where the service lateral will be above 15,000 volts so that all details concerning the design and installation of the service lateral may be worked out to the mutual satisfaction of both the Customer and the Company. Ask for supplement ESB 752 or 758 for details regarding this service type and see Section 7 for metering requirements.

5.0 SERVICE EQUIPMENT

5.1 GENERAL

Most of the Company's requirements in this section account for specific Company operating practices or concerns. Company imposed requirements address in particular: network services, where high fault values are available; theft of service precautions; and certain required service configurations to permit the Company to operate its supply system in a safe and reliable manner for all customers.

5.1.1 Service Equipment Required

Service Equipment shall be furnished, installed owned and maintained by the Customer as part of the permanent wiring of each service entrance for any Company-provided service.

All service equipment shall meet the requirements of the National Electrical Code and all local authorities having jurisdiction. Service equipment rated above 400 amperes shall also meet the requirements of the American National Standards Institute and National Electrical Manufacturers Association (NEMA) as well as the additional requirements as outlined in this section. All service equipment housed in a compartment shall be adequately ventilated to limit the temperature rise in accordance with the latest NEMA Standards. As stated in the National Electrical Code (NEC), Customer service equipment shall be located at the nearest point of entrance of the service conductors and ample workspace shall be provided. On group installations, all service equipment shall be permanently marked by the Customer to clearly identify the space, office, store, apartment, etc. to which it is connected.

5.1.2 Service Equipment Minimum Continuous Current Rating

For single residential and small commercial applications, service equipment shall have a minimum rating of 100 amperes. Consult the Company for acceptable minimum service equipment ratings for other uses.

5.1.3 Service Equipment Minimum Short Circuit Withstand Capability

Service equipment shall be suitable for the short circuit current available at its supply terminals. For residential single phase services supplied from the Company's radial supply system, the minimum short circuit withstand current shall be no less than 10,000 amperes RMS symmetrical. For services supplied directly from a transformer, see Section 9.3 for available fault current. For network services, see Section 5.3.

5.1.4 Routing of Metered and Unmetered Conductors

See Section 4.1.7. Portions of the service equipment shall have provisions for security locking by the Company from the supply point to the metering location where they contain unmetered conductors.

5.1.5 Taps Ahead of Main Service Equipment

Any tap made ahead of the main service equipment for emergency systems, control power for circuit breaker, etc. shall be provided with disconnecting means and overcurrent protection adequate for the duty. Such connections shall be made only where specifically accepted by the Company and approved by the NEC.

5.1.6 When Service Equipment Ahead of Metering is Required

Refer to Section 7 for accepted metering configurations where a Customer shall install main service equipment ahead of metering in applications 600 volts and less. Consult the Company for metering and service equipment configurations in applications above 600 volts.

5.1.7 Service Equipment on Service Poles, Pedestals, or Posts

5.1.7.1 Service equipment must be installed by the Customer on all service poles, pedestals, or posts:

- where the service pole, pedestal, or post is greater than 10 feet (3.0 m) from a single building or structure; see the NEC for disconnect requirements in the building;
- where more than one building or structure is supplied by a service pole that is served overhead by the Company; and
- for mobile home(s).

Note: Conduit is required for all service entrance conductors installed underground between the meter and service equipment.

5.1.7.2 Meter pedestals are free-standing units intended to be mounted outdoors on a concrete pad in conjunction with underground wiring. If a free-standing meter pedestal is used, it shall extend a minimum below the finished grade or ground line with stabilizing means extending below the frost line to ensure that the meter mounting stays in a plumb position. See Section 7 for further details. Meter pedestals for self-contained metering must be listed devices and shall also incorporate circuit breakers, but these are not intended to replace the service disconnecting means required at the building.

5.1.8 Grouped Metered Services to Separate Buildings on One Premise

Where the Company and local AHJ approve more than one metered service to separate buildings on a Customer's premise, all metering shall be grouped at a specific location(s) approved by the Company. These metered services shall have associated service equipment on the load side of the meter at the grouped meter location. All meters and service equipment must be properly identified.

5.1.9 Service Equipment Arrangement

The Service Equipment may consist of multiple circuit breakers or fused switches with fuses, provided:

- the number of breakers or fused switches does not exceed six;
- breakers and fused switches must be in a common enclosure, or in a group of separate enclosures grouped in one location.

Exceptions:

- Service to a building in a network area having main switch capacity up to and including 4,000 amperes requires a single main disconnecting device.
- Service to a building in a network area having main switch capacity greater than 4,000 amperes, may generally have a maximum of three main disconnecting devices, with no device smaller than 2,000 amperes.
- Service less than 600 volts from an underground distribution line (excluding URD and UCD) requires a single main disconnecting device.
- Standby generation with a transfer switch need not be grouped; however, identification is required in accordance with the National Electrical Code.
- A Customer-designated emergency system that requires separate service equipment for a Customer supplied by the Company's radial system. This service equipment shall be located within 100 circuit feet (30 circuit meters) from a padlockable load break disconnect switch installed in the service entrance cable at the building's grouped main service equipment location.

Any service equipment located on the line side of meters (cold sequence) shall be an enclosed type, with facilities for sealing by the Company. Fuse replacement or breaker reset must be possible without disturbing the enclosure seal.

Where multiple service equipment is provided for either commercial or dwelling occupancy, each disconnecting means shall be marked in a conspicuous, legible, and permanent manner to indicate which portion of the installation it controls.

5.1.10 Service Equipment Minimum Attributes

Service equipment 600 volts and less shall meet the following minimum requirements:

5.1.10.1 Interrupting Rating

See Section 5.1.3 and the National Electrical Code to select proper service equipment to withstand the maximum available fault current from the Company's supply and utilization equipment contribution. Overcurrent protection shall provide fault interrupting capability, at service voltage, not less than the value specified by the Company (see Section 9).

The disconnecting means shall be capable of opening load current.

5.1.10.2 Inductive Heating

Current carrying parts shall be sufficiently spaced from enclosure metals to preclude inductive heating. Enclosures of nonferrous metals may be used, if desired.

5.1.10.3 Metering Transformer Space

Where used, provide required space and accessible mounting facilities for the Company's metering transformers based on full rating of the service equipment.

5.1.10.4 Bonding

All non-current carrying metal parts, mounting brackets, frameworks, enclosures, etc. shall be bonded to an equipment ground.

5.1.10.5 Spare Fuses

Where a switch and fuse combination is used, the Customer shall be responsible for maintaining a readily accessible stock of spare fuses.

5.1.10.6 Circuit Breaker

If an air circuit breaker is used, it shall meet the following requirements in addition to those in 5.1.10.1 and 5.1.10.4 above:

5.1.10.6.1 No Undervoltage Tripping

No undervoltage tripping devices except by Company's permission.

5.1.10.6.2 Control Circuit Protection

A control circuit used only for closing the circuit breaker may be connected on its line side provided the tap is protected by high interrupting capacity fuses of a type acceptable to the Company.

5.1.11 Instrumentation and Control Wiring

All instrumentation and control wiring shall utilize stranded conductors rated for the use intended, refer to IEEE Std. 525 for a design and installation guide of cable systems.

5.2 RESIDENTIAL

It is recommended that service equipment for a residence include the necessary feeder and branch circuit protective devices in accordance with the National Electrical Code.

5.3 NETWORK SERVICE

5.3.1 General

It is important that the Company be consulted at an early stage concerning the design and coordination of the service lateral connections with the service equipment when the supply is from a network system. The Customer shall submit three copies of detailed plans and specifications of the service location and equipment to the Company for approval. The network service entrance equipment shall be approved by the Company prior to fabrication.

The Company will inform the Customer concerning the number and size of the service conductors and the magnitude of the short circuit that the service equipment may be called upon to interrupt.

Due to the various locations where the Company provides network services and the differences in operational and design requirements for the various networks, Customers must contact and coordinate the requirements of network service equipment with the Company.

5.4 RADIAL SERVICES

Service Equipment specifications and arrangements shall be discussed with the Company for approval prior to the purchase of equipment or proceeding with the installation.

The Company will inform the Customer concerning the magnitude of the current that the service equipment may be called upon to interrupt.

5.4.1 More than Six Service Disconnects

A single main service equipment shall be installed where there are more than six disconnects and overcurrent means at one location.

Where line-side connected, self-contained grouped meter sockets are installed, additional service equipment on the line side of meters is required if the number of line-connected meters exceeds six.

5.4.2 Radial Service, 300 amperes Continuous or Less Served at Less Than 600 volts

Note: Excluding URD areas, service equipment rated 300 amperes continuous or less served from radial underground lines shall conform to requirements of service equipment for network service. (See Sections 5.3.3 to 5.3.6.)

Where the Service Equipment is rated 300 amperes continuous or less, and the secondary service voltage is as indicated, the Customer shall terminate its service entrance conductors at a location designated by the Company in the following manner: (See figures in Section 7.)

- in a self-contained meter socket for all 240 volt single phase and below including 208/120 volt three phase services.
- in service equipment on the line side of a self-contained meter socket for all 480 volt class services.

5.4.3 Radial Service, Above 300 amperes Continuous Served at Less Than 600 volts

Note: Service equipment rated above 300 amperes continuous, served from radial underground lines shall conform to requirements of service equipment for network service. (See Sections 5.3.3 to 5.3.6.) An overcurrent device on each pole of an air circuit breaker, if used, shall provide time delay overload protection and instantaneous tripping for currents of fault magnitude.

For service equipment less than 600 volts rated above 300 amperes continuous, it is important that the Company be consulted at an early stage concerning the design and coordination of the service lateral connections with the service equipment. The Customer shall submit detailed plans and specifications to the Company for approval before the purchase of the service equipment.

5.5 INDIVIDUAL MULTIPLE OCCUPANCY BUILDING SERVICE

In multi-occupancy buildings several stories high, the installation of unmetered risers in conduit to a single approved, accessible meter center located on various floors shall conform to the following criteria and be reviewed by the Company for acceptance.

- Disconnecting and protective equipment shall be provided at the service entrance point for each floor level(s).
- Disconnects at the service point shall indicate the floor level(s) served.
- Where a single riser is being provided for several floor levels, disconnecting and protective equipment shall be provided at each grouped meter location. The purpose of this requirement is to allow isolation of equipment on a specific floor without affecting the service to other floors.
- Any disconnect, pull box or any access to unmetered conductors shall have provisions for sealing by the Company.

5.6 RADIAL LOADS SERVED ABOVE 600 VOLTS

The Customer shall consult the Company in every case where the service voltage may exceed 600 volts. The Company will designate the type of service based on the location, size and nature of the proposed load and its relation to the Company's facilities. See Company's Electric System Bulletin Nos. 751, 752, 753, or 758 for further details.

The location of the service equipment and the general electrical arrangement will be agreed upon after mutual consideration of all factors by the Customer and the Company. Based on the electrical arrangement selected, the Company will advise the Customer concerning its requirements for basic insulation level, protective equipment and metering facilities and will supply such additional information as short circuit data, relay recommendations, etc., so the Customer can complete the design of its installation. The Customer shall submit detailed plans for inspection and approval by the Company prior to the purchase of equipment or proceeding with the installation in accordance with the applicable supplement to these specifications noted above.

6.0 GROUNDING

6.1 GENERAL

This section applies to services 600 volts and below. Refer to the applicable supplements to these specifications and consult the Company for grounding applications above 600 volts.

6.2 EQUIPMENT TO BE GROUNDED

The Customer shall provide an effective ground and shall connect it to the service equipment and the following equipment in accordance with the National Electrical Code (NEC):

- The grounding stud of a self-contained meter socket trough for existing meter pole services without service equipment.
- The grounding stud of a transformer rated meter socket trough from the Customer's service ground or for pad mounted transformers, the transformer ground grid.
- The grounding stud and neutral bus of the service equipment.
- All metal service enclosures and conduits.
- The frames and secondary neutral of all instrument transformers.
- The rigid metal conduit riser on the Company's pole at a point ten (10) feet above ground.
- CSST gas piping systems shall be bonded to the electrical service grounding electrode system at the point where the gas service enters the building in accordance with NFPA 54. The bonding jumper shall not be smaller than 6 AWG copper wire or equivalent.

6.3 GROUNDING METHODS

6.3.1 All grounding shall be done in accordance with the NEC as a minimum or any other applicable code enforced by the inspection authority having jurisdiction. The Company is not responsible for problems or damage to customer equipment due to a less-than-optimum grounding electrode system. The Company shall not be liable for damage to the property of the Customer resulting from unbalanced voltage conditions due to the opening of a neutral service conductor.

6.3.2 In the absence of a suitable water piping system, the Customer's grounding system shall consist of electrodes as permitted by the NEC.

6.3.3 Achieving a resistance to ground value that exceeds NEC requirements provides better protection from lightning transients and can help improve power quality. A single grounding electrode, which does not have a resistance to ground of 25 ohms or less, shall be augmented by additional electrode(s) in accordance with the NEC.

6.4 GROUNDING RESTRICTIONS

Exclusive of the above requirements:

- Gas service piping and gas meters shall not be used as a grounding electrode for the connection of a grounding electrode conductor.
- A grounding electrode conductor shall not be connected to the meter socket trough.
- The meter socket trough shall not be used to ground other equipment.
- Consult the Company on existing 3-phase delta services no longer standard where the service conductors shall be insulated from the service equipment according to the NEC and grounded only at the Company's supply transformer.

6.5 GROUND FAULT PROTECTION

The Customer shall install ground fault protection for its equipment in accordance with the NEC.

7.0 METERING

7.1 GENERAL

In most instances, the Company will furnish, install, own, maintain, and connect all meters required for billing purposes at the delivery voltage on the Customer's side of the service point in accordance with the Company's applicable tariff and applicable state laws and regulations. This includes meter instrument transformers and meter cable when required. The Company's metering equipment shall not be used to operate any Customer devices except for metering pulse signals as permitted in Section 7.6. The Customer, regardless of equipment ownership, shall permit minor alterations by the Company for the metering purpose.

7.1.1 Access

It is in the interest of both the Customer and the Company that a suitable and adequately protected meter location be provided to ensure accuracy and to facilitate installation, reading, and maintenance. All metering equipment must be readily accessible to the Company's personnel at all times. The Company will designate this location. The Company requires the Customer to install its service wiring so that the meter is accessible to Company employees from the outside of the Customer's building in accordance with the Company's applicable tariff. Meter installations for services 600 volts and less up to and including 320 continuous amperes, normally will be located outdoors.

Meters shall not be installed in, or allowed to remain in areas that later become, stairways, fire escapes, coal bins, fruit cellars, bathrooms, toilets, bedrooms, attics, store windows, transformer vaults, behind shelves, near moving machinery or similar inconvenient or dangerous locations.

7.1.3 Working Clearances

7.1.3.1 Indoor Installations

In those cases where transformer rated meters or grouped meters are installed indoors, they shall be located as close as practicable to the point where the service enters the building and adjacent to the service equipment.

For multiple metering centers, the mounting height to the center of the meters shall be 6 feet (1.8 m) maximum and 2 feet (600 mm) minimum above floor indoors.

A clear working space of at least four feet (1.2 m) shall be provided and maintained in front of all meter socket covers with a minimum headroom of 6-1/2 feet (2.0 m).

7.1.3.2 Outdoor Installations

The mounting height of individual or ganged meter troughs shall be mounted with the center of the meter 3-1/2 to 5-1/2 feet (1.0 to 1.7 m) above final grade. For multiple metering centers, the mounting height of the center of the meters shall be 6 feet (1.8 m) maximum and 2-1/2 feet (750 mm) minimum above final grade outdoors.

For Traffic Signal services where the Company's service drop is attached to the Customer's traffic pole structure in the public way, the bottoms of the traffic control box, the meter socket trough, and any wire drip loops must be more than 8 feet (2.5 m) above grade. Or, the tops of the traffic control box and the meter socket trough must be below 6 feet (1.8 m) and there must be 8 feet (2.5 m) clear space without handholds or footholds starting at no higher than 6 feet (1.8 m) above grade. The meter socket trough shall be mounted in a location away from traffic for reasonable protection from damage and preventing climbing into energized overhead conductors.

7.1.4 Physical Protection

Electric Meters shall be located away, or fully protected in a manner acceptable to the Company, from opening doors, commercial driveways, areas used for the piling of snow and where, in the Company's determination, the meter or service entrance is subject to damage through vibration or any other physical means. Examples of suitable protection methods include bollards, fender posts, guardrails, etc.

Where the meter is located in residential driveways or walkway areas, it shall be mounted to have reasonable protection from damage.

On a service pole, post, or pedestal, the meter shall be mounted to have reasonable protection from damage. Metering facilities for customers shall not be installed on a Company pole.

Where the Company provides the gas service, no electrical equipment or electric meter(s) shall be located directly over or under any gas meter or regulator vent. Eighteen inches (450 mm) of horizontal clearance shall be maintained between any electric meter socket and a gas regulator vent. Consult the Company prior to the installation of either service to avoid conflicts of meter location or where the gas service is supplied by others, consult that company.

7.1.5 Violations

Any Customer or Contractor wiring to a meter or service location that is not approved by the Company is done at its own risk. Corrections of such violations shall be at the Customer's or Contractor's expense.

7.1.6 Unmetered Wiring

The Company will seal all meters and meter facilities on the Customer's premises. All cabinets, equipment enclosures and conduit fittings containing unmetered wiring of any voltage shall be made secure before the service will be energized.

No conduit body fittings (condulets) or pull boxes in raceways containing unmetered service conductors are permitted. Where unavoidable in some special situations, pull boxes or wiring troughs may be permitted upon the Company's prior acceptance and shall have provisions for the Company's lock and seal and be accessible to the Company.

The breaking of seals or tampering with meters or unmetered wiring by unauthorized persons is prohibited. Attention is called to the criminal laws in the states where service is rendered, which make such unauthorized tampering a misdemeanor punishable by fine or imprisonment, or both.

7.1.7 Taps Ahead of Metering

Any tap made ahead of the main service billing meter(s), for emergency systems, control power for utilization equipment, etc. shall be specifically approved by the Company and shall be metered.

Exception: Control power for circuit breaker operation only shall be permitted to be unmetered.

7.1.8 Meter Relocation

Whenever it is necessary to relocate an existing service entrance, service equipment, or meter board, the new installation shall be made by the Customer at its expense in accordance with these specifications. When the change is to be made, the Customer's electrician should make a definite time arrangement in advance, so the Company can have the new service drop or lateral and the meter available on completion of the Customer's electrical work. No service entrance shall be left unmetered.

7.1.9 Group Metering

Where two or more meters are to be installed, all shall be grouped at one location. Prior to the Company setting the meters, each meter position shall be permanently marked by the Customer to clearly identify the space or apartment to which it is connected.

Where the Customer desires to provide either a meter center (multi-socket panel base assembly) or a pedestal style metering assembly, they must be approved by the Company prior to installation. See Section 7.2 for specifications. Meter centers and metering assemblies are limited to either 120/240 volts or 208Y/120 volts or 277/480 volts or 480Y/277 volts, with individual meters rated for either 100, 150, 200 or 320 amperes.

7.1.10 Emergency System Metering

Customer designated emergency system metering in most cases will be transformer rated. Consult the Company for specific guidance.

7.1.11 Shared Metering (for NY only)

In a multiple tenant building with individual metering, the house load requires a separate meter. The house load is that which is common to the property such as halls, entryways, outdoor lighting, building appliances, etc. and under the property owner's management. The Company shall be consulted in each case.

7.2 METER APPLICATIONS AND REQUIREMENTS 600 VOLTS AND LESS

The following tables are the Company's specified metering applications and requirements for services 600 volts and less.

Table 7.2-1 Meter Socket and Transformer-rated Meter Applications

Note #	Service Type	Service Voltage	# Phases	Service Size (Amps)	# Wires	# Meter Terminals	Hot / Cold Sequence	Manual Bypass Required	Figure #
Self-contained									
	Residential	120/240	1	100 / 200	3	4	Hot	No	7.3-1
	Residential URD	120/240	1	200	3	4	Hot	No	7.3-2
	Residential 2-6 gang	120/240	1	150 each	3	4	Hot	No	7.3-7
1	Residential	120/240	1	400	3	4	Hot	Yes	7.3-3
2	Residential	120/208	1	100 / 200	3	5	Hot	No	7.3-4
3	Commercial	120/240	1	100 / 200	3	4	Hot	Yes	7.3-1
	Commercial 2-6 gang	120/240	1	200 each	3	4	Hot	Yes	7.3-7
1	Commercial	120/240	1	400	3	4	Hot	Yes	7.3-3
2	Commercial	120/208	1	100 / 200	3	5	Hot	Yes	7.3-4
2	Commercial - Network	120/208	1	200	3	5	Cold	Yes	7.3-4
	Commercial 2-6 gang	120/208	1	100 each	3	5	Hot	Yes	7.3-7
	Commercial	277/480	1	100	3	5	Cold	Yes	7.3-4
1	Commercial	277/480	1	400	3	5	Cold	Yes	7.3-3
	Commercial	208/120	3	200	4	7	Hot	Yes	7.3-5
1	Commercial	208/120	3	400	4	7	Hot	Yes	7.3-6
1	Commercial - Network	208/120	3	400	4	7	Cold	Yes	7.3-6
	Commercial	480/277	3	200	4	7	Cold	Yes	7.3-5
1 & 4	Commercial	480/277	3	400	4	7	Cold	Yes	7.3-6
above 400A (non-self contained, metering transformers are used)									
	Residential	120/240	1	Above 400	Company Supplies Socket		Hot	N/A	7.4.1-1, -4
	Commercial	208/120	3	Above 400	Company Supplies Socket		Hot	N/A	7.4.1-1, -2, -4
	Commercial	480/277	3	Above 400	Company Supplies Socket		Hot	N/A	7.4.1-1, -2, -4
	Commercial - Network	208/120 480/277	3	400	Company Supplies Socket		Cold	N/A	7.4.1-3
Notes									
1	A 400A service with a class 320 meter and socket is limited to 320 continuous amperes load capacity - See Table 7.2-4 for rating requirements of service.								

2	5th meter terminal is located in the 9:00 o'clock position and connected to the neutral.
3	Where a non-standard 120V, 2 wire, 30A service is maintained, use 240V, 3 wire, 100A service and use 2 wire for load connection.
4	This service (self-contained 480V class - 400A) shall be suitable for available fault current, see Table 7.2-2. [*New requirement in MA, NH, and RI.]*

Table 7.2-2 Self-contained Meter Socket Requirements

Req.	Self-contained Meter Socket Criteria
1	All meter sockets shall have independent test laboratory listing agency label certifying to ANSI/UL 414, ANSI C12.7, NEMA 250, NEMA Pub lication No. EL-17, and NFPA 70 (NEC).
2	All meter sockets shall be ringless and individual covers must have a hasp provision for the Company's seal.
3	All meter socket enclosures shall be outdoor NEMA 3R rated and withstand the ambient and environmental conditions where located. Meter facilities shall be protected from dust, moisture, corrosion, etc. (Some extreme conditions may require a minimum NEMA 4X rated enclosure.)
4	Overhead types shall have hub opening at top for top entry in meter socket or central wiring space of ganged sockets.
5	All meter sockets shall have adequate continuous duty and short circuit withstand ratings applicable for the service connection. Refer to Sections 5 and 9 and note following this table.
6	Jaw assembly shall permit use of "Mylar plastic disconnect sleeves" being applied over the blades of the watt-hour meter without cutting or mutilation of the insulator material.
7	100A and 150A rated meter socket jaw assemblies shall be compatible with Class 200 rated watt-hour meters.
8	Neutral position shall be bonded to the meter socket enclosure.
9	Bolted or lay-in type terminals and terminal blocks shall have Allen or hex head terminal screws rated for 150 inch-pounds (17 Newton-mete rs) tightening torque minimum.
10	Underground (bottom entry) types and central wiring space of ganged types shall have 3/8 inch (10 mm) diameter stud terminals capable of pulling tensions up to 400 lbs. (1.78 kN) force. ✓ The Customer shall install crimp type or approved spring-type compression connectors. Mechanical (bolted) connectors are not acceptable. ✓ Parallel conductors (2 maximum) attached to stud terminals shall be terminated with stackable crimp type compression connectors (or spacers approved for the purpose). ✓ Completed connection requires tw o threads of the stud exposed.
11	Connection temperature rating is preferred at 90 degrees C and insulation material to be rated 600V and arc track resistant.
12	The meter socket meets the wire bending requirements within the enclosure and at terminations according to the NEC.
13	A manual, single handled By-Pass with locking jaw and safety arc shield is required for all commercial and 320A class residential applications.

Note: *Meter Socket Minimum Short Circuit Withstand Capability*

Meter sockets shall have a minimum short-circuit withstand rating of 10,000 amperes rms symmetrical at 300 volts AC. The exceptions are 200 and 320 ampere-rated single or three phase meter sockets having short circuit ratings based on the use of an overcurrent protective device on a circuit capable of delivering not more than:

RMS SYM. AMPS, MAX.	MAX. OVERCURRENT PROTECTION, AMPS	VOLTS MAX.	RMS SYM. AMPS, MAX.	MAX. OVERCURRENT PROTECTION, AMPS	VOLTS MAX.
200,000	200 CLASS J or T FUSE	600	25,000	100 CIRCUIT BREAKER	240
100,000	400 CLASS J or T FUSE	600	22,000	1 ph. 125 CIRCUIT BREAKER	240
100,000	100 CLASS RK5 FUSE	600	18,000	200 CIRCUIT BREAKER	240
50,000	600 CLASS T (300V) FUSE	300	14,000	ANY CIRCUIT BREAKER	600
42,000	200 CLASS RK1 FUSE	480			

Table 7.2-3 General Self-contained Meter Socket Installation Responsibilities Checklist

The Company will:

- ✓ Designate Service and Meter Locations.
- ✓ Furnish and install service drop conductors to the point of connection and make final connection, except as permitted under Section 4.2.6 for residential overhead service upgrade projects.
- ✓ Install the meter.

Customer will:

- ✓ Furnish and install the service entrance conductors and equipment in accordance with the requirements of the National Electrical Code and the Company.
  - Use an approved oxide inhibiting compound on aluminum conductors (not on meter jaws).
  - Install expansion joint in underground conduit according to NEC Article 300 for underground served meter socket
- ✓ Make connections in meter socket trough.
  - Use approved compression connectors on stud-type underground line connections for URD type meter sockets.
- ✓ Install the meter socket on approved support according to Section 7.7.
- ✓ Obtain an electrical inspection certificate from a recognized electrical inspection authority.

Table 7.2-4: 320A Meter Socket Applications

[New requirement in MA, NH, and RI.]

Those applicants or existing customers applying for 400-ampere service at a delivery voltage of 120/240, 120/208 or 277/480 volts that propose to install a self-contained 320-ampere meter socket shall meet the following criteria:

- ✓ Group the Class 320 meter socket with an 80% derated main circuit breaker service equipment.
- ✓ Demonstrate as part of the municipal or third party inspection approval that the load side capacity is not more than 320-ampere continuous (see NEC Article 220).
- ✓ Customer designs resulting in higher calculated peak load current or using 100% rated main circuit breaker or fuses greater than 320 amperes will require an instrument transformer metered service.
- ✓ The Customer shall reserve space for a future instrument transformer meter cabinet, since any failure of the Company's self-contained meter due to loads exceeding 320 continuous amperes will require an upgrade to instrument transformer metering prior to re-energization.
- ✓ All 480 volt class self-contained metering installations shall be cold sequenced and include line side service equipment that allows the meter(s) to be de-energized by Company employees. Additional disconnects may be installed between the service equipment and each self contained 480V meter as necessary for multiple metered applications.

Note: In all cases, the Company reserves the sole right to specify the final metering configuration based on the Customer's load characteristics and Good Utility Practice.

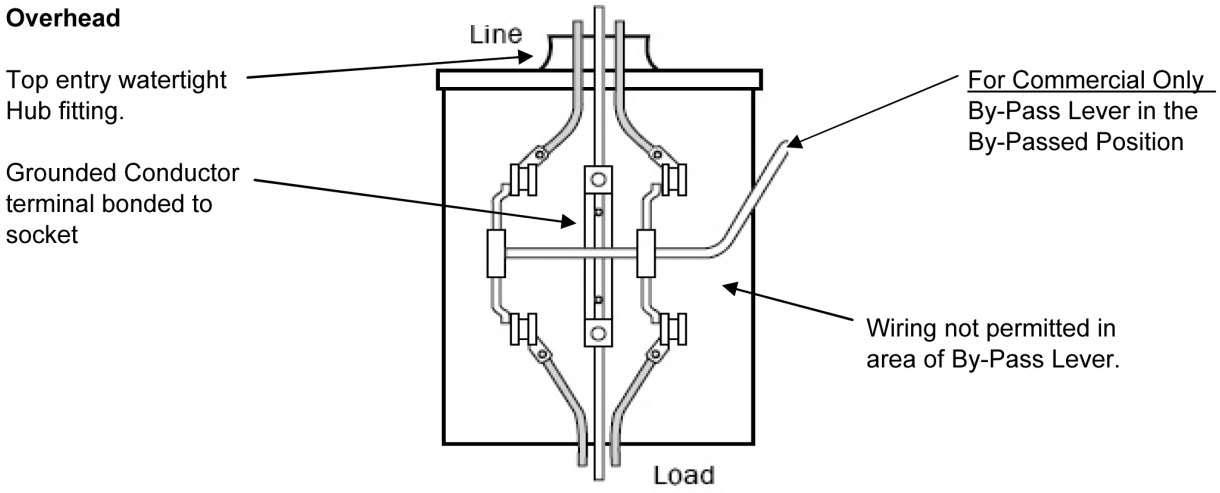
7.3 SELF-CONTAINED METER SOCKET INSTALLATIONS

Meter socket troughs shall not be used as junction boxes or wiring troughs for splices or taps. The Customer shall consult with the Company prior to meter trough installation when considering a meter installation using other than the preferred wiring configuration. The following illustrations are typical arrangements required for the applications and requirements specified in Section 7.2.

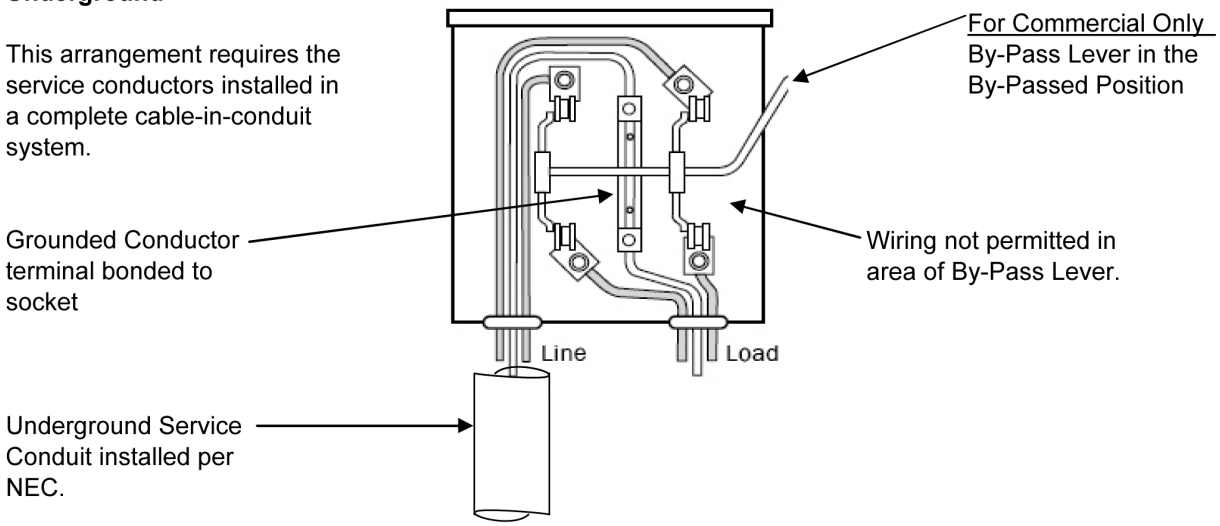
Figure 7.3-1 Typical Single Phase Residential or Commercial Meter Socket Connections 120/240 Volt, 3 Wire, 200 Ampere Maximum Continuous Duty

4 Terminal Meter Socket
Meter Form - 2S

Overhead

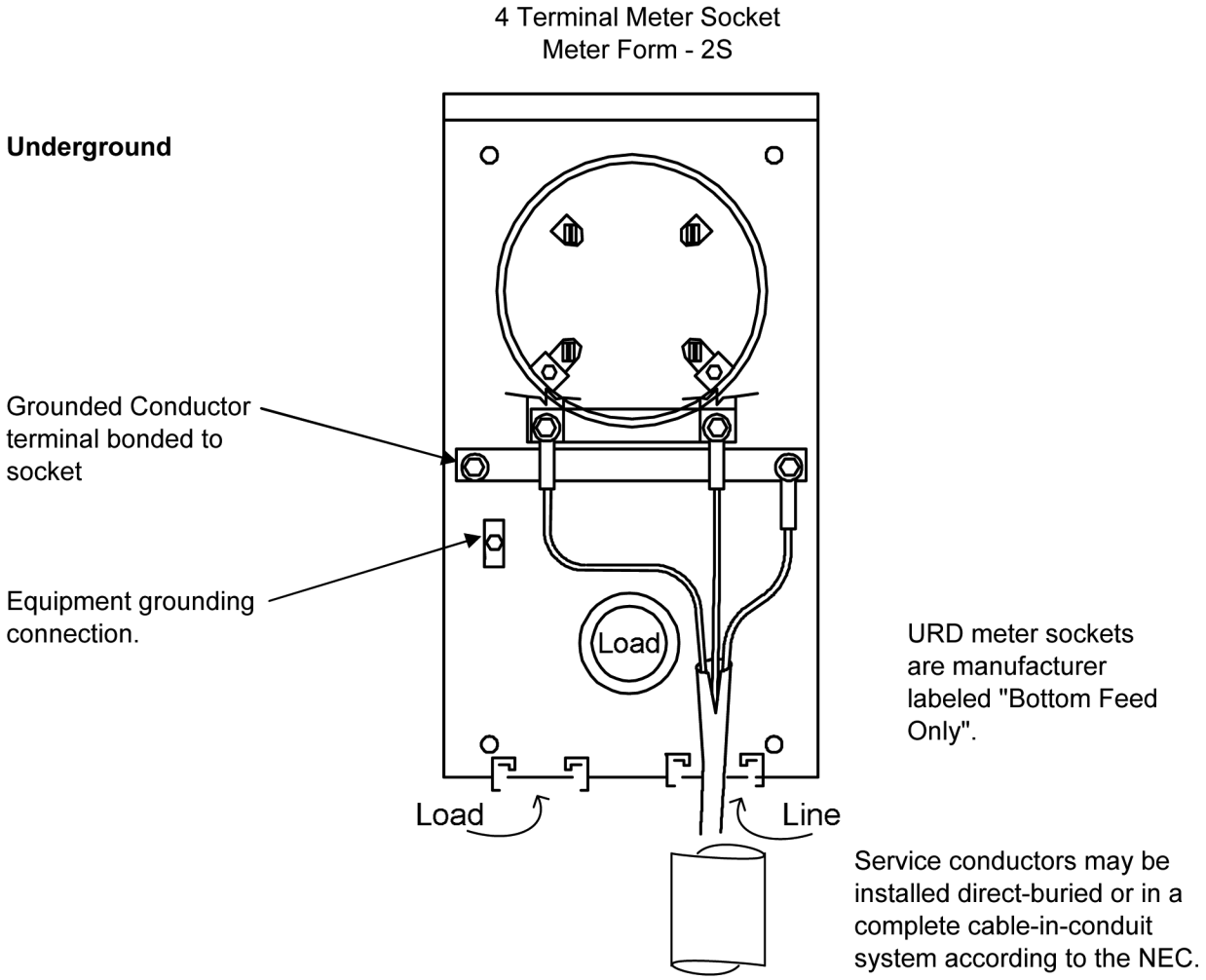


Underground



See Tables 7.2-1 through 7.2-3 for further details on application, requirements, and responsibilities.

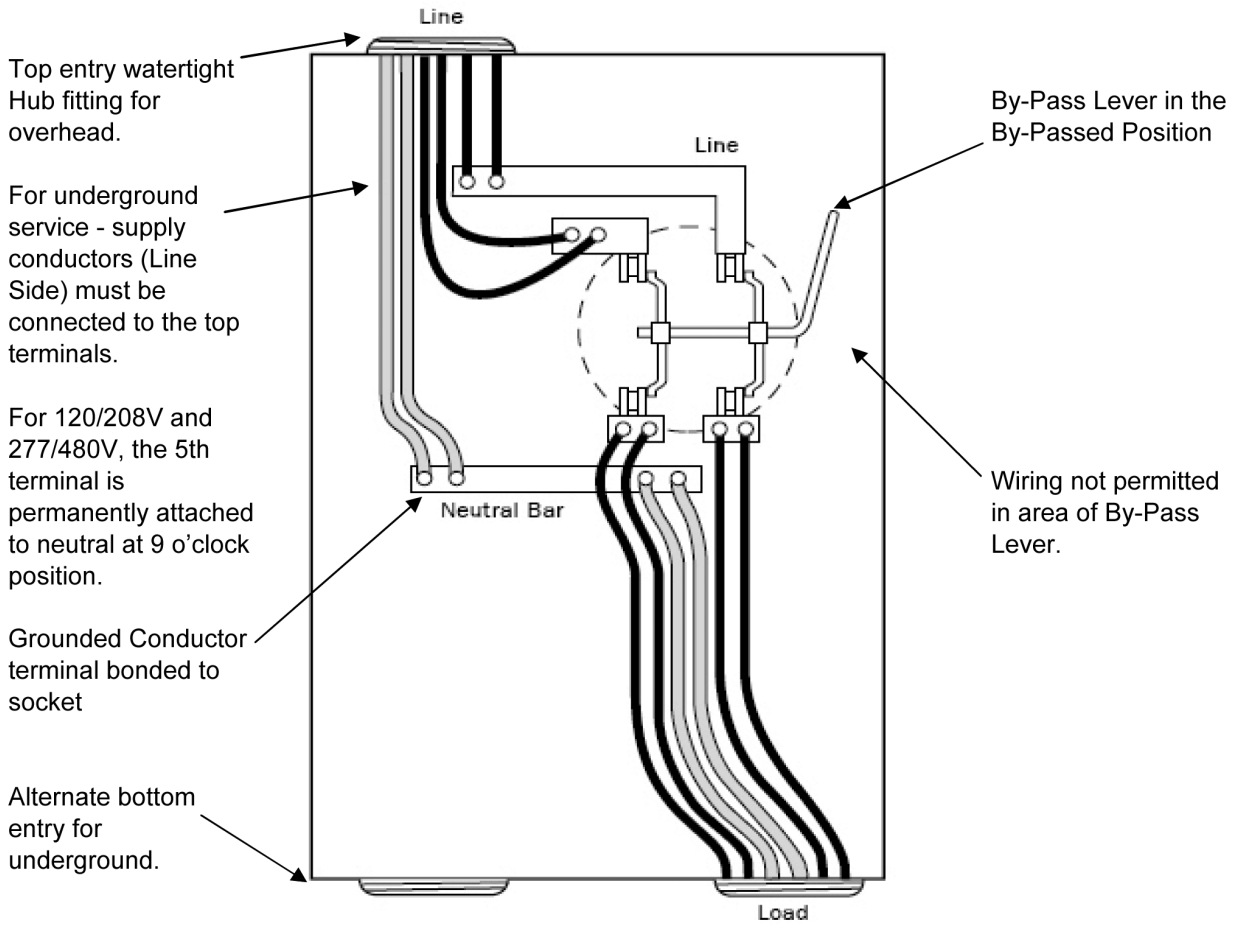
Figure 7.3-2 Typical Single Phase Residential URD Meter Socket Connection 120/240 Volt, 3 Wire, 200 Ampere Maximum Continuous Duty



See Tables 7.2-1 through 7.2-3 for further details on application, requirements, and responsibilities.

Figure 7.3-3 Typical Single Phase Residential or Commercial Meter Socket Connections 120/240 Volt or 120/208 Volt or 277/480 Volt, 3 Wire, 320 Ampere Maximum Continuous Duty

4 and 5 Terminal Meter Sockets
Meter Forms - 2S and 12S



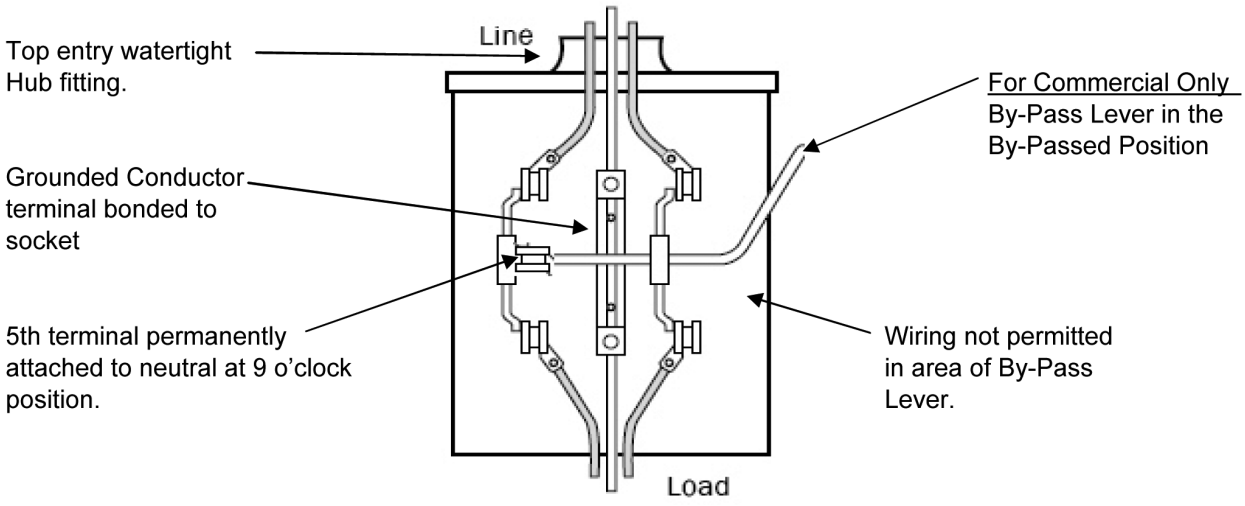
✓Applications: For Single phase 3 wire 120/240 volts or 120/208 volts or 277/480 volts 320 ampere continuous service (one meter installation).
✓Service entrance cable or service entrance conductors shall be installed according to the NEC. Side or rear entry (exit) not permitted. The preferred wiring for overhead installation is in the top of the meter socket and exiting the bottom. The preferred wiring for underground installation is in the bottom left side of the meter socket and exiting the bottom right side.
✓Underground service conductors for residential may be installed direct-buried or in a complete cable-in-conduit system according to the NEC. Conduit is required for commercial.

See Tables 7.2-1 through 7.2-3 for further details on application, requirements, and responsibilities.

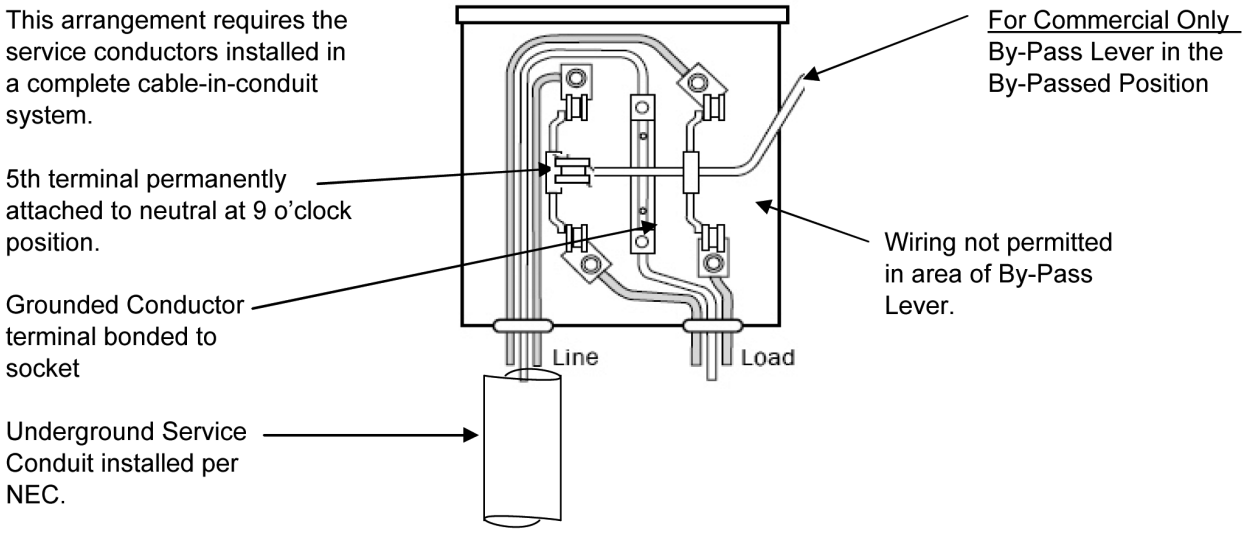
Figure 7.3-4 Typical Single Phase Residential or Commercial Meter Socket Connections 120/208 Volt and 277/480 Volt, 3 Wire, 200 Ampere Maximum Continuous Duty

5 Terminal Meter Socket
Meter Form - 12S

Overhead



Underground

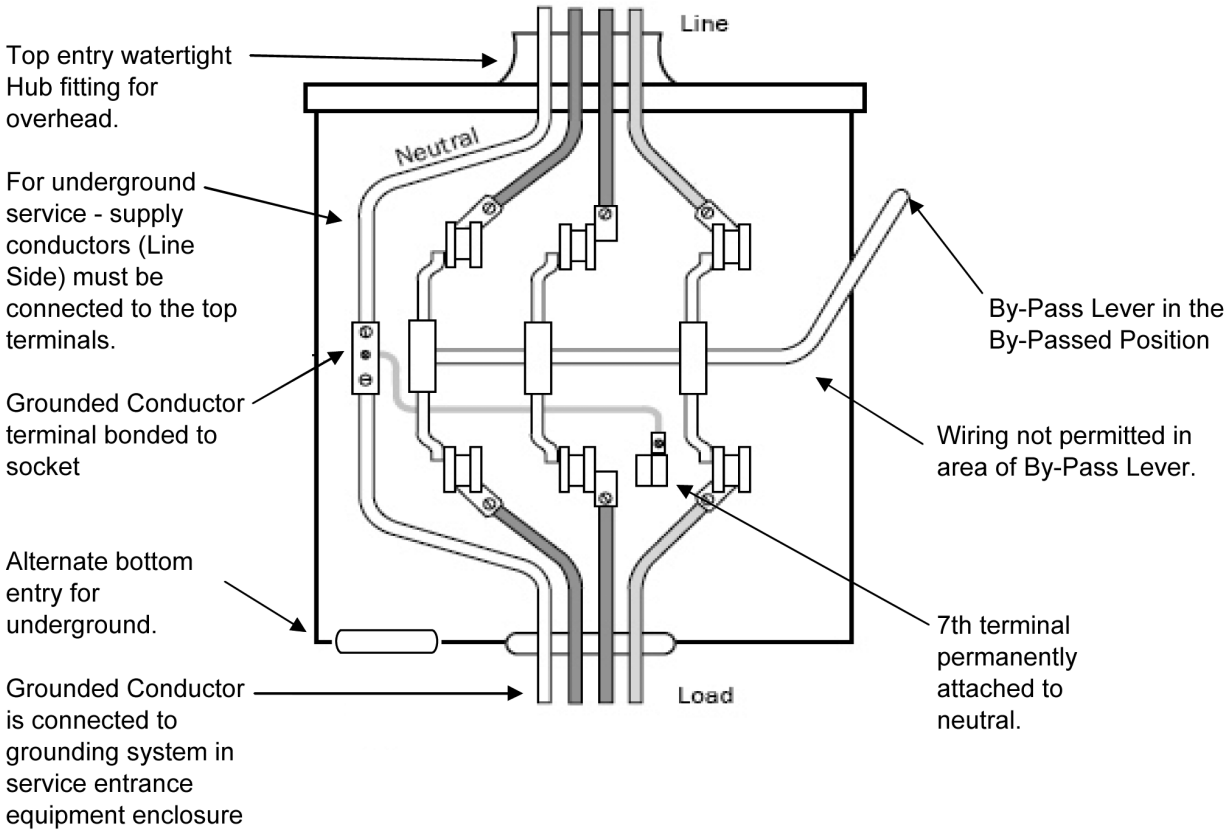


All 480 Volt class self-contained meters shall be cold sequenced.

See Tables 7.2-1 through 7.2-3 for further details on application, requirements, and responsibilities.

Figure 7.3-5 Typical Three Phase Commercial Meter Socket Connections 208Y/120 Volt and 480Y/277 Volt, 4 Wire, 200 Ampere Maximum Continuous Duty

7 Terminal Meter Socket
Meter Form - 16S



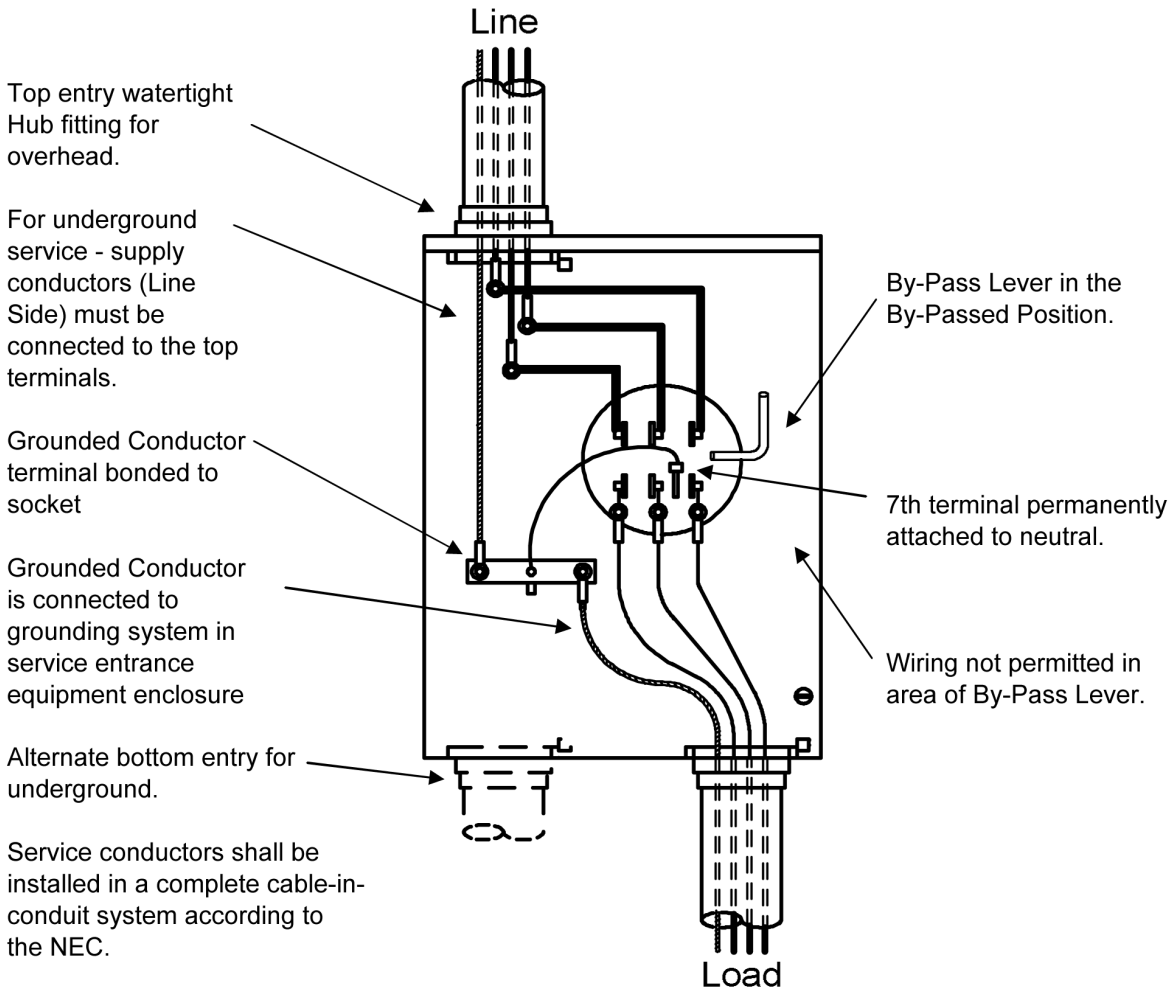
Service conductors shall be installed in a complete cable-in-conduit system according to the NEC.

All 480 Volt class self-contained meters shall be cold sequenced.

See Tables 7.2-1 through 7.2-3 for further details on application, requirements, and responsibilities.

Figure 7.3-6 Typical Three Phase Commercial Meter Socket Connections 208Y/120 Volt and 480Y/277 Volt, 4 Wire, 320 Ampere Maximum Continuous Duty

7 Terminal Meter Socket
Meter Form - 16S

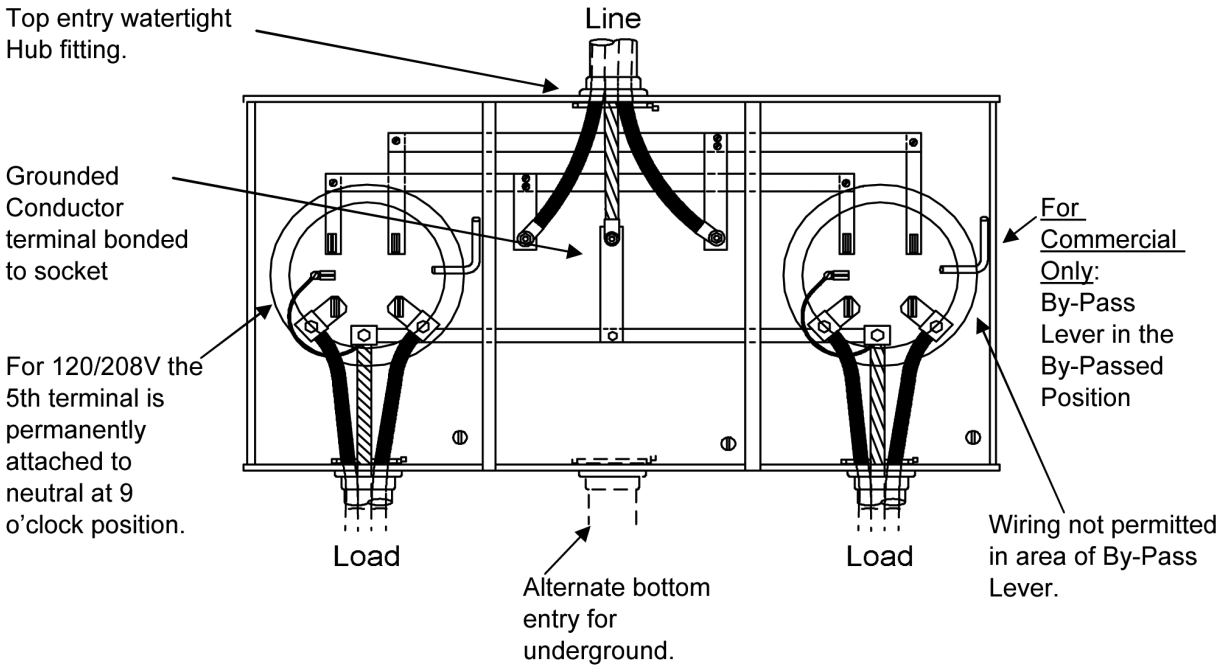


✓Applications: For three phase 4 wire 208 wye/120 volts or 480 wye/277 volts 320 ampere continuous service (one meter installation).
✓Service entrance cable or service entrance conductors shall be installed according to the NEC. Side or rear entry (exit) not permitted. The preferred wiring for overhead installation is in the top of the meter socket and exiting the bottom. The preferred wiring for underground installation is in the bottom left side of the meter socket and exiting the bottom right side.
✓Cold sequence metering arrangement is required if single-phase 277/480V or 3 phase 480Y/277V service.

See Tables 7.2-1 through 7.2-3 for further details on application, requirements, and responsibilities.

Figure 7.3-7 Typical Single Phase Residential or Commercial 2-to-6 Ganged Meter Socket Connections 3 Wire, 120/240 Volt 150 Ampere and 120/208 Volt 100 Ampere, Maximum Continuous Duty per

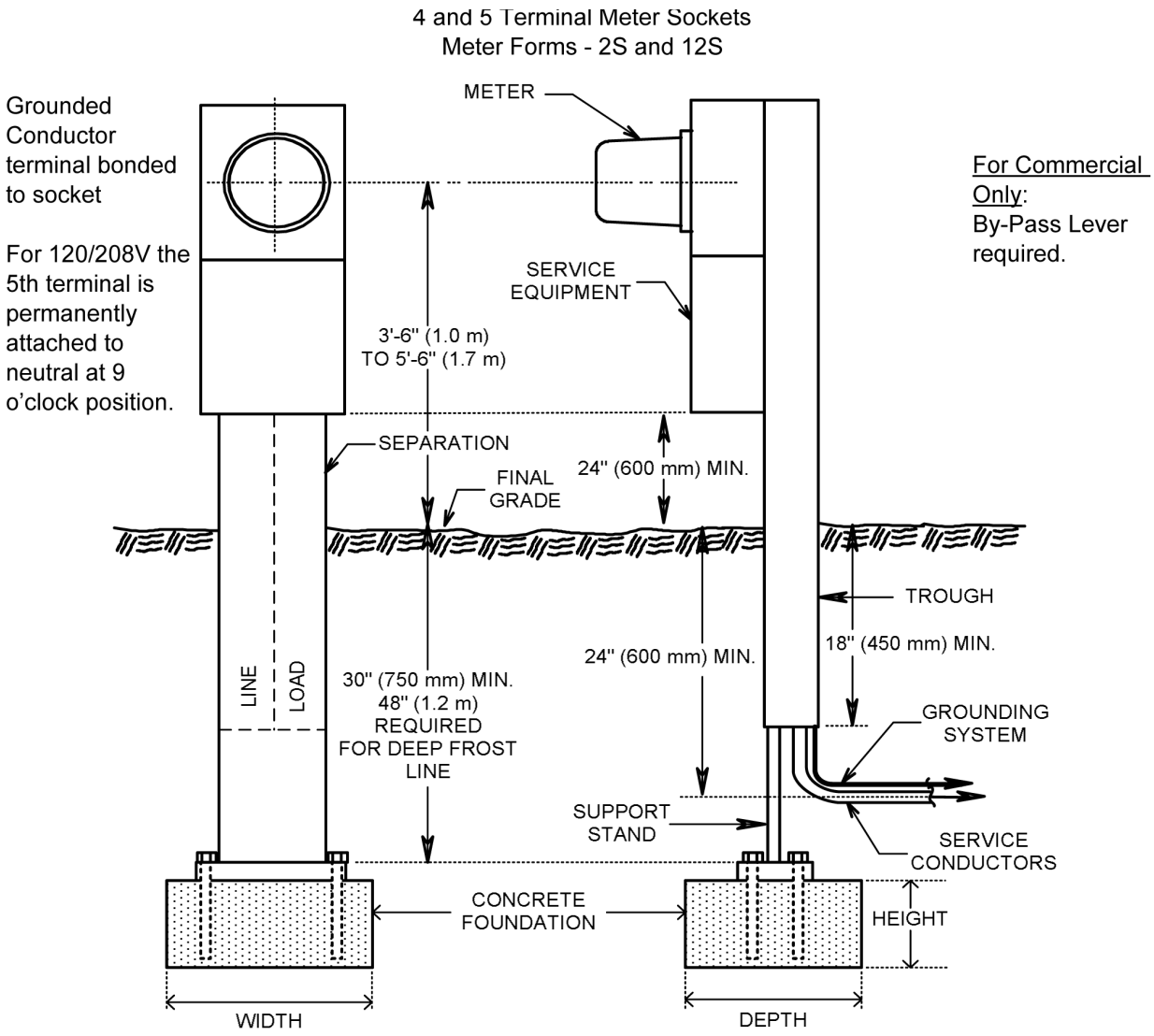
4 and 5 Terminal Meter Sockets
Meter Forms - 2S and 12S



✓One-hole pad crimp-type or spring type compression connector for 3/8"(10mm) stud size to be furnished and installed by customer.
✓Fifth terminal supplied by Customer. Connected to socket trough neutral stud by Customer with #10 AWG copper insulated conductor.
✓Multimeter channel cannot be modified for additional positions.
✓Connect grounded circuit conductor to service equipment neutral bus.
✓Grounding system shall be installed according to NEC requirements.
✓Load side to Customer's service equipment. If the meters serve another building or structure, service equipment shall be adjacent to the meters.
✓For underground service, service conductors for residential may be installed direct-buried or in a complete cable-in-conduit system according to the NEC. Conduit is required for commercial.

See Tables 7.2-1 through 7.2-3 for further details on application, requirements, and responsibilities.

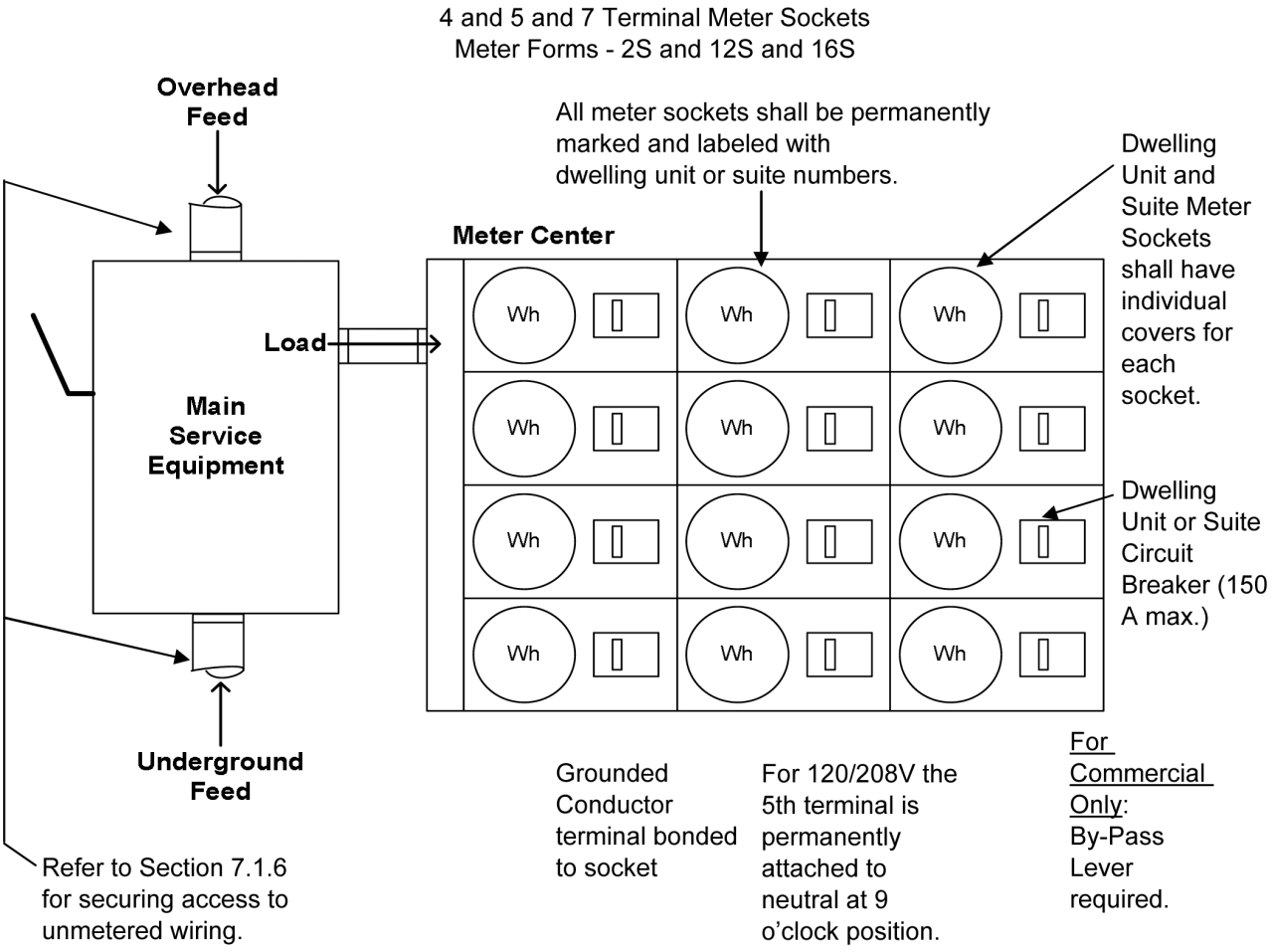
Figure 7.3-8 Typical Residential or Commercial Service Pedestal Single Phase Service 120/240 Volt 200 Amp and 120/208 Volt 100 Amp, 3 Wire Figure



✓Applications include mobile homes, residential, and small commercial service.
✓Grounding system installed as required by NEC.
✓Underground service conductors to handhole or transformer by Customer for residential may be installed direct-buried or in a complete cable-in-conduit system according to the NEC. Conduit is required for commercial. Metered and unmetered conductors shall not occupy same raceway. Six inch (150mm) minimum cable separation between line and load cables in common trench.
✓Concrete footing minimum dimensions shown for a single pedestal [28" (710mm) wide, 18" (450mm) deep, 12" (300mm) high] greater size footing required for multiple or larger pedestal units.
✓Service pedestal to be furnished, installed and maintained by Customer. Pedestal shall meet Table 7.2.-2 for meter socket section. Pedestal location shall be accepted by the Company.
✓Other service supports may be considered. Prior approval is required from the Company.

See Tables 7.2-1 through 7.2-3 for further details on application, requirements, and responsibilities.

Figure 7.3-9 Typical Residential or Commercial Meter Center (more than six meters) Single Phase and Three Phase Service 120/240 Volt 200 Amp and 120/208 Volt 100 Amp, 3 Wire and 208Y/120 Volt, 4 Wire

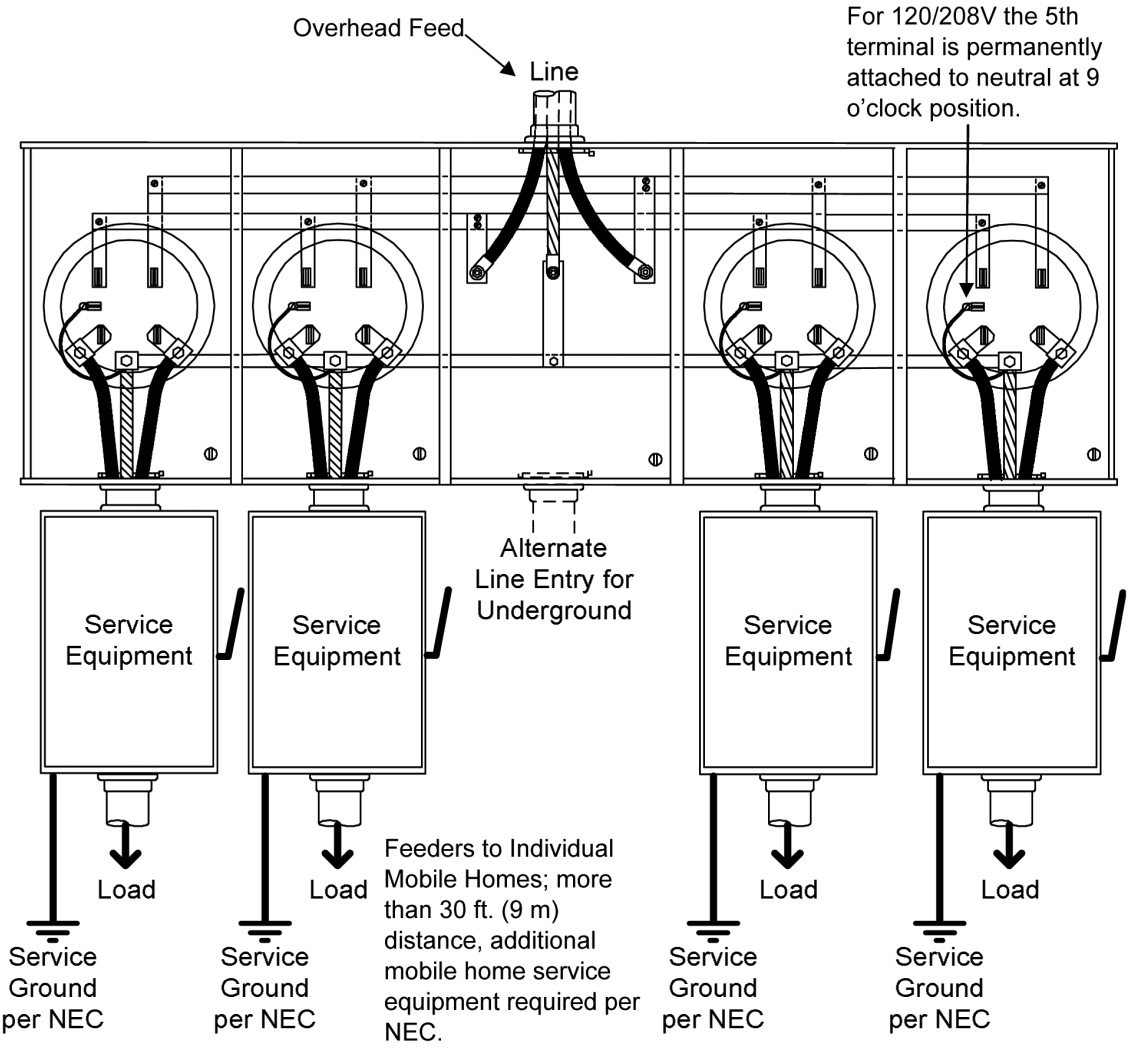


✓Bond metallic conduit in accordance with NEC Article 250.
✓See Section 4 for service entrance conductors in approved conduit and sized according to the NEC.
✓Meter board/support construction according to Section 7.7 and securely mounted, at least 6" (150mm) from top of meter board to ceiling or beam.
✓Fifth terminal is needed at 9 o'clock position for 120/208 Volt 3wire installations.
✓Meter centers may be mounted vertically or horizontally, depending upon manufacturer's specific design. Raintight where located outdoors.
✓6'-0" (1.8m) maximum above floor or final grade to center of top row of meters.
✓2'-0" (600mm) minimum above floor indoors and 2'-6" (750mm) minimum above final grade outdoors to center of bottom row of meters.

See Tables 7.2-1 through 7.2-3 for further details on application, requirements, and responsibilities.

Figure 7.3-10 Typical Mobile Home and Recreational Vehicle Park Meter Socket Applications

Residential Ganged for up to 4 Mobile Homes
Single Phase Service
120/240 Volt 150 Amp and 120/208 Volt 100 Amp, 3 Wire per Position
4 and 5 Terminal Meter Sockets
Meter Forms - 2S and 12S



✓ Service arrangement to be used for existing overhead served mobile home parks or new groups of up to four mobile homes where URD rules do not apply and where single meter or grouped indoor meter installation is not practical.

✓ See Section 4 for service entrance conductors in approved conduit and sized according to the NEC. If metallic conduit, bond conduit in accordance with the N.E.C.

✓ Install service entrance ground in accordance with N.E.C.

✓ Outdoor meter support materials and construction according to Section 7.7 and securely mounted.

✓ Meter sockets are supplied by the Customer and the Company will supply meters.

✓ All meter sockets shall be permanently marked and labeled with individual mobile homes served.

See Tables 7.2-1 through 7.2-3 for further details on application, requirements, and responsibilities.

For metered service pedestal serving a mobile home underground, see Figure 7.3-8.

7.4 TRANSFORMER-RATED METERING 600 VOLTS AND LESS, 400 AMPS AND ABOVE

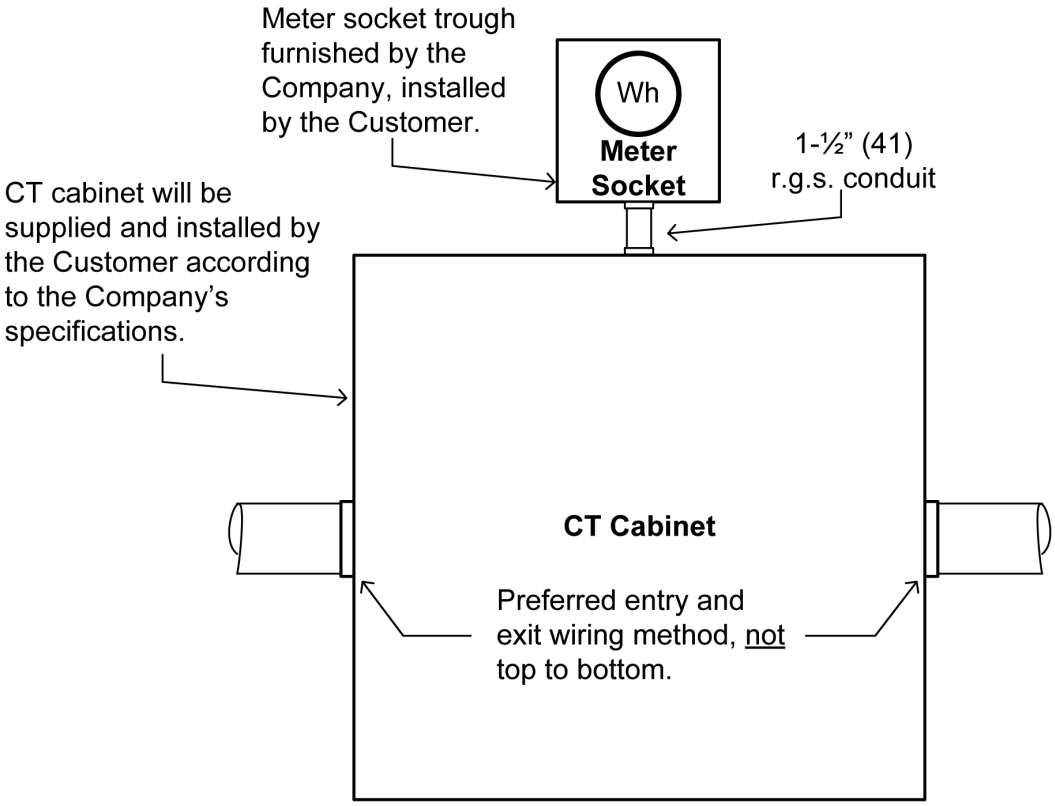
7.4.1 Instrument Transformers and Enclosures

The Company will specify and furnish the quantity and type of all current and voltage transformers for revenue metering. The Customer shall install all instrument transformers except those for pad-mounted metering. Enclosures shall be approved by the Company but furnished and installed by the Customer *[New requirement in NY.]*. All transformer enclosures must have facilities for Company locks. Instrument transformer cabinets shall not be used as junction boxes or for branch circuit wireways. The preferred entry and exit wiring method for metering transformer cabinets are from the side not the top or bottom. The Customer shall consult with the Company prior to transformer-rated meter cabinet installation when considering a meter installation using other than the preferred wiring configuration. In some cases, the Company may choose to supply the instrument transformers to be installed by the switchgear manufacturer.

The following illustrations are typical transformer-rated metering arrangements required for the applications and requirements specified in Section 7.2.

Figure 7.4.1-1 Typical Commercial CT Cabinet Secondary Metering Installation

120/240 volt Single-phase
208Y/120 volt & 480Y/277 volt Three-phase
400 A through 800 A

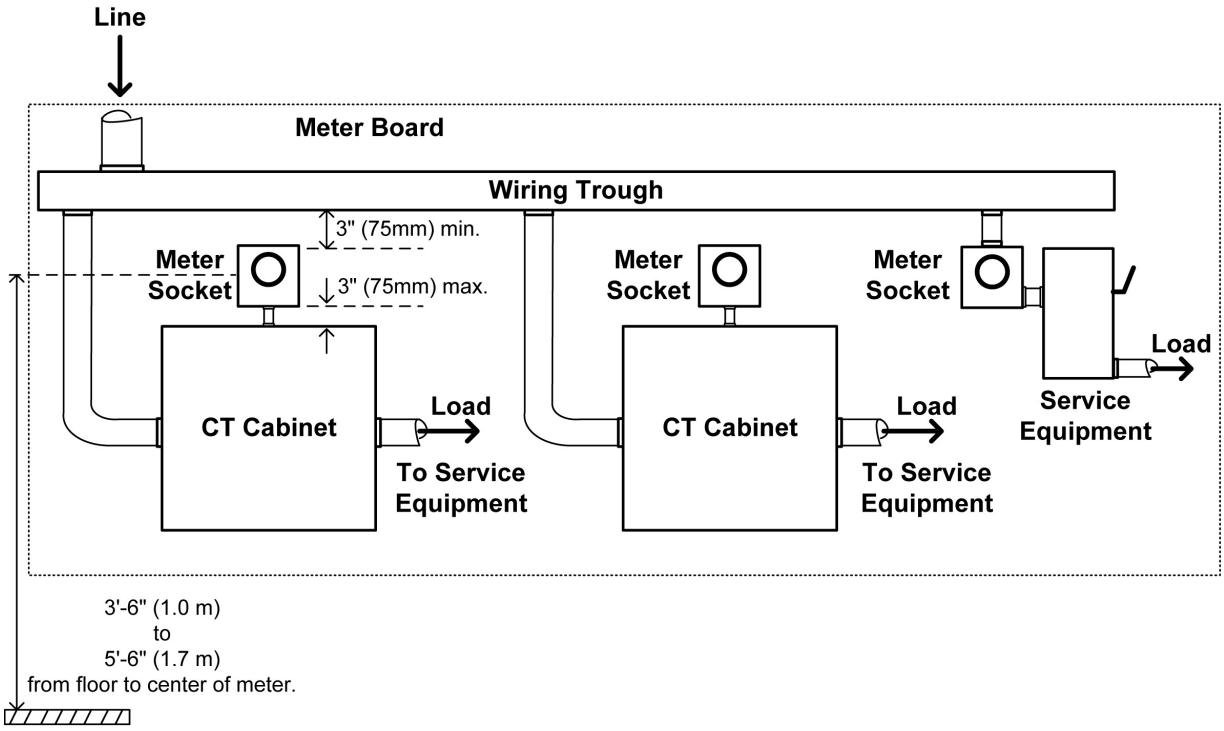


Customer-owned Metering CT Cabinet Requirements:

- ✓ Minimum Size - 36" (900 mm) wide x 36" (900 mm) height x 10" (250 mm) deep
- ✓ Rolled Lip Cover
- ✓ Permanently installed hinge pins, removable cover in open position
- ✓ Padlock and Sealing Provisions
- ✓ NEMA 3R Rainproof Enclosure Indoor/Outdoor Use
- ✓ Listed by Independent Recognized Testing Laboratory
- ✓ Mounting Provisions for Field-installed Instrument Current Transformers
- ✓ Preferred entry and exit wiring on sides; not top and bottom
- ✓ Grounding Stud

See Tables 7.2-1 through 7.2-3 for further details on application, requirements, and responsibilities.

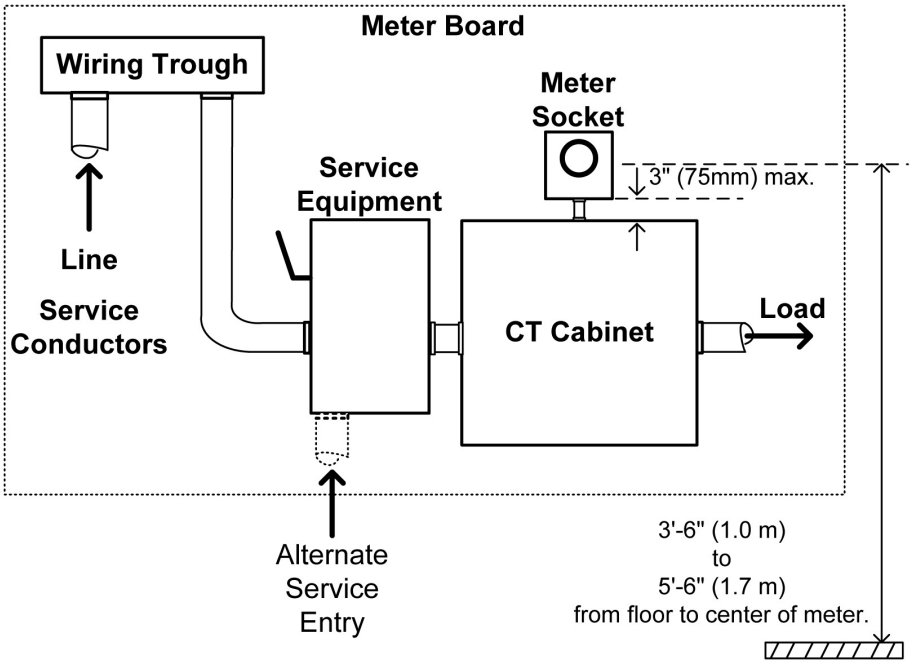
Figure 7.4.1-2 Typical Indoor Commercial Installation Two to Six Meter Service Entrance 800A Maximum From Overhead Line



- ✓ See Section 7.4.1 and Figure 7.4.1-1 for metering CT cabinet requirements, 400A to 800A.
- ✓ 1-½" (41) rigid galvanized steel conduit required between CT cabinet and meter socket.
- ✓ See Sections 7.2 and 7.3 for appropriate self-contained meter socket installations below 400A. Cold sequence installation required for 480V class self-contained meter sockets.
- ✓ Wiring trough in accordance with NEC requirements and includes provisions for locking or sealing by the Company.
- ✓ See Section 7.7 for Meter Board requirements.

See Tables 7.2-1 through 7.2-3 for further details on application, requirements, and responsibilities.

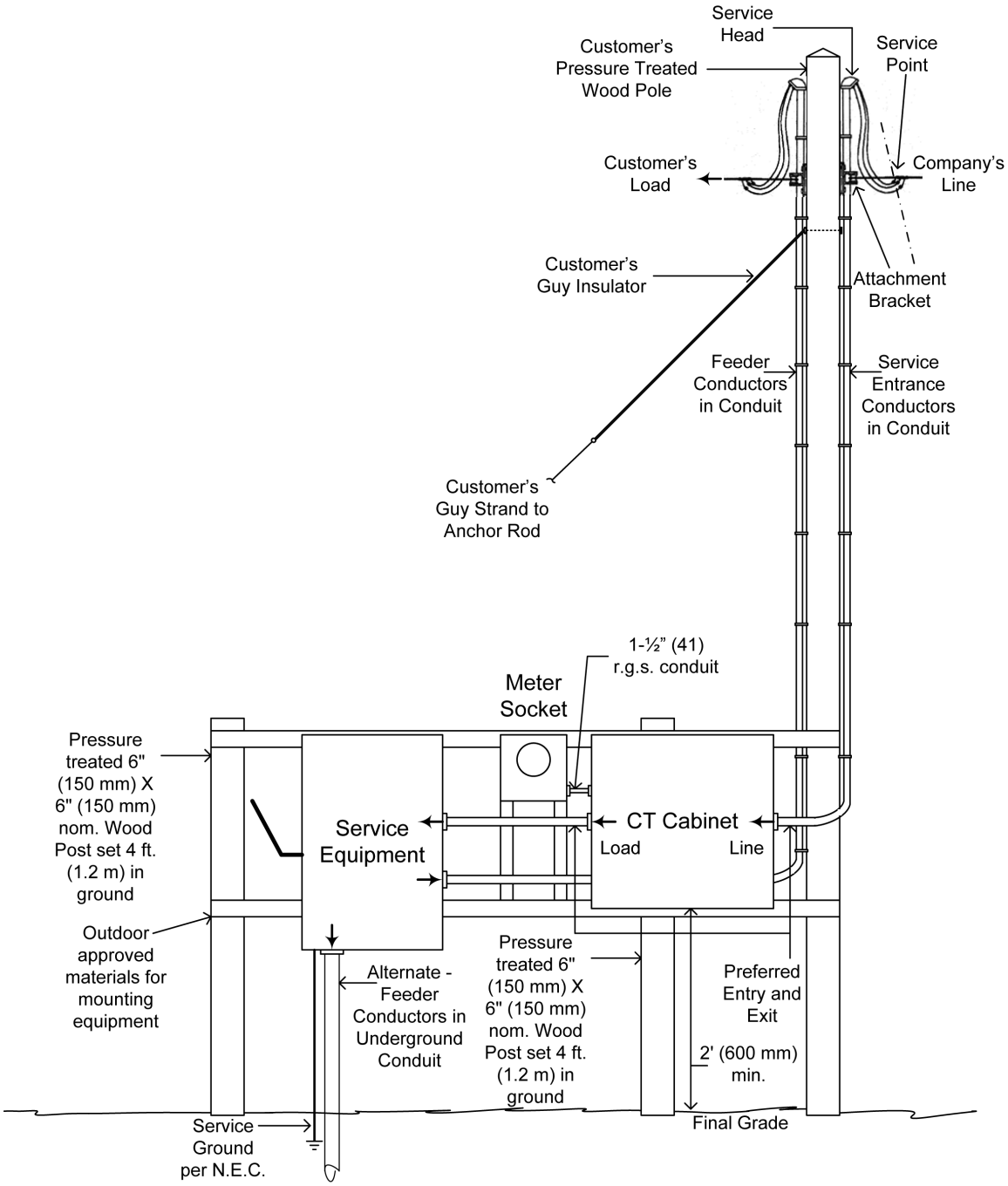
Figure 7.4.1-3 Typical Indoor Commercial Installation One Meter Service Entrance from Network or Radial Underground Line Three-Phase, 4 Wire, 208Y/120V, 400A



- ✓ See Section 7.4.1 and Figure 7.4.1-1 for 400A metering CT cabinet requirements.
- ✓ 1-½" (41) rigid galvanized steel conduit required between CT cabinet and meter socket.
- ✓ Wiring trough in accordance with NEC requirements and includes provisions for locking or sealing by the Company.
- ✓ See Sections 4 and 5 for underground service connection requirements (radial underground line and network services).
- ✓ See Section 7.7 for Meter Board requirements.

See Tables 7.2-1 through 7.2-3 for further details on application, requirements, and responsibilities.

Figure 7.4.1-4 Typical Outdoor Service Pole Installation Single-Phase, 3 Wire, 120/240V for Loads 72 to 100kVA Demand or Three-Phase up to 800A From Overhead Line



- ✓ See Section 7.4.1 and Figure 7.4.1-1 for metering CT cabinet requirements, 400A to 800A.
- ✓ See Section 7.7 for Meter Support requirements.

See Tables 7.2-1 through 7.2-3 for further details on application, requirements, and responsibilities and Section 4 for overhead service connection requirements.

7.4.2 Meter Sockets

The Company will furnish meter sockets for use with instrument transformers. Meter socket enclosures shall be installed by the Customer at the Company's specified location and wired by the Company. Where the metering is on a pad-mounted transformer, the Company will both install and wire the meter socket.

7.4.3 Metering Sequence

All metering equipment shall be installed on the line side of the service disconnecting means (Hot Sequence) with the exception of network services. Network services shall have metering equipment installed on the load side of the service disconnecting means (Cold Sequence).

7.4.4 Instrument Transformer Secondaries

The Customer will furnish and install a 1-1/2 inch (41) rigid galvanized steel conduit between the instrument transformer enclosure and the meter socket which shall be in the same location within sight. The use of conduit body fittings (condulets) with removable covers is not acceptable. The maximum distance between the instrument transformers and the meter shall be 50 feet (15 meters). Secondary wiring will be furnished and installed by the Company.

7.4.5 Pad-mounted Transformer Service Metering

At the Company's option where a single customer is supplied from a 300 kVA or larger pad-mounted transformer, bushing current transformers will be used. The meter socket will be mounted on the outside of the secondary voltage compartment of the pad-mounted transformer.

7.4.6 Metal-Enclosed Free-Standing Service Cubicles Rated 600 volts or Less (Secondary Voltage Installations)

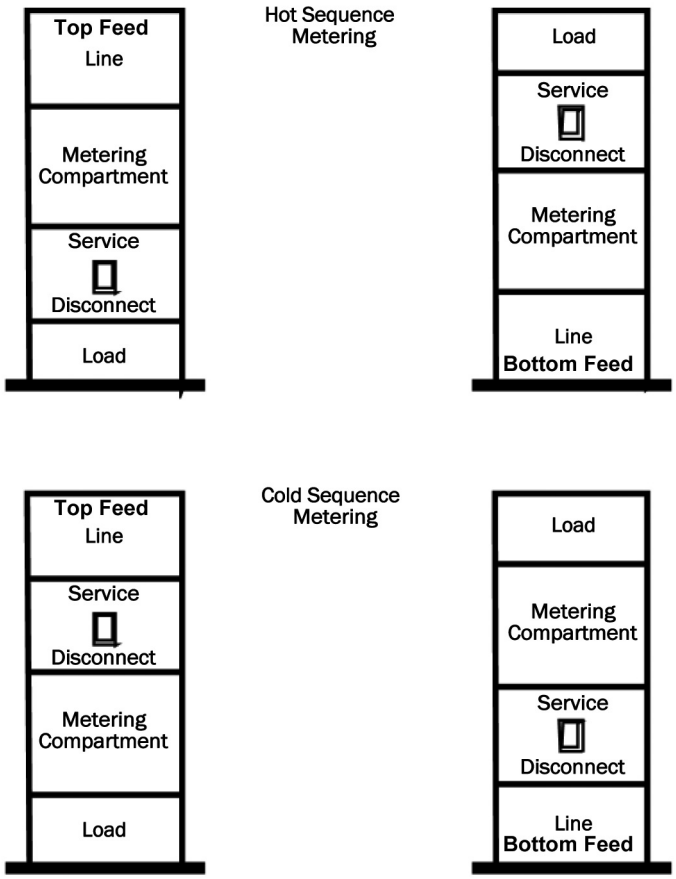
7.4.6.1 General

The Customer shall provide the Company with equipment specifications prior to ordering any equipment. All components of equipment shall conform to the latest editions of all applicable ICEA & ANSI standards, and the Company recommends that all equipment be certified and approved by a laboratory testing organization such as UL, ETL, CSA, etc.

7.4.6.2 Metering Sequence

Refer to Section 7.4.3 and see Figure 7.4.6.2-1.

Figure 7.4.6.2-1: Instrument Transformer Metering Sequence - Service Cubicles Rated 600 volts



Note: Cold sequence metering is required on the network system.

7.4.6.3 Unmetered Supply Conductors

Compartments enclosing unmetered supply conductors shall be accessible through hinged doors or removable panels provided with hardware for the installation of locks as specified by the Company.

7.4.6.4 Meter Location

A meter location shall be provided that is large enough for mounting a meter socket supplied by the Company. The meter socket shall be installed at the location assigned by the Company, as near as practical to the instrument transformers. The maximum distance between meter and instrument transformers shall not exceed 50 feet (15 meters). A continuous run of rigid metal conduit shall be provided by the Customer between the meter socket and the instrument transformers.

7.4.6.5 Customer's Auxiliary Equipment

The connection of the Customer's auxiliary transformer for heat, light and receptacle(s) installed at the meter panel location and elsewhere within the Customer's switchgear, shall be on the load side of the Company's instrument transformers.

7.4.6.6 Metering Transformer Equipment Compartment

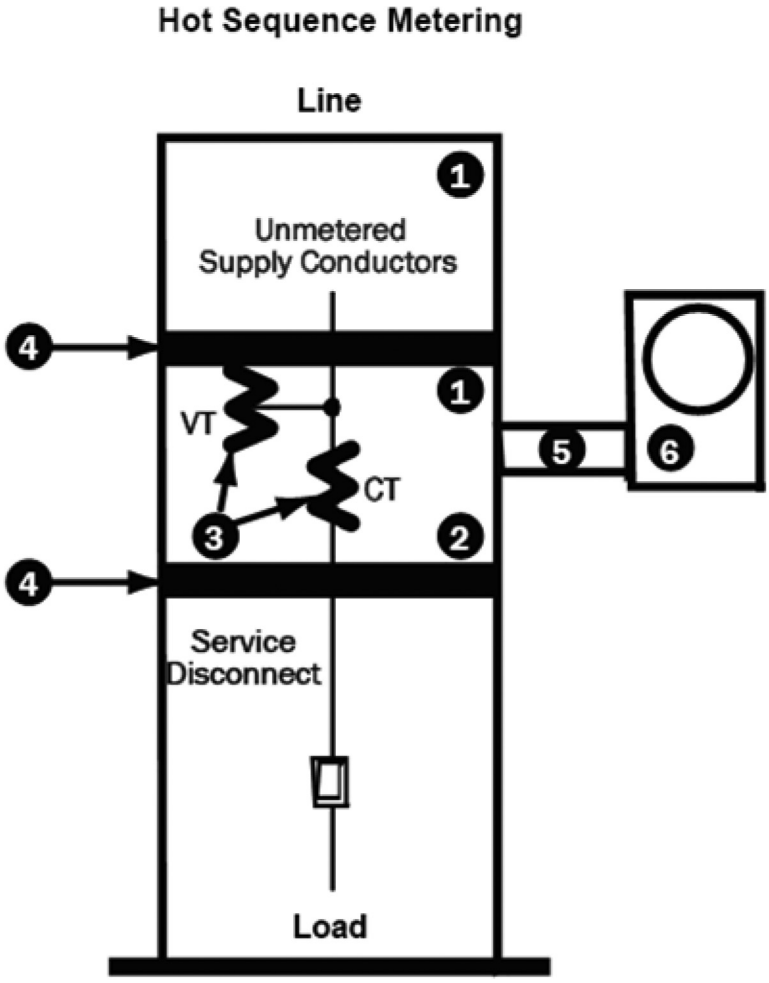
A separate properly barriered compartment, completely isolated within the equipment, shall be provided for the installation of current and voltage transformers of a type and rating as specified and furnished by the Company. This compartment shall be designed so that each of the transformers can be readily removed or changed without disturbing the others after installation and shall be solely accessible by the Company. (See Figure 7.4.6.7-1.) The Customer shall have provisions in the metering transformer compartment for the Company's connection of the metering potential neutral to the service equipment neutral bus.

Where the metering transformer compartment is located in an unheated area or building, provisions shall be made for heating the compartment to prevent condensation. The Customer shall maintain a minimum 10 feet (3 m) unobstructed clearance in front of the instrument transformer compartment door. The compartment shall be solely accessible by the Company, any section-to-section openings for through bus shall be as small as phase to ground clearance will allow. Phase buses shall be mechanically independent of the instrument transformers and the transformers shall be not part of the bus support system. Removable bus bar sections shall be provided by the Customer to permit installation and removal of current transformers. Silicon-bronze bolts and stainless steel nuts and washers shall be provided by the Customer for connection of the Company's current transformers.

Access to the metering compartment shall be through a full door hinged to permit horizontal swing of at least ninety degrees and provided with hardware for locking as specified by the Company.

No equipment other than Company owned metering equipment shall be installed in the compartment. Transformers shall be installed in each position so that the rating and polarity marks are readily and safely readable.

Figure 7.4.6.6-1: Metering Instrument Transformer Compartment in Service Cubicles Rated 600V



Notes:

1. Compartments lockable.
2. Instrument transformer compartment.
3. Metering transformer supplied by the Company.
4. Insulating barriers.
5. 1-1/2" (41) Rigid Galvanized Steel conduit.
6. Meter socket mounted adjacent to service cubicle.
7. A connector shall be provided in the metering transformer compartment for purposes of connecting the metering potential neutral to the incoming service neutral.

7.4.6.7 Voltage Transformers

In general only within MA, NH, and RI, voltage transformers will be supplied for metering services where the supply is 240 volts or greater. Primary connections for the voltage transformers shall be made on the supply side of the current transformers. Instrument transformer-rated metering 400 amperes and greater, below 600 volts applications in Upstate NY do not require voltage transformers.

7.5 METERING ABOVE 600 VOLTS

Where the service exceeds 600 volts, the Customer shall consult the Company. In such cases, the Company will furnish additional information about the metering requirements. See Electric System Bulletins 751 and 758 for primary metering transformer compartment requirements within medium voltage rated Customer-owned switchgear. In addition, see ESB 753 for typical primary meter pole and ESB 752 for typical outdoor substation metering requirements.

7.6 METERING PULSE SIGNALS

At the Customer's request, the Company will install at the Customer's expense at the point of metering a source of kWh pulses so that the Customer may monitor load/demand for the purpose of load control. Time pulses will not be provided. The Company is not responsible for customer equipment failure for the loss of pulse signals.

Analog signal provisions are subject to the Company's applicable tariff; consult the Company for application.

7.7 METER BOARDS AND SUPPORTS

7.7.1 Meter Mounting

All meters shall be durably and securely mounted in a true vertical position on a flat surface.

7.7.2 Approved Materials

The Customer shall provide and mount a meter support for each installation.
Materials acceptable for all installations are:

- 3/4 inch (19 mm) marine grade plywood.
- Galvanized steel slotted framing channel (Kindorf, Unistrut, Superstrut, or approved equal) 12 gauge zinc coated steel, with holes, 1-1/2-inch (38 mm) h X 3/4-inch (19 mm) w X (length = width of associated meter socket), two required, one for top, one for bottom. Zinc coated steel bolts 1/4-inch (6 mm) dia. X 3/4-inch (19 mm) long with nut and washer, total of four required, two for top, two for bottom of meter socket.
- 1-1/2-inch (38 mm) thick minimum pressure treated wood (approved outdoor ground contact rating minimum) with zinc coated lag bolts, two required, one for top, one for bottom of each board secured to structure.
- Masonry or solid brick wall of building with corrosion inhibiting protection applied to the meter enclosure.

Painted and/or treated 3/4-inch (19 mm) plywood board is acceptable in dry indoor locations. The support shall provide a clear space for mounting the Company's metering devices. Provision should be made for air circulation behind the meter board to inhibit "dry rot".

Where a meter support is required or used in an outdoor location, material used shall be protected from the effects of weather.

Irregular surfaces require provisions for flat support of meters. Meter boards are the preferred installation, alternatively, the building structure sub-surface may be used and the siding trimmed around the meter without interference of knockouts and meter cover.

Where service connection is made to the building, the meter shall be mounted on that building.

An outdoor manufactured meter pedestal as specified in Section 7.3 is also an approved meter support method.

8.0 MOTORS AND CONTROLLERS

8.1 GENERAL

It is important that the Company be consulted concerning the type of electric service available to insure correct application (phase and voltage) of the motor to be used. The correct application of motors is the Customer's responsibility. Motors should be sized to tolerate possible phase voltage unbalance, must be of a type that uses minimum starting current, and must conform to the Company's requirements and the applicable electrical code as to wiring, kind of equipment, and control devices. Starting current limitations are prescribed for conventional motorized equipment rated in horsepower and air conditioning or heat pump equipment rated in Btu/hr. Cases not covered in this section shall be referred to the Company.

8.2 SINGLE PHASE MOTORS

8.2.1 120 Volt Supply

Motors with ratings of one half (½) horsepower or less and window-type air conditioning units whose running-load current does not exceed 7½ amperes, with not more than four (4) starts per hour and with a locked-rotor current not exceeding 50 amperes, may be connected to 120 Volt supply. Motors having a full load running current of more than 7½ amperes but less than 12 amperes, and conforming to the above locked-rotor current limitations, may be connected to a 120 Volt branch circuit only if such branch circuit supplies the one unit and does not supply lighting units or other appliances. It is strongly recommended that units drawing more than 7½ amperes full-load running current be connected to 240 or 208 Volt circuits. Generally, motors larger than 5 HP should be three phase but the Company may require that single-phase motors be used where three-phase service is not readily available.

8.2.2 208 or 240 Volt Supply

Motors with ratings larger than one half (½) but less than six and one-half (6½) horsepower will be regularly supplied at 208 or 240 volts, provided the locked-rotor current does not exceed the values given in Table No. 8.6-1. In predominantly residential areas, and for small commercial installations, the Company should be consulted before installing motors with ratings of three (3) horsepower or larger.

8.2.3 Maximum Locked-Rotor Currents

Single-phase motors supplied from combined light and power secondary systems shall not have locked-rotor current values in excess of those shown in Table No. 8.6-1. Motors having locked-rotor current values in excess of those shown in the table shall be equipped with starters that will limit the current to the values specified. Domestic laundry equipment with operating cycles and electrical characteristics as currently available are considered acceptable.

Motors that start more than four (4) times per hour are an exception to the above and may cause interference to other customers. Automatically (frequently) started motors for general use, such as motors for refrigerators, oil burners, and similar devices, shall not have a locked-rotor current exceeding 23 amperes at 120 volts or 19 amperes at 240 volts. For multi-motored devices arranged for starting of motors one at a time, the locked-rotor current limits shall apply to the individual motors.

8.2.4 Single-Phase Motors on Three-Phase Service

Where single-phase motors are supplied from a 3-phase service, they shall be properly balanced across the three (3) phases.

8.3 THREE-PHASE MOTORS

8.3.1 Size of Motors

In order that the proper capacity may be available to supply the load, the Company should be advised of the motors to be installed. In predominantly residential areas, the Company should be consulted before installing 3-phase motors with ratings over five (5) horsepower.

8.3.2 Maximum Locked-Rotor Currents

Three-phase motors supplied from a combined light and power secondary system shall not have locked-rotor current values in excess of those shown in Table No. 8.6-2. Starting compensators are ordinarily required for 3-phase motors seven and one-half (7½) horsepower and larger. Exceptions to this practice will be allowed to the extent local distribution facilities permit. Motors having current values in excess of those shown in the table shall be equipped with starters, which will limit the current to the values specified. Increment start motors must have not less than a one-half-second interval between steps. The Company should be consulted concerning the installation of three-phase motors ten (10) horsepower or larger and must be consulted on motors larger than 15 horsepower.

8.4 MOTOR PROTECTION

Protective devices shall be installed on the load side of the meter.

8.4.1 Overload Protection

All motors should be properly protected against overload, including overloads caused by low voltage conditions.

8.4.2 Protection Against Single-Phase Operation

Three-phase motors shall be protected against the possibility of the failure of any one phase of the supply circuit. Three overcurrent (overload) units shall be used, one in each phase, unless the motor is protected against single-phase operation by other approved means. It is the Customer's responsibility to protect three phase motors against the possibility of single-phase operation.

8.4.3 Reverse Phase Protection

On motors for passenger and freight elevators, cranes and hoists, and other equipment where reversal or direction of rotation might cause property damage or injury, approved reverse phase relays together with circuit breakers, or equivalent devices, should be used on all three phase installations so that the motor circuit will be opened in the event of loss of any phase or phase reversal. The operation of this relay and associated circuit breaker should be instantaneous and should be such that the circuit cannot be re-energized until the normal phase relations are restored.

8.4.4 Undervoltage Protection

Motors that cannot be safely subjected to full voltage at starting, or would start on return of normal voltage after an interruption and endanger life or property, shall be provided with automatic undervoltage protection. Such protective device shall ensure that with either no voltage or undervoltage, the motor will be disconnected from the line and the starter will be returned to the “off” position. Where continuous operation of motorized equipment is essential, motor controllers should be arranged to allow motors to operate through a transient no voltage condition lasting for 1/2 second. The Company shall be consulted where problems of this nature may be encountered.

8.5 MOTOR-STARTING REQUIREMENTS

8.5.1 Objectionable Voltage Variation

Momentary fluctuation of the circuit voltage occurs each time a motor is started on the circuit. Where this effect is pronounced, a visual disturbance or lighting flicker may be observed by the Customer or other Customers served from the same system. In extreme cases, the motor itself may have difficulty starting.

8.5.2 Current Inrush Limitation

To suppress objectionable voltage variations and maintain proper service to the Customer and its neighbors, it is necessary to set maximum permissible limits to the current drawn from the service during each step of a motor-starting operation, based upon the frequency of starts. These limits are designed to cover typical cases and the Company gives no warranty that particular conditions may not later require a change. The specific motor-starting current limitations stated in Section 8.6 or furnished by the Company indicate the maximum allowable increases in current on the line side of the motor-starting device at any instant during the starting operation.

These limitations do not restrict the total current that can be taken by the motor, but may require that this total be built up gradually, or in steps during starting. Where a step-type starter is used, an appreciable time must be allowed on each step and the current increase of each step shall not exceed the imposed limitation. Closed transition between starting steps is required.

When motors are started in a group instead of individually, the starting current limitations apply to the group and not the individual motors.

8.5.3 Favorable Locations

There are locations on the Company's system where starting currents larger than specified above can be permitted. These locations are on services from network systems, which supply large loads or where special conditions exist. The Company shall be consulted to determine whether larger starting currents per step will be permitted for a specified installation.

8.5.4 Company Notification of 3 HP Single Phase and 10 HP Three Phase Applications

The Company shall be advised before any single phase motor 3 HP (equivalent 25,000 Btu/Hr.) or larger, or any three phase motor rated 10 HP (equivalent 75,000 Btu/Hr.) or larger is purchased and/or installed by a Customer. The information to be given the Company shall include:

- Largest HP
- Rated Voltage
- Rated PF
- Is Motor started under load?
- Type and characteristics of starter employed, if any
- Motor application (i.e. sawmill, stone crusher, elevator, air conditioner, etc.)
- Single phase or three phase
- Locked Rotor indicating Code Letter
- Frequency of motor starting and inrush current surges.
- Type and characteristics of starter employed, if any

8.6 MAXIMUM PERMITTED STARTING CURRENT

These tables are based on not more than four (4) starts per hour with long periods of continuous operation under maximum load conditions. Consult the Company if these conditions cannot be met.

The maximum starting currents permitted for a single phase and three-phase conventional motorized equipment rated in horsepower and for air conditioning or heat pump equipment rated in Btu/Hr. are:

Table 8.6-1 - Single Phase Motor Starting Current

Service Voltage	Max. Starting Current Per Step Max. Four Starts Per Hour	Max. Equiv. Rating of Air Conditioner or Heat Pump Btu/Hr.
120 volts	50 amperes	10,000
208 or 240 volts	60 amperes for 2 HP motor	20,000
208 or 240 volts	80 amperes for 3 HP motor	25,000
208 or 240 volts	Residential use - Consult Company. Commercial use - 120 amperes for 5 HP to 6.5 HP.	40,000

Table 8.6-2 - Three Phase Motor Starting Current

Service Voltage	Max. Starting Current Per Step Max. Four Starts Per Hour	Max. Equiv. Rating of Air Conditioner or Heat Pump Btu/Hr.
208 volts	100 amperes up to 5 HP motor	40,000
208 volts	130 amperes for 7-1/2 HP motor	50,000
208 volts	160 amperes to 10 HP motor	75,000
208 volts	230 amperes for 15 HP motor	150.000
480 volts	50 amperes up to 5 HP motor	40,000
480 volts	65 amperes for 7-1/2 HP motor	50,000
480 volts	80 amperes for 10 HP motor	75,000
480 volts	115 amperes for 15 HP motor	150,000

9.0 TRANSFORMER INSTALLATIONS ON CUSTOMER PREMISES

9.1 GENERAL

The Company may require installation of its transformers and other line equipment on the Customer's property. Customer shall provide suitable space, vaults, foundations or pads, conduit and enclosures as required by the Company. Customer shall provide satisfactory access at all times to the space, enclosures, or vaults for the Company to install, or remove, operate and maintain its equipment. Consult the Company for transformer installations in network, UCD, and URD areas.

9.2 INSTALLATIONS

One of the following general transformer installations may be used for services rated below 600 volts:

9.2.1 Cluster Mounted Overhead Transformers

9.2.1.1 Recommended

Where:

- the Company's system is a primary supply voltage,
- the required transformation does not exceed 3-100 kVA transformers for 208Y/120 volts, or 3-167 kVA transformers for 480Y/277 volts, and
- aesthetics are not of prime concern.

Note: *At the Company's sole discretion, request for overhead service above 200A at 480Y/277 volts or above 400A at 208Y/120 volts may be served by the Company's overhead secondary service conductors. However, demand of 150kVA or more is generally preferred to be supplied by a pad mounted transformer service. The Company shall discuss service arrangements with the Customer or Applicant accordingly.*

9.2.1.2 Company Furnishes

The Company will furnish, install, own and maintain:

- the primary service lateral including transformer pole, equipment, transformers, and
- one overhead service drop.

See Section 4 for service limitations, allocation of service line cost, and service drop requirements.

9.2.1.3 Customer Furnishes

The Customer shall provide:

- property on which to erect the terminal pole for the cluster mounted transformers, and
- the necessary right-of-way for the overhead primary circuit including guying.

9.2.2 Outdoor Single Phase Pad Mounted Transformer

9.2.2.1 Recommended

Where the length of the underground service lateral would be excessive.

9.2.2.2 Provisions:

The installation provisions and costs shall be in accordance with the Company's filed tariffs in the applicable state. See Section 4 and ESB's 751 and 754 for the underground primary service lateral and secondary service conductor connection provisions to single-phase pad mounted transformer installations.

Table 9.2.2.2-1 Company and Customer Outdoor Single Phase Pad Mounted Transformer Provisions

State	Company furnishes, installs, owns and provides maintenance for:	Customer furnishes, installs, owns and provides maintenance for:
MA & RI	▸ an outdoor pad mounted transformer	▸ property on which to construct the transformer foundation ▸ transformer box pad foundation ▸ ground grid ▸ outdoor pad mounted transformer foundation excavation ▸ bollards, if required by the Company
NH	▸ transformer box pad foundation ▸ an outdoor pad mounted transformer ▸ ground grid	▸ property on which to construct the transformer foundation ▸ outdoor pad mounted transformer foundation excavation ▸ bollards, if required by the Company
NY	▸ transformer box pad foundation ▸ ground grid ▸ an outdoor pad mounted transformer	▸ property on which to construct the transformer foundation ▸ outdoor pad mounted transformer foundation ex ▸ bollards, if required by the Company

9.2.2.3 Installation Method

- For pad mounted transformer location considerations and requirements, refer to the Company's ESB 754.
- The Customer's underground service conductors approved for direct burial installed according to the NEC shall extend at least 10 feet (3.0 m) and be coiled within one foot (300 mm) of transformer for connection by Company.
- All connections, permanent or temporary, at the Company's transformer shall be made by the Company. The Company will not permit this connection to be made by others.
- Refer to the following figures for typical outdoor Single-Phase Pad Mounted Transformer installation requirements.

See Section 4 and ESB 751 for service limitations, allocation of service lateral cost, and service lateral cable installation requirements.

9.2.3 Outdoor Three Phase Pad Mounted Transformer

Refer to the Company's Electric System Bulletin Nos. 754 and 759B for outdoor three-phase pad mounted transformer installation requirements.

9.2.4 Transformer Vault in Non-Network Area

Refer to the Company's Electric System Bulletin No. 754 for indoor three-phase vault type transformer installation requirements.

9.3 AVAILABLE FAULT CURRENT

For equipment rating purposes, the following tables list the maximum fault currents available at the Company's transformer secondary terminals. These fault currents are based on the lowest impedance of transformers the Company procures and on infinite supply impedance on the primary side. Customer motor or parallel generator contributions and customer service conductor impedances are not included in figures given. Consideration for future load growth and subsequent transformer change-out may require initial installation of service equipment to have a larger fault current interrupting rating to ensure its suitability according to the NEC. Any costs associated with changes to Customer-owned equipment shall be borne by the Customer.

9.3.1 Network Services

Small network services have 100,000 amperes RMS symmetrical available fault current. However, available fault current in some network locations, particularly for services supplied from network transformer vaults, may exceed 100,000 amperes. The Customer must consult the Company for requirements particular to the area from which the network service will be provided.

9.3.2 Single Phase Transformers

Table 9.3.2-1 Single Phase Transformers Available Fault Current

kVA 1Φ Unit Transformer Rating	amperes RMS Symmetrical 240 Volt
25 & below	10,500
50	13,900
75	20,900
100	27,800
167	46,400

9.3.3 Three Phase Overhead Transformers

Table 9.3.3-1 Three Phase Overhead Transformer Available Fault Current

kVA		amperes Symmetrical Fault Current	
3 - 1Φ Units	Total 3 Bank	208Y/120 volts	480Y/277 volts
3-10	30	10,000	----
3-25	75	20,900	10,000
3-50	150	27,800	12,100
3-75	225	41,700	18,100
3-100	300	55,600	24,100
3-167	500	92,600	40,100
3-250	750	138,800	60,200
3-333	1,000	----	80,200
3-500	1,500	----	120,300

9.3.4 Three Phase Pad Mounted Transformers

Table 9.3.4-1 Three Phase Pad Mounted Transformer Available Fault Current

kVA	amperes Symmetrical Fault Current	
3Φ Units Pad Mounted	208Y/120 volts	480Y/277 volts
75	20,900	10,000
150	34,700	15,100
300	69,400	30,100
500	92,600	40,100
750	41,700 *	18,100 *
1,000	55,600 *	24,100 *
1,500	----	36,100 *
2,000	----	48,200
2,500	----	60,200

* Size interrupting rating for largest fault current the service could expect.

10.0 DISTURBANCES AND POWER QUALITY

10.1 GENERAL

Customers with equipment that cause interference on the Company's system affecting other customers; shall, upon notice from the Company, take immediate remedial measures to avoid such interference. Customers shall provide any facilities necessary to secure their own equipment against disturbances including but not limited to loss of phase, transients, voltage pulses or harmonic or carrier frequencies whether originating with their own equipment or elsewhere. These facilities shall be installed on the load side of the Customer's service equipment.

The Company is not responsible for disturbances resulting from weather conditions, acts of God, operations on the Company's system that are within good utility practice, or that may be generated by the operation of other Customer-owned equipment. The Company's goal is to provide a high quality service, and it will make every effort to work with its Customers to identify and to minimize the effects of these disturbances. If disturbances do occur, the Customer is advised to call the Company's Customer Service Center.

10.2 MOTORS

All motors connected to the Company's lines shall be of a type that shall have inrush current and other operating characteristics deemed acceptable by the Company. (See Section 8 for recommendations and guides on motors and controllers.)

10.3 DEVICES WITH INTERMITTENT HIGH CURRENT

The operation of large flashing signs over 10 kVA, arc welders, resistance welding machines, arc furnaces, dielectric and induction heaters, electric furnaces and boilers, heat pumps, X-ray equipment, motors connected to variable load machinery, reciprocating compressors, pumps, molding machines, rock crushers and similar apparatus having intermittent flow of large currents sometimes interferes with other users of the electric service and may require special facilities for satisfactory service. The Customer shall consult the Company in each case so that the type of electric service that will be supplied, the corrective equipment needed and other special precautions that must be taken will be mutually known factors before planning to use such apparatus. The Company in accordance with its applicable tariff may withhold connection to such loads which are considered detrimental to the service of other customers.

10.4 AUTOMATIC RECLOSING

Where the Company has installed on its facilities equipment for automatic reclosing after an interruption of power supply, it shall be the obligation of the Customer to provide at its expense:

- adequate protective equipment for all electrical apparatus of the Customer that might be adversely affected by the Company's reclosing equipment, and
- such equipment as may be required for the prompt disconnection of any apparatus of the Customer that might affect proper functioning of the Company's reclosing equipment.

10.5 ELECTRICAL INTERFERENCE

If at any time devices (i.e. carrier frequency systems, SCR controllers, etc.) installed by the Customer are causing interference on the electrical system of the Company, Customer, or to any other person, then upon notice from the Company, it shall be the responsibility of the Customer to install remedial equipment or take such other measures as may be necessary to reduce such interference to a tolerable level. Table 10.5-1 can generally be used as a guide for what are tolerable levels for current distortion. The Company, at its own discretion, may relax these limitations provided no interference is experienced. Table 10.5-2 for voltage distortion shall be adhered to. In certain cases a more stringent limitation may apply.

Table 10.5-1 Harmonic Current Limits for Non-Linear Loads at the Point-of-Common-Coupling (PCC) with Other Loads, at Voltages of 120V to 69kV

MAXIMUM HARMONIC CURRENT DISTORTION IN % OF FUNDAMENTAL						
	HARMONIC ORDER (ODD HARMONICS)					
I sc /I L	< 11	11 ≤ h < 17	17 ≤ h < 23	23 ≤ h < 35	35≤ h	THD
< 20*	4.0	2.0	1.5	0.6	0.3	5.0
20-50	7.0	3.5	2.5	1.0	0.5	8.0
50-100	10.0	4.5	4.0	1.5	0.7	12.0
100-1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0

Notes:
1. Even harmonics are limited to 25% of the odd harmonic limits above.
2. *All power generation equipment is limited to these values of current distortion, regardless of actual Isc/IL.
3. Where Isc = Maximum short circuit current at PCC.
4. And IL = Maximum load current (fundamental frequency) at PCC.
5. For PCC's from 69 to 138 kV, the limits are 50 percent of the limits above. A case-by-case evaluation is required for PCC's of 138 kV and above.

Table 10.5-2 Harmonic voltage limits for power producers (Public Utilities or Non-Utility Generators)

HARMONIC VOLTAGE DISTORTION IN % AT PCC FOR SYSTEM NORMAL CONDITIONS*			
Maximum for:	≤ **69kV**	**69-138kV**	**>138kV**
Individual Harmonic	3.0	1.5	1.0
Total Harmonic Distortion (THD)	5.0	2.5	1.5

*For start-up, inrush conditions, limits can be exceeded by 50%.

10.6 POWER SUPPLY TO VOLTAGE SENSITIVE EQUIPMENT COMPUTERS AND SENSITIVE EQUIPMENT

Customers who use computers, microprocessor controlled equipment, solid state devices, x-ray equipment, or other voltage sensitive electronic equipment should consider the installation of auxiliary devices designed to protect this equipment from power disturbances. These power disturbances may be in the form of voltage sags or surges, spikes, temporary loss of power, or any other deviation from normal. The Customer may have to safeguard this equipment by the application of line filters, solid state line-voltage regulators, transient suppressors, isolating transformers, uninterruptible power supply (UPS) systems or motor generators. Utility distribution systems normally operate between certain voltage limits as established by National Standards and state rules. The Company should be contacted for further guidance.

10.7 ISOLATION TRANSFORMER

Where lighting or other reduced-voltage equipment is permitted from existing 3-phase, 3-wire, delta non-standard services, isolation transformers are required. The secondaries of these isolation transformers shall be properly grounded. The minimum number of single-phase transformers that may be used to serve the reduced-voltage load on a 3-phase, 3-wire service is shown in the following table:

Table 10.7-1 – Minimum Number of Single-phase Transformers to Serve Reduced-voltage Load on a 3-phase, 3-wire Service

Reduced-Voltage Load in Kilowatts or % of Total Demand on Service (whichever is larger)	**Number of Transformers**
Less than 5	1
5 to 10 inclusive	2
Over 10	3

The Company should be consulted prior to buying isolation transformers for this type of installation. Since auto-transformers do not provide isolation between primary and secondary windings, they shall not be used on 3-phase, 3-wire, ungrounded-delta service except to supply reduced voltage for motor starting. Auto-transformers used to supply other branch circuits shall be supplied only by a grounded system as outlined in the National Electrical Code or of any other applicable code.

11.0 CUSTOMER-OWNED ELECTRIC SOURCES – INCLUDING STANDBY GENERATORS

11.1 GENERAL

Installations of Customer-owned generating equipment (or other electric sources) require adherence to fundamental rules for the safeguard of all personnel and the Company's equipment. Any generating equipment that is or can be connected to any circuit which is, or can be supplied from the Company's distribution system shall meet the requirements of this section. This is to prevent any unanticipated backfeed of electricity into the Company's system as required by the Company's applicable tariffs.

With the exception of emergency or standby generators, permitted by the Company for sole use during utility outages, all generating sources shall be metered at the generator(s) output.

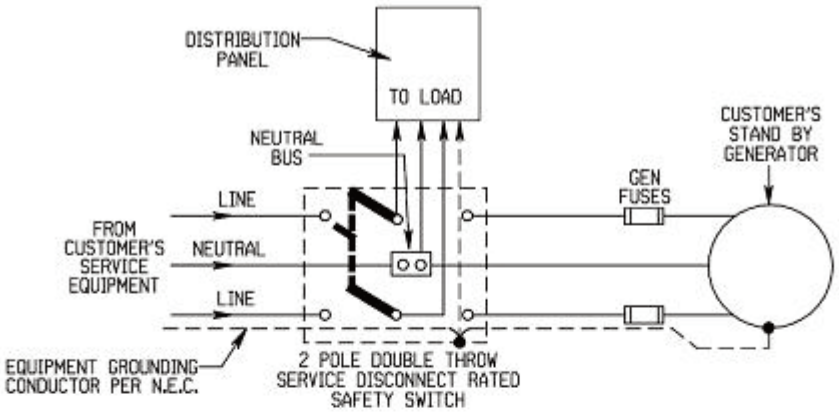
Any non-residential Customer generation on its premise requires submittal of documentation to the Company in accordance with the Company's applicable tariff prior to installation. Consult the Company for the prescribed forms.

11.2 EMERGENCY AND STANDBY ELECTRIC SOURCES

11.2.1 Compliance Criteria

The Customer shall notify the Company prior to installing non-parallel, standby generating equipment and obtain approval for the method of connection. Where the Customer installs a standby generator for the purpose of supplying all or a part of the load in the event of an interruption in the supply of Company service, the Customer's wiring shall be arranged so that no electrical connection can occur between the Company's service and the Customer's other source of supply. This will require the installation of a double-throw, "break-before-make" type switch. This transfer scheme must meet these requirements established by the Company; see illustrations below. Unless required in Section 11.2.3, residential standby generator installations will not need prior Company approval since the Customer's electrical inspection approval certificate will ensure compliance with these Company specifications and the NEC.

Figure 11.2.1-1 Standby Generator Non-parallel Operation with Company Connection Supplying Customer's Entire Load



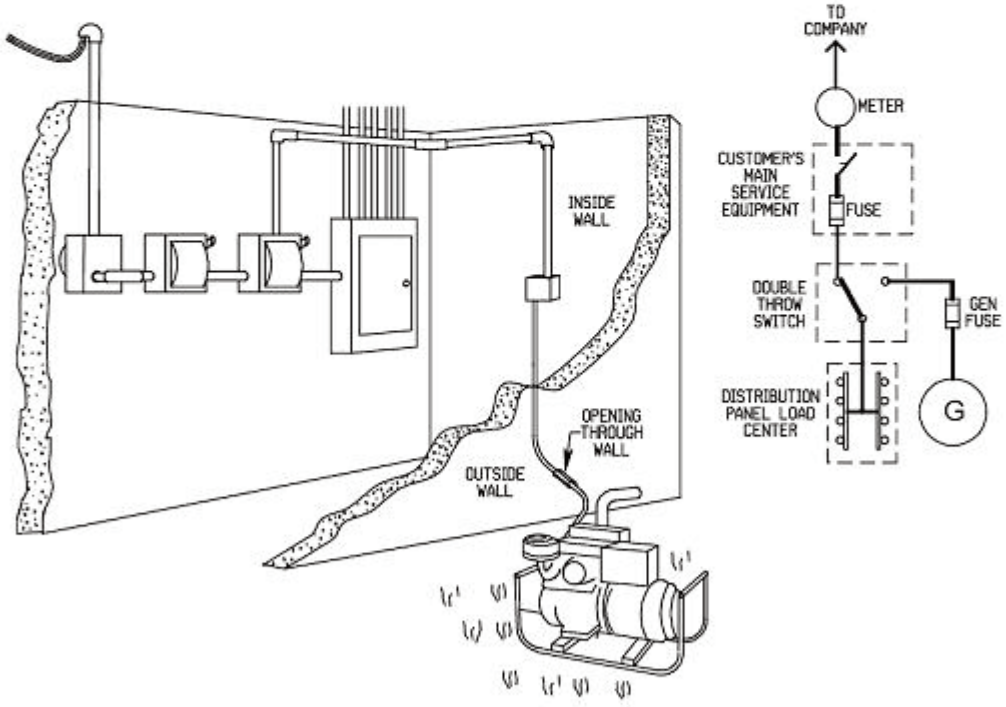


Figure 11.2.1-2 Connection of Standby Generator Supplying One 120 volt Branch Circuit

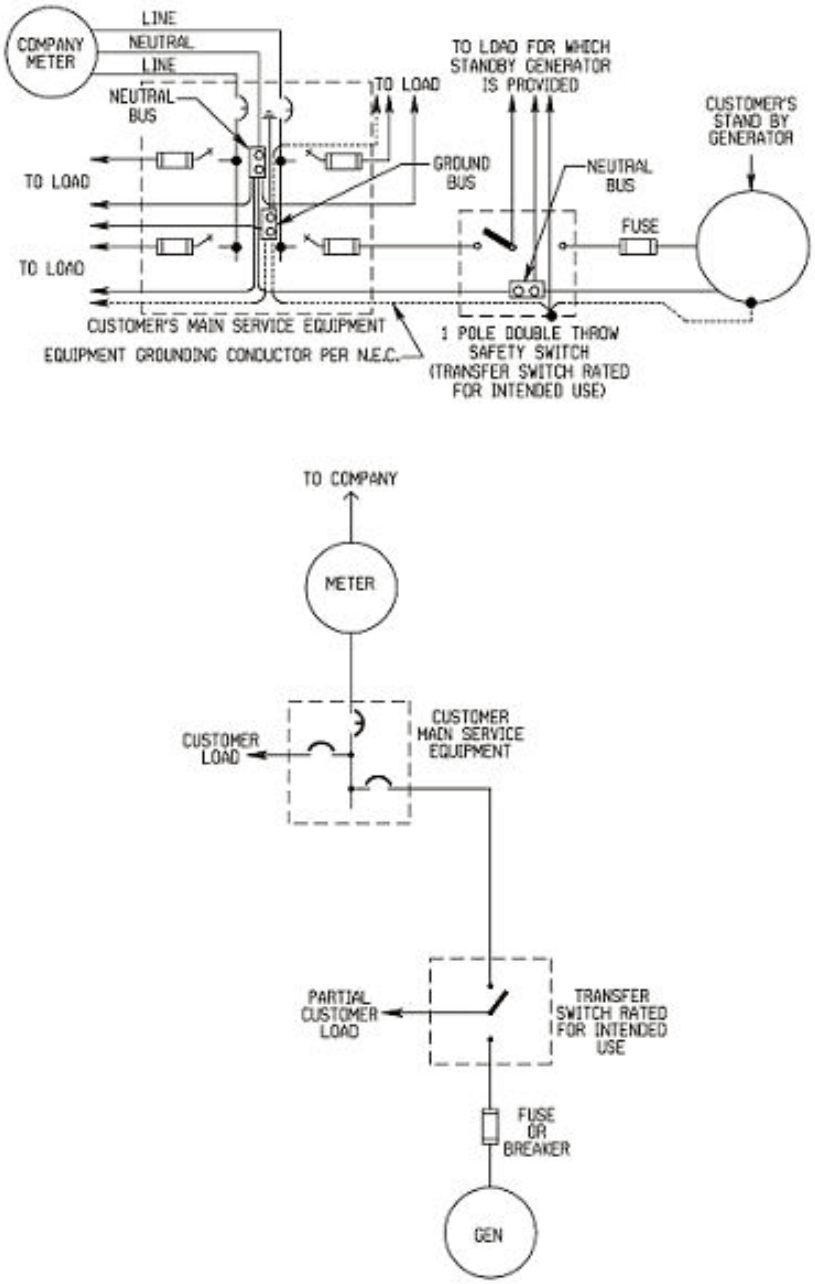
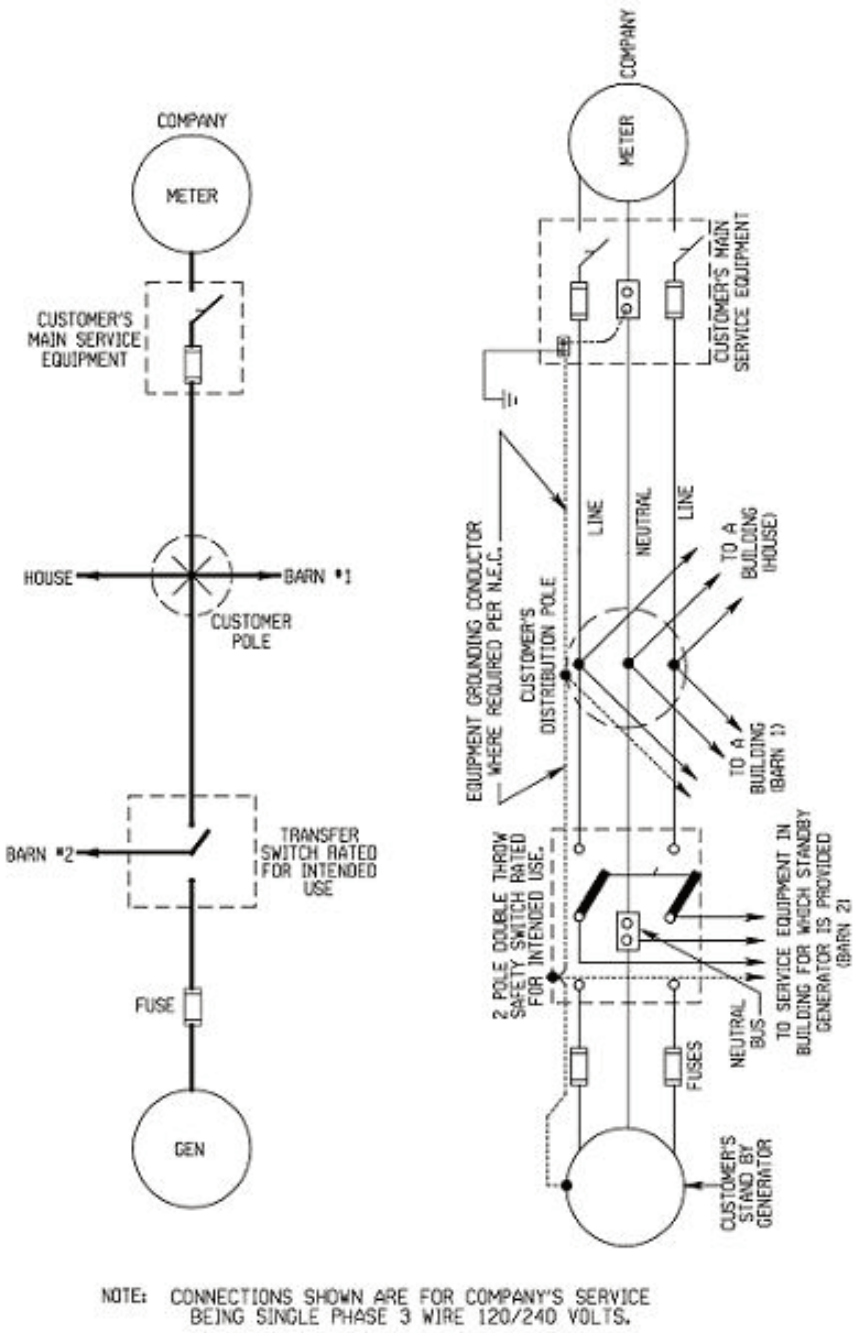


Figure 11.2.1-3 Connection of Standby Generator Supplying One Building From Customer's Main Distribution Point



NOTE: CONNECTIONS SHOWN ARE FOR COMPANY'S SERVICE BEING SINGLE PHASE 3 WIRE 120/240 VOLTS.

A non-residential Customer utilizing generation shall meet the following requirements if it proposes the installation under the Company's definitions of emergency or standby power system:

- Accepted documentation on file with the Company.
- Stated conditions when the Customer's emergency or standby generator may serve load on its premise for periods of time required by regulation or statute. Otherwise, test periods shall not exceed 10 hours per month.
- Maintain a written operating log indicating date, time, hours, and purpose of operation available to the Company upon request.
- Non-compliance will result in billing and installation of generator meter(s) in accordance with the Company's tariff.

11.2.2 Electric Source Type & Installation Method

11.2.2.1 AC or DC

The stand-by generator should be 60 Hertz alternating current. If a direct current generator is used, the installation must be arranged so that all motors, radios and other equipment that will not operate on direct current are disconnected from circuits before the circuits are energized from the stand-by generator.

11.2.2.2 Separately Derived Systems

When an AC generator is installed as a separately derived system, grounding of the neutral conductor shall be in accordance with the National Electrical Code. Separately derived systems require a switched neutral conductor in the transfer switch. Figures in this bulletin do not show this system configuration. The Customer is required to maintain safe step and touch voltages when installing a separately derived system in conjunction with the Company's electric service connection (this may require the services of a design professional).

11.2.2.3 Temporary Emergency Connections

To avoid serious risks to utility workers and the general public, Customers without permanently connected transfer systems may temporarily install emergency generators under the following conditions:

- Generator connection is made on the load side of the main disconnect device (i.e. circuit breaker, switch, or fuse block).
- The main disconnect device is tagged in the "open" position after ensuring disconnect is electrically open. The tag shall clearly state "do not operate".
- The Company's meter shall not be accessed.
- Notify the Company when electrical separation cannot be made by the Customer's equipment.

11.2.3 Transfer Systems

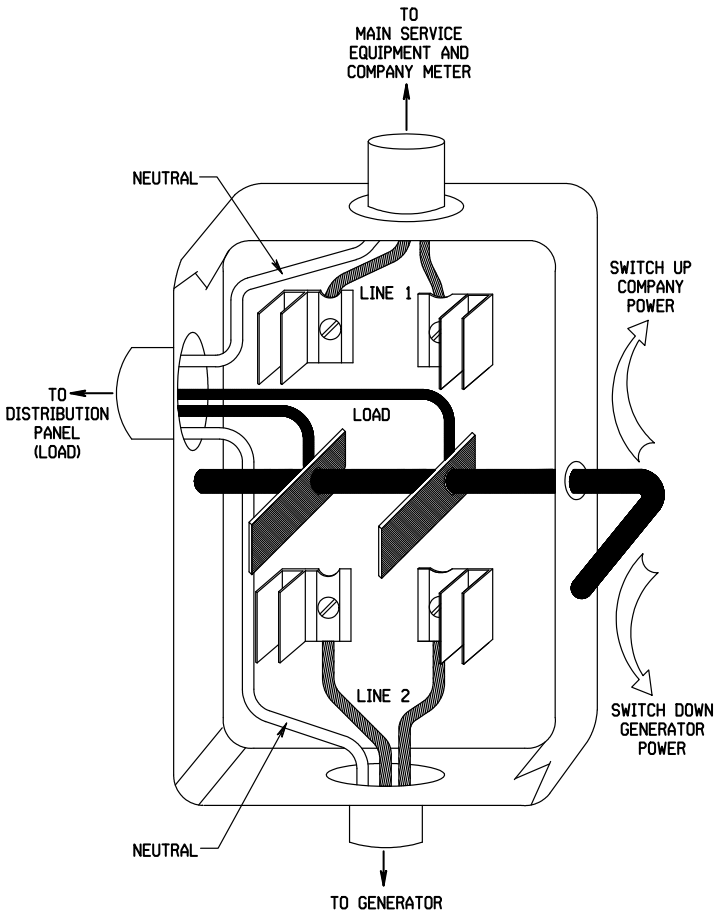
11.2.3.1 Service Equipment Rated Transfer

Transfer switches listed and labeled "suitable for use as service equipment" are permitted for use as main service equipment upon prior approval by the Company. See service equipment definition for necessary equipment arrangement. All other transfer switches shall be connected on the load side of the main service equipment.

11.2.3.2 Open-Transition Transfer

A double throw switch or contactor using a "break-before-make" sequence shall normally be provided to transfer all ungrounded conductors of an emergency lighting or power load to either the stand-by generator (or other electric source) or the normal supply.

Figure 11.2.3.2-1 Double Throw Safety Transfer Switch
(Not Service Equipment Rated)



Where automatic throw-over switching is installed, the Customer shall provide an isolation switch in combination with each automatic transfer switch. The isolation switch shall provide a lockable means for manually isolating the emergency generator. The Company will tag the isolation switch in a locked open position during maintenance or repair of Company supply lines. Arrangements utilizing interlocking of single-throw devices are not acceptable.

11.2.3.3 Closed Transition & Auto Transfer

These requirements apply to closed transition schemes associated with standby or emergency generators where the generator will momentarily operate in parallel with the Company's system. This can be accomplished utilizing breakers or an Automatic Transfer Switch (ATS).

- The Customer shall submit for acceptance by the Company three copies of the single line, specifications, complete vendor prints, relay settings and a description of operation of the system.
- Requirements for Closed Transition Switching back to the Company's system:
  1. Closed transition switching shall occur within 15 cycles.
  2. Once the parallel is made, a transfer failure relay shall monitor the utility and generator breaker to ensure the transfer operation has been completed. If the transfer has not been completed

within 30 cycles, the transfer failure relay shall trip the generator breaker. For ATS installations, the transfer failure relay shall monitor the switch contacts.

3. The settings for paralleling the generator to the Company's system shall not exceed the values listed in Table 11.2.3.3-1. All devices that perform paralleling shall be utility grade, that is, they must meet the requirements of IEEE C37.90.1, 2, and 3.

Table 11.2.3.3-1 Relay settings to parallel standby or emergency generators with the Company system

Generator Size (kW)	Max. Frequency Difference (Δ f, Hz)	Max. Voltage Difference (Δ V, %)	Max. Phase Angle Difference (Δ Φ, degrees)
0-500	0.3	10	20
>500 – 1,500	0.2	5	15
>1,500 – 10,000	0.1	3	10

4. The system shall be designed such that loss of the utility source will automatically open the utility breaker prior to closing the generator breaker (open transition).
5. The system shall allow functional testing of the various operating and failure modes outlined in the description of operation.
6. The Company reserves the right to witness functional testing of the transfer scheme, including failure modes. In these cases, it shall be the responsibility of the Customer to demonstrate proper operation and functional testing.

- Exercising Generator:

1. If there is no load bank, and it is the intention of the customer to exercise the generator in parallel with the Company for an extended period of time (> 30 cycles), the generator shall meet the requirements of ESB 756.
2. The Customer can exercise the generator with building load under requirements Items one through six above and the Company's filed Tariff.

11.2.4 Identification and Clearances

11.2.4.1 In accordance with the NEC, a sign shall be placed at the service-entrance equipment that indicates the type and location of on-site standby power sources.

11.2.4.2 Customer's on-site generator and fuel storage are often located adjacent to Company pad-mounted transformers for ease in using the same trench to the electrical room. The Company requires protection between the transformer and the generator fuel storage unit, by either a twenty (20) foot (6 m) separation or a masonry wall. This wall should be erected parallel to and located three (3) feet (900 mm) from one side of the pad-mounted transformer foundation. The wall should be six (6) feet high and extend approximately three (3) feet (900 mm) beyond each end of the transformer foundation. Refer to ESB 754 for further details for such application which shall be supplied to the Company for approval.

11.3 PARALLEL ELECTRIC POWER PRODUCTION

No Customer or Independent Power Producer (IPP) shall install or operate electric generation (or other electric sources) in parallel with the Company's system without prior notification to and approval by the Company. Customers considering the installation of parallel electric power production equipment to supply all or a portion of their electrical energy requirements and who wish to arrange for, or continue to receive, service from the Company's system for their remaining electrical energy requirements and/or for stand-by service, must consult with the Company regarding the design, installation and operation of such equipment. (See Company's Electric System Bulletin No. 756 and its applicable appendix for additional details.) Precautions must be taken to maintain adequate safety and quality of service to other customers. Customers wishing to sell electric energy

shall call the Company's Customer Service Center or those having managed accounts shall consult with their Account Manager for the Company's purchase policy.

11.3.1 Inverters

Direct current electric sources may be operated in parallel with the Company's system through a synchronous inverter where its installation will be designed such that a Company system interruption will result in the removal of the inverter from the Company's system. The Customer shall submit specifications for approval by the Company prior to procurement or installation of the inverter. (See Company's Electric System Bulletin No. 756 and its applicable appendix for additional details.)

12.0 UTILIZATION and SPECIAL EQUIPMENT

12.1 ELECTRIC FENCES

The Company urges extreme care in the selection of an electric fence system. A direct electrical connection to a fence or a connection through resistance, reactance, or lamp bulb, is not permitted without an approved controller. For guidance in safety methods, materials, and equipment to construct electric fences, those interested are referred to U.S. Department of Agriculture, Farmers Bulletin No. 1832 or to qualified experts such as the Department of Agricultural Engineering,
Cornell University, Ithaca, New York.

12.2 SIGNS AND AUTOMATICALLY CONTROLLED LIGHTING

The Company shall be consulted in advance when signs or automatically controlled lighting are to be installed. Flashing signs shall be properly balanced throughout each portion of the flashing cycle.

12.3 LIGHTNING AND SURGE PROTECTION

When a Customer desires to install its own lightning or surge arrester it shall be connected on the load side of the main service disconnect by and at the expense of the Customer. For protection to be effective, such devices should be connected in conjunction with any applicable codes and approved by the AHJ. The Customer shall be responsible for providing, installing, operating, maintaining, and inspecting any such installations. The Company will not be responsible for damage to a Customer's equipment resulting from voltage surges that may occur on the Customer's wiring.

For services above 600 volts, lightning or surge arrester installations should be made in accordance with recommendations of the Company's Engineering Department and the applicable supplements to these specifications.

12.4 POWER FACTOR CORRECTION, CAPACITORS

Maintenance of high power factor is of the utmost importance to both Customer and Company in the operation of each of their distribution systems. Company rates are based, in general, on a minimum average power factor. The minimum average power factor value shall be that specified in the Company's applicable rate tariff that the billing is partly based on the reactive demand (RkVA) under which the Customer takes service. The Company should be consulted in advance regarding all installations likely to develop low power factors so that such conditions may be rectified by measures adapted to each proposed installation.

Customers are encouraged to maintain a power factor near 95 percent. The use of synchronous motors is desirable since these contribute to good power factor. Where possible, induction motors should be applied so as to operate at, or near, full rating.

12.4.1 Capacitor Installation

A Customer, installing capacitors to improve the power factor of its load, should obtain from the Company the characteristics of the supply system so that the capacitors can be properly applied. Consult the Company prior to procuring and installing power factor correction equipment for Company review and acceptance to assure that service to other customers will not be adversely affected by the manner in which such equipment is installed and operated.

12.4.2 Static VAR Compensators (SVC)

A Customer, installing static VAR compensators (SVC) to improve its power operating efficiency of its electric system, should obtain from the Company the characteristics of the supply system so that the SVC's can be properly applied. Consult the Company prior to procuring and installing SVC equipment for Company review and acceptance.

12.5 RADIO AND TELEVISION

12.5.1 Transmitting Station, Repeater, or High Frequency Equipment

Before a Customer installs and operates radio or television transmitters, repeater, or other high frequency equipment at a specific location, the Company shall be consulted for information on the type of electric service that will be supplied and the special precautions that must be observed so that the operation of this apparatus will not interfere with electric service to other Customers.

12.5.2 Antennas

Outdoor antennas for radio or television sets shall not be erected over, under or in close proximity to the Company's wires or any other wires carrying electric current, and shall not be attached to the Company's poles or Customer riser masts. To do so may result in serious accident or damage to equipment. Where practical, antenna conductors shall be installed so as not to cross under open electric conductors. Where proximity to electric conductors of less than 250 volts cannot be avoided, the clearance shall be at least two (2) feet (600 mm). In all cases, the National Electrical Safety Code conditions shall be met.

12.5.3 Eliminator or Trap

Installation of an eliminator or trap where necessary shall be suitable and shall be installed by the Customer in such manner as to prevent radio, telephone, television, and other interference feeding back into the supply circuit.

12.6 CARRIER CURRENT SYSTEMS

If a Customer uses building wiring for a carrier current system for remote control of power, communication, signaling, or other purposes, the Customer shall install suitable filter equipment or make other provisions approved by the Company to keep the Company’s distribution facilities free from any high-frequency components or carrier currents produced by the Customer’s equipment. Consult the Company prior to procuring and installing carrier current system equipment for Company review and acceptance. The Customer is also responsible for correction of any interference caused to other customers.

13.0 REVISION HISTORY

Version	Date	Description of Revision
1.0	04/20/10	Initial version of new document superseding all previous revisions of ESB 750 and the Electrical Service Information and Requirements (Green Book)

Part C – "APPENDICES"

Appendix 1 - Overhead Attachment Methods

Overhead service attachment brackets shall be of Company approved materials.

Table App1-1 – Company-accepted Attachment Materials

Item No.	Description	Vendor ID	Vendor Cat. No.
B53A	Bracket, insulated service. Reinforced porcelain wire holder for attachment of multiplex services to 1-1/4" through 2-1/2" metal mast.	Joslyn Cooper	J0588 DW2C3
B53B	Bracket, insulated service. Reinforced porcelain wire holder for attachment of multiplex services to 3"to 4" metal mast.	Chance Cooper PPC Insul.	P1226 DW3C1 6913
B54	Bracket, insulated service. "House Knob." Reinforced porcelain or nylon wire holder with 3" #22 hot dip galvanized wood screw. EEI TD 24 Style 5. (1)	Chance Joslyn Cooper PPC Insul.	3-11-45 JO893 DW2R4 1987
B17	Bolt, "J". 3/8" x 11" galv. steel special for attaching service bracket to house. (2)	Joslyn Cooper DR6E1	BT3917
I-10	Insulator Clevis. Insulated galv. assembled with dry process porcelain insul. for #2 AWG & #4 AWG triplex services. (1)	Joslyn Cooper	J1945 DC7F11
I-11	Clevis, insulated spool type sec. dead-end EEI-TD20-Item 2 clevis with ANSI C29.3 Class 53-3 insulator.	Joslyn Cooper PPC Insul.	J0342W/J97 DC3F66 4113
I-12	Clevis, secondary insulator clevis galv. steel for use with I-25 insulator (Not included) 3000# ult. For use on #1/0 AWG & 336 kcmil triplex services. 5/8" cotter bolt & s.s. cotter key. (2)	Chance Joslyn Cooper PPC Insul.	T207-0105 23491 DC13C4 4112
I-25	Insulator, sec. rack spec. ANSI C29.3-class 53-2, 0-600V.	Chance Joslyn Cooper PPC Insul. Victor Ins. Lapp	C909-0032 J151 WD684 5101 2012 8442-70
B7A2	2½" Expansion Shield Lag Screw, cast of zinc-base alloy. Long style for use with 3/8" lag screws on masonry construction. (1)	Diamond Rawl Star	001106 1155 1825-00200

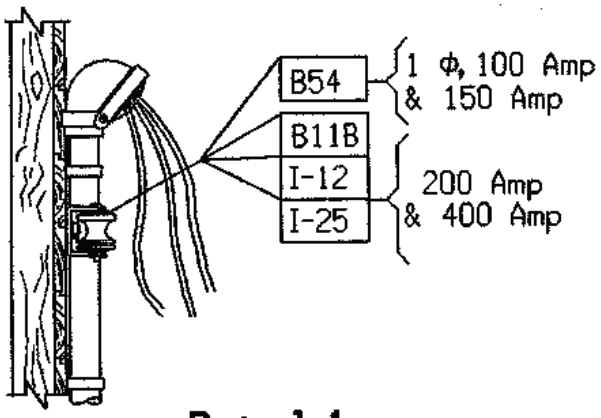
Table App1-1 (cont'd)

Item No.	Description	Vendor ID	Vendor Cat. No.
B11A	3/8" x 3" Galv. Steel Lag Screw, with square head shoulder shank and gimlet point. (1)	Cooper Joslyn	DF3L3 J8773
B11B	3/8" x 4" Galv. Steel Lag Screw, with square head shoulder shank and gimlet point. (2)	Cooper	DF3L4
B13	Machine Bolt, 5/8" x 12" square head steel bolt (with nut). Galv. Steel with 6" min. thread length. (2)	Chance Hughes Cooper	8812 B612-4 DF3B12
W1	Flat Washer, 2-1/4" square x 3/16" Galv. Steel	Chance Joslyn Cooper Flagg (MIF) PPC Insul.	6813 J1075 DF2W4 P56A 6330

Notes: *(1) For up to 600 lbs. service drop tension only.*
(2) For up to 1100 lbs. service drop tension only.

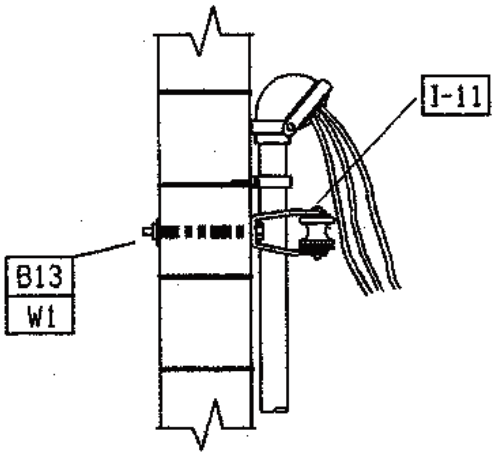
Refer to the following illustrations for Company-accepted attachment methods.

Figure App1-1 – Illustrated Details of Overhead Service Attachment Methods: Details



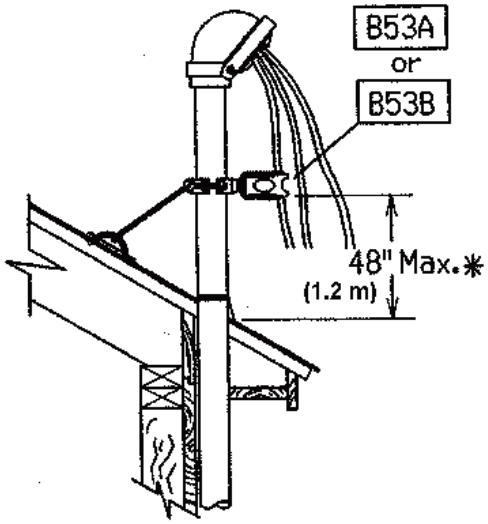
Detail 1

Insulated Service Attachment Bracket Assembly for Small Wood Frame Residence or Commercial Buildings



Detail 3

1 Φ or 3 Φ Attachment Bracket Assembly for Masonry Buildings or Steel Structural Support Member.

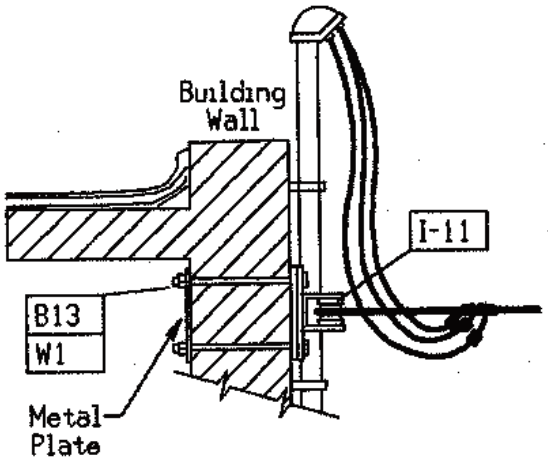


Detail 2

1 Φ or 3 Φ Attachment Bracket Assembly for Low Profile Buildings.

* Note:

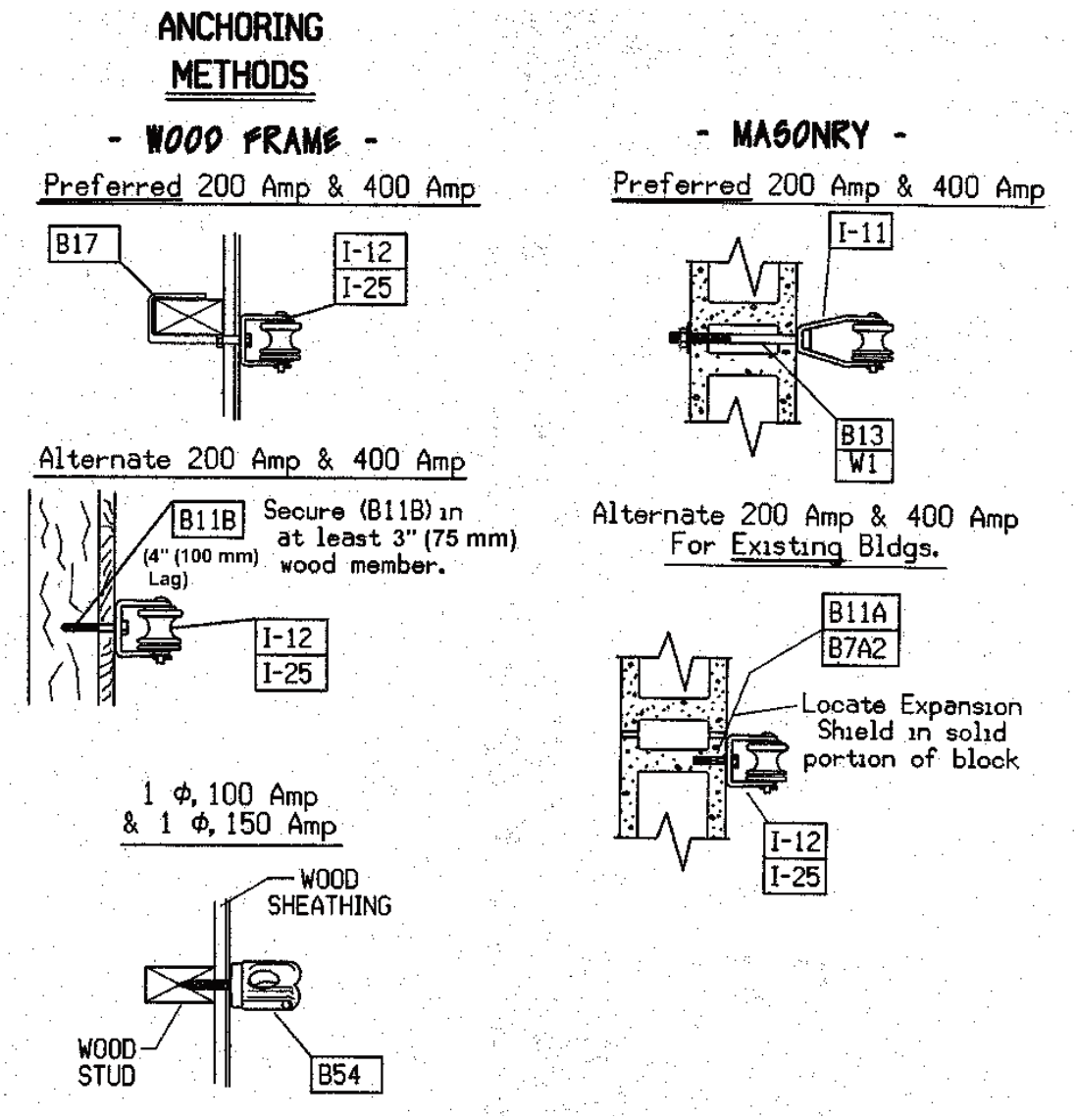
Minimum Attachment Height shall be such that the Service drop's drip loop is not less than 18" (450 mm) above the roof.



Detail 4

Attachment Bracket Assembly for 800 Amp Services

Figure APP1-2 – Illustrated Details of Overhead Service Attachment Methods: Anchoring



MATERIAL LIST			
ITEM	**DESCRIPTION**	**ITEM**	**DESCRIPTION**
B53A	600V Insulated Service Bracket (1-1/4" (35) to 2-1/2" (63) pipe)	I-25	3", 600V Insulator 2-1/2" (65 mm) Expansion Shield
B53B	600V Insulated Service Bracket (3" (78) to 4" (103) pipe)	B7A2	Lag Screw (Zinc Alloy) 3/8" (10 mm) X 3" (75 mm) Lag Screw
B54	600V Insulated Service Bracket "House Knob" (3" (75 mm) Lag Screw)	B11A	3/8" (10 mm) X 4" (100 mm) Lag Screw
B17	3/8" (10 mm) X 11" (280 mm) "J" Bolt	B11B	5/8" (16 mm) Machine Bolt
I-10	600 V Insulator Clevis	B13	2-1/4" (57 mm) Square Flat
I-11	600V Insulated Spool	W1	Washer
I-12	3" (75 mm) Clevis		

Appendix 2 - Traffic Control Metered Service Requirements

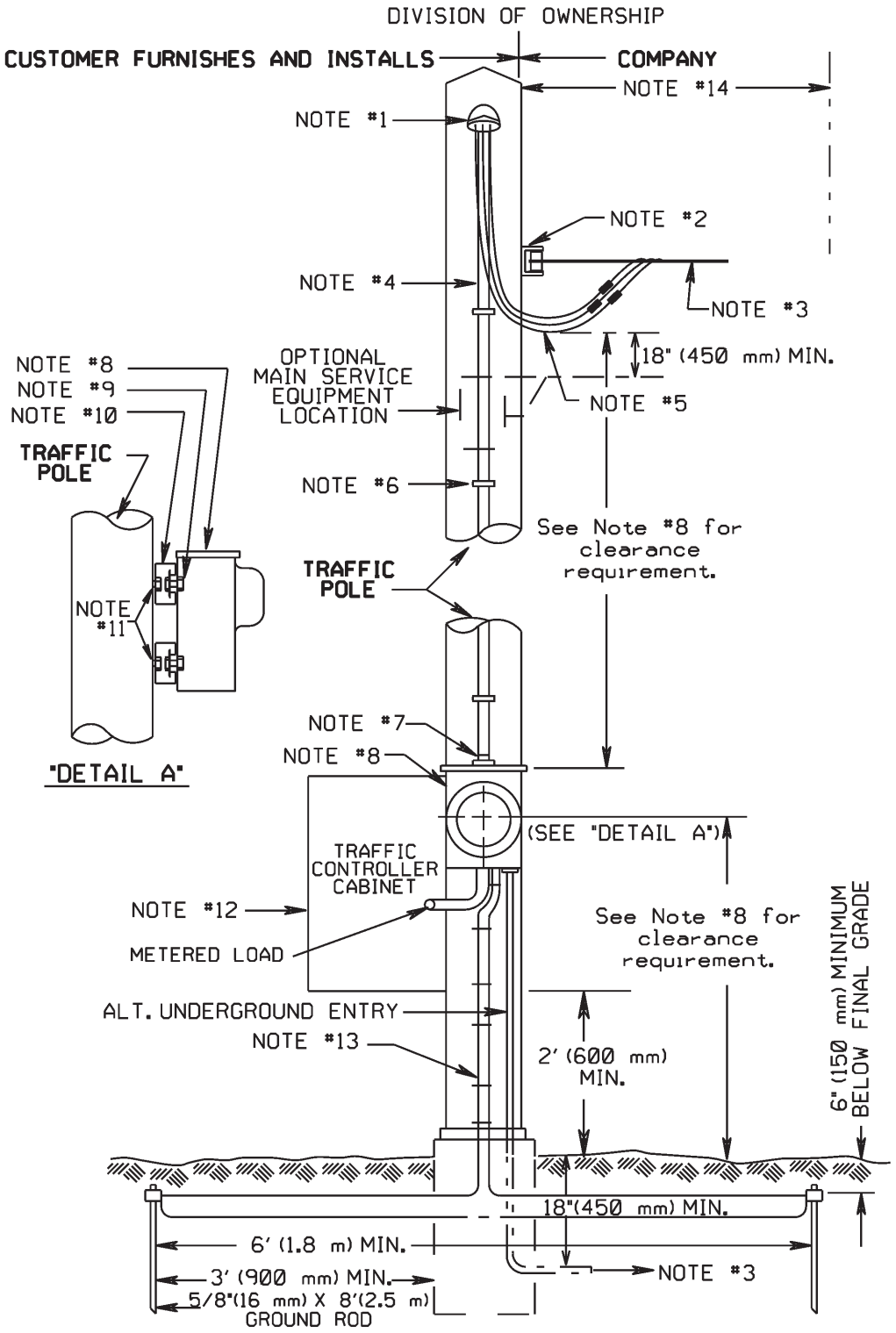
(For D.O.T., Municipal, and individual customers as designated in the Company's applicable tariff.)

Notes for Figure App2-1

(The figure is typical in nature; however, variations may be permitted with prior consultation with the Company and approval granted in writing.)

NOTE #1	Raintight service head.
NOTE #2	Service bracket furnished and installed by Customer below weatherhead.
NOTE #3	Company service drop for overhead service. For underground service, Customer's cable-in-conduit (continuous) to Company's line.
NOTE #4	Service entrance cable or service entrance conductors in approved conduit. PVC Schedule 80 recommended, see Section 4. Bond metallic conduit in accordance with N.E.C. Article 250.
NOTE #5	Leave 24" (600 mm) of service entrance conductors for service drop connection by Company.
NOTE #6	Straps at not more than 30" (750 mm) intervals.
NOTE #7	Watertight fitting.
NOTE #8	Commercial meter socket trough furnished and installed by Customer in a true vertical position, see Section 7. Locate on structure away from traffic flow and such that the bottom of the meter socket trough is more than 8 feet (2.5 m) above grade. Or, the top of the meter socket trough must be below 6 feet (1.8 m) and there must be 8 feet (2.5 m) clear space without handholds or footholds starting at no higher than 6 feet (1.8 m) above grade. For service supplied from a network, a main disconnect is required and metering shall be cold-sequence.
NOTE #9	¼" (6 mm) dia. X ¾" (19 mm) long bolts with nut and washer, all zinc coated steel. A total of four required, two for top, two for bottom.
NOTE #10	Slotted framing channel (Kindorf, Unistrut, Superstrut, or Company accepted equal), 12 gauge zinc coated steel, with holes, 1-1/2" (38 mm) h X ¾" (19 mm) w X (length = width of associated meter socket). Two required, one for top, one for bottom.
NOTE #11	Meter support attached to Customer's structure with materials approved for the purpose.
NOTE #12	Outdoor service equipment, see Section 5. For transfer switch applications, refer to Section 12. Where in the public way and the Customer's structure is connected to the Company's overhead service drop, traffic controller equipment and service equipment shall be located such that the bottom of the equipment is more than 8 feet (2.5 m) above grade. Or, the top of the traffic control box must be below 6 feet (1.8 m) and there must be 8 feet (2.5 m) clear space without handholds or footholds starting at no higher than 6 feet (1.8 m) above grade.
NOTE #13	Install service entrance ground in accordance with N.E.C.
NOTE #14	10 ft. (3.0 m) minimum distance from service pole to Company's line, see Section 4 regarding clearances.

Figure App2-1 – Typical Traffic Control Metered Service Installation



CHANGE PROPOSAL FOR NATIONAL GRID "SPECIFICATIONS FOR ELECTRICAL INSTALLATIONS"

INSTRUCTIONS — PLEASE READ CAREFULLY

Electronic media submittal of proposals is preferred. Type or print legibly in black ink. Use a separate copy for each proposal. Limit each proposal to a SINGLE section. All proposals must be received by National Grid's SEIC to be considered for the next revision of ESB 750. Proposals received that are not in the prescribed format will be returned to the submitter. If supplementary material (photographs, diagrams, reports, etc.) is included, please submit one (1) printed copy and the electronic file copies in Adobe Acrobat (pdf) for the National Grid Specifications for Electrical Installations Committee (SEIC).

SUBMITTED BY: *(Include all appropriate information for contact purposes.)*		**DATE:**
Name	Street Address/City/State/Zip/Email Address (Or Internal Company Location)	Telephone

CHANGE PROPOSED FOR:

ESB Document No.	Section/Part/Paragraph/Article reference
750 (2010)	

PROPOSED CHANGE: *(Include proposed new wording, or identification of wording to be deleted.)*

SUBSTANTIATION: *(Note: State the problem that will be resolved by your recommendation; give the specific reason for your proposal including copies of tests, research papers, fire or safety or operation experience, etc.)*

❒ *I understand that I acquire no rights in any publication of National Grid in which this change proposal in this or another similar or analogous form is used.*

SIGNATURE:

Mail suggestions to:
National Grid, Distribution Asset Management, Customer Facilities Engineer, 300 Erie Boulevard West Syracuse, New York 13202-4250
Or, Email to seic@us.ngrid.com (electronic submittals are preferred)

Electrical Inspections are a Vital Public Safety Function

Inspections Can Save Lives and Property: Inspections by qualified inspectors reduce the potential for fire and shock hazards due to incorrectly installed electrical products and systems covered by the National Electrical Code©, save lives, and reduce property damage that may result from unsafe electrical installations.

Inspections Mean Compliance with Laws: Most states and localities require electrical installations to comply with the National Electrical Code©, to protect public safety. Electrical inspections help confirm that electrical wiring and systems are installed "according to Code."

Inspections Check for Safety Products: Most states and localities require electrical products to be "listed" by recognized product safety certification organizations. Electrical inspections help confirm that properly certified products meeting U.S. safety standards are installed.

Inspections Confirm that Qualified Installers are on the Job: Electrical inspections protect against untrained or careless installers. Too often, unqualified installers perform unsafe electrical installations, and may also use products that don't meet national safety requirements or local laws and codes.

No Public Funding: Government funding isn't needed to pay for proper and thorough electrical inspections. The cost of inspections is usually covered by fees paid directly by builders and contractors. This vital public safety function doesn't have to cost taxpayers or cash-strapped governments a dime.

Inspections Can Help Lower Insurance Premiums: Property insurance premiums are generally lower in areas with strong building codes enforced by professional inspectors. That's because qualified electrical inspections help protect lives and property.

Signed by: The Inspection Initiative: An Industry Coalition Supporting Qualified Electrical Inspections (first issued 1997)

National Grid is an international energy delivery company. In the U.S., National Grid delivers electricity to approximately 3.3 million customers in Massachusetts, New Hampshire, New York and Rhode Island, and manages the electricity network on Long Island under an agreement with the Long Island Power Authority (LIPA). It is the largest distributor of natural gas in the northeastern U.S., serving approximately 3.4 million customers in Massachusetts, New Hampshire, New York and Rhode Island. National Grid also owns over 4,000 megawatts of contracted electricity generation that provides power to over one million LIPA customers.

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Supplement to

Specifications for Electrical Installations

Errata and Revisions
for the Electric System Bulletin 750 Series

January 2015
(Supersedes all previous versions of Errata and Revisions

NOTICE: This publication contains changes and corrections to the Company's **Specifications for Electrical Installations, the "ESB750—0410 Book", and its supplements**. This is periodically issued when the need arises. The most current information on a topic will therefore be a combination of the base document listed in this table of contents and the current version of this list. Upon periodic revision of a base document herein referenced, all list items associated with that base document will be removed.

TABLE of CONTENTS

General Notice

P.S.C. No. 220: P.S.C. No. 220 *Schedule for Electric Service* ("P.S.C. No. 220 Electricity Tariff") supersedes and replaces former P.S.C. No. 207 *Schedule for Electric Service* ("P.S.C. No. 207 Electricity Tariff") effective April 27, 2009 ("Effective Date"). As of the Effective Date, all references to P.S.C. No. 207 Electricity Tariff in agreements existing as of the Effective Date shall be construed as references to P.S.C. No. 220 Electricity Tariff.

The Rule Numbers, Forms, and Service Classifications in P.S.C. No. 220 Electricity Tariff as of the Effective Date are identical to those of P.S.C. No. 207 Electricity Tariff as of the day immediately prior to the Effective Date, but Leaf Numbers may differ. To avoid any possible ambiguity resulting from this change, references to Leaf Numbers in P.S.C. No. 207 Electricity Tariff in agreements existing as of the Effective Date shall be construed as references to the equivalent Leaf Numbers for the same Rule Numbers, Forms, and Service Classifications in P.S.C. No. 220 Electricity Tariff.

Therefore, all references to P.S.C. No. 207 in any of the Company's ESB 750 series bulletins shall be construed as references to P.S.C. No. 220 (see: http://www.nationalgridus.com/niagaramohawk/non_html/rates_psc220.pdf).

ESB No. 750-2010 (Version 1.0, 04/20/2010) – Specifications for Electrical Installations (Upstate NY, MA, NH, and RI)

PAGE	SECTION	EFFECTIVE DATE	CHANGE
11	Electric Service Areas	Sep-2010	Add the following web link below the Massachusetts map: https://www.nationalgridus.com/non_html/shared_about_svcmap_meco.pdf
27	1.10.2	Sep-2010	Add "operating" before "demands" in second sentence.
41	4.1.2	Sep-2010	In second sentence, the word "laterals" was cut off.
43	Figure 4.1.9-1	Sep-2010	Remove 48", 18", and 32" horizontal dimensions from Figure 4.1.9-1, which are not related to the intent of this section.
45	Figure 4.1.10-2	Sep-2010	Add "50 ft. maximum length" to service drop.
46	Figure 4.1.10-3	Sep-2010	Change the figure's title to read as follows "Figure 4.1.10-3 Typical Underground Service Post for Permanent or Temporary Service Below 600 volts".
50	4.2.4	Nov-2013	Replace Section "4.2.4 Overhead Service Line Clearance" in its entirety with: National Grid's overhead service line conductors must comply with the clearance requirements of the National Electrical Safety Code and National Grid's Overhead Construction Standards. The Customer's service bracket, located near the point of attachment, must be installed in such a location to allow for minimum clearance of overhead service line conductors to be met. In all cases, the Company shall determine the location of the point of attachment. See Section 4.2.4.2 for special clearances to swimming pools.
50	4.2.4.1	Sep-2010	Add the following notes to the table: **Notes to Table 4.2.4.1-1:** 1 Vertical clearance values for conductors are for 100 ft. (30.0 m) spans at 60°F (15°C) final unloaded sag and phase-to-ground voltages. No allowance is made for sag for vertical clearances at a building or structure's point of

PAGE	SECTION	EFFECTIVE DATE	CHANGE
			attachment. Consult the Company for clearances required for longer spans. 2 Vertical clearance above roadways subject to truck traffic may have higher requirements based on the highway authority having jurisdiction. 3 A roof, balcony, or area is considered readily accessible to pedestrians if it can be casually accessed through a doorway, ramp, window, stairway, or permanently mounted ladder by a person on foot who neither exerts extraordinary physical effort nor employs tools or devices to gain entry. A permanently mounted ladder is not considered a means of access if its bottom rung is 8 ft. (2.45 m) or more from the ground or other permanently installed accessible surface. 4 Where the height of a residential building does not permit its service drop(s) to meet these values or where clearances are compromised, please consult the Company. 5 Consult the Company if work may be expected in the future near lines or between the building and lines. The clearance shall be increased to ensure 10 ft. (3.0 m) minimum clear space for electrically unqualified persons, tools, machinery, and equipment or the line must be de-energized, guarded, and marked-up as required by safety codes. The clearance shall consider space required when ladders or scaffolding are to be used when maintaining the building or structure. The Customer will be responsible for any charges incurred by the Company to provide safe clearances for Customer activity.
51	4.2.4.2	Nov-2013	Replace Section “4.2.4.2 Clearance to Swimming Pools” in its entirety with: National Grid follows the latest revision of National Electric Safety Code (NESC) with respect to allowable clearances, including clearances between electrical equipment and swimming pools. Customers or their authorized agents proposing to install a swimming pool within 30 feet, horizontally, of overhead wires shall contact National Grid to arrange for a site visit by a Company representative. This shall occur prior to the construction or installation of the pool. The Company will reply in writing with any clearance restrictions found. Swimming pools are not to be located less than 5 feet (1.5 meters) horizontally from *underground* cables. Underground utility locations must be requested prior to swimming pool construction as described on Page 22. The Customer or their authorized agent shall contact the Company if any buried electrical utility cables are identified. Clearance violations caused by the placement of an above ground or in-ground swimming pool must be

PAGE	SECTION	EFFECTIVE DATE	CHANGE
			corrected to remove the potential hazard. The Customer will be responsible for the relocation of the swimming pool or the cost of relocation of the Company's electrical facilities (poles, wires, transformers, etc) to meet the Company's minimum clearance specifications. Electric service will be discontinued if the clearance violation cannot be made safe within a reasonable time frame as determined by the Company. See Section 3.12. Appendix 3 contains the text, illustrations, and tables derived from NESC Rule 234E1 that the Company follows in determining swimming pool clearances to overhead wires. **Under no circumstances should anyone, other than qualified Company personnel, attempt to measure clearances to the Company's electrical facilities.**
52	Table 4.2.4.3-1	Sep-2010	Add the following note after the table "For single-phase, 200A and less service drops, a 2 inch (53) rigid galvanized steel conduit riser may be permitted providing it is braced with a 5/16" (8mm) steel guy wire. See Section 1.11.1 when considering alternative installation methods and materials."
54	4.2.6	Sep-2010	Add the following new last paragraph: "In Upstate NY where there are no jurisdictional requirements for licensed electricians, the Company will permit individuals with qualifications as outlined in the National Electrical Code (NEC) to disconnect and temporarily reconnect a residential overhead service on the customer side of the service point under the same conditions stated above. Refer to the Company's Web site at http://www.nationalgridus.com/niagaramohawk/construction/4_overhead.asp for details and the procedure to permit and schedule this work."
56	4.5.4.1	Sep-2010	Add to last sentence in first paragraph of Section 4.5.4.1 "and no more than 2 for each service connection". Add another sentence to the end of the first paragraph "For conductor sizes greater than 500kcmil, the Customer will be responsible to provide the Company with connectors if necessary to connect to overhead transformers."
69	7.1.3.2	Sep-2010	Add the following new last sentence to the first paragraph: "A clear working space of at least four feet (1.2 m) shall be provided and maintained in front of all meter socket covers; however, shall not be less than 3 ft. (0.9 m) to a property line."
70	7.1.4	Sep-2010	Delete last (fourth) paragraph of Section 7.1.4.
76	Figure 7.3-3	Sep-2010	Add "For Commercial Only" above note "By-Pass Lever in the By-Passed Position".
80	Figure 7.3-7	Sep-2010	Add "Position" at the end of the figure's title.
81	Figure 7.3-8	Sep-2010	Remove the word "Figure" at the end of the figure's title. Add "and refer to Section 5.1.7.2 for more information" to the end of the last sentence in Figure 7.3-8.
86	Figure 7.4.1-2	Sep-2010	Delete the redundant title below the figure's title.
104	11.2.1	Sep-2010	Change the third sentence in Section 11.2.1 to read as follows: "This will require the installation of a double-throw, "break-

PAGE	SECTION	EFFECTIVE DATE	CHANGE
			before-make" type switch or similar disconnecting device acceptable to the Company; see Section 11.2.3."
109	11.2.3.2	Sep-2010	Move the last paragraph below the figure in Section 11.2.3.2 to be the last paragraph in Section 11.2.3.3.
118	Figure APP1-2	Sep-2010	Correct the right side table list as follows: **ITEM DESCRIPTION** I-25 3", 600V Insulator B7A2 2-1/2" (65 mm) Expansion Shield Lag Screw (Zinc Alloy) B11A 3/8" (10 mm) X 3" (75 mm) Lag Screw B11B 3/8" (10 mm) X 4" (100 mm) Lag Screw B13 5/8" (16 mm) Machine Bolt W1 2-1/4" (57 mm) Square Flat Washer
122	Appendix 3	Nov-2013	Add New "Appendix 3 – Swimming Pool Clearance Criteria"

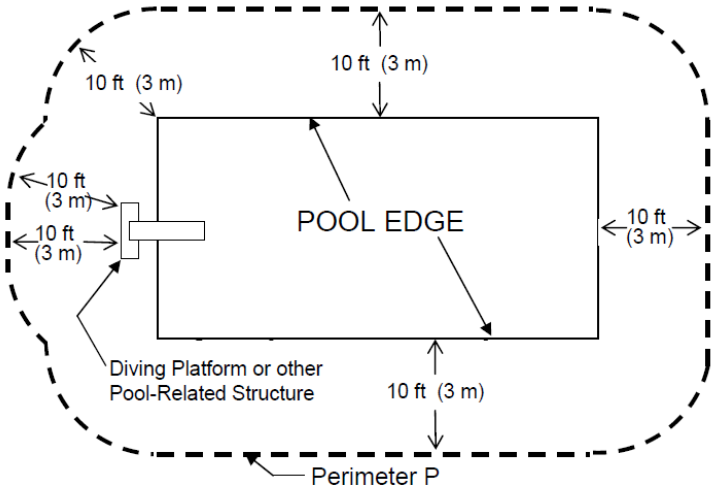
APPENDIX 3 – Swimming Pool Clearance Criteria

National Grid shall use the criteria within Appendix 3 to determine the allowable clearance between overhead conductors and swimming pools and swimming pool related structures.

Criteria 1

The Company's overhead conductors are not to be located within 10 feet, horizontally, of a swimming pool, diving platform, diving tower, water slide, or other fixed, pool-related structure as illustrated by the dashed line (Perimeter P) in Figure App3 -1. Likewise, a swimming pool, diving platform, diving tower, water slide, or other fixed, pool-related structure is not to be located within 10 feet, horizontally, of an overhead conductor. Overhead conductors must also meet the clearance requirements illustrated in Table App3-1 and Figure App3-2.

Figure App3-1



Overhead conductors are not to be located within Perimeter P.

PAGE	SECTION	EFFECTIVE DATE	CHANGE

Criteria 2

If it is not physically practical to implement Criteria 1 within the property, then overhead conductors will be allowed within the dotted Perimeter P of Figure App3-1, but in accordance with the clearance requirements illustrated in Table App3-1 and Figure App3-2.

Table App3-1 – Clearances Over or Near Swimming Pools (See Note 4)
Voltages are Phase to Ground for Effectively Grounded Systems

Figure App3-2 Dimension	Effectively Grounded Neutral, Grounded Guys, Ungrounded Guys, Exposed to 300V or Less (See Note 1), and Fully Shielded Lashed Aerial Cable (See Note 2)	0 to 750V Multiplex Cable (See Notes 2 & 3) and Ungrounded Guys Exposed to 300V to 750V (See Note 1)	0 to 750V Open Conductor and Semi-Conductor Shielded or Unshielded Lashed Aerial Cable	750V to 22kV Conductor (Bare, Covered, Tree Wire or Spacer Cable)
A	23.5 ft; 7.2 m	24.0 ft; 7.4 m	24.5 ft; 7.5 m	26.5 ft; 8.1 m
B	15.5 ft; 4.8 m	16.0 ft; 4.9 m	16.5 ft; 5.1 m	18.5 ft; 5.7 m
V	The clearance shall be as required in Table 4.2.4.1-1			

Note 1 - Ungrounded guys shall be considered on a case by case basis.

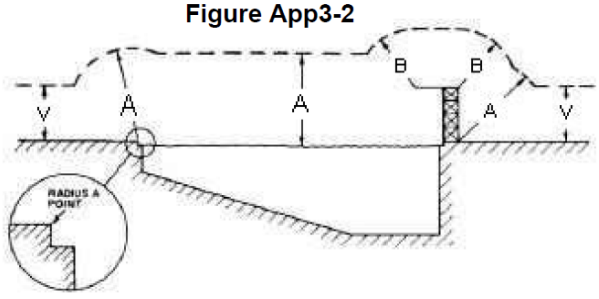
Note 2 – These clearances do not apply to effectively grounded neutrals, guys, fully shielded lashed aerial cable or 0V to 750V multiplex cable when these facilities are 10 feet (3 meters) or more horizontally from the edge of the pool, diving platform, diving tower, water slide or other fixed, pool-related structures.

Note 3 - Does not include multiplex cables with an insulated neutral.

Note 4 – The vertical clearance values for conductors are for 100 foot (30 meter) spans at 60°F (15°C) final unloaded sag and phase-to-ground voltages. No allowance is made for sag for vertical clearances at a building or structure's point of attachment. The Company will increase the clearances required for longer spans.

Note 5 – Voltages above 22kV, phase to ground, will be handled on a case by case basis.

Figure App3-2



PAGE	SECTION	EFFECTIVE DATE	CHANGE
Dimension A – Clearance in any direction from the water level, edge of pool, base of diving platform, or anchored raft. Dimension B – Clearance in any direction to the diving platform, tower, water slide, or other fixed pool related structures. Dimension V – The dimension from Table 4.2.4.1-1, the applicable of the first, second, or fifth row			

New England Green Book (July 2000) – Electrical Service Information and Requirements

Superseded in April 2010, refer to ESB750--0410.

ESB No. 751-2014 (June 2014) "General Requirements for Services Above 600 Volts"

New Issue, No Errata.

ESB No. 752-1994, 2nd Printing April 2002 "Service above 15,000 volts"

PAGE	SECTION	EFFECTIVE DATE	CHANGE
6	I.G.4.b	Jul-2002	Move first sentence of second bullet to Section I.G.4.c.
7	I.G.4.c	Jul-2002	After the second sentence, insert first sentence of I.G.4.b's second bullet.
15	V.F.1	Nov-2002	Add the following before the first sentence in V.F.1: "The Company shall review and accept the protective relay devices provided by the Customer for protection schemes required by the Company to protect its system. The use of utility grade relays and relay redundancy is a normal Company requirement."
15	V.F.3	Nov-2002	Change V.F.3 to read as follows: "3. Company-designated protective devices The Company will review for acceptance the Customer's proposed settings of those relays that the Company's System Protection Engineering Dept. designates as being required to satisfy the Company's protection practices. Any relay setting accepted by the Company shall not be changed or modified at any time without the prior written consent of the Company."
16	V.F.5	Nov-2002	Change V.F.5 to read as: "The Customer is responsible for specifying the relay settings and performing the calibration, testing, maintenance and trouble-shooting of their entire protective system. The Customer shall provide written notice to the Company prior to energization that these items have been verified."

ESB No. 753-1993, 2nd Printing April 2002 "Primary Meter Pole"

PAGE	SECTION	EFFECTIVE DATE	CHANGE
10	V.B.1.a	Dec-2014	Modify to read:

PAGE	SECTION	EFFECTIVE DATE	CHANGE
			The Pole shall be a Minimum Class 3, full length penta treatment, conforming to the standards of EEI TD-103 and ANSI O5.1
Figures 3 through 4	Note 4	Apr-2009	The "johnny ball" guy insulator is no longer acceptable as they do not meet present insulation requirements for this type of installation. Fiberglass guy strain insulators are now specified. Ensure the guy insulators are placed to prevent the transfer of energy from the Company's wires to (i) the Customer wires, (ii) any communication wires on the pole or (iii) the public on the ground. Depending on spacings on the pole, multiple guy insulators may be needed to meet the multiple requirements. Consult the Company for inquiries regarding the design, equipment, and installation of the pole guy.

ESB No. 754A-1992, 2nd Printing June 2002 "Single Phase Outdoor Pad Mounted Transformer"

Superseded in April 2010, refer to ESB750--0410 and ESB 754. See also ESB 759 for the Company's primary cable installation requirements in the Customer's trench or underground conduit system.

ESB No. 754-2007 "Outdoor Pad Mounted or Vault Enclosed Three Phase Transformer"

Remove all references to ESB 759 effective in April 2010, refer to ESB750--0410 and new ESB 759. See ESB 759 for the Company's primary cable installation requirements in the Customer's trench or underground conduit system. In addition,

PAGE	SECTION	EFFECTIVE DATE	CHANGE
19	Figure 2 Note 6	Sep-2010	Add Note to A , add to bullet 4 in B "propane / LP or LNG gas", and add bullet 5 in B "chemical storage silos / tanks" to read as follows: 6. Clearances from objects: A. An area measuring 10 feet from any point of the transformer pad shall be kept free of all: • buried water lines, storm drainage lines, gas lines, other electric lines; • underground fuel storage tanks; and • above grade fire hydrants, cell towers, self contained diesel or diesel byproduct fueled generators, and outdoor enclosed generators. ***NOTE:*** The 10 ft. clearance may be reduced with a noncombustible barrier (see Note 3) and shall not be less than five (5) feet from the edge of the transformer pad. The Customer or their authorized representative shall obtain this clearance reduction approval from the Company and the local AHJ(Authority Having Jurisdiction), as necessary, prior to the noncombustible barrier installation. B. An area measuring 25 feet from any point of the

PAGE	SECTION	EFFECTIVE DATE	CHANGE
			transformer pad shall be kept free of all: • exposed water lines, gas piping, sewer lines; • open conductor electric lines; • above grade gas meters or regulator vents, fuel storage tanks or dispensing units, and non-enclosed gasoline/ propane / LP or LNG gas fueled generators; and • chemical storage silos / tanks. ***NOTE:*** The 25 ft. clearance may be reduced to 10 ft. with a noncombustible barrier (see Note 3) and shall not be less than five (5) feet from the edge of the transformer pad. The Customer or their authorized representative shall obtain this clearance reduction approval from the Company and the local AHJ (Authority Having Jurisdiction), as necessary, prior to the noncombustible barrier installation.
31	Figure 11	Sep-2010	Replace typical manhole requirements drawing with updated ground wire; see * below.
32	Figure 11 (cont'd)	Sep-2010	Replace typical manhole requirements continuation drawing with updated proper ground wire and detail Y; see * below.

* See below.

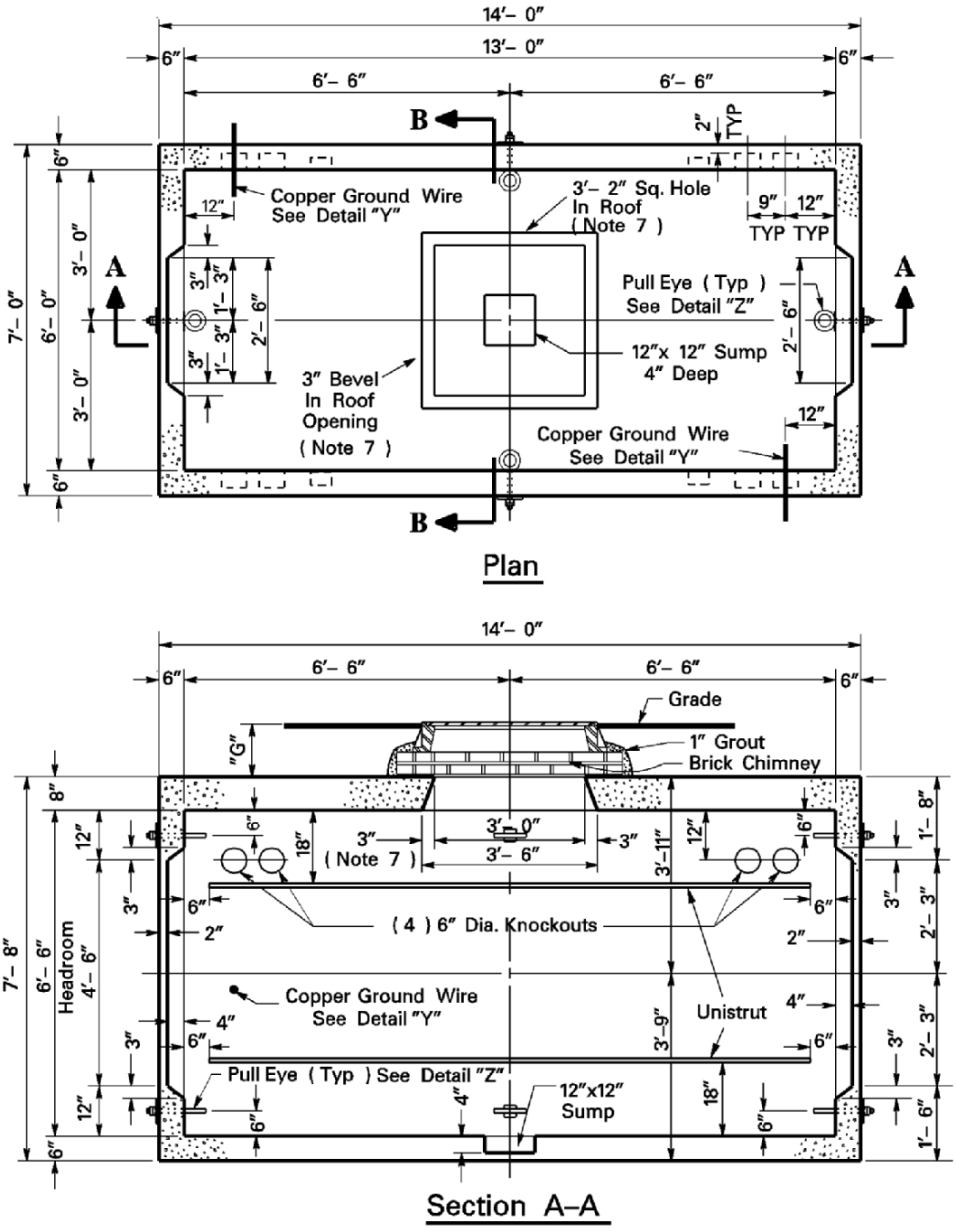
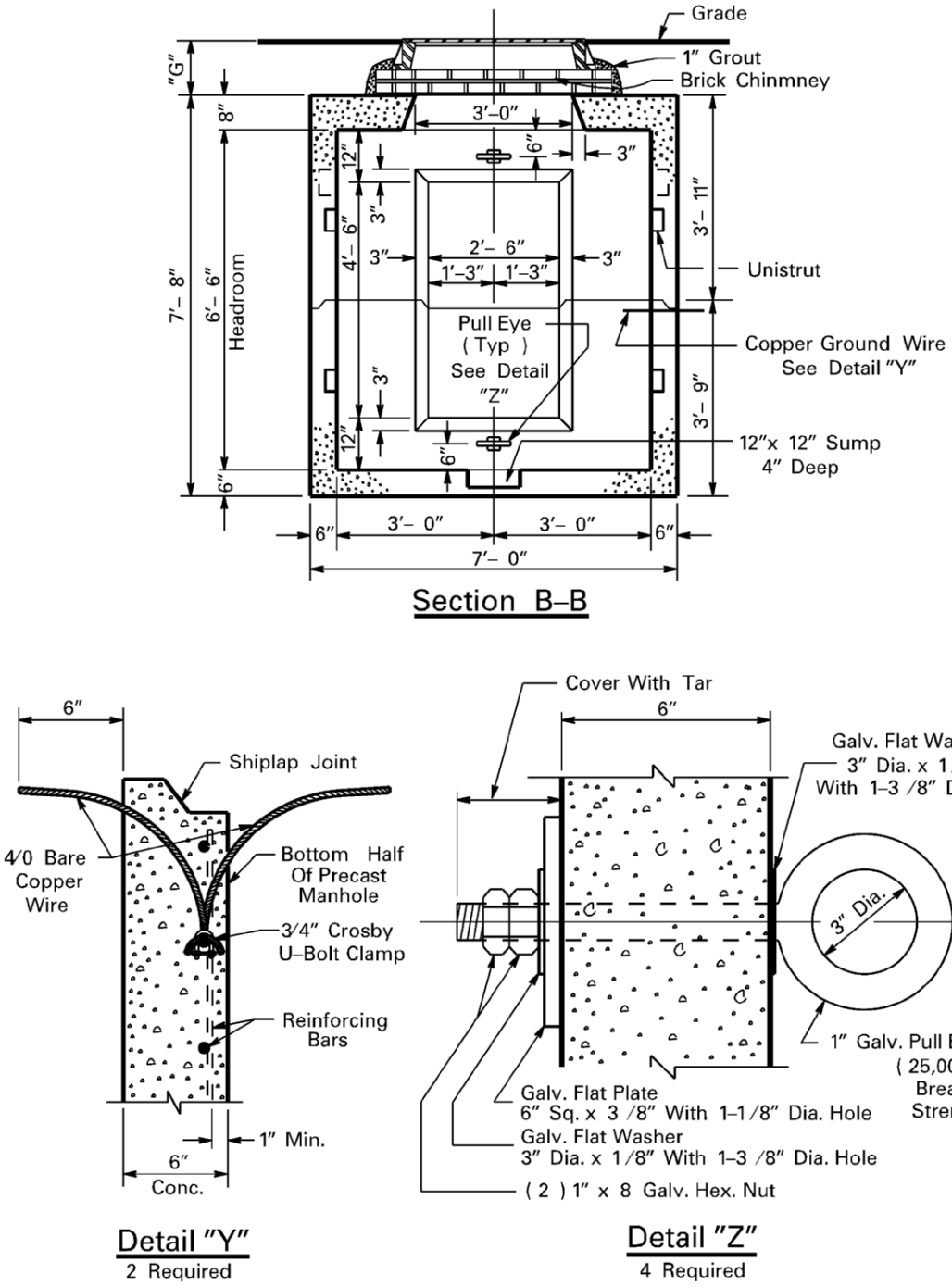


FIGURE 11: TYPICAL MANHOLE REQUIREMENTS



Note: Construction joint to be sealed with asphalt or equivalent.

FIGURE 11 (CONTINUED)

ESB No. 755-2003 "Operation & Maintenance Requirements for Services Above 600 volts"

No errata.

ESB No. 756-2014 "General Requirements for Parallel Generation Connected to a National Grid Owned EPS", version 2.2

No errata.

ESB No. 756 Appendix A; "Requirements for Parallel Generation Connected to National Grid Facilities in New York", version 1.2

No errata.

ESB No. 756 Appendix B; "Distributed Generation Connected to National Grid Distribution Facilities Per The New York Standardized Interconnection Requirements", version 3.0

No errata.

ESB No. 756 Appendix C; "Distributed Generation Connected to National Grid Distribution Facilities Per The Massachusetts Standards for Interconnecting Distributed Generation", version 2.0"

No errata.

ESB No. 756 Appendix D; "Distributed Generation Connected to National Grid Distribution Facilities Per The Rhode Island Standards for Interconnecting Distributed Generation", version 2.0

No errata

ESB No. 756 Appendix E; "Requirements for Parallel Generation Connected to National Grid Facilities in New Hampshire", version 1.1

No errata

ESB No. 757, Aug. 1973 "Network Services"

PAGE	SECTION	EFFECTIVE DATE	CHANGE
1	1.1	Nov-1999	Change "800 amperes and above at 480Y/277 volts" to "480Y/277 volts".
10	4.2.3	Nov-1999	Delete the Local Authority Approval part in its entirety.
19	13.4.1	Nov-1999	Delete "paragraphs 94, 97 and 100".

ESB No. 758, Jan. 1985 "Primary Service to Metal Enclosed Gear"

PAGE	SECTION	EFFECTIVE DATE	CHANGE
2	C Paragraph 11	Nov-1999	Delete the Inspection part in its entirety.
3	H	Nov-1999	Delete Paragraphs 18 through 20 and Paragraph 22.
4 and 5	I	Nov-1999	Delete Paragraphs 23 through 26.
5	J Paragraph 28	Nov-1999	In the first sentence, change "outdoor" to "indoor".
8 - 10	M	Sep-2010	Change this metering section in its entirety and replace it with

PAGE	SECTION	EFFECTIVE DATE	CHANGE
			the new information ** below.
Fig. 1	Note #3	Apr-2002	In Note 3, change "see Paragraph 18" to "see ESB 750 Section 4".
Fig. 1	Note #4 (new)	Sep-2010	Add new note: "Note #4: The clearances shown from the front of the service equipment to a building wall and from the rear of the service equipment to a building wall shall be both 10 foot (minimum) if the switchgear is designed with the Company required access to the incoming termination compartment on one side while the metering PT/CT compartment is on the other side; see Figure 1A. Otherwise, if the Company's access to both compartments is on the same side, then the other side's clearance can be reduced to the clearances presently shown." Add new Figure 1A ** below.

** See below.

M. PRIMARY SWITCHGEAR METERING COMPARTMENTS SPECIFICATIONS

M.1 Equipment Furnished by the Company

1. The Company will furnish all meters, metering instrument transformers, potential transformer primary fuses and test devices required for billing purposes at the delivery voltage.
2. The Company will specify the quantity and type, of all current and potential transformers for billing purposes.
3. The current and potential transformers for the Company's billing meters shall normally not be used to operate any other Customer devices, see ESB 750, Section 7.

M.2 Customer's Responsibility

1. Codes, Standards, and Wiring Adequacy:

a. Components of the primary switchgear metering transformer compartment shall conform to the latest editions of the following national standards and codes:

Component	Applicable National Standard
• Cable	ICEA
• Power Switchgear	ANSI C37.20.2
• Power and Instrument Transformers	ANSI C57
• Surge Arrestors	ANSI C62
• Insulators	ANSI C29
• Apparatus Bushings	ANSI C76

b. The Company recommends approval certification by a laboratory testing organization acceptable to the authority having jurisdiction according to the National Electrical Code, e.g. UL, ETL, CSA, etc.

2. Metering Transformer Equipment Compartment:

a. A separate enclosing compartment shall be provided solely for the billing metering transformers. The metering transformer compartment shall be solely accessible by the Company. The Customer shall have provisions for the Company's locking the access door with a 3/8" (10 mm) shank padlock.

b. The connection of the Customer's auxiliary transformer for heat, light and receptacle(s) installed at the meter panel location and elsewhere within their switchgear, shall be on the load side of the Company's billing metering transformers.

c. Where the metering transformer compartment is located in an unheated area or building, provisions shall be made for heating the compartment to prevent condensation.

d. The entire metering compartment shall be designed and constructed with adequate ventilation.

e. The minimum width of the metering transformer compartment must be based on the electrical clearances of Figure M-1. The Customer shall maintain a minimum 10 ft. (3.0 m) unobstructed clearance in front of the metering transformer compartment access door.

f. The Customer shall provide space and supports for the Company's current and potential transformers as part of the service entrance equipment. Provisions for mounting shall be designed in a manner that is easily accessible for work. The supports shall be drilled for fixed-in-place mounting hardware (i.e. nuts, bolts, washers) in accordance with dimension information concerning this equipment furnished to the Customer for the design of their installation. Suspending instrument transformers from the roof area of the switchgear shall not be permitted.

   In MA, NH, and RI, the current transformers shall be in a completely barriered and isolated compartment from the potential transformer compartment; see Figure M-1A. This compartment shall be so designed that, after proper electrical isolation, each of the current transformers can be readily removed or changed without disturbing the others. Company personnel must have access for inspection without interruption of service.

g. The Company's potential transformers (PTs or VTs) for metering healthcare facilities shall be mounted on drawout carriages to ensure that the equipment will be readily accessible for safe inspection and replacement without causing an outage. Where potential transformers are mounted on a drawout carriage, the front of the carriage shall extend up, to close the section when transformers are in the operating position. Primary contacts for the drawout feature shall be of a design that ensures continued maintenance of the contact pressure. Visible grounding devices shall be provided to make certain that the drawout carriage mounted potential transformer primary terminals are grounded when the carriage is withdrawn. The drawout carriage frame must be grounded to the switchgear ground throughout its travel.

h. Primary fuses for the Company's potential transformers will be supplied by the Company. The Company will specify if primary fuses shall be separately mounted, in holders supplied by the switchgear manufacturer, and installed in a properly barriered compartment completely isolated from adjoining equipment. Sufficient working space shall be provided to permit fuses to be readily and safely checked or replaced without removing the transformer from its mount. Fuse replacement must be accomplished without interruption of service to the customer.

i. No instrument transformers shall be installed closer than 6 inches (150 mm) to the ground or floor upon which the switchgear is installed.

j. Instrument transformers shall be installed in such positions that the rating and polarity marks are readily and safely readable.

k. The metering transformer compartment shall be solely accessible by the Company. This requires section-to-section openings for through bus to be maintained as small as phase to ground clearances in Figure M-1 will allow.

l. Where the clearances in Figure M-1 cannot be provided, Glastic (NEMA Type GPO 3 material) barriers are required between potential transformers and between potential transformers and the enclosure walls.

m. Connections for the Company's potential transformers shall be made on the supply side of the current transformers except for generator producing facilities. A connection shall be made available by the Customer from each phase bus with a #6 AWG copper solid wire including crimped connectors and hardware to connect the Company's metering potential transformers.

n. The phase bus shall be mechanically independent of the instrument transformers. Company metering transformers are not to be used as part of the bus support system. Removable bus bars shall be furnished by the Customer to permit installation and removal of current transformers. If aluminum bus is used, tin-plated or silver-plated terminals shall be provided by the Customer including silicon-bronze bolts and stainless steel nuts and washers for connection of the Company's metering current transformers.

o. A grounding stud shall be provided for grounding each phase of the bus on the line side and load side of the metering transformers and mounted such that removal of instrument transformers does not affect the ground provisions. The Company will specify the ground stud to be used.

p. A 5/8" (16 mm) dia. by 24" (600 mm) long copper ground bail shall be connected to the ground bus at both ends and located 7" (175 mm) behind the door and 5" (125 mm) above the door sill. In MA, NH, and RI, ground pads and "jug handles" shall be installed on the equipment ground bus as shown in Figure M-1A.

3. Metering Conduit:

The Customer shall furnish, install and maintain rigid conduit for the wiring from metering transformers to the billing meter panel. The maximum distance between meter and potential transformers shall be 50 feet (15 meters).

a. Internal:

Where the billing meter panel is part of the switchgear and the conduit is internal between sections, this conduit shall be 1-1/2" (41), PVC Sched. 80 with bushings on each end.

b. External:

The rigid conduit shall be at least 1-1/2" (41) galvanized steel. The conduit run is permitted a maximum of two 90 degree conduit bends (condulets shall not be used).

c. A pull line shall be installed in the conduit.

4. Billing Metering Panel:

a. Outdoor Billing Compartment: (where switchgear is located greater than 50 feet (15 meters) from the Customer's building)

Note: *These requirements apply to a compartment of the Customer's primary switchgear or to a separate free-standing outdoor cabinet.*

(1) The compartment's minimum dimensions shall be 48" (1.2 m) wide x 90" (2.3 m) high x 24" (600 mm) deep. For a separate free-standing outdoor cabinet the minimum dimensions shall be 48" (1.2 m) wide x 60" (1.5 m) high x 24" (600 mm) deep.

(2) The internal panel shall be 3/4" (19 mm) thick x 44" (1.1 m) wide x 60" (1.5 m) high minimum painted exterior grade plywood.

(3) The Customer shall install a 1-1/2 inch (41) rigid galvanized steel conduit from the Company's metering transformer compartment to the Company billing meter cabinet.

(4) The billing metering compartment shall be lighted (75 watt minimum), contain a 20A GFI protected 120/240VAC duplex receptacle, be heated (250 watt minimum, thermostatically controlled), and be ventilated.

(5) The compartment door shall include a three point latch and provisions for a 3/8" (10 mm) shank padlock by the Company.

(6) The Customer's switchgear heater control circuitry equipment shall be located in this compartment.

b. <u>If Utility Meters are being installed inside</u>:

(1) The Customer shall install a 1-1/2 inch (41) rigid galvanized steel conduit from the Company's metering transformer compartment to the Company approved meter location.

(2) The Customer shall provide and mount a meter board for each indoor installation as illustrated in Section 7 of ESB 750.

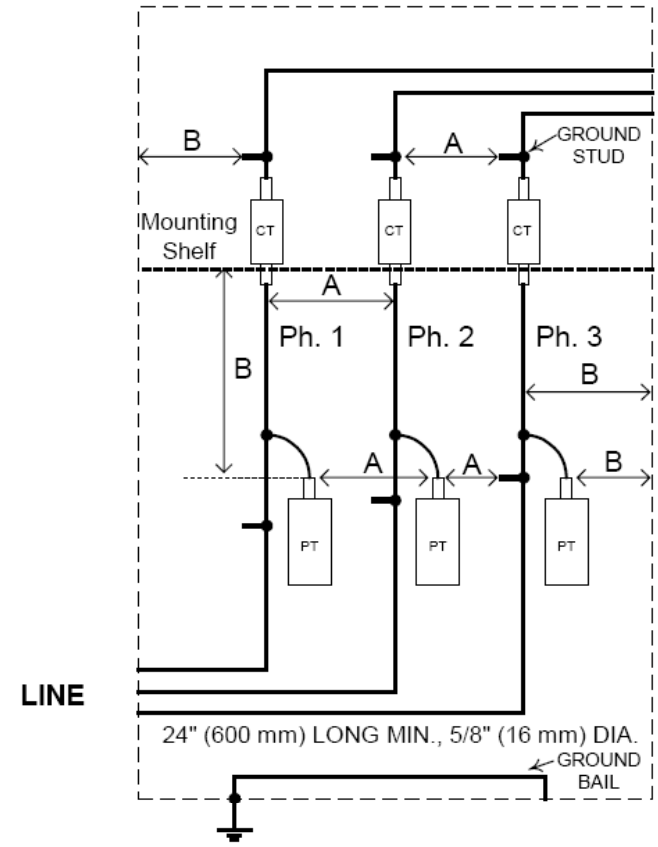
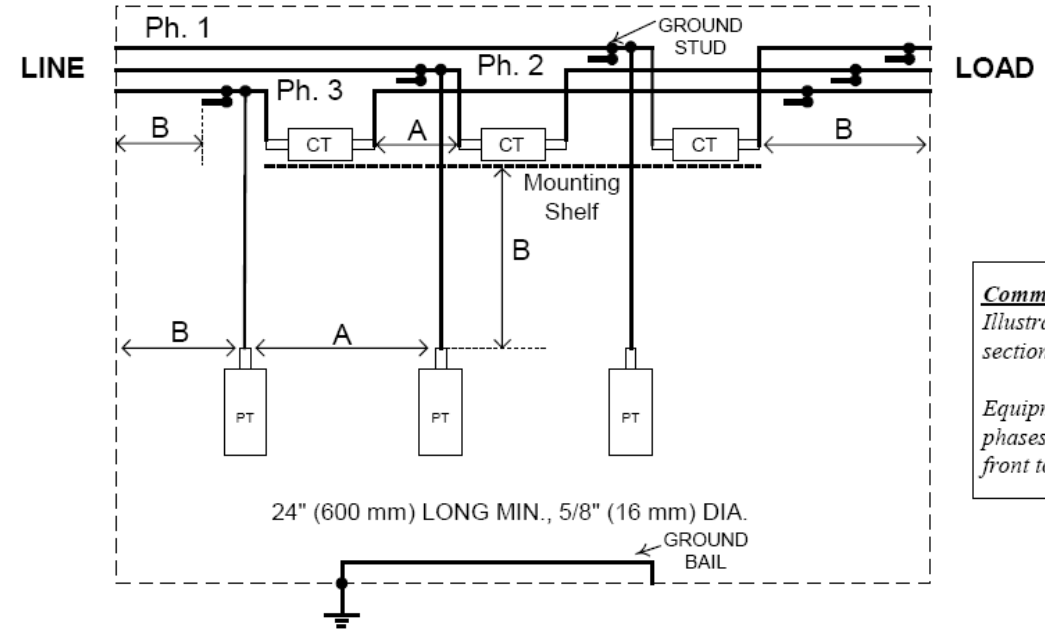


TABLE of INDOOR SEPARATIONS*

kV Class	kV BIL	A (φ-φ)	B (φ-Grd)
4.76	60	4.5" (115 mm)	3.0" (80 mm)
8.25	75	5.5" (140 mm)	4.0" (105 mm)
15.0	95	7.5" (195 mm)	5.0" (130 mm)
25.8	125	13.0" (335 mm)	8.0" (200 mm)
38.0	150	13.5" (340 mm)	10.5" (270 mm)
	200	18.0" (460 mm)	13.0" (325 mm)

*Note: *These separations are minimums and should not be considered recommended design. The Company recommends exceeding minimums where space permits.*

FREESTANDING SWITCHGEAR METERING PT & CT COMPARTMENT



Comments:
Illustrations show section view only.

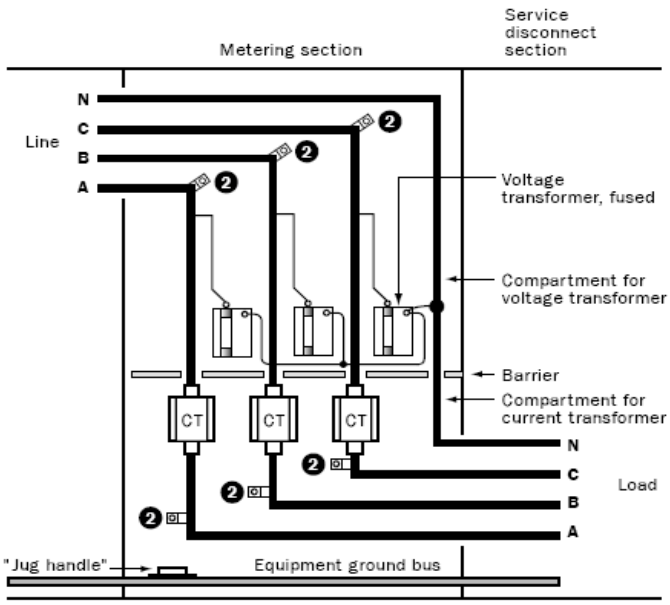
Equipment and bus phases are spaced front to back.

LOW PROFILE SWITCHGEAR METERING PT & CT COMPARTMENT

Figure M-1 – Typical Primary Switchgear Metering Transformer Compartment Clearances

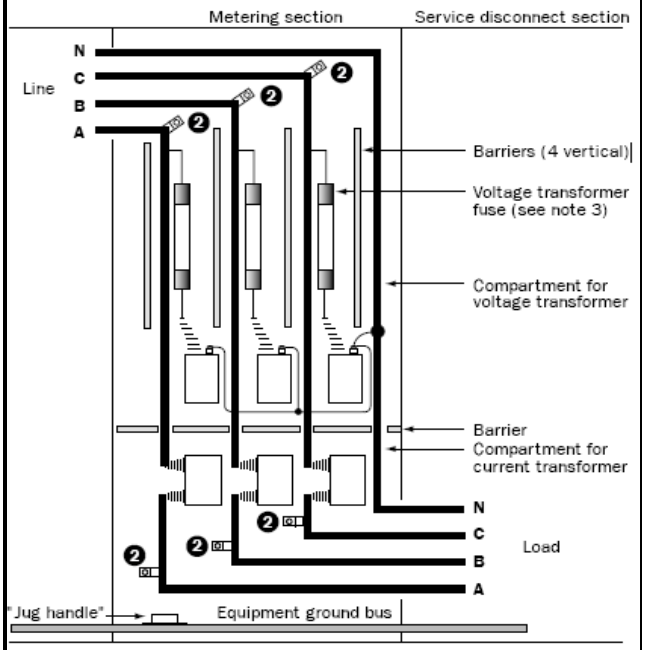
For MA, NH, and RI:

Metal Enclosed Switchgear
15-kV 4-Wire – Wye Service



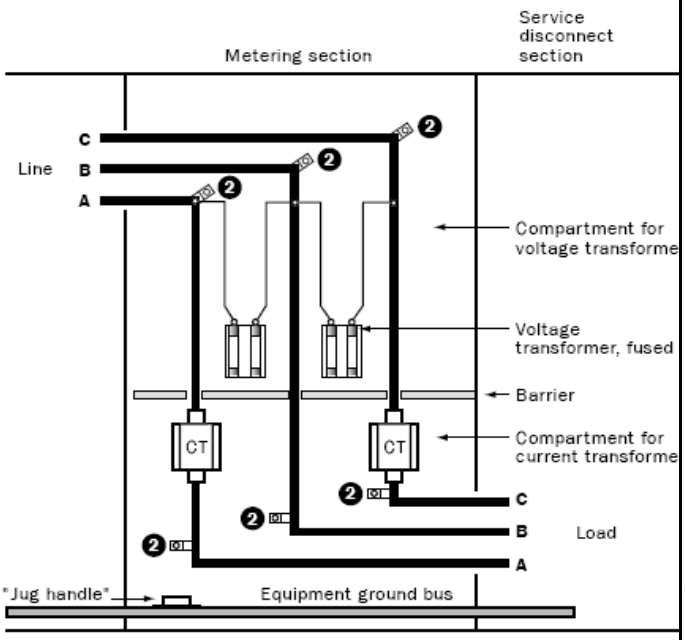
Note: 1. The above layout is a general arrangement and is not intended to restrict the manufacturer's design of metal enclosed gear.
2. Ground pads with 7/8" diameter hole.

Metal Enclosed Switchgear
24 kV and 35.5 kV – Voltage Transformer Fusing
4-Wire – Wye Service



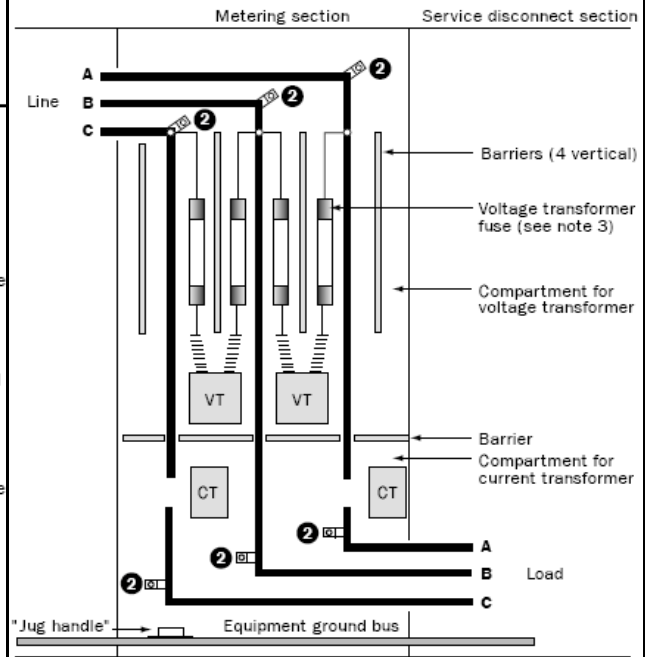
Note: 1. The above layout is a general arrangement and is not intended to restrict the manufacturer's design of metal enclosed gear.
2. Ground pads with 7/8" diameter hole.
3. V. T. Fuses: General Electric type EJO - 1
24 kV, Class C, 2" diameter, ampere rating 0.5E
34.5 kV, Class D, 3" diameter, ampere rating 1.5E

Metal Enclosed Switchgear
15-kV 3-Wire – Delta Service



Note: 1. The above layout is a general arrangement and is not intended to restrict the manufacturer's design of metal enclosed gear.
2. Ground pads with 7/8" diameter hole.

Metal Enclosed Switchgear
24 kV and 35.5 kV – Voltage Transformer Fusing
3-Wire – Delta Service



Note: 1. The above layout is a general arrangement and is not intended to restrict the manufacturer's design of metal enclosed gear.
2. Ground pads with 7/8" diameter hole.
3. V. T. Fuses: General Electric type EJO - 1
24 kV, Class C, 2" diameter, ampere rating 0.5E
34.5 kV, Class D, 3" diameter, ampere rating 1.0E

Figure M-1A – Typical Primary Switchgear Metering Transformer Compartments

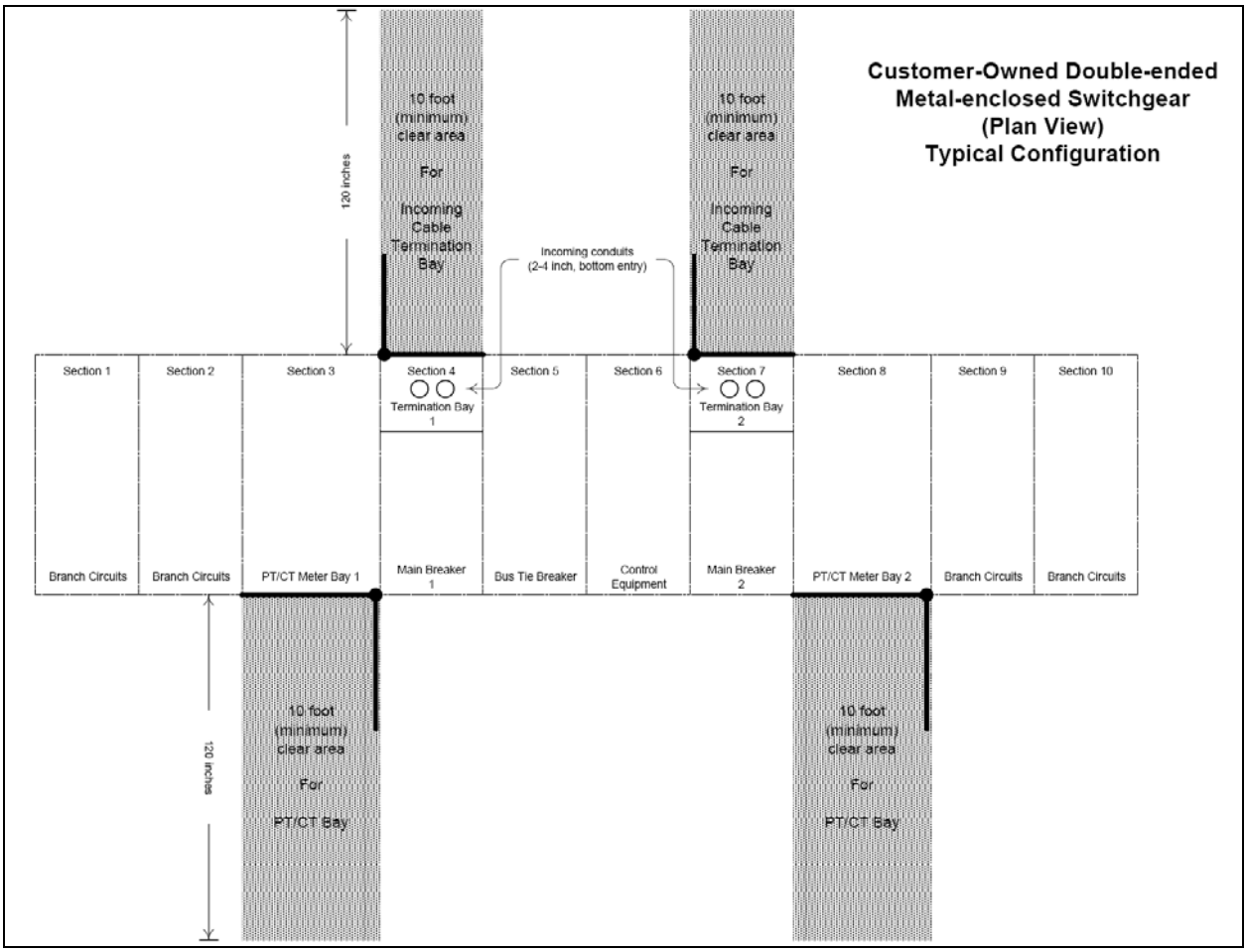


Figure 1A – Clear Area Requirements in Front of Line Termination and Metering Transformer Compartments for 15kV Class Primary Switchgear

ESB No. 759

Superseded in Oct. 2007 by ESB 754. New ESB 759 "Underground Distribution Guidelines" is presently being developed.

REVISION HISTORY

Version	Date	Description of Revision
1.0	09/27/10	First version of new document superseding all previous issues of the ESB 750 series Errata and Revisions.
2.0	12/31/14	Various Revisions.

/END OF DOCUMENT/

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HERE WITH YOU. HERE FOR YOU.

Supplement to

Specifications for Electrical Installations

General Requirements Above 600-Volt Service

Electric System Bulletin No. 751

June, 2014

(Supersedes all previous versions of ESB 751)

PREFACE

This supplement of the Specifications for Electrical Installations (ESB 750) supersedes previous ESB 751 documents from the Niagara Mohawk Power Corporation legacy company of National Grid.

This supplement covers additional specifications for performance requirements of Company provisions and customer responsibilities where service delivery is greater than 600 Volts and is applicable for the following National Grid companies:

Massachusetts Electric Company

Nantucket Electric Company

The Narragansett Electric Company

Niagara Mohawk Power Corporation

This supplement is available from the Company's web site and may be obtained:

- From the Internet at http://www.nationalgridus.com/electricalspecifications,
- Or in printed form by contacting either of the Call Centers in Massachusetts or New York (see inside cover of ESB 750). However, printed copies are not document controlled, so for the latest authorized version please refer to the Company's website.

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 PURPOSE

This Supplement to Electrical System Bulletin (ESB) 750 provides the Company's and Customer's performance requirements for service interconnections greater than 600 Volts. It also provides general design and compliance verification review process requirements for a Customer or Generator-owner who is, or will be supplied by a National Grid (Company) designated voltage in excess of 600 Volts.

It is important that the Customer or Generator-owner and their engineer or contractor obtain and refer to the Specifications for Electrical Installations booklet (ESB 750, latest version) and other applicable ESB 750 series supplements in conjunction with these requirements.

1.2 SCOPE

Performance requirements for services above 600 Volts contained herein cover communications with the Company, planning and approval processes, required technical submittals and compliance verification for medium and high voltage customer installations.

Prescriptive requirements for the Customer or Generator-owner shall comply with the appropriate Company Electric System Bulletin (ESB) which covers details for their service installation. These Bulletins include:

ESB 750 -	Specifications for Electrical Installations
ESB 752 -	Services Above 15,000 Volts
ESB 753 -	Primary Meter Pole
ESB 755 -	Operation & Maintenance Requirements for Services Above 600 Volts
ESB 756 -	Requirements for Parallel Generation Connected to a National Grid Owned EPS
ESB 758 -	Primary Service to Metal Enclosed Gear
ESB 759B -	Underground Commercial Distribution (UCD) Installation & Responsibility Guide

2.0 CUSTOMER'S RESPONSIBILITIES FOR TAKING SERVICE ABOVE 600 VOLTS

1. The Customer shall consult the Company in every case where the service voltage may exceed 600 Volts. The Company will designate the type of service based on the location, size and nature of the proposed load and its relation to the Company's facilities.
2. Refer to Sections 1.7.2 and 2.0 in ESB 750 for requirement of a Design Professional related to the design of the Customer's service connection above 600 Volts. In addition, only qualified persons are permitted to install, operate, maintain and/or work on these facilities. Prior to ordering equipment for new or changed services, the Customer must obtain acceptance of their design proposal from the Company. Refer to Section 4.2 in ESB 755.

2.1 SERVICE PLAN

The Company will develop a written Service Plan documenting the method for serving a specific Customer. The Service Plan documents the Company's method for serving a specific Customer. Electrical studies to support the Service Plan development may require Customer contributions based upon service complexity. Service Plans are generally developed for Customers interconnecting to the Company's Electric Power System (EPS) at voltages exceeding 15kV. The Service Plan includes, but is not limited to, the specified delivery voltage, required technical submittals for Company review, and verification requirements.

2.2 COMPANY ELECTRIC POWER SYSTEM MODIFICATIONS

Company modifications, other than the line extension and service lateral, may be required. These modifications may require funding from the Customer. It is the Customer's responsibility to obtain for the Company, and/or pay for such environmental and highway permits, rights-of-way and easements from other parties secured by the Company on behalf of the Customer's project. All cost estimates are required to be paid in full, by the Customer, prior to the commencement of construction activities by the Company, and prior to the interconnection of the Customer's facility.

2.3 TELECOMMUNICATION SERVICE

Depending on the installation, the type and configuration of the service, and at the discretion of the Company, the Customer may need to provide telecommunications circuits and related equipment to ensure coordination with the Company's electric power system. The cost and coordination of such installations is the responsibility of the Customer. Maintenance of the telecommunications service lines is the responsibility of the telecommunications provider. The Company will specify the required types of telecommunications systems required for coordination with the Company's Electric Power System (EPS).

2.4 CODES, STANDARDS, AND REFERENCES

See Section 1.0 of the Company's ESB 750 and the other prescriptive ESB 750 Series listed in Section 1.2 above for all applicable codes and standards that the Customer's installation shall adhere to.

3.0 DEFINITIONS

Note: *The following are terms defined as used in this publication.*

Refer to ESB 750 Section 2.0 and the other prescriptive ESB 750 Series for definitions.

Customer – A "Customer" will be synonymous with a "Generator Owner" for the purpose of this Supplement

Design Professional – A Professional Engineer, authorized and licensed to practice in the respective state or jurisdiction in which the project will be installed and operated

Qualified Person – As defined by the National Electrical Code, is "one who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved"

ACRONYMS/SYNONYMS

ANSI – American National Standards Institute
Energization - "In Service"
EPS - "Electric Power System"
ESB - "Electric System Bulletin"
IEEE – Institute for Electrical and Electronic Engineering
TOA – "Transmission Outage Authorization"

4.0 GENERAL SERVICE CONNECTION REQUIREMENTS ABOVE 600 VOLTS

4.1 VOLTAGES AVAILABLE ABOVE 600 VOLTS

All new services will be 60 Hertz, single phase or three phase, alternating current, designated by the Company. For service above 600 Volts, the Company will solely designate the type of service based on the location of the Customer and the size and character of the proposed load. The following types of service above 600 Volts in Tables 4.1-1 and 4.1-2 are generally standard but not all types are available at all locations. The Customer should consider the installation of their own voltage regulation equipment if necessary to maintain utilization voltage within the limits of the latest edition of ANSI C84.1.

Table 4.1-1 Available Services above 600 Volts (Upstate NY)

Phases	Wires	Company's Nominal Delivery Voltage (Volts)	Company's Typical Voltage Delivery Levels		Note
			Minimum Customer Load (kVA)	Maximum Customer Load (kVA)	
3 3 3 3	3 4 3 3	2,400 4,160 4,800 12,000	500	1000	1.,3.
3	4	13,200	500	2500	1.,3.,4.
3	3	23,000; 34,500; 46,000; 69,000	1000	5000	2.,4.
3	3	115,000	5000	Circuit Capability	2.
3	3	230,000; 345,000	As determined by Company	As determined by Company	2.

Notes to Table 4.1-1:

1. *Electric services of 500 kVA and less are typically served through the Company's secondary distribution network. The Company may require a Customer to take service above 600 Volts to serve loads less than 500 kVA under special circumstances. Single-phase services above 600 Volts are limited to a maximum of 100 kVA. For variances to these delivery voltages, consult the Company.*
2. *Consult the Company.*
3. *The arrangement of supply facilities will be specified by the Company.*

4. *Maximum demand may be more or less depending upon supply and location of the proposed service. Based on specific supply circuit conditions, the maximum load shown may be adjusted as determined by the Company.*

Table 4.1-2 Available Services above 600 Volts (MA, NH, and RI)

Phases	Wires	Company's Nominal Delivery Voltage (Volts)	Company's Typical Voltage Delivery Levels		Note
			Minimum Customer Load (kVA)	Maximum Customer Load (kVA)	
3 3 3	4 3 3	4,160 4,800 12,000	500	1000	1.
3	4	13,200	500	As determined by Company	1.
3	4	13,800	500	As determined by Company	1.
3	4	34,500	500	As determined by Company	2.
3	3	23,000; 34,500; 46,000; 69,000	1000	As determined by Company	2.
3	3	115,000; 230,000; 345,000	As determined by Company	As determined by Company	2.

Notes to Table 4.1-2:

1. *Single-phase services above 600 Volts are limited to 100 kVA.*
2. *Consult the Company.*

4.2 APPLYING FOR SERVICE GREATER THAN 600 VOLTS

The Customer shall submit, to the Company, a written request for service and/or interconnection prior to progressing their design toward final review. These required submittals, at a minimum, are described in Section 5, "Stage A: Preliminary Design Submittal Phase".

4.3 DESIGN ACCEPTANCE REVIEW

The Company's Design Acceptance Review shall signify that the proposed arrangement and equipment meets the Company's minimum requirements. This review shall not be construed to be a certification of the Customer's facilities or an approval of their installation in regard to its overall safety, adequacy, or compliance to applicable codes and standards. The Customer shall refer to ESB 750, Section 1 for these requirements.

4.4 DESIGN ACCEPTANCE REVIEW PROCESS

The Company undertakes the review of a Customer's project in various steps to ensure the design and related construction is progressing in a logical and timely manner. These steps provide for frequent and relevant feedback to the Customer and/or their agent(s). The Company's review is summarized as follows, and explained in detail in the sections that follow:

4.4.1 Design Review Summary

Stage A: Preliminary Design Submittal Phase

The Company will receive preliminary information about the project to formulate a general understanding of the proposal, and to identify and communicate obvious concerns to the Customer.

Stage B: Design and Procurement Phase

The Company becomes engaged in the review of the Customer's proposal regarding the design and its overall impact of the interconnection to the Company's EPS. The Company and Customer shall jointly establish a schedule for the review of the Customer's submittals. Any schedule proposed is subject to the quality of the submittals and the complexity of the design and proposed installation.

Stage C: Construction and Installation Phase

The Company will receive final sets of design drawings and related submittals from the Customer, based on comments and revisions from Stage B.

Stage D: Compliance Verification Testing Phase

The Company shall review calibration and test results, and witness the operation of critical interconnection equipment, including, but not limited to, circuit breakers, disconnect switches, and relays.

Stage E: Energization and/or Synchronization Phase

The Company will authorize the Customer to energize their own equipment in accordance with the Company's switching procedures and the Customer's Energization Plan, once requirements set forth above are satisfactorily completed.

Stage F: Project Close-Out Phase

The Company will receive drawings that reflect final as-built conditions of the completed project.

4.4.2 Submittal of Design Materials to the Company

THE CUSTOMER SHALL SUBMIT THEIR PLANS AND SPECIFICATIONS TO THE COMPANY BEFORE ORDERING EQUIPMENT OR STARTING WORK to ensure that the proposed design for the electric service installation conforms with Company requirements. All technical submittals, including conceptual drawings and progress drawings, shall be provided in hard copy and electronically (Adobe Acrobat (*.pdf)). Each hard copy submittal shall consist of three (3) full sets. Emailing of pdf files is the preferred method of receiving electronic files. The electronic file size must be less than 10MB per email. Drawings shall be prepared in conformance with ANSI Y32.2, IEEE 141 and IEEE 446 symbol and drafting nomenclature.

All devices and equipment specified shall be of power utility grade and not industrial grade.

See Appendix A for a summary of the submittal requirements.

4.4.3 Schedule

The Company's schedule is largely dependent on the quality of submittals provided by the Customer and/or their Consultant(s). Mandatory time frames for generation projects are specifically noted in ESB 756. Time frames for non-generation type projects are typically negotiated between the Company and Customer, and are also described within the various design review stages listed below. The Company and Customer will use the milestones as outlined in Table 4.4.3 or as amended in ESB 756 and its associated appendix for generation projects when developing a mutually accepted project schedule in Stage B.

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Table 4.4.3 - Typical Company Milestone Requirements for Customer Projects

ID	Activity Description
Stage A: Preliminary Design Submittal Phase	
1	Customer submits Written Proposal for Load & Technical Requirements (Motor Data, plot plan, proposed single-line diagram, in service date, etc.) and/or Interconnection Application for generators
2	Company determines Service Voltage and Supply System Configuration
3	Company develops Service Plan
Stage B: Design and Procurement Phase	
4	Customer accepts Service Plan and authorizes Company to proceed
5	Company will develop the necessary charges, including any up-front engineering retainer fees. Customer's contribution towards project is received after Company develops cost estimates.
6	Customer submits design documents including specifications and manufacturer's shop drawings. Company concurrence is required prior to purchase of any equipment. Functional Electrical Drawings shall be submitted together as one package, under the design authority of the Engineer of Record
7	Company reviews Customer's design & returns comments
8	Company designs necessary service facilities
9	Customer proposes project schedule with updated in-service date
10	Customer submits Testing and Commissioning Plan
11	Customer submits Energization Plan
Stage C: Construction and Installation Phase	
12	Customer submits final design drawings stamped by Professional Engineer, licensed to practice in the state where the project is being developed. These final design submittals are based on the comments and revisions issued by the Company per Stage B above.
13	Customer procures equipment
14	Customer proposes construction start date
15	Customer installs equipment and submits ground grid and major equipment test results (Transformer, Circuit Breaker, Relaying CT/PT, etc), and any other required submittals
16	Company installs necessary service facilities
17	Customer installs Company's revenue metering transformers, primary connections, secondary conduit, and meter panel
18	Company completes metering installation
19	Customer mounts Company's Telemetering cabinet (where required) and routes input cables
20	Customer provides a contact to coordinate energization with Company
Stage D: Compliance and Verification Testing Phase	
21	Customer provides 6-week advance notice of functional testing, final Testing & Commissioning and Energization Plans (45 days advance notice for generation facility under FERC requirements)
22	Customer's communication circuits (where required) shall be made available from telecommunications service provider.

ID	Activity Description
23	Company verifies metering wiring installation is complete
24	Company and Customer verify end-to-end functionality of telecommunications installations (where required)
25	Third Party Inspection Agency certification or Municipal approval received
26	Customer notifies Company in writing that wiring and relay calibration tests (if not fuses) are satisfactorily completed. This notification shall be accompanied by a copy of the relay test reports and as-left relay settings.
27	Company field audit (walk-through) of Customer's service
28	Company witnesses proper functioning of Customer protective devices (if not fuses)
29	Customer resolves any open items
Stage E: Energization and/or Synchronization Phase	
30	Company's supply system interconnection complete
31	Company review/acceptance of Customer's resolved open items from Stage D (above)
32	Customer/Company hold final pre-energization meeting. Company delivers standard operating instructions and operating diagram for services above 15KV
33	Company arranges necessary supply system switching orders
34	Customer receives authorization for energization
35	Customer completes pre-energization project requirements
36	Company proceeds with energization of supply interconnection
37	Customer's facilities energization completed (In Service) Company verifies billing meter proper operation. Company verifies protection CT's are passing current
Stage F: Project Close-Out Phase	
38	Final as-built drawings delivered to Company within 90 days after energization (120 days after synchronization for generation facility under FERC requirements). As-Built drawings shall be sealed by a Professional Engineer, licensed to practice in the state where the project is being developed.
39	Company reconciles project costs with Customer.

5.0 DETAIL DESIGN SUBMITTAL PROCESS

Stage A: Preliminary Design Submittal Phase

- A written narrative of the project, why it is necessary and what limitations on the Customer or Company's facilities are causing the project to take place
- *For parallel generation applications*, indicate generator type (synchronous, induction, inverter based, etc) and fuel type (biomass, natural gas, wind, solar, hydro, etc.) on Interconnection Application submittal. Reference ESB 756 for full requirements.
- Expected diversified electric demand (kW, kVA)
- Utilization voltage (Volts AC) within the facility
- Power Factor in %
- Load Factor in % with expected usage in kWH/month
- Total HP/kW of all motors/generators connected and starting sequence, if required
- Identify any motor 50HP or greater, and:

  - any generator to be connected (HP/kW, Volts AC).
  - number of starts per day and number of starts per hour for each motor
  - type of motor (induction, synchronous, etc), RPM, Phases, Efficiency, Power Factor, Locked Rotor Current, Nameplate Code Letter
  - type of starting to be implemented for any motor 50HP or greater: across-the-line full voltage, or reduced voltage at percent voltage initial start, or soft start. Specifications for motor starter to determine the limits of inrush mitigation.
- The desired electric in-service date for energization
- The desired electric in-service date for:
  - full demand; and
  - staged incremental demand
- Temporary construction service needs, including:
  - Utilization Voltage (Volts AC)
  - Demand (KW)
  - Date needed
- A proposed single-line diagram of the proposed electric service. The Company reserves the right to determine the main source of protection (i.e. circuit breaker in lieu of fuse) if coordination with the Company's upstream protective device cannot be achieved.
- Site Plan of the proposed service arrangement, to scale.

Stage B: Design and Procurement Phase

The service voltage and the construction type (overhead or underground) have different requirements for the Company's review. The matrix shown in Appendix A describes the specific requirements for each type of service over 600 Volts. The descriptions below provide guidance on the required nature and content of the submittal.

- **Functional Electrical Drawings** which shall consist of the Single Line Drawing, AC Elementary Drawings and DC Elementary Drawings, shall be submitted together as one package, under the design authority of the Engineer of Record. Drawings shall be prepared in conformance with ANSI Y32.2, IEEE 141 and IEEE 446 symbol and drafting nomenclature. Reference ESB 750 Section 1.7.2.1.

  - **Complete Functional Electrical Single Line*** detailing all devices up to, and including, the Customer's secondary bus. Functional Electric Single Line drawing for parallel generator installations shall show the entire system through the electrical generator connection. It shall include: all protective devices including ratings and classes in sufficient detail to show intended operation; all instrument transformers with ratios; power and station service transformers with ratios, kVA, winding configurations, impedances; etc. All Customer interconnection devices, including switches, breakers, fuses, busses and transformers shall be uniformly placarded in accordance with the Company's nomenclature practices. The Company shall assign these device numbers which aid in communications and coordination during switching operations between the Company and the Customer.
  - **Electrical AC ELEMENTARY Drawing* (a.k.a. Three Line Diagram)** including all equipment shown on the functional electrical single line (see above).

- **Electrical DC ELEMENTARY Drawing*** in sufficient detail to show the functional control operation of the Customer's equipment. The D.C. elementary schematic diagram shall show, by means of graphic symbols, all devices having any interaction with the tripping function of the protective devices shown on the functional electrical single line (see above). Relay contacts shall always be shown in the de-energized position. Ladder-type diagrams are not acceptable.

- **Site Plans*** consisting of a large scale drawing with landmarks such as buildings, roads, railroads, environmental concerns, existing Company electrical structures, and the proposed location of the Customer's service facilities. Where the Customer's electric service facilities are located within a building, the building plan shall also be included. Proposed location of the Company's billing meter shall be shown on the site drawings submitted.
- **Electrical Assembly*** consisting of a detailed plan and profile drawing of the substation, switchgear, wooden or steel structures, in sufficient detail to clearly determine electrical clearances and placement of equipment on each of the structures. Where switchgear is proposed, the electrical assembly drawings will include the manufacturer's detailed switchgear assembly drawings with plan and profile details for each cubicle, specific to the proposed installation.
- **Profile Drawings*** consisting of a minimum of two perpendicular cuts of the site plan (see above). Profiles shall be of the substation, switchgear, primary meter pole, or switchgear building, and shall be in sufficient detail to allow for the Company's determination of electrical and working space clearances. Substation fence heights shall be shown in these profiles.
- **Substation Lightning Protection Plan*** which shows the location of lightning protection within the substation and the related method of calculations demonstrating the shielding of the Customer's facilities. Reference ESB 752 for further technical details.
- **Protective Device Coordination Study*** incorporating a summary list of proposed relay settings and/or fuse curves which show coordination with Customer-owned equipment and Company-owned upstream protection devices. (Note: Settings shall not be shown on drawings.) A settings summary sheet shall be provided, along with the specific relay manufacturer's setting file.
- **Structural and Foundation Drawings*** to demonstrate the adequacy of the substation receiving point (take-off structure). The Company will provide the conductor tensions, heights, spacing and angles. These specifications shall be shown on the Customer's drawings.
- **Ground Grid Analysis and Ground Grid Drawing*** in compliance with IEEE 80 and 81, shall include soil resistivity test results and ground grid design for safe step and touch voltages and acceptable ground potential rise. The ground grid design shall identify the target ground grid resistance used as the basis of calculation of the step voltage, touch voltage and GPR. There shall be a separate ground grid drawing, in plan view, to scale, showing the location of ground conductors, ground rods, and connection to above grade metallic structures.
- **Meter, Control Cable, and Power Conduit Drawings*** including location, depth of burial, materials, and routing. These drawings shall be to scale. These drawings shall include (where applicable), handhole and manhole locations and details per the Company's ESB 759B. Note: The Company shall provide and install secondary wiring from the Company's metering transformers to the Company's billing meter in Customer provided and Customer installed raceway as directed by the Company.
- **Control House Layout** in plan view and profile.

  Relay Panel Drawings including test switch designations and locations. This drawing shall depict the front view of the devices as they are to be located on the panel. All devices shall have a nameplate labels, consistent with the three line and DC elementary drawings.

Detailed Manufacturer's Cut Sheets of major components (i.e., breakers, fuses, disconnect switches, transformers, PT/CT's, arresters, etc.) shown on the electrical single line drawing. The Company shall specify which equipment shall be submitted for review.

- **Transformer Manufacturer's Cut Sheets** shall include nameplate, test reports and outline drawings including winding configurations, taps, BIL ratings, impedances, CT test reports, etc.
- **Main Disconnect Switch Manufacturer's Cut Sheets** shall include nameplate, ratings, certifications, conductor tension limits, and ice break capabilities.
- **Circuit Breaker Manufacturer's Cut Sheets** shall include BIL ratings, continuous symmetrical and asymmetrical interrupting ratings, control voltage source, CT test reports, related nameplate data, etc.
- **Circuit Breaker Tripping Energy Source Cut Sheets** shall identify type of energy source used (battery, capacitor, UPS, etc.). The source shall be shown to be adequate to trip the breaker(s) under low voltage and no voltage conditions.
- **Fuse Manufacturer's Cut Sheets** shall include TCC curve number with minimum melt and total clear curves, symmetrical and asymmetrical interrupting ratings, and ratings of the fuse cut-outs.
- **Relay Manufacturer's** full specified model number and firmware version. Relay operating manual may be required if requested by the Company.
- **Generator Manufacturer's Specifications:** shall include nameplate information, a complete set of engine specifications, generator specifications and operating characteristics as well as control system data (for rotating machines), DC input and AC output specifications (including firmware versions) and testing certifications for inverter based systems.

- **Telecommunications:** if required, as determined by the Company, shall include wiring diagrams, equipment drawings, and circuit assignments as coordinated with the Company.
- **Maintenance Plan:** which identifies the specific equipment to be maintained and the maintenance schedule. See the Company's ESB 755 for guidance.
- **Sequence of Operations:** required for all generation related interconnections, and services which involve automatic bus transfer. A written document which explains how automated switching will occur based on planned and unplanned outage events, and the automatic restoration back to original conditions. Correct breaker, bus, transformer, and disconnect nomenclature shall be referenced throughout this procedure, and shall be consistent with the submitted single line drawing.
- **Testing and Commissioning Plan (TCP):** shall include the procedural steps for testing and functional verification of the Customer's relay, breakers, interlocking schemes, and related protection devices. The Company has an interest in witnessing portions of the overall test specific to those devices which interconnect to the Company's EPS. The Company reserves the right to modify the testing procedure as necessary to ensure the integrity of the Company's EPS. The individual relay test plan does not need to be submitted at this time. However, during witness testing (see Section 6.1.3), the Company will require the test plan to be made available, and, the Company reserves the right to modify the test plan as necessary.
- **Energization Plan: Refer to Section 7.3 of this Bulletin for specific details related to the submittal of the Energization Plan prior to energization.**

***** The Company requires these engineered submittals to be sealed by the Customer's retained Design Professional.

The Stage B review typically takes the Company 4 to 6 weeks on average, to complete, **after all required submittals are received by the Company**. The Company's review is an iterative process between the Company and the Customer's Design Professional. The complexity of the design and the high voltage expertise of the Customer's Design Professional can adjust this time frame accordingly. The Company's other project commitments at peak times can also extend the time to complete this review.

The Customer shall submit final for-construction design drawings for acceptance by the Company, per Stage B (above), prior to ordering equipment or starting construction. Reference ESB 750 Section 1.7.2.1.

Stage C: Construction and Installation Phase

Three (3) paper copies and an electronic media file, in pdf format, of the final "Final/For Construction" submittals, shall be furnished to the Company. These "Final/For Construction" submittals shall include all changes from the Stage B review. These submittals shall be sealed by the Customer's retained Design Professional as indicated above in Stage B.

The Company shall schedule various site visits during construction as necessary, depending on the complexity of the project. Typical site visits include, but are not limited to, observation of the initial site preparation, installation of ground grid, equipment bonding, and a final, pre-energization walk-through.

6.0 COMPLIANCE AND VERIFICATION

Stage D: Compliance and Verification Testing Phase

The Company has an interest in maintaining reliability of the Electric Power System to which the Customer is interconnected. To this end, and prior to energization, the Company shall observe and verify that the Customer's facility has been constructed, and is functioning in accordance with the Company-accepted design.

6.1 CUSTOMER NOTIFICATION OF SATISFACTORY COMPLETION OF CONSTRUCTION

Six (6) weeks prior to the Company's field audit, the Interconnection Customer shall provide written documentation of satisfactory construction completion. This shall include the contractor's functional testing schedule and Testing and Commissioning Plan for the protective relay systems.

6.1.1 Required Testing Documentation

The Company will require various test reports prior to the Company's on-site witness testing:

- Transformer Acceptance Test Report based on actual on-site testing
- Relay settings and relay functional testing results (per coordination study accepted by Company)

- CT ratio and saturation test reports
- PT test reports
- Ground grid resistance test
- Circuit breaker acceptance test (where circuit breaker is used as main overcurrent protective device)
- Verification of adequacy of DC battery supply
- A letter, written by the Customer or their assigned agent, indicating the protection and control scheme has been functionally tested in accordance with the Customer's submitted design as accepted by the Company. *Typically, the Customer's assigned relay technician will test the entire control schematic, highlighting the various portions of the control circuits on the drawings as they are tested.* This procedure needs to be completed prior to the Company's witness testing.

6.1.2 Customer's Testing and Commissioning Plan Requirements

The Customer's Testing and Commissioning Plan shall include, but is not limited to:

1. A step-by-step process which proves the operation of the key interconnection protective devices, including relays, breakers, and switches
2. Systems and Components to be "Witness Tested".
   - The injection of analog inputs to the microprocessor relays to actuate the output, and to see the correct device operate. "Jumpering" of input or output contacts will not be accepted as verification of device operation.
   - Verification of phase angles between sources and relay inputs

6.1.3 Relay Witness Testing

The Company, at its own discretion, shall witness the operation of key Customer owned protection devices and schemes to ensure compliance and verification with the design documents previously approved by the Company. The Customer's relay technician shall have the knowledge and appropriate equipment available to work through the Testing and Commissioning Plan (see above) as necessary.

6.1.4 Company's Field Audit

The Company shall make a final walk-through field audit of the substation to confirm the construction of the substation is in substantial conformance with the Company accepted design submittals. The Company will also verify live part clearances, verify final grounding attachments, observe related safety signs and fencing, and ensure the Company has access to the substation or main disconnect device, as a condition of acceptance.

During the Company's Field Audit, the Company shall verify the permanently installed placards on the specific devices, as required by the Company and as outlined by Stage B (see Complete Functional Electrical Single Line). The placards shall be clearly visible to operators.

6.1.5 Electrical Inspection by Code Enforcement Authority

The design and construction of the Customer's substation shall be in accordance with the requirements of the National Electrical Code, unless the Customer is considered a "supply" company, and provides such evidence to the Company of this status. Therefore, the Customer shall provide evidence of an electrical inspection, performed by the Authority Having

Jurisdiction or their assigned agent. The assigned agent, consisting of a third party underwriting agency must be approved within National Grid's electric service territory.

NOTE: The Customer's third party or municipal electrical inspection approval certificate shall be submitted to the Company prior to energization, preferably before or at the time of the Company's on-site field audit of the Customer's station.

6.1.6 Customer Operating Agreement and Company Operating Diagram

National Grid requires a list of 24 hour emergency contacts from the Customer, once their facility is interconnected to the National Grid transmission system. During the operation of the transmission system, National Grid will occasionally need to contact the Customer for information, discussion, switching, or emergency reasons. The Customer shall provide a list of the primary and alternate contact personnel in the order which National Grid should attempt to contact them. The information required is:

1. Name
2. Business Address
3. Business Telephone Number
4. Mobile Telephone Number
5. Home Telephone Number
6. E-mail Address

The Company will issue the Customer Operating Agreement and a Company Operating Diagram specific to the Customer installation. The Operating Agreement will include key Company contact numbers for normal and emergency operation, along with general information for system operations. The Company issued Operating Diagram includes the Customer's 24 hour emergency contact information, per above, which will be on file at the Company's Power Control Center. This information should be updated, as necessary, by the Customer to ensure appropriate Customer contact information is maintained. *Normally, National Grid would not attempt to contact the Customer's representatives at home or after normal business hours unless there is an emergency.*

6.1.7 Company's Right to Operate

The Company reserves the right to operate, and if necessary tag the Customer's main disconnecting device (and generator disconnecting device) as necessary, for the protection of the EPS, the Company's employees and the general public.

7.0 ENERGIZATION AND/OR SYNCHRONIZATION

Stage E: Energization and Synchronization Phase

7.1 PREREQUISITES

Once the Company has determined that all requirements in Stage D, Compliance and Verification have been met, the Company will authorize energization of the Customer's facility in accordance with the accepted Testing and Commissioning Plan and the Company's standard operating procedures.

7.2 AUTHORIZATIONS

The Company's Control Centers require advance notice prior to energization. **Two (2) weeks** advance notice is required when 115kV system interruptions are to be scheduled and typically **one (1) week** for 23kV, 34.5kV, and 46kV systems. **Three (3) business days** advance notice are required for distribution circuits operating less than 15kV.

7.3 ENERGIZATION PLAN

7.3.1 Energization Coordinator

The Customer shall designate an Energization Coordinator, and prepare and submit an Energization Plan to the Company for review and comment.

7.3.2 Energization Plan Development and Execution

1. The Energization Plan is a step by step switching process which identifies the order in which each device will be operated to energize the Customer's facility. The Energization Plan shall comply with the Company's ESB 755 and NESC Section 44. The Energization Plan shall include but not be limited to, such items as:
   - Steps for the removal of grounds and releasing of corresponding clearances;
   - Switching control procedures;
   - Required phasing and synchronization tests; and
   - Load and operational tests required to place the apparatus or systems on line without risk to the electrical infrastructure.
   - Sequence of Operations including steps for all normal and abnormal modes of operation and control.

2. The Energization Plan shall be executed upon meeting the following minimum pre-energization requirements for the Customer's station:
   - The Company requires satisfactory completion of the items listed in Section 5.0 above.
   - The Customer's outdoor substation physical protection shall be in place in accordance with applicable codes and local requirements, i.e., fence, gates, signs, locks, grounding system in accordance with Section 5.1.4 above.
   - The Customer's standard nomenclature will be in place, in the form of tags and/or stickers, for the Customer-owned substation which will be consistent with the operating diagram and operating agreement as listed in Section 5.1.4 above.
   - The Customer and Company shall hold final pre-energization meeting. Company delivers standard operating instructions and operating diagram for services above 15KV during this meeting. The Customer's Energization Coordinator shall be at this meeting.

7.3.3 Synchronization

1. Before generation can be synchronized with the Company's power system, the following shall be satisfactory to the Company:
   - Special equipment as required, for necessary operating control, monitoring, and security on the Company's system, shall be operable per Section 5.0 above.

- The Company's verification testing of the Customer's generation control equipment shall be completed per Section 5.0 above.
- The Company shall verify the relay testing of the designated devices before the generation is permitted to parallel with the Company's system per Section 5.0 above.

8.0 PROJECT CLOSE OUT

Stage F: Project Closeout Phase

As-built documentation is required at the end of the design process. Within 90 days of energization (or within 120 days of synchronization for a generation facility under FERC requirements), the Customer shall submit a full set of the drawings and documents in Stages B and C above, to ensure the Company's operating documents are complete for proper supply system operation. The as-built submittal shall include any deviations from the "Final/For Construction" drawings and shall consist of three (3) full sets of hard copy drawings and documents along with an electronic version per Section 4.4.2, above. Any deviations from the original "Final/For Construction" drawings shall be bubble-clouded for ease of identification. These as-built drawings shall be sealed by the Customer's Design Professional in accordance with the requirements of Section 4.4.4 (Stage B) above.

The Company will reconcile any outstanding charges, either credit or debit, with the Customer as part of this phase.

9.0 PERIODIC VERIFICATION

In addition to the requirements as set forth by National Grid's Electric Service Bulletin 755, "Operation and Maintenance Requirements for Services Above 600 Volts", the following periodic verification requirements are expected:

1. The Company reserves the right to examine the Customer's facility and perform or witness testing of any equipment or devices where both parties have a mutual interest at any time.
2. The Company reserves the right to periodically check the Customer's designated protective devices. A check will consist of a visual/mechanical examination of the designated required devices, seals (where applicable) and associated wiring. Where seals exist and if broken, the protective devices shall be recalibrated, tested and re-sealed by the Company.
3. The Customer or Generator-owner shall maintain an operating log at their facility indicating changes in operating status (available or unavailable generation, maintenance outages, trip indications or other unusual conditions found upon inspection). For generators which are "block-loaded" to a specific kW level, changes in this setting shall also be logged. This log shall be made available to the Company upon request.
4. The Company reserves the right to inspect the Customer or Generator-owner facilities and maintenance records to verify the correct operation of all equipment which affects Company operation and safety.

5. Arrangements shall be provided so that authorized Company employees may have access to the Customer's substation, switching facilities and metering at any time and without delay. See Section 5.1.7.

10.0 REVISION HISTORY

Version	Date	Description of Revision
0.0	1/6/14	DRAFT
1.0	6/3/14	FINAL

APPENDIX A

REQUIRED SUBMITTALS BASED ON PROJECT TYPE AND DELIVERY VOLTAGE

TYPE OF SERVICE	SUBSTATION-SERVICE ABOVE 15KV	PRIMARY METERED SERVICE TO METER POLE 600V-15KV	PRIMARY METERED SERVICE TO SWITCHGEAR 600V-15KV	PARALLEL GENERATOR-SERVICE FROM 600V TO 15KV	PARALLE GENERATOR-SERVICE ABOVE 15KV	NOTES
REFERENCE ESB 750 SUPPLEMENTAL BULLETINS	ESB 752	ESB753	ESB758, 759B	ESB 753,758,756, 759B	ESB 752,756	
COMPLETE FUNCTIONAL ELECTRICAL SINGLE LINE	X	X	X	X	X	
SITE PLANS	X	X	X	X	X	
ELECTRICAL ASSEMBLY	X	X	X	X	X	
PROFILE DRAWINGS	X	X	X	X	X	
SUBSTATION LIGHTNING PROTECTION PLANS	X				X	1
PROTECTIVE DEVICE COORDINATION STUDY	X	X	X	X	X	
AC ELEMENTARY (THREE LINE) DRAWINGS	X	X	X	X	X	
DC ELEMENTARY DRAWINGS	X	X	X	X	X	2
STRUCTURAL DETAILS	X				X	3
GROUND GRID ANALYSIS	X				X	
METER, CONTROL CABLE AND POWER CONDUIT DRAWINGS	X		X	X	X	
CONTROL HOUSE LAYOUT	X				X	4
RELAY PANEL DRAWINGS	X		X	X	X	
DETAILED MANUFACTURER'S CUT SHEETS	X	X	X	X	X	
TELECOMMUNICATIONS	X			X	X	5
MAINTENANCE PLAN	X	X	X	X	X	
SEQUENCE OF OPERATIONS	X			X	X	5
TESTING AND COMMISSIONING PLAN	X		X	X	X	5
ENERGIZATION PLAN	X			X	X	5

NOTES:

GENERAL: ANY ADDITIONAL SUBMITTALS MAY BE REQUIRED BY THE COMPANY AS NECESSARY. THIS MATRIX PROVIDES ONLY GENERAL GUIDANCE BASED ON TYPICAL PROJECTS.

1. ONLY REQUIRED FOR OPEN AIR INSTALLATIONS WHERE CONDUCTORS OR TERMINATIONS ARE DIRECTLY EXPOSED TO LIGHTNING STRIKES

2. IF MAIN AND SECONDARY PROTECTIVE DEVICES ARE FUSES, THERE IS NO NEED FOR DC ELEMENTARY DRAWINGS. IF EITHER MAIN OR SECONDARY PROTECTIVE DEVICE IS A CIRCUIT BREAKER, OR IF THE GENERATOR PROTECTION INCLUDES A CIRCUIT BREAKER, A DC ELEMENTARY DRAWING(S) IS REQUIRED.

3. UNLESS OTHERWISE REQUESTED BY THE COMPANY AT THE COMPANY'S DISCRETION

4. WHERE CONTROL HOUSE IS PROVIDED

5. AS SPECIFICALLY REQUIRED BY COMPANY

SUPPLEMENT TO

SPECIFICATIONS FOR

ELECTRICAL INSTALLATIONS

SERVICE ABOVE 15,000 VOLTS

ELECTRIC SYSTEM BULLETIN No. 752

OCTOBER 1994, 2ND PRINTING APRIL 2002

(Supersedes issue dated June 1985 and incorporates Nov. 1999 Errata List)

Niagara Mohawk
A National Grid Company

TABLE OF CONTENTS

Section **Page**

TABLE OF CONTENTS (cont'd)

Figures

Illustrations

I. INTRODUCTION

A. PURPOSE

1. This Supplement to **Electrical System Bulletin (ESB) #750** provides general requirements and recommendations for a Customer who is or will be supplied by a Niagara Mohawk, a National Grid Company (Company) designated voltage in excess of 15,000 volts.

2. Additional information specific to the particular installation will be furnished upon determination of the station arrangement and station location as mutually agreed upon by the Customer and the Company.

3. **It is important that the Customer and their engineer or contractor obtain and refer to the Specifications for Electrical Installations booklet (ESB #750, latest revision) in conjunction with this supplement.**

B. SCOPE

1. These requirements are a guide to the Customer in making electrical installations where the Company designates service voltage above 15,000 volts. The proper application of this guide will provide satisfactory service compatible with the electrical supply to others served by the Company System.

2. These requirements do not cover the Customer's complete electrical installation design, but concern only those points in which the Customer, architect, their consulting engineer, electrical contractor, and the Company have a mutual interest.

3. The Company furnishes the incoming line either overhead or underground to the Customer's electric station.

4. The Customer furnishes the complete electric station.

C. CUSTOMER'S RESPONSIBILITY

1. The Customer shall obtain building permits and/or zoning variances as required for construction.

2. The Customer shall be responsible to ensure that provisions are included in any station design for possible future expansion to accommodate additional Company interconnections, additional Customer interconnections or leads, and additional breaker, transformer or switching capability.

3. The Customer shall be responsible to have all electrical and physical design documents prepared by a design professional, in accordance with Section 1.7 of ESB 750, and as further detailed later in Section I.G of this bulletin.

D. COOPERATION

1. For a specific electric service installation, it is essential that the Company meet with the Customer, their consulting engineer, contractor or equipment manufacturer to mutually establish the arrangement and location of the proposed facilities. As a result of this meeting,

   a. The Customer will provide the Company with a single line diagram and station location plan.

   b. The Company will designate the supply voltage and provide available fault values to the Customer.

2. If the Customer makes changes in the design or scheduling of the project, then any previous specific information furnished by the Company shall be subject to review and possible change by the Company.

3. The information the Customer or their contractor furnishes to the Company in regard to the Customer's proposed electrical installation shall be in **writing**.

4. The complexity of modern electrical installations makes it essential that there be continuous close cooperation between all parties involved.

5. It is the Company's desire to assist the Customer in understanding details of their electric service installation. When the information is not in this booklet, the Company invites inquiries from the Customer, their consulting engineer, their electrical contractor or their equipment manufacturer.

6. The Company's Consumer Relations Department will advise the Customer concerning any contribution which may be required of them for materials supplied and work performed by the Company.

E. CODES, STANDARDS AND WIRING ADEQUACY

1. The Customer's electric service equipment and its installation shall conform to the requirements of the latest edition of the National Electrical Safety Code, National Electrical Code (where Applicable), and all governmental ordinances, building codes and Company requirements and specifications.

2. Components shall conform to the latest editions of the following national standards and codes:

Component	Applicable National Standard
Cable	ICEA
Power Switchgear	ANSI C37
Power and Instrument Transformers	ANSI C57
Lightning Arresters	ANSI C62
Insulators	ANSI C29
Apparatus Bushings	ANSI C76
Grounding	IEEE 80

3. The Customer, their engineer, contractor and supplier should aim to provide a modern, adequate electrical installation with ample provision for future needs.

4. IEEE Standard No. 1109 "Guide for the Interconnection of User-owned Substations to Electric Utilities" is a publication that could be helpful.

F. INSPECTION

1. To protect the Customer's interest, as well as its own, the Company requires the Customer to furnish satisfactory evidence from the local authority having jurisdiction as to the safe condition of their entire electrical installation before energizing the service to a new installation or re-energizing a service that has been disconnected for more than twelve (12) months.

2. This may be in the form of an approval or certificate from the New York Board of Fire Underwriters, Factory Insurance Association, Factory Mutual Fire Insurance Company or other inspection organizations acceptable to the Company.

3. Catastrophic occurrences such as fire, flood, etc. shall require a new certificate as to the safe condition of the entire electrical installation before re-energizing.

4. Application for inspection should be made before the work is started.

5. When significant station alterations are made, a new approval or certificate is required to assure compliance with safety requirements.

G. COMPLIANCE

1. **THE CUSTOMER SHALL SUBMIT THEIR PLANS AND SPECIFICATIONS TO THE COMPANY BEFORE ORDERING EQUIPMENT OR STARTING WORK** to insure that the proposed design for the electric service installation conforms to Company requirements.

2. Before an order is placed for electrical equipment, three copies of the Customer's or manufacturer's specifications shall be furnished to the Company for review and acceptance.

3. Review and acceptance by the Company shall not be construed to be a certification of the Customer's facilities. The Customer must obtain approval from a certified inspection agency.

4. Required Documents and Submission Process

The required delivery of the design documents shall be as described in submittal stages "a" through "d" below. Drawings shall be originals prepared by the Customer's retained design professional and comprehensively detail the design of the electrical facility on a single sheet to permit full interpretation and understanding of all aspects. The drawings shall be prepared in conformance with ANSI Y32.2, IEEE 141 and IEEE 446 symbol and drafting nomenclature. All devices specified shall be of power utility grade and not industrial grade.

In order to speed and efficiently facilitate review, no portion of a submission should be sent until every element of the package is complete, final and deliverable in a single package in any of the following stages. Unless otherwise requested and at the sole discretion of the Company, no individual document, or partial design, of a submission will be accepted for Company review until the Customer has declared that the package is complete. In all instances, six (6) complete sets of design documents shall be submitted for Company review and acceptance.

a. PRELIMINARY SUBMITTAL

- Plot plan
- Functional single line diagram with proposed ratings of disconnecting devices, over current protection, transformer size and impedance.

b. DETAILED ELECTRICAL DESIGN SUBMITTAL

- Complete functional single line detailing all devices up to, and including, the Customer's secondary protective device. It should include: all protective relays in sufficient detail to show intended operation; all instrument transformers with ratios, including excitation curves; power and station service transformers with ratios; etc.
- List of proposed relay settings based on a formal relay coordination study. Settings shall not be shown on drawings.
- Electrical AC ELEMENTARY in sufficient detail to show the functional control operation of the station. The elementary schematic diagram shall be in three-line format and show, by means of graphic symbols, all devices

having any interaction with the tripping function of the main protective device. Specifically, it shall include all individual items of equipment, devices within the equipment, their coils, contacts, windows, terminals, AC source, and each connection (wire, cable or bus) between equipment and devices.

- Electrical DC ELEMENTARY, if required by protective device, in sufficient detail to show the functional control operation of the station. The D.C. elementary schematic diagram shall show, by means of graphic symbols, all devices having any interaction with the tripping function of the main protective device. Specifically, it shall include all individual items of equipment including batteries, battery charger, devices within the equipment, their coils, contacts, windows, terminals, and each connection (wire, cable or bus) between equipment and devices. (Note – Ladder-type diagrams are <u>not</u> acceptable.)
- Structural detail and foundation drawings of the high voltage receiving point.
- Assembly plan and elevation details of the high voltage station and its safety structures including grounding plans.
- Meter conduit drawings
- Control house layout
- Relay panel drawings
- Material lists of major components
- Transformer nameplate and outline drawings
- Main disconnect switch nameplate, showing ratings and certifications
- Equipment specifications for lightning arresters; power fuses; main high voltage interrupter or breaker; main disconnect switch; switchgear; power transformer

c. FINAL, FOR-CONSTRUCTION SUBMITTAL

A complete set of all drawings and equipment specifications outlined above, marked final/for construction. Also, at this time the manufacturer's test reports for the power transformer and circuit breaker or high voltage interrupter shall be submitted. This is the end of the design process. The full set of design professional sealed final documents shall then be submitted with the service application for review in total by the Company.

d. FINAL, AS-BUILT IN FIELD SUBMITTAL

Once construction is complete and the service energized, a full set of the drawings in item c above shall be submitted within 90 days. They shall accurately document the as-built status of the project, including any deviation from the final for-construction design drawings, and again be sealed by the Customer's design professional.

5. Proposed location and arrangement of Company metering equipment shall be shown on drawings submitted.

6. Relay diagrams shall always show relay contacts in the de-energized position.

7. The Company will issue written instructions on operating procedures for the Customer's service equipment directly involved with the Company's system. These instructions shall be followed in all operations involving the Customer's service equipment.

8. The following conditions are to be performed and/or maintained by the Customer's contractor while working in the vicinity of the Company's overhead lines. This list shall be noted on the Customer's design drawings and posted at the work site.

   a. No personnel or equipment or combination thereof shall come closer than the following distances to any energized conductor: (From New York State High Voltage Proximity Act - 1989.)

600V ≤ 50kV	**>50kV≤115kV**	**230kV**	**345kV**
10 ft.	15 ft.	17 ft.	20 ft.

   b. Equipment which is operated in the direct vicinity of the overhead lines shall be effectively grounded.

   c. Equipment which has the capability of extending within the wire clear zone established above shall have a warning sign attached identifying the potential hazard.

   d. No equipment utilized in site preparation grading, etc. shall be operated within ten (10) feet of any electric line supporting structure.

   e. There shall be no changes in grade within the Company's Right-of-Way unless approved by the Company.

   f. There shall be no excavation under the overhead lines within 15 feet of the nearest wood member or guy anchor and/or 25 feet of the nearest steel member of an electric line supporting structure.

   g. All spoil not used to backfill the excavation shall be removed from the Company's Right-of-Way.

   h. There shall be no blasting on the Company's Right-of-Way.

   i. The site preparation procedures shall include no activities which cause material to flow off of the Company's Right-of Way.

   j. No activities shall be permitted which compromise the electrical or structural integrity of the overhead electric facilities.

   k. No activities shall be permitted which prevent or inhibit the Company from exercising reasonable ingress and egress along the Company's Right-of-Way.

   l. The Company reserves the right to review and inspect for its purposes any construction drawings, specifications, and activities being carried on within the Company's Right-of-Way.

9. See Figures 1-4 for required electrical installation clearances.

10. The Company reserves the right to review and inspect the installation as it progresses.

11. An authorized representative of the Company will examine the Customer's installation before it is energized to insure compliance with these specifications.

II. DEFINITIONS

Note: Definitions as used in this specification are provided in the **"Specifications for Electrical Installations" book (ESB#750), Section 2**.

III. GENERAL

A. ACCESS

1. Arrangements shall be provided so that authorized Company employees may have access to the Customer's substation, switching facilities and metering at any time and without delay.

2. A suitable driveway shall be provided by the Customer to permit truck or maintenance vehicle access to the station area. This driveway should be adequate to handle a crane and lowboy truck, if necessary, without additional work.

IV. SERVICE CONNECTIONS

A. GENERAL

1. The Customer shall provide a suitable receiving structure for attachment of the Company's line, this attachment is the defined "service point."

2. The Company will provide a cable to flat terminal connector to connect the Company's line to the Customer's equipment.

3. Service voltages above 15kV are unregulated. Voltage excursions of ±10% are possible. The Customer shall consider the installation of their own voltage regulation equipment if necessary.

4. The Customer shall consult with the Company regarding right-of-way easements required between the Company's line and the Customer's station.

B. OVERHEAD SERVICE CONNECTIONS

1. The Company will provide the incoming line dead end clamps, insulators, and clevises for attachment of the Company's overhead line to the Customer's structure.

2. The Customer shall provide a suitable structural member for attachment of the Company's hardware. This structural member shall have a hot dipped galvanized steel dead-end tee bracket mounted at each incoming conductor attachment point. This bracket shall have 13/16" mounting holes on 6" centers and the tab shall have a 1" diameter hole with no less than 1-½" of material from the edge of the hole to the edge of the tab.

C. UNDERGROUND SERVICE CONNECTIONS

1. The Company will provide the incoming cable and terminations for attachment of the Company's underground line to the Customer's equipment.

D. PHASE DESIGNATION

1. Phase Designation and Sequence

   a. All the Company service circuits have the line leads designated with the phase numbers 1, 2 and 3.

   b. The Company will identify the phase number for each conductor at the point of connection of the service circuit to the Customer's equipment; the Customer shall mark their equipment accordingly.

c. The phase sequence is 1-2-3 and rotation is counter-clockwise.

E. CONDUIT

1. Any conduit required for control circuits, metering circuits or power circuits shall be furnished, installed, owned and maintained by the Customer. It shall be installed at the following minimum depths:

Control circuits	- 18"
Metering circuits	- 18"
Power circuits below 600 V	- 18"
Power circuits above 600 V	- 30"

2. The conduit layout shall be approved by the Company before installation.

3. The installation of spare conduits is recommended.

4. Frost effects shall be taken into consideration when designing underground conduit layouts.

V. CUSTOMER SERVICE EQUIPMENT

A. STATION REQUIREMENTS

1. Electrical Short Circuit Capability

The station equipment shall be suitable for the maximum fault current available at its supply terminals. The Company will provide the expected fault values available less the Customer contribution. Consideration for future system or load growth may require initial installation of service equipment having a larger interrupting rating.

2. Structural Design

a. Clearances:

(1) Standard electrical clearances shall be maintained, see Figures 1, 2, 3 and 4.

(2) Appropriate normal and minimal electrical clearances from energized parts above walkways, roads, and railroads and in other special circumstances are specified in the latest editions of ANSI C2 and IEEE Std. 1119.

(3) All clearances shall conform to state and local codes and ordinances.

b. Line Tensions:

(1) The structures shall be designed to withstand the conductor tensions specified by the Company without exceeding the stresses specified in the latest NEMA Standard SG-6 or latest superseding publication.

(2) Minimum tensions, spacings and heights for the service conductor attachments will be provided by the Company for each installation.

3. Structural Materials

a. It is recommended that the substation structure be constructed of galvanized structural steel conforming to NEMA and ANSI Standards.

b. Structures of other materials may be accepted if adequately designed.

4. Foundation

a. Foundation piers for the substation structure shall extend below the frost line and shall withstand the overturning moment resulting from the specified

conductor tension and wind loads.

b. Foundations for transformers and other apparatus may be of the slab type resting on 12" of #2 crushed stone. Soil pressures appropriate to the soil conditions in the station area shall be used in designing foundations.

5. Oil filled Equipment

a. Spacing of oil filled equipment - the Customer should use NFPA 850 as a guide and consult their insurance carrier for separation requirements.

b. Oil Containment

(1) The station must be designed and installed to comply with Title 40, Code of Federal Regulations, Part 112 "Oil Pollution Prevention" (40CFR112).

(2) Compliance to 40CFR 112 shall be verified in writing by the Customer's engineer from transformer design data and design data for any other oil-filled electrical equipment at the station facility.

c. For further guidance on fire prevention and oil-spill containment, see IEEE Std. 979 and IEEE Std. 980.

6. Grading

a. The rough grade of the substation site should have a minimum slope of 1" in 10', sloped toward drainage ditches or tile designed to carry the runoff of surface water.

b. The design should insure a dry surface throughout the substation area.

7. Surfacing

The area of the substation, including 3' outside of the fence, should be surfaced with at least 6" of #2 crushed stone.

8. Insulators and Connections

a. All power connections shall be adequately supported to resist the mechanical stresses including those imposed by short circuit current equal to the interrupting current rating of the circuit protective means.

b. Where, because of atmospheric contamination or for other reasons, the Customer's station switch insulators or bushings are rated for voltage higher than actually supplied, appropriate coordinating gaps shall be installed.

9. Station Fence or Wall

a. At a minimum, outdoor installations shall be protected by an 8' high (minimum) grounded wire mesh fence. This fence shall consist of at least 7' high wire fabric of at least #9 gauge galvanized wire, 2" mesh, topped by 3 strands of barbed wire; and such gates, removable sections, etc. as necessary.

b. Other fence materials or walls may be substituted where approved by the Company.

c. All gates shall be provided with hasps with provisions for Customer and Company padlocks so that only authorized persons have access into the fenced area. Refer to Figure #3 for safety clearance to fence.

10. Signs

a. The Customer shall provide signs, 12" x 17", installed on the outer sides of the station fence with maximum of 50 feet apart or minimum of one on each side and rear of fenced area, all personnel and vehicle gates, and on all entry doors to station control rooms, each sign reading in large legible letters, "DANGER - High Voltage Within - Keep Out – Access Restricted to Qualified Persons Only".

b. In addition, there shall be a 20" x 28" sign mounted on the fence gate which reads, "DANGER, Private Property, No Trespassing".

11. Illumination

a. The Customer shall provide suitable illumination for the substation area.

b. Appropriate minimum lighting levels for various circumstances of indoor, outdoor, and roadway areas are given in the latest editions of NFPA 70 and ANSI C2.

c. Emergency lighting shall be provided in attended areas in accordance with local codes and regulations.

12. Lightning Masts

a. The substation structure shall be equipped with suitable lightning masts providing the necessary cone of protection. The "rolling sphere" method is acceptable for shielding against direct lightning strokes using a 250 ft. radius sphere.

b. Other lightning protection measures may include:

shield wires, arrays, arresters, higher BIL levels, etc. However, overhead ground wires are not to be used over station equipment.

c. For more information on direct stroke lightning protection, see NFPA 780.

B. SWITCHES & SWITCHGEAR

1. Disconnecting Switches

a. One vertical break disconnecting switch shall be provided for each service circuit at the point where the service circuit attaches to or enters the Customer's station.

b. This switch shall be three pole, single throw, gang operated.

c. The switch shall be in accordance with ANSI Standard C37 for Power Switching Equipment, NEMA and UL guidelines.

Note: The ice test shall pass for 1/2" ice loading, NESC Heavy.

d. The switch mechanism may be manually or electrically operated.

e. This mechanism shall be provided with a means for locking in both open and closed position.

f. The operating handle shall be grounded and connected to a potential equalizing grid.

g. It is recommended that where the station arrangement makes it practical, the

switch operating mechanism should be interlocked with the circuit breaker or fault interrupter so that the switch will not be used to interrupt load current.

h. Where the switch may be used to interrupt transformer magnetizing current, a load break switch may be required.

i. For outdoor installations, this switch shall be horizontally upright mounted.

(1) The switch should be a vertical break rotating insulator type with three insulator stacks per pole.

(2) The switch shall be complete with arcing horns.

(3) All non current carrying metal parts should be either hot-dipped galvanized steel or corrosion resistant material of adequate strength.

(4) Other types of switches may be acceptable with prior Company approval.

j. Insulators shall be of the porcelain (ceramic) type; other types may be acceptable with prior Company approval.

k. After installation and before being energized, the switch must be thoroughly operationally tested in accordance with manufacturer's instructions.

2. Construction of the switchgear control building shall conform to National Fire Protection Association (NFPA), U.L., and all local fire codes.

3. Panic Hardware

a. Doors to switchgear rooms or walk-in metal clad switchgear shall be equipped with panic hardware.

b. The lock preventing access to these rooms shall not prevent egress.

C. LIGHTNING ARRESTERS

1. Recommended lightning arrester voltage rating in kV MCOV and type will be provided by the Company.

2. Lightning arresters should normally be connected on the load side of the service disconnecting switch.

3. Where lightning arresters must be connected on the supply side of the service disconnecting switch, each arrester shall be provided with a separate isolating switch.

4. Lightning arresters shall be mounted so that their bases are a minimum of 8'-6" above grade or floor level; otherwise, a suitable guard fence or metal enclosure shall be provided around them.

D. FAULT PROTECTION EQUIPMENT

1. Fault protection equipment shall be designed for the maximum voltage rating of the service and shall be capable of interrupting the maximum short circuit current available from the system to isolate a short circuit from the supply, see Figure 2.

2. Circuit interrupting devices containing flammable materials shall be adequately segregated from other equipment and buildings to limit damage in the event of an explosion or fire, see ANSI C2 NESC.

3. Power Fuses

a. Where fuses are applicable for protection of service installations and are desired

by the Customer, their rating and time-current characteristics will be specified by the Company to coordinate with the supply system protective equipment.

b. Substitution of any fuse, other than that specified, must have Company approval.

c. The Customer should maintain a stock of at least four spare fuses, a spare set of fuse clips, and fuse or switch operating poles as required; all in an accessible dry storage space.

4. Circuit Breakers

a. Circuit breakers used in service installations shall be three pole and of a rating acceptable to the Company.

b. Breakers may be oil or oil-less type (such as vacuum or SF_6 (Sulfur Hexafluoride) gas-insulated).

c. Breakers shall be in accordance with latest ANSI Standard C37 for Power Circuit Breakers.

d. It is recommended that circuit breakers be tripped by direct current supplied from a battery.

(1) Such a battery shall be rated not less than 48 volts, with ampere hour capacity suitable for the application.

(2) Facilities shall be provided to maintain the battery in a fully charged condition.

(3) Capacitor trip devices are not acceptable.

e. The Customer's circuit breaker source side bushings shall be equipped with current transformers having characteristics as specified by the Company to supply protective relays associated with the circuit breaker. Potential transformers may also be required. Relay data and transformer ratios shall be marked on the single line diagram.

f. The use of bypass switches around protective devices is not permitted.

Note: Using a transfer breaker and transfer bus can avoid this concern.

5. High Voltage Fault Interrupter

a. In locations where system conditions would normally require installation of a circuit breaker, the use of other types of fault interrupters may be approved by the Company.

b. The fault interrupter shall be furnished with a control pack approved by the Company. The motor and control voltage shall not be less than 48 volt D-C.

c. Where a fault interrupter is provided, the source side bushing of each phase of the Customer's power transformer shall be equipped with current transformers.

(1) These current transformers shall be the source for the relays which will actuate tripping of the fault interrupter.

(2) The relay data and current transformer ratio shall be marked on the single line diagram.

d. Where a fault interrupter is provided, a remotely located Company line circuit breaker will normally interrupt faults in excess of the fault interrupter rating.

e. The Customer, in selecting this type of protection, runs the sole risk and responsibility for damage to their own equipment as would be the case if they supplied their own main circuit breaker.

E. POWER TRANSFORMERS

1. Specification

Power transformer specifications shall be mutually agreed upon by the Customer and Company in accordance with nationally accepted standards.

2. Voltage Regulation

a. Voltage taps should be specified to best deliver the rated low voltage over the range or normal system operating voltages.

b. The Customer should consider the use of regulators or transformers with load tap changing equipment if critical voltage control is required for their facility.

3. Grounding

a. It is the Customer's responsibility to specify the method for grounding the transformer secondary neutral, i.e. - solidly grounded, resistance grounded, impedance grounded, or ungrounded.

b. The Customer shall furnish, install, own and maintain any grounding equipment.

4. Bushing Connections

a. Connections to power transformers shall be non-rigid to guard against undue thermal or mechanical stress on transformer bushings.

b. Adequate cable support is required to prevent undue stress on the transformer bushings.

5. Current Transformers

a. For test purposes to pass current, current transformers in the Customer's power transformer neutral circuit shall be externally mounted. This applies to the neutral only.

b. Neutral current transformers shall be located on the transformer side of the resistors or reactors etc., and shall be rated for full line-to-neutral voltage.

F. PROTECTIVE RELAYS AND COORDINATION

1. The Customer or their authorized representative shall be responsible for the proper installation, adjustment and operation of protective relays and switchgear including periodic test procedures, as outlined in NFPA 70B - Electrical Equipment Maintenance, to maintain proper operation of service entrance equipment.

2. The Company may require some of these tests to be performed by Company personnel to insure coordination with the electrical supply system.

3. The Company will seal the designated relay devices listed on the Company-supplied relay setting sheets, verify accuracy of associated circuit wiring, and perform a functional test of the required interrupting devices, i.e. trip test.

4. Periodically, the Company will check the Company designated relay devices. The check will consist of a visual/mechanical examination of the designated required relay devices, seals and associated wiring. If seals are broken, the protective devices shall be recalibrated, tested and re-sealed. Cost of corrections will be borne by the

Customer.

5. The Customer is responsible for specifying the relay settings and performing the calibration, testing, maintenance and trouble-shooting of the remainder of the Customer-owned protective system.

6. Phase Designation Coordination

   a. Coordination of the Customer's low voltage phase designation with that of the high voltage service circuit phase designation shall not be overlooked.

   b. Customer's installation layouts shall provide phase designations fully coordinated between high voltage and low voltage equipment.

   c. The Company will assist the Customer to this end, providing the Company receives composite wiring diagrams from the high voltage service circuits to the low voltage load circuits.

   d. Phase designation coordination will facilitate checking of protective relay wiring, testing of relays, and proper installation and operation of all the Customer's electrical facilities.

   e. Isolated, fragmented and individual wiring diagrams for units of the Customer's installation are not sufficient for checking phase arrangement.

7. Specific Relays

   a. The Company's minimum requirements and recommendations for protective relay facilities for a specific electric service installation will be provided upon submission of the single line diagram.

   b. If during the course of a project, changes and additions to the single line diagram are identified, then such changes and additions shall be submitted to the Company on a revised single line diagram for the Company's approval prior to implementation or purchase of equipment.

8. Location of Relays

   a. All relays for the Customer's service installation whose operation could affect the Company's facilities should be readily accessible to authorized personnel of both the Customer and the Company.

   b. Relays should be located so as to be free of dust, dirt, dampness and corrosive atmosphere.

9. Relay Test Facilities

   a. All protective relay connections shall be provided with suitable test points to facilitate initial, as well as periodic check and calibration.

   b. Lockout auxiliary relays shall be provided with test devices. Draw-out case design relays with built-in test facilities are recommended. If separate test devices are used, they shall be General Electric type PK-2 or ABB (Westinghouse) FT-1 test blocks with the wiring between the test block and the relay in accordance with Company standards. Information on these standards will be provided when requested by the Customer.

   c. A 120/240 volt, 50 ampere, single phase, three wire, NEMA 10-50, convenience receptacle (Hubbell #7963), or equal, located near the relay panel, shall be provided for relay testing purposes.

d. Where three phase relaying and/or metering will be installed, a three phase 100A, 208Y/120V source is required.

10. Control Wiring

a. DC control wiring in locations subject to dampness, for individual conductors, shall be ICEA Class "B", 600 volt rated.

b. All multiple conductor control cables shall be ICEA Class "C", 600 volts with jacket thickness as specified by ICEA.

c. Cable systems required to interconnect protective relaying, metering, instrumentation, control, communications, and low-voltage power equipment systems should be in conformance with IEEE Std. 525.

d. Supervisory Control - Customers who wish to use Supervisory Control and Data Acquisition (SCADA) systems shall follow the guidelines set forth in ANSI/IEEE Std. C37.1.

11. Exclusion of Current Transformer Selector Switches

a. Meter selector switches or meters shall not be connected into the secondary circuits of current transformers used with protective relays specified by the Company.

b. If separate metering current transformers cannot be provided, the metering must be isolated by suitable saturating auxiliary current transformers.

G. OPERATION AND MAINTENANCE REQUIREMENTS

The following is in the mutual interest of the Company and the Customer where the Customer's service equipment is directly involved with the Company's System.

1. General Requirements

a. The switching protocol procedure for the mutual interest of the Company and the Customer will be provided by the Company based on the following information from the Customer:

- Contact personnel and telephone numbers and
- Single-line diagram from Section I.G above of the Customer’s primary and secondary equipment directly involved with the Company’s system.

b. The Customer is responsible for maintaining this information up-to-date and notifying the Company of any changes.

c. All switching within the Customer's service equipment above 15 kV, shall be in accordance with Company provided customer operating instructions. The Customer is responsible for developing operating instructions for the balance of their electrical system.

d. The Company can provide isolation and grounding guarantees at the Customer's service disconnect or Company isolation point on the supply line ahead of the Customer's service equipment. However, the Customer is responsible for their grounding provisions to work on their de-energized equipment.

e. The Customer shall operate within established Company mark up rules in any switching operations with the Company for their equipment that both the Company and the Customer have a mutual interest. It is expected the Customer

will provide a qualified person as defined in the National Electrical Code and any other applicable codes.

f. The Customer must recognize and abide by the Company's mark up rules. The Customer shall conduct their switching based on their switching practices insuring that the Company's mark up is not jeopardized or modified.

g. References to minimum customer requirements for maintenance, operating, and safety of their high voltage installation include but are not limited to:

- NFPA 70B "Recommended Practice for Electrical Equipment Maintenance"
- NETA-MTS "Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems"
- NFPA 70E "Electrical Safety Requirements for Employee Workplaces"
- IEEE/ANSI C2 "National Electrical Safety Code"
- OSHA 29 CFR 1910.269

2. Specific Requirements

a. Service Personnel and Safety:

- The Customer is responsible for performing all switching and O&M functions for their equipment.
- The Customer shall arrange to have qualified personnel available at all times for the proper and safe operation of their equipment.
- "Qualified Personnel" training shall cover correct operating and safety procedures including, but not limited to:

  distinguishing exposed live parts,

  determining the nominal voltage of exposed live parts,

  determining of the minimum approach distance, and

  the use of precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools for working on or near exposed live parts of electrical equipment.

b. The Company does not provide any operating tools for the Customer's use. The Customer shall provide their own operating equipment such as tongs, insulating switching sticks, insulated rubber gloves, grounds, ground bails, studs and grounding sticks; voltage detection equipment, etc. needed for the safe performance of operating functions. This operating equipment shall be properly maintained and tested according to the manufacturer's instructions.

c. Line terminations and the metering transformer compartments of the Customer's switchgear will be locked by the Company when the Company's work is completed and marked clear with the Controller.

3. Switching

a. All switching or other work on high voltage circuits shall be performed by qualified personnel fully equipped with safety equipment tested for the circuit voltage involved.

b. All Company directed switching within the Customer's station shall be done in accordance with Company-provided switching instructions.

c. The Company will provide nomenclature for Customer's labeling of the main disconnect switch and other electrical equipment referred to in the Company's switching instructions. The Customer shall make provisions for the labeling of this equipment and any necessary mark-up tag holder.

d. Tags shall be used to prohibit operation of electrical devices and shall indicate that employees are at work. Equipment shall be locked and rendered inoperable by locking and tagging unless its design does not so permit. Tags alone may be used when the equipment can not be rendered inoperable by locking.

e. NO WORK SHALL BE DONE ON AN AIR BREAK SWITCH WHILE THE INCOMING LINE IS ENERGIZED.

(1) Notify the Company and arrange for an interruption and a guarantee before doing any work at or near this section. Also, if requested, a grounding guarantee may also be requested.

(2) THE MAIN DISCONNECTING SWITCH SHALL BE LOCKED OPEN PRIOR TO CHANGING FUSES OR WORKING ON HIGH VOLTAGE EQUIPMENT.

(3) THE SAFETY PRECAUTIONS outlined in the NESC ANSI C2, OSHA and local requirements shall be strictly adhered to. The Customer shall ensure the circuit/equipment has been tested as deenergized and grounded prior to work.

4. Maintenance

a. The Customer is responsible for maintaining all equipment under their ownership.

b. Proper preventative maintenance is important to the operation of the equipment and shall be performed.

c. NFPA Standard No. 70B on "Electrical Equipment Maintenance" and NETA-MTS "Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems" are two publications that could be helpful in setting up a dynamic maintenance program. Copies of test records of major station equipment and protective devices that both the Company and the Customer have a mutual interest in shall be maintained on the premise and be made available to the Company upon request, e.g. breaker, transformer, outdoor switches, and relay devices.

d. The Company does not provide any spare parts for the Customer's installation. The Customer should determine their inventory of spare parts for circuit breakers, fault interrupters, switchgear, and other electrical equipment essential to minimize their interruption time.

e. Customer access to Company controlled electrical spaces within Customer-owned electric facilities:

The Company's control of electric spaces in Customer-owned electric facilities is for the sole purpose of protecting the integrity of the Company's energy supply and security of the utility metering equipment. Any costs shall be

determined by the Company's filed tariff. In these requirements, "Customer" refers to the Customer or their agent. Under this and all other policies, it is expected and it is the Customer's responsibility to provide a qualified person as defined in the National Electrical Code and any other applicable codes.

(1) The Company can provide isolation and grounding guarantees at the Customer's service disconnect or Company isolation point on the supply line ahead of the Customer's service equipment. However, the Customer is responsible for their grounding provisions to work on their de-energized equipment.

(2) When the Customer does not require a guarantee on the supply line and needs access to Company-controlled electrical spaces for their maintenance purposes, the Company in its sole judgment may determine the ability to grant access to the Customer for the duration established by the Company. When granted, the Company will witness the Customer's placement of their lock immediately after the removal of the Company's lock. Upon notification by the Customer that their work is complete, the Customer shall relinquish access back to the Company and the Company's lock shall be placed immediately upon the removal of the Customer's lock. In each case the transfer shall occur in the presence of both parties. The Company will check it's electrical equipment for any signs of tampering.

In the event that the required access is of short duration and the Company's representative remains on site, to avoid a second trip, it is understood they are doing so without any supervisory or oversight capacity relative to the Customer.

VI. GROUNDING

A. GROUND GRID

1. Normally, the substation ground grid design should conform to the requirements of IEEE Std. 80.

2. The ground grid shall not be closer than 25 feet from any buried fuel lines. However, some instances may require greater distances. Consult the Company whenever buried fuel lines are in proximity to the station.

3. The Customer shall install a ground grid of #4/0 bare stranded copper conductor or as specified by the Company, connected to an earthing means such as driven ground rods.

4. Below grade connections shall be made with compression type connectors or by a "Cadweld" or equivalent process.

5. For outdoor installations the ground grid shall form one or more closed loops, 18 inches below grade, surrounding the Customer's service equipment structure. One loop must be installed 2'-6" outside of the fenced area and swing gate path(s).

6. Ground Grid Resistance

   a. A ground resistance test should be conducted in accordance with IEEE Std. 81.

   b. The ground resistance of the ground grid shall be verified by the Company after installation by the Customer prior to adding cover material (but before connection to water pipe or overhead line ground wire) using a Biddle ground tester, or by other suitable means, to be assured that the ground resistance is no

greater than the value specified by the Company.

7. Connection of the ground grid to a continuous underground metallic water piping system is recommended.

8. When connection is made to a water piping system, the connection shall be made on the source side of the water meter where possible. Otherwise, the water meter shall be provided with a bonded by-pass.

B. CONNECTIONS TO GROUND GRID

1. The following components should be solidly connected to the ground grid using #4/0 copper conductor minimum:

   a. Metallic conduits for power and control cables, including the entire run of service lateral conduit if needed.

   b. Bonds for metallic cable sheaths and terminals.

   c. Metal supporting structures and frameworks.

   d. Lightning arresters and protective gaps.*

   e. Tanks of power transformers.

   f. Frames of circuit breakers and switchgear units.

   g. Overhead static shield wires.*

   h. Lightning masts.*

   *Note: These items shall be connected separately to the ground grid.

2. All non-current carrying metallic parts of the Customer's installation shall be adequately grounded to the grid.

3. Disconnecting switch bases, fuse mount bases, insulator supports, and instrument transformer frames or cases are normally adequately connected to the ground grid through their mechanical fastenings and the supporting structure if the structure is metal. If these items are installed on a non-conductive structure, these items shall be suitably grounded.

4. All fences enclosing the Customer's station shall be continuously grounded by being solidly connected to the ground grid using not less than #4/0 AWG bare stranded copper conductor, at all corner posts, at not more than 50 foot intervals around the fence perimeter and immediately on each side of gates or removable sections. The gates themselves shall be grounded by a flexible copper braid.

5. <u>Switches</u>

   a. Each group-operated air break disconnecting switch or fault interrupter device remote operating mechanism shall be connected to the ground grid near the operating handle by means of a flexible, tinned copper braid of at least 200 ampere rating.

   b. For outdoor installations a potential equalizing grid of buried copper grid (typical grid shown by Figure 6 in rear of booklet) shall be placed at the foot of the column supporting the operating mechanism.

   c. This potential equalizing grid shall be connected in two places to the switch main grounding lead using at least #2 and preferably #4/0 bare stranded copper conductor.

d. **NOTE:**
EVEN WITH THE GROUND PRECAUTIONS SUGGESTED, IT IS IMPERATIVE THAT A PERSON OPERATING GROUP-OPERATED SWITCHES WEAR RUBBER GLOVES.

6. A #2AWG bare stranded copper conductor (minimum) connection from the ground grid shall be made available at the meter panel for use by the Company to ground the billing meter equipment.

VII. METERING

A. EQUIPMENT FURNISHED BY THE COMPANY

1. The Company will furnish all meters, metering instrument transformers, potential transformer primary fuses and test devices required for billing purposes at the delivery voltage.

   a. Metering Transformers

      (1) The Company will specify the quantity, type, rating and primary connections of all current and potential transformers for billing purposes.

      (2) The current and potential transformers for the Company's billing meters shall not be used to operate any other devices.

   b. Potential Transformer Primary Fuses

      (1) The Company will specify when potential transformer primary fuses are to be used, together with the quantity, type, rating and connections of such fuses and their mountings.

B. CUSTOMER'S RESPONSIBILITY

1. Meter Equipment Mounting

   a. The Customer shall provide space and supports for the Company's current and potential transformers as part of the service entrance equipment structure.

   b. The supports shall be drilled for mounting bolts in accordance with dimension information concerning this equipment furnished to the Customer for the design of their installation.

   c. The Customer's station service transformer shall be on the load side of the billing metering transformers.

2. Secondary Connection Conduit

   a. The Customer shall furnish, install and maintain conduit for the wiring from metering transformers to the billing meter panel.

   b. The conduit shall be at least 1-1/2" galvanized steel or an equivalent approved by the Company.

   c. The conduit shall be run by the shortest practicable route, using conduit bends instead of conduit fittings.

   d. The conduit shall normally not exceed 100 circuit feet and with no more than two 90 degree bends.

   e. This conduit shall be grounded.

   f. A pull wire shall be installed in the completed conduit.

3. Meter Panel Specification

The Customer shall provide a panel for billing meters, together with mounting for the panel. The panel may be one of the following:

a. 3/4" thick painted or stained plywood panel, wall mounted, minimum of 48" x 48". For installation of 2000kW and above, a minimum of 48" wide x 60" high panel shall be provided.

(1) The wall-mounted plywood panel shall be located with lower edge 30" from the floor and so that there is a clear working space of not less than 48" from the panel front.

b. 3/4" minimum thickness Benelex #70 panel, or other approved insulating material, switchgear mounted a minimum of 30" wide and 60" high. The switchgear cubicle must be 36" wide minimum.

(1) The switchgear mounted panel should have offset hinges and a meter projection clearance of at least 16" from the front of the panel and stud projection clearance of at least 10" from the rear of the panel. This type of panel can only be furnished in an indoor location or walk-in aisle type switchgear.

4. Meter Panel Location

a. The billing meter panel should be located indoors in a heated and lighted location conveniently and safely accessible to authorized Company employees.

b. The location should be clean, dry and free of corrosive atmospheres.

c. A 20 ampere, 120 volt, single phase convenience receptacle, served from the Customer's distribution panel, shall be installed at the meter panel location.

5. For outdoor service equipment installations where a suitable indoor metal panel location cannot otherwise be provided, the Customer may be required to erect a meter house as shown in Figure 8 in the rear of this booklet. This house must be provided with heating facilities, one light outlet and one 20 ampere, 120 volt, single phase convenience receptacle served from the Customer's distribution panel.

6. Where the Customer elects to install outdoor metalclad switchgear not of the walk-in aisle type, the Customer may provide a separate walk-in cubicle, 36" wide minimum, to be used solely for the billing meters.

a. The billing meters shall be located on a Benelex #70, or other approved insulating material panel furnished and installed on the back wall of the cubicle by the Customer.

b. The panel shall be in one piece and a minimum of 3/4" thick x 30" wide x 60" high, mounted with the center point 48" above the floor.

c. The cubicle shall be safely and conveniently accessible to authorized Company employees, clear of all obstructions, clean, dry, free of corrosive atmosphere, heated, ventilated, lighted and with a 20 ampere, 120 volt, single phase convenience receptacle, served from the Customer's distribution panel and installed at the meter panel location.

d. The cubicle shall have a hinged door capable of being opened from the inside of the cubicle.

e. The door shall be locked with a Company padlock.

7. At an outdoor substation with a single transformer and where a control building is not otherwise needed, a weatherproof metal metering cabinet may be acceptable to the Company.

   a. Cabinet dimensions shall normally be 48" x 48" x 18"; larger dimensions may be required for certain applications.

   b. It may be mounted on a column of the metering transformers support structure with its lower edge 30" above finished grade.

   c. The door shall be equipped with a doorstop to secure the door in open position and shall have padlock provision.

   d. A 3/4" painted plywood panel normally 42" x 42" shall be mounted in the rear of the cabinet with 1" clear space between the rear wall and the plywood panel.

   e. A thermostat controlled heater and a 20 ampere, 120 volt, single phase ground fault protected receptacle shall be provided in the panel, to be supplied from the Customer's station service transformer.

   f. Cabinet shall be cross vented top and bottom with filters.

C. REMOTE METERING

1. The Company will specify when a telephone conduit and circuit is required to the metering facilities.

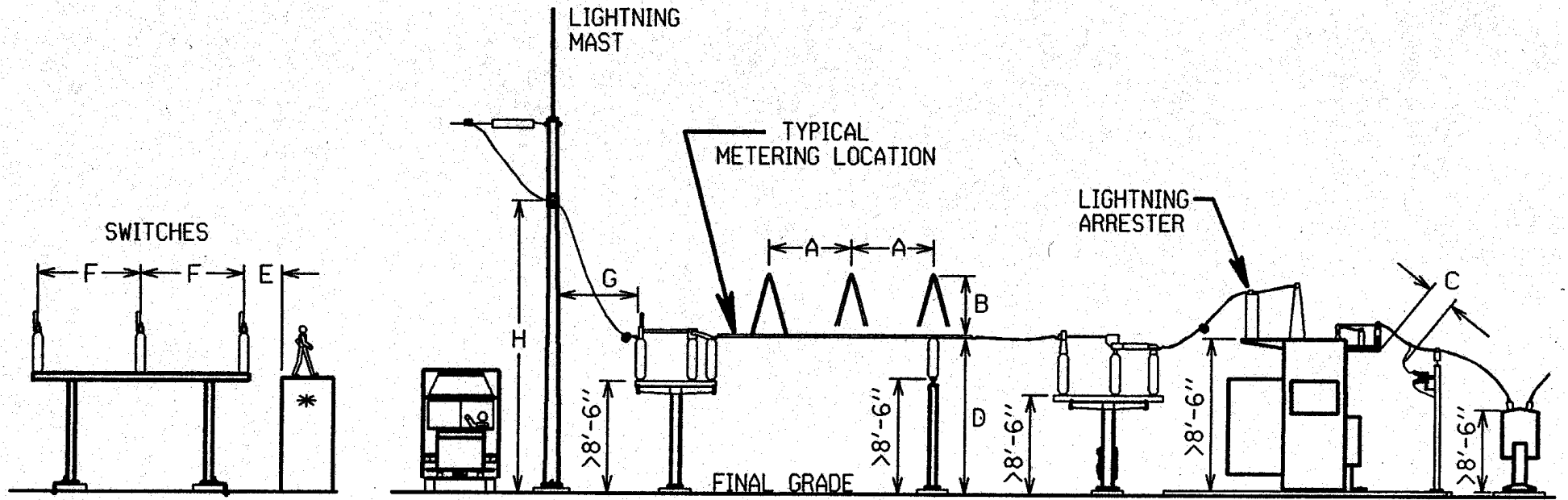
2. Where the Customer desires control or metering facilities other than billing metering located remote from the main substation location, consideration should be given to the use of isolating and/or neutralizing transformers in the low voltage circuits from substation to the control or meter equipment. In each case the peculiarities of each installation must be specifically studies to determine the advisability of such protective measures.

THIS APPLICATION DIAGRAM'S SOLE PURPOSE IS TO ILLUSTRATE THE APPLICATION OF THE VARIOUS ELECTRICAL CLEARANCES FOR OUTDOOR STRUCTURES.

IT DOES NOT NECESSARILY REPRESENT STANDARD STRUCTURES OR ELECTRICAL ARRANGEMENTS.

WHENEVER A FOUNDATION IS LARGE ENOUGH FOR A WORKMAN TO STAND ON WITHOUT CONSCIOUS EFFORT, THE MINIMUM AND RECOMMENDED CLEARANCES SHALL BE FROM THE TOP OF THE FOUNDATION AND NOT FINISHED GRADE.

A - RECOMMENDED CENTERLINE-TO-CENTERLINE SPACING OF BUS
B - CLEARANCE BETWEEN LIVE PARTS
C - CLEARANCE FROM LIVE PARTS TO GROUND
D - MINIMUM VERTICAL CLEARANCE TO UNGAURDED LIVE PARTS ACCESSIBLE ONLY TO PERSONNEL ON FOOT
E - MINIMUM HORIZONTAL CLEARANCE TO UNGUARDED LIVE PARTS FROM ANY PERMANENT SUPPORTING STRUCTURE FOR WORKMEN
F - PHASE-TO-PHASE SPACING FOR HORN GAP SWITCHES
G - PHASE-TO-GROUND SPACING FOR HORN GAP SWITCHES
H - MINIMUM VERTICAL CLEARANCE TO UNGUARDED LIVE PARTS ACCESSIBLE TO VEHICULAR TRAFFIC



* ANY PERMANENT SUPPORTING STRUCTURE FOR WORKERS

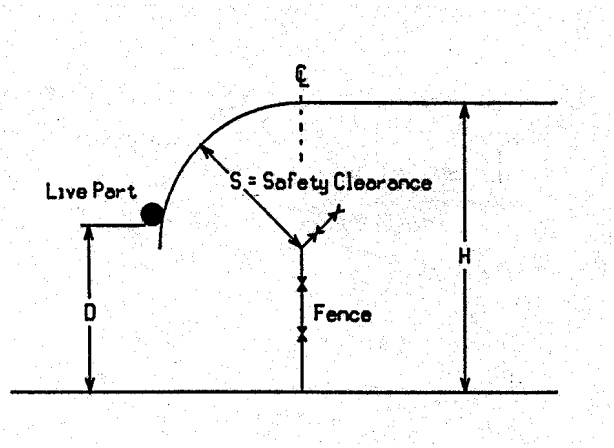
APPLICATION DIAGRAM ELECTRICAL CLEARANCES
FIGURE 1

Preferred Nominal System Voltage		2400V 4160V 4800V 7200V 8.32kV	12kV 13.2kV	23kV	34.5kV	46kV	69kV	115kV	138kV	230kV	230kV	230 kV	345 kV
B.I.L.		95kV	110kV	150kV	200kV	250kV	350kV	550kV	650kV	750kV	900kV	1050 kV	1300 kV*
Max. kV Rating		8.25	15.5	25.8	38.0	48.3	72.5	121	145	242	242	242	362***
(A) Recommended Centerline-to-Centerline Spacing of Buses		18"	2'-0"	2'-6"	3'-0"	4'-0"	5'-0"	7'-0"	8'-0"	9'-0"	11'-0"	13'-0"	15'-0"
(B) Clearance Between Live Parts	Rec.	12"	18"	2'-0"	2'-6"	3'-0"	4'-0"	6'-0"	7'-0"	8'-0"	10'-0"	11'-0"	13'-6"
	Min.	7"	12"	15"	18"	21"	2'-7"	4'-5"	5'-3"	6'-0"	7'-5"	8'-9"	9'-8"
(C) Clearance from Live Parts-To-Ground	Rec.	8"	10"	12"	15"	18"	2'-5"	3'-11"	4'-4"	5'-2"	6'-4"	7'-7"	9'-4"
	Min.	6"	7"	10"	13"	17"	2'-1"	3'-6"	4'-2"	4'-10"	5'-11"	6'-11"	8'-8"
Min. Clearance to Unguarded Live Parts for Personnel on Foot	(D) Vertical	9'-0"	9'-6"	10'-0"	10'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-2"
	(E) Horizontal	3'-4"	3'-6"	3'-9"	4'-0"	4'-4"	4'-11"	6'-1"	6'-8"	7'-4"	9'-4"	10'-0"	11'-8"
Spacing of Horn Gap Switches <u>without</u> Arc Extinguishing Device**	(F) Phase-to-Phase	3'-0"	3'-0"	4'-0"	5'-0"	6'-0"	7'-0"	10'-0"	12'-0"	16'-0"	16'0"	18'-0"	20'-0"
	(G) Phase-to-Ground	2'-0"	2'-0"	2'-6"	3'-0"	3'-9"	4'-3"	6'-0"	7'-6"	9'-0"	10'-0"	11'-0"	12'-0"
(H) Minimum Vertical Clearance to Unguarded Live Parts for Vehicular Traffic	Wire	22'-0"		25'-0"			30'-0"			34'-0"			37'-0"
	Rigid Bus	22'-0"		20'-0"			21'-0"	22'-0"	22'-0"	24'-0"			26'-0"
(S) Safety Clearance to Station Fence	Min.	10'-0"	10'-2"	10'-4"	10'-8"	10'-11"	11'-8"	13'-0"	13'-9"	14'-11"	15'-5"	16'-5"	18'-4"

* Corresponds to 2.5 Per Unit Switching Factor. ** Consult the Company for switch applications with arc extinguishing device. *** The maximum voltage for the 345kV system in the Oswego NY area are higher, consult the Company.

OUTDOOR STRUCTURE ELECTRICAL CLEARANCES

FIGURE 2



1. Safety Clearance to Substation Fences

A. Dimension "H" is the Minimum Vertical Clearance to Unguarded Live Parts for Vehicular Traffic from Figure 2.

B. Dimension "D" is the Minimum Vertical Clearance of Unguarded Live Parts for Personnel on Foot from Figure 2.

C. Dimension "S" is the Safety Clearance determined from Figure 2.

D. The Safety Clearance boundary is located by constructing an arc with Radius "S" from a point on the centerline of the station fence (without regard to fence height) such that the arc intersects the horizontal line defined by Dimension "D" and is tangent to the horizontal line Defined by Dimension "H" and to the vertical line defined by Dimension "S" measured horizontally from the fence center line. All exposed live parts shall be outside this Safety Clearance boundary shown above.

2. Minimum Vertical Clearance in Areas Accessible to Vehicular Traffic

The vertical clearance is measured vertically from finished crushed stone surface to the lowest conductor or live part. The tabulated clearances are based on National Electrical Safety Code clearances for highways, roads, streets and fields subject to truck traffic with voltage adder and allowance for sag due to temperature.

3. Access Clearance to Substation Fences

Normal design practice is to provide adequate drive space between the perimeter fence and the structure for maintenance trucks. However, when the drive space cannot be provided, the minimum fence to live part clearance shall not be less than the safety Clearance dimension determined by use of sketch shown above.

The intent of these safety clearance requirements is to prevent unqualified or public personnel from coming into accidental contact with live parts by inserting sticks or poles, etc., over or through a fence or wall.

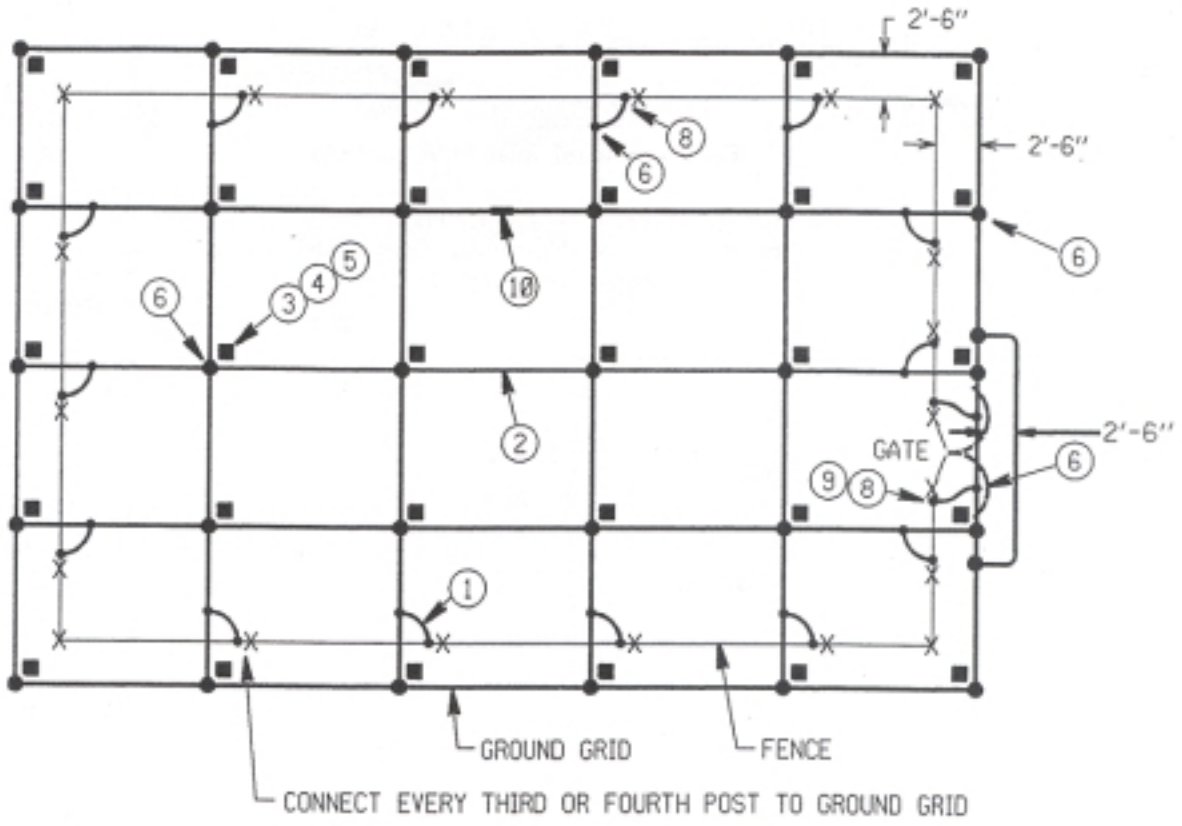
SAFETY CLEARANCE REQUIREMENTS
FIGURE 3

TABLE of INDOOR SEPARATIONS*							
Max. kV Class Rating		**5.08**	**8.25**	**15**	**25.8**	**38**	**38**
Nominal System Voltage		**2400V 4160V 4800V**	**6900V 7620V**	**8320V 12kV 13.2kV**	**23kV**	**34.5kV**	**34.5kV**
BIL in kV		**60**	**75**	**95**	**125**	**150**	**200**
Spacing of Buses	**Rec.**	12"	14"	18"	20"	24"	26"
	Min.	9"	10"	12"	14"	18"	20"
Spacing of Live Part-to-Live Part	**Min.**	4.5"	5.5"	7.5"	13"	14.5"	18"
Spacing of Live Parts-to-Ground	**Min.**	3"	4"	5"	8"	10.5"	13"
Minimum Clearance To Unguarded Live Parts	**Vert.**	9'-0"	9'-6"	9'-6"	10'-0"	10'-0"	10'-0"
	Horiz.	4'-0"	4'-0"	5'-0"	5'-0"	6'-0"	6'-0"

***Note:** These separations are minimums and should not be considered recommended design. The Company recommends exceeding minimums where space permits.

INDOOR STRUCTURE
ELECTRICAL CLEARANCES

FIGURE 4



BASIC GROUND GRID & CONNECTIONS

For Switch Mechanism Grounding, See Fig. 6
For Fence Grounding, See Fig. 7

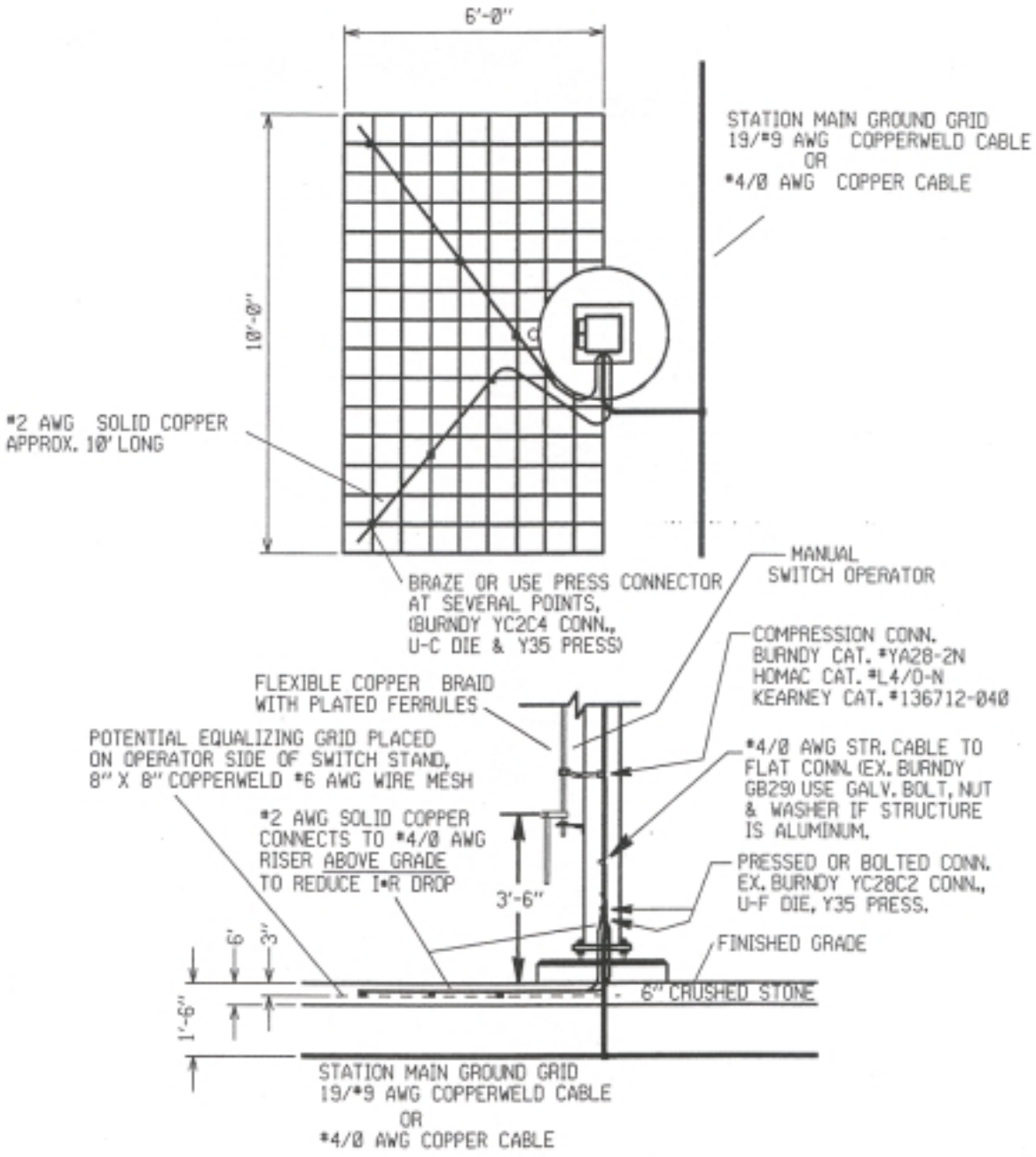
ITEM	MATERIAL LIST	Catalog No.
1	CABLE, #4/0 Stranded copper for riser connections	
2	CABLE, #4/0 stranded copper for main ground grid	
3	GROUND RODS, 5/8" Copperweld, threaded sectional type, 6 feet long	
4	COUPLING, for 5/8" threaded COPPERWELD ground rod	
5	CONNECTOR, 5/8" ground rod to #4/0-250 kcmil cable	Burndy Cat. #YGL29
6	CONNECTOR, tee, cross or splice type, #4/0-250 kcmil cable	Burndy Cat. #YGL29

STATION GROUNDING
FIGURE 5

BASIC GROUND GRID & CONNECTIONS (continued)

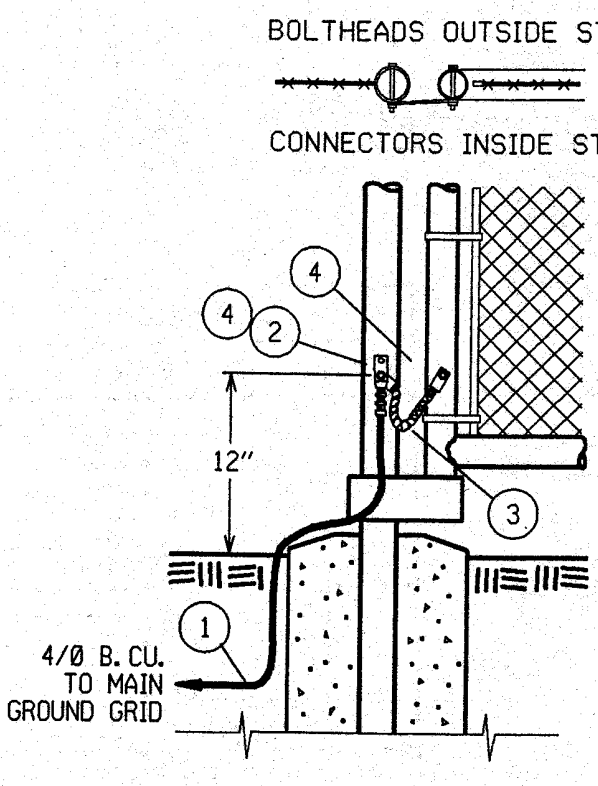
ITEM	MATERIAL LIST	Catalog No.
7	CONNECTOR, parallel type, #4/0 to #4/0 copper cable	Burndy Cat. #YC28C
8	CONNECTOR, #4/0 copper to flat Burndy type YA, circumferential indent type GB, bolted (1 cable) (2 cables)	Burndy Cat. #YA28- Homac Cat. #L4/0- Kearney Cat. #136712-040
9	FLEXIBLE BRAID, 200 Amp.	Frankel Cat. #FB11-NR18 Burndy Cat. #BD18
10	SPLICE, compression #4/0 to #4/0 copper	Anderson Cat. #VCHS-4/0 Burndy Cat. #YCS28 Burndy Cat. #YCS28C (Crimpit Type)

STATION GROUNDING
FIGURE 5 (CONT'D)



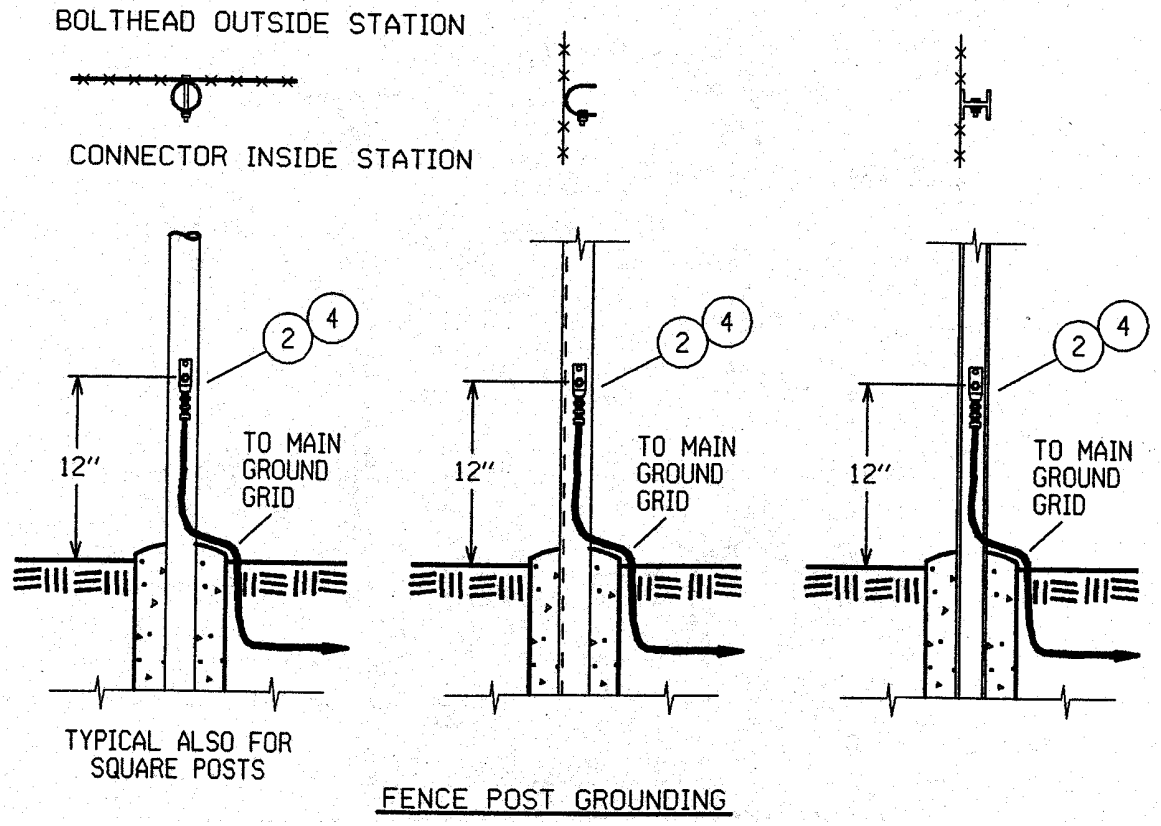
NOTE: Connections between switch handle, column, potential equalizing grid and station main grounding grid are to be made in such a manner that no fault current will be carried through the potential grid.

SWITCH MECHANISM GROUNDING
FIGURE 6



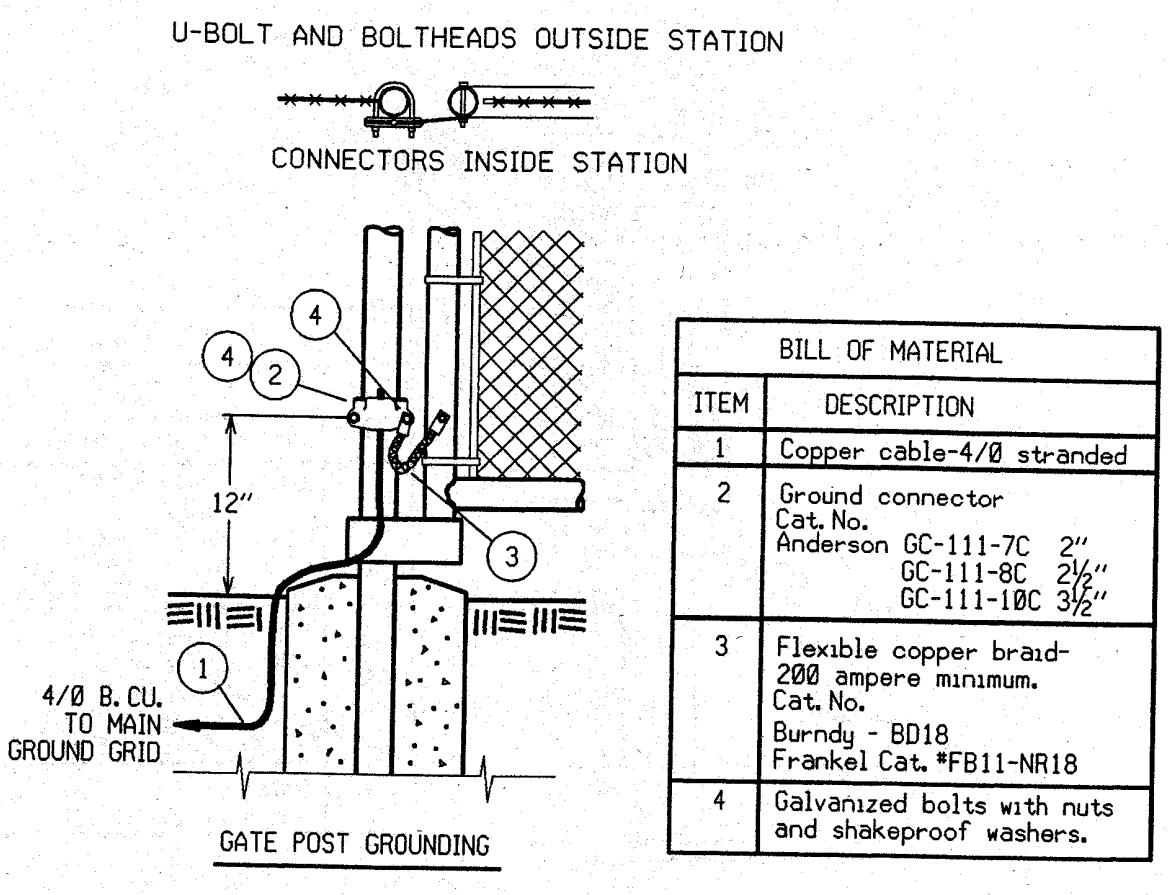
GATE POST GROUNDING

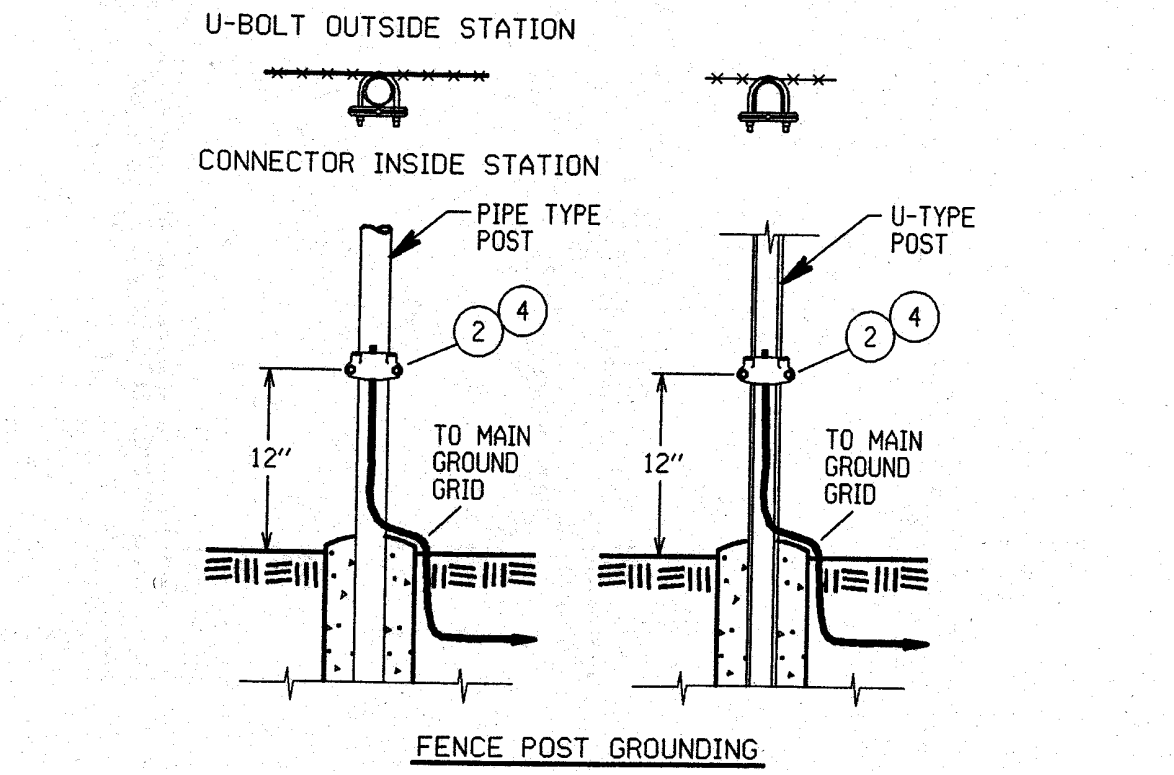
BILL OF MATERIAL	
ITEM	DESCRIPTION
1	Copper cable-4/0 stranded
2	Ground connector Catalog No. Burndy - YA28-2N Homac - L4/0-N Kearney - 136712-040
3	Flexible copper braid- 200 ampere minimum. Catalog No. Burndy - BD18 Frankel Cat. - #FB11-NR18
4	Galvanized bolts with nuts and shakeproof washers.



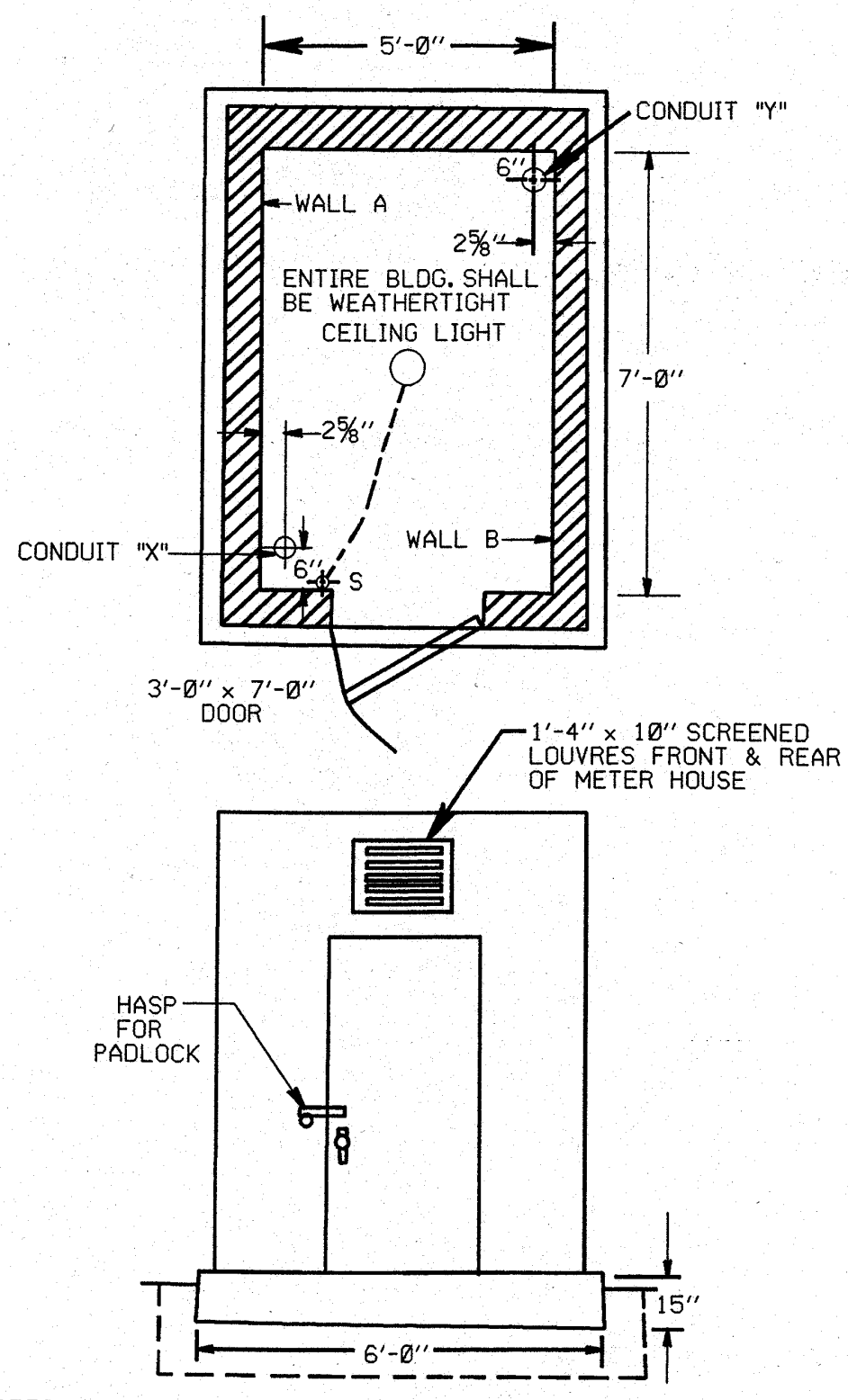
FENCE POST GROUNDING

FENCE GROUNDING DETAILS
FIGURE 7



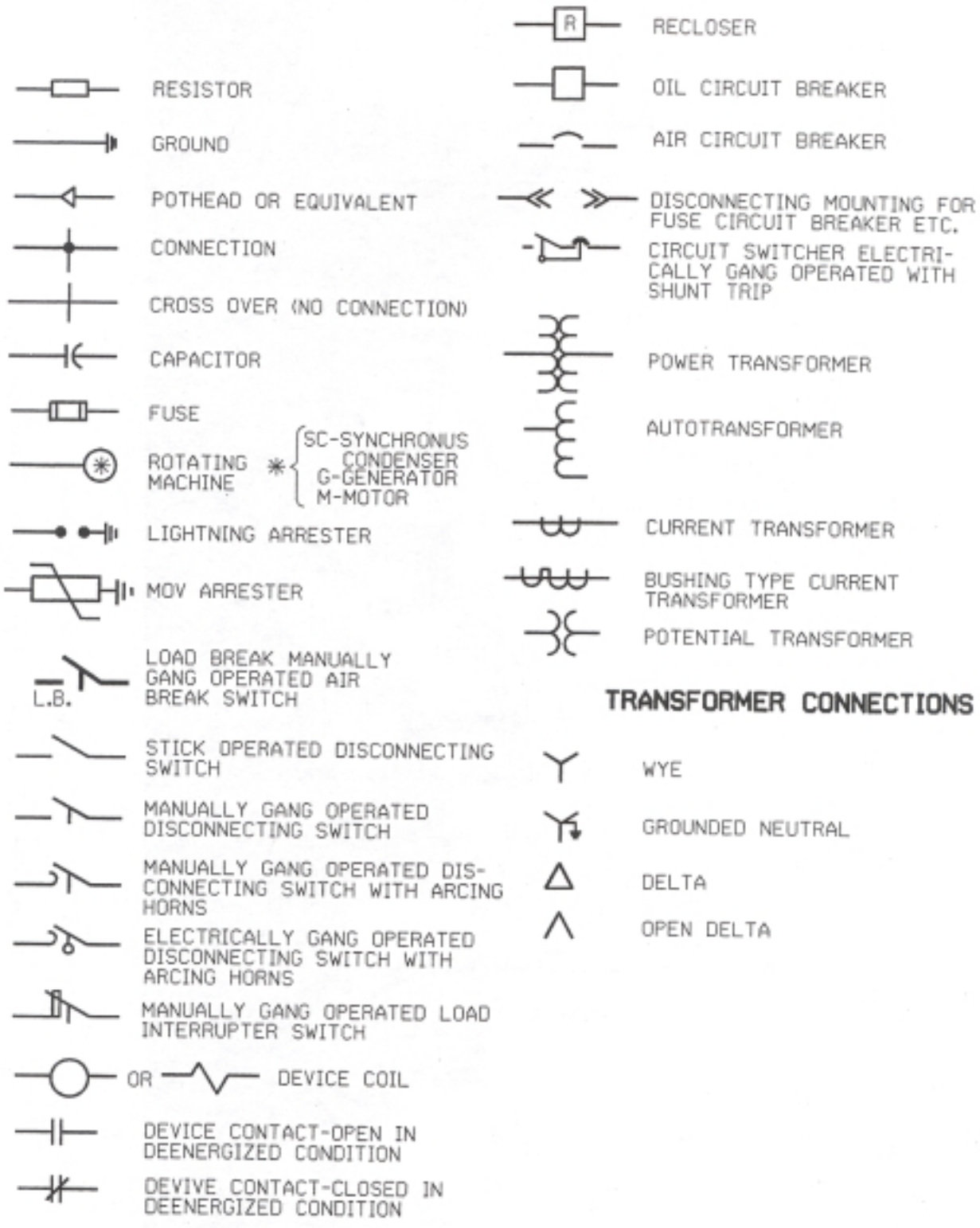


ALTERNATIVE FENCE GROUNDING DETAILS
FIGURE 7A



NOTES:
1. METER HOUSE TO BE WEATHERPROOF
2. SUPERSTRUCTURE SHALL BE ANCHORED TO FOUNDATION
3. METERING EQUIPMENT IS TO BE MOUNTED EITHER ON WALL "A" USING CONDUIT "X" OR ON WALL "B" USING CONDUIT "Y"
4. 120V,20A RECEPTACLE REQUIRED
5. ALTERNATE-PREFAB., IF ACCEPTABLE TO COMPANY

METER HOUSE
FIGURE 8



SYMBOLS FOR SERVICE EQUIPMENT DIAGRAMS
FIGURE 9

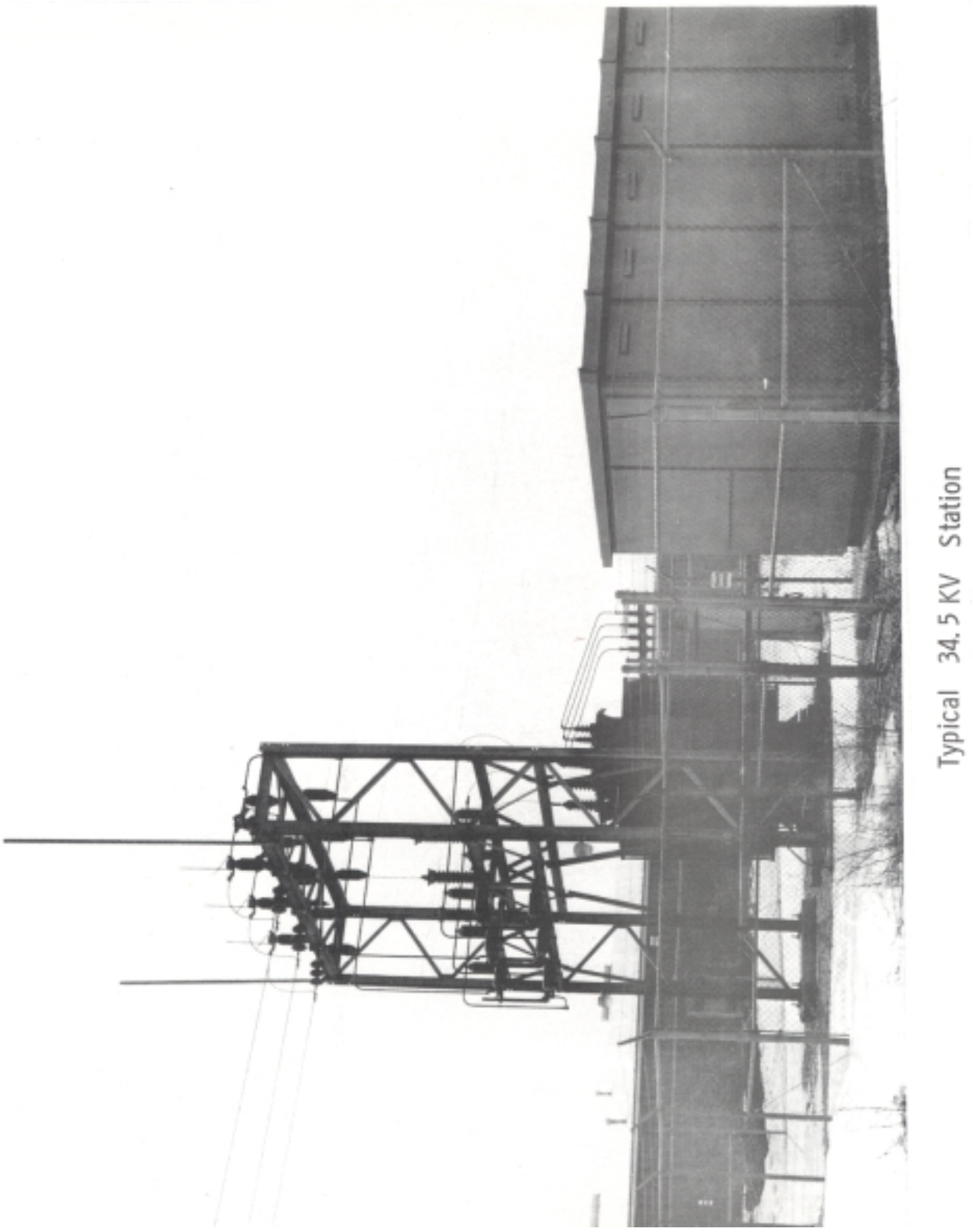
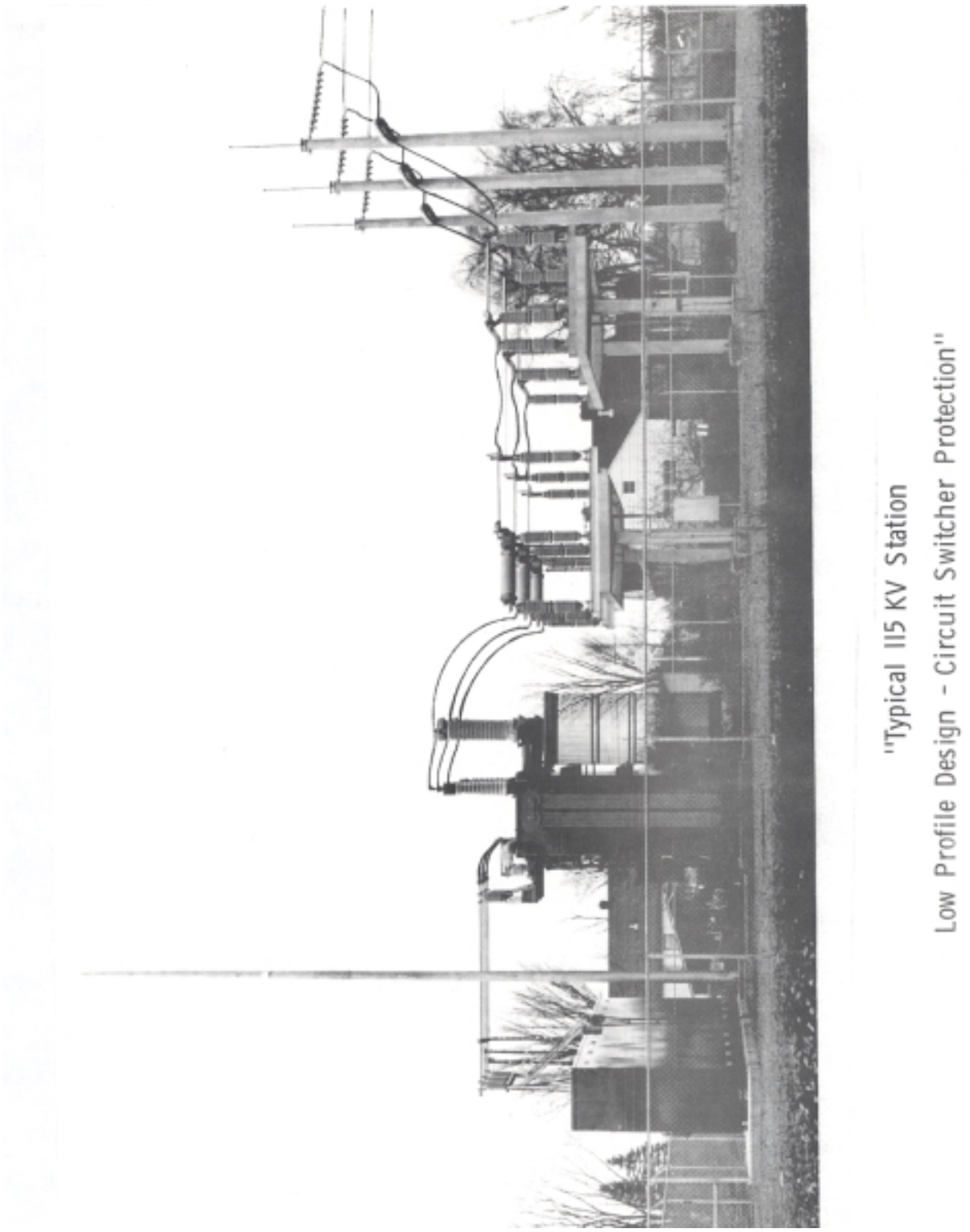


ILLUSTRATION 1



"Typical 115 KV Station
Low Profile Design - Circuit Switcher Protection"

ILLUSTRATION 2