

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
METROPOLITAN ELECTRICITY AUTHORITY (MEA)
THE KINGDOM OF THAILAND

No. 56

FEASIBILITY STUDY
ON
POWER DISTRIBUTION SYSTEM
IMPROVEMENT AND EXPANSION PLAN
IN THE METROPOLITAN AREA
IN
THE KINGDOM OF THAILAND

FINAL REPORT

APPENDIX

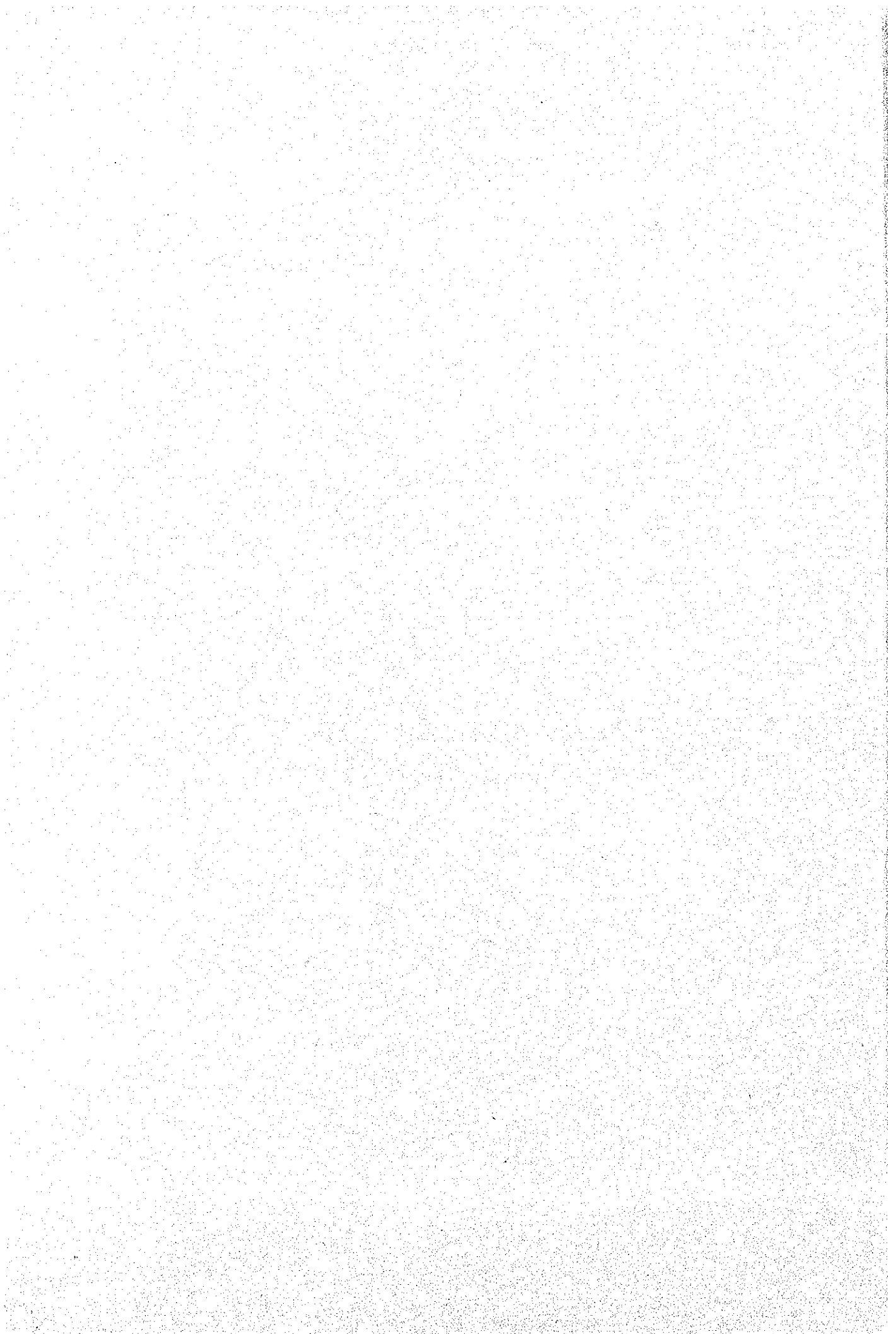
NOVEMBER 1995

TOKYO ELECTRIC POWER SERVICES CO., LTD.
ELECTRIC POWER DEVELOPMENT CO., LTD.

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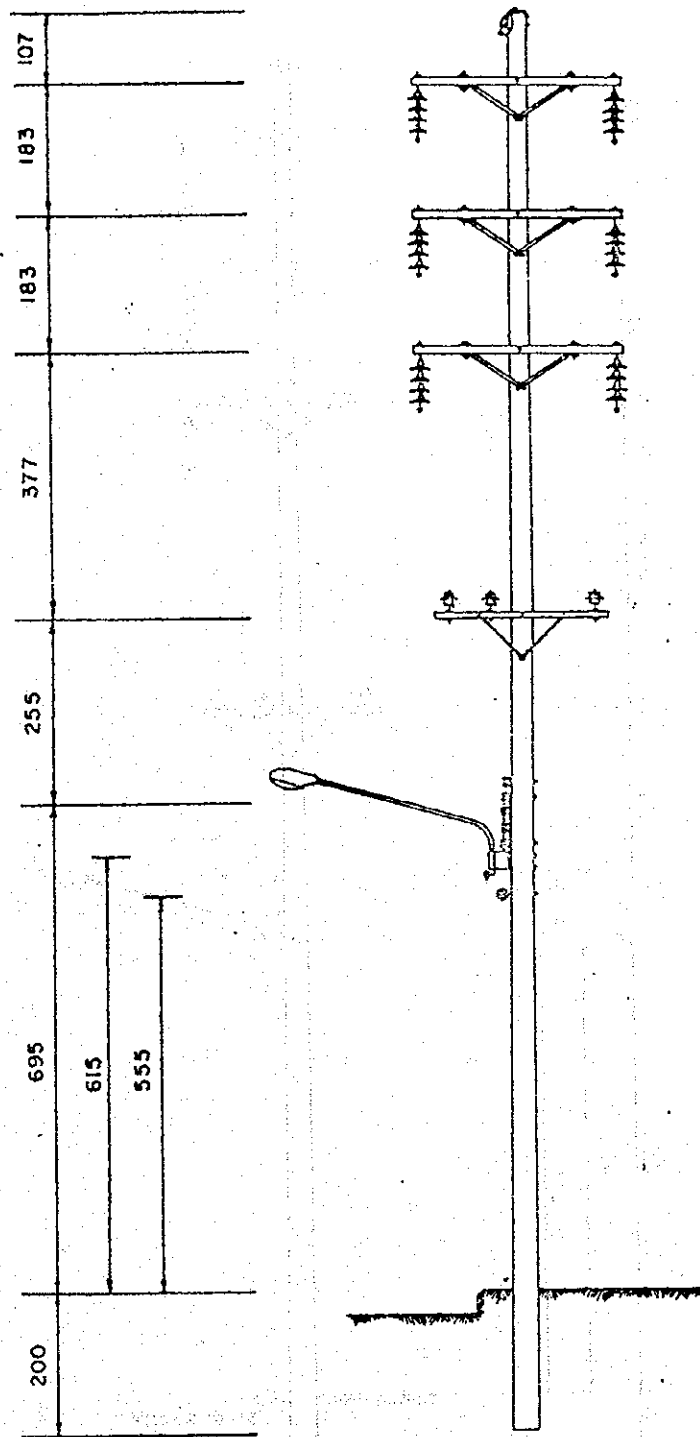


APPENDIX

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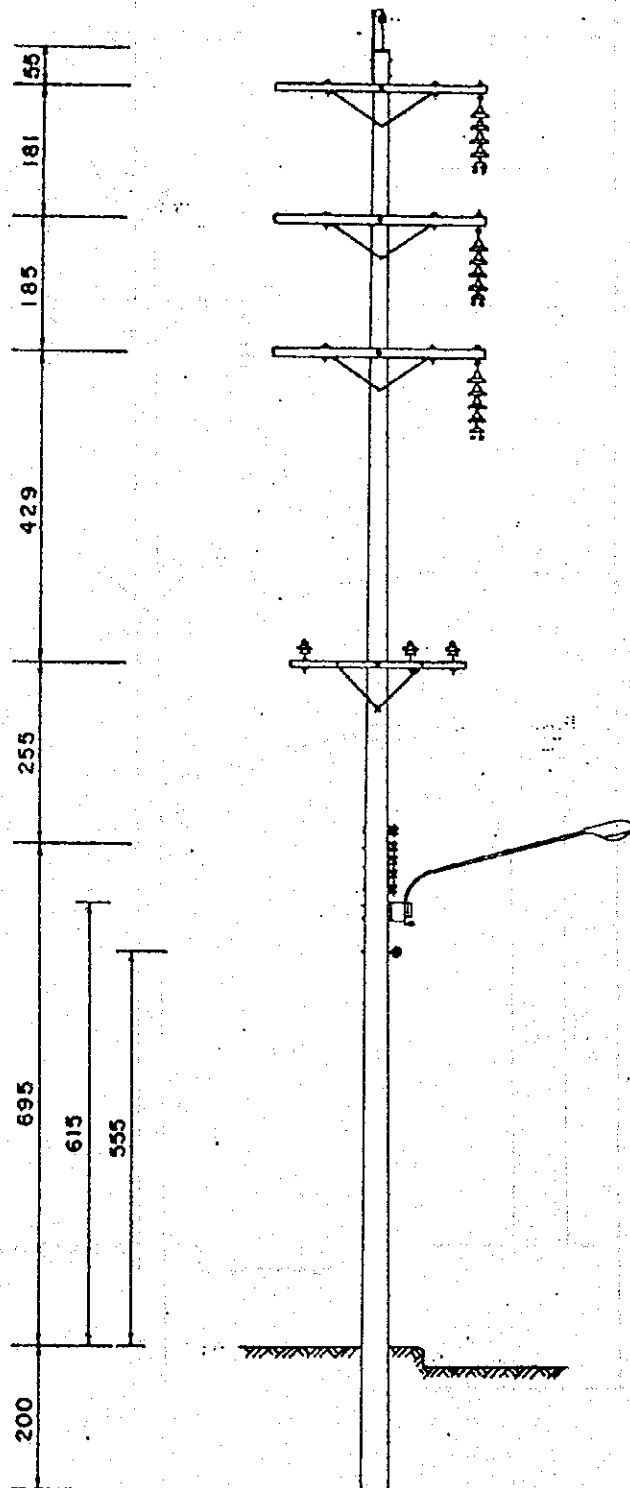
CHAPTER 3





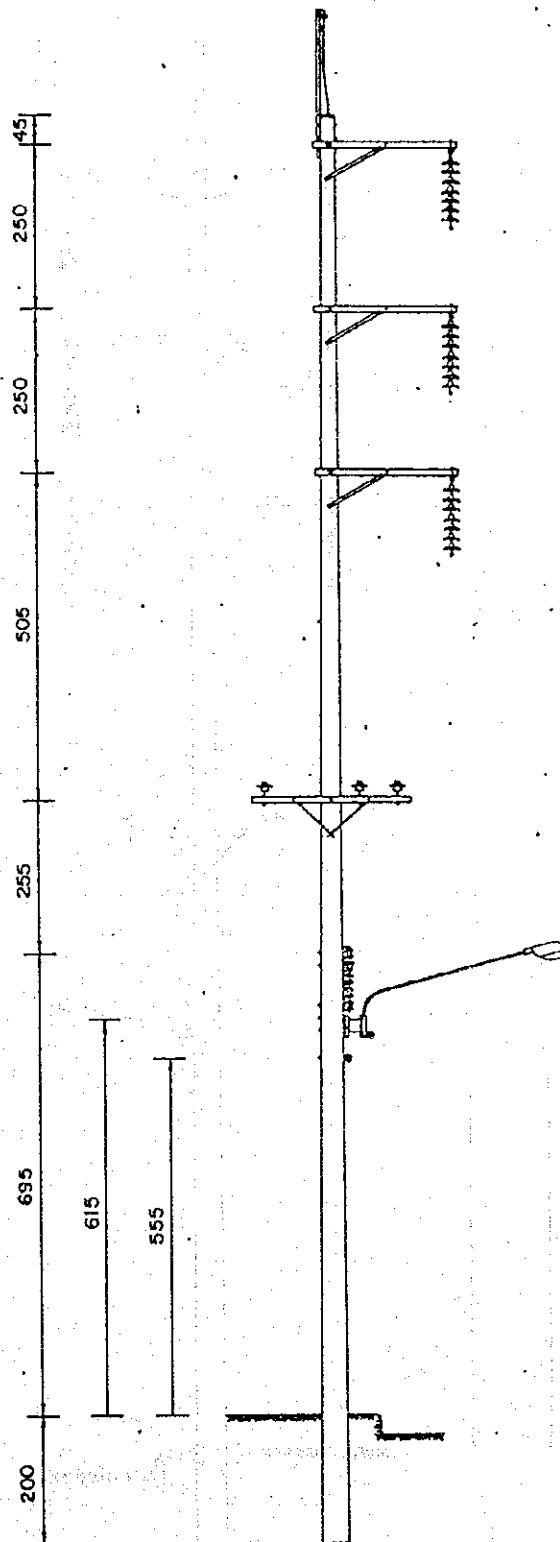
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Appendix 3.3-1 69kV Double Circuit Tangent Structure



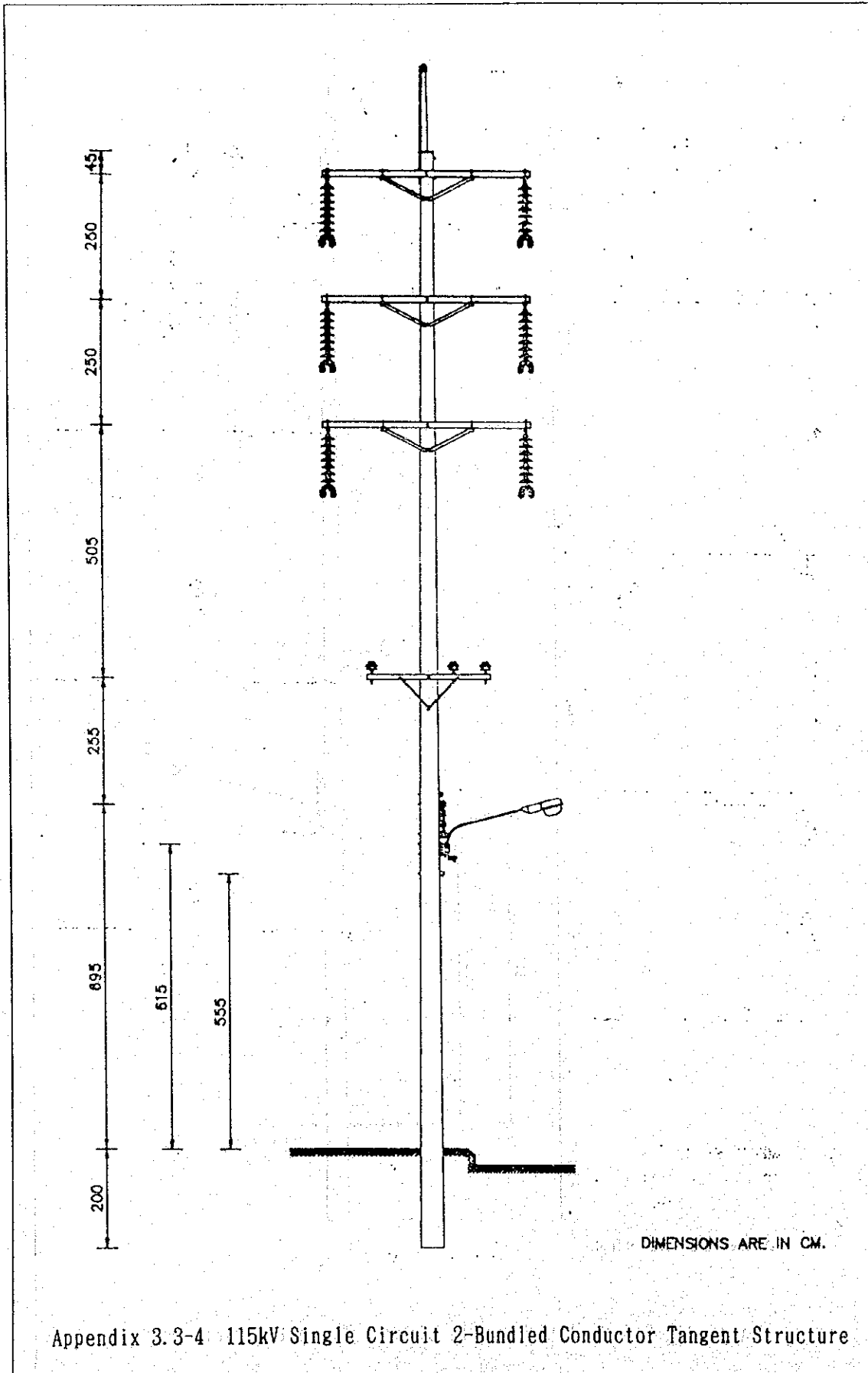
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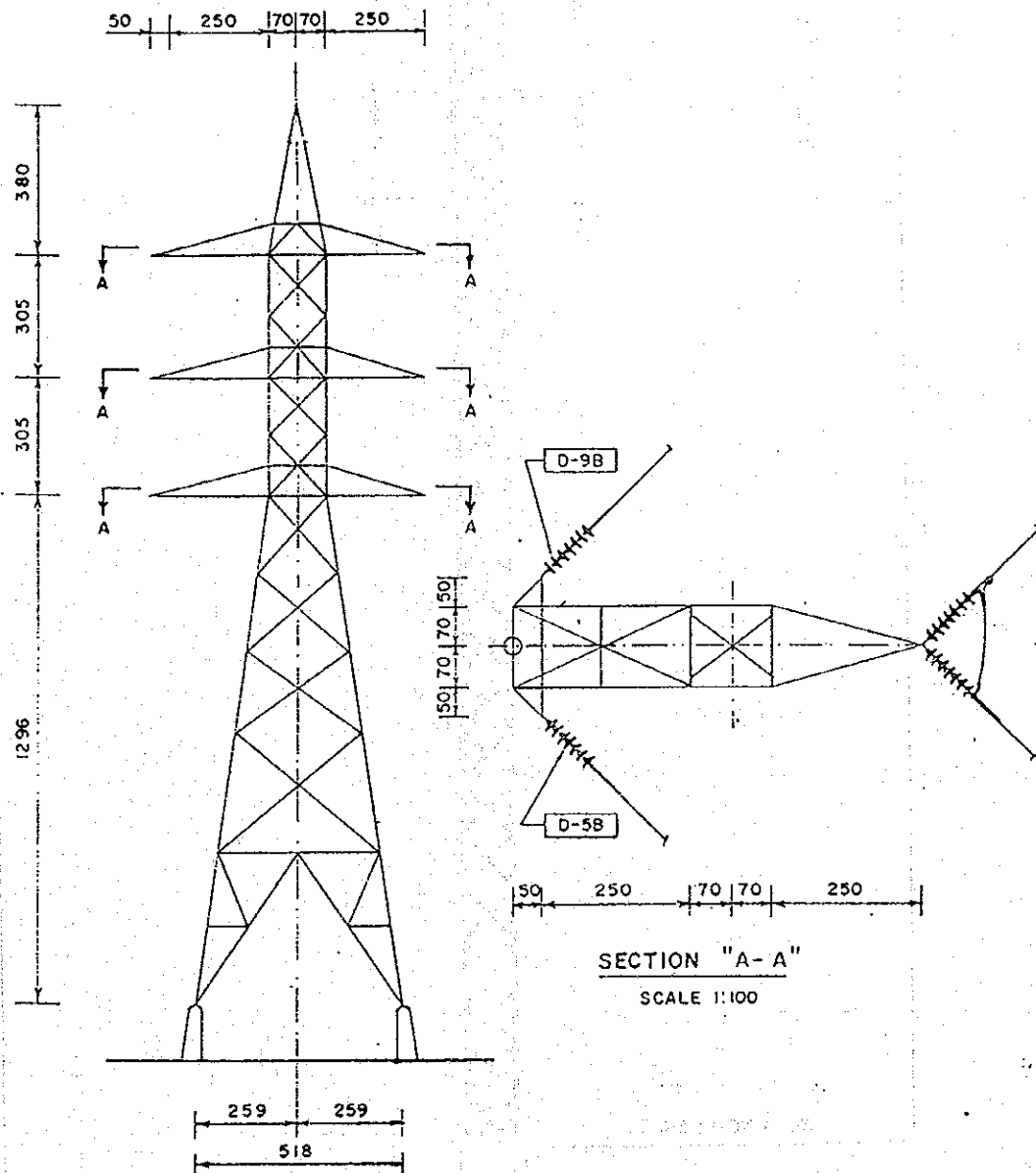
Appendix 3.3-2 69kV Single Circuit 2-Bundled Conductor Tangent Structure



DIMENSIONS ARE IN CM.

Appendix 3.3-3 115kV Single Circuit Tangent Structure

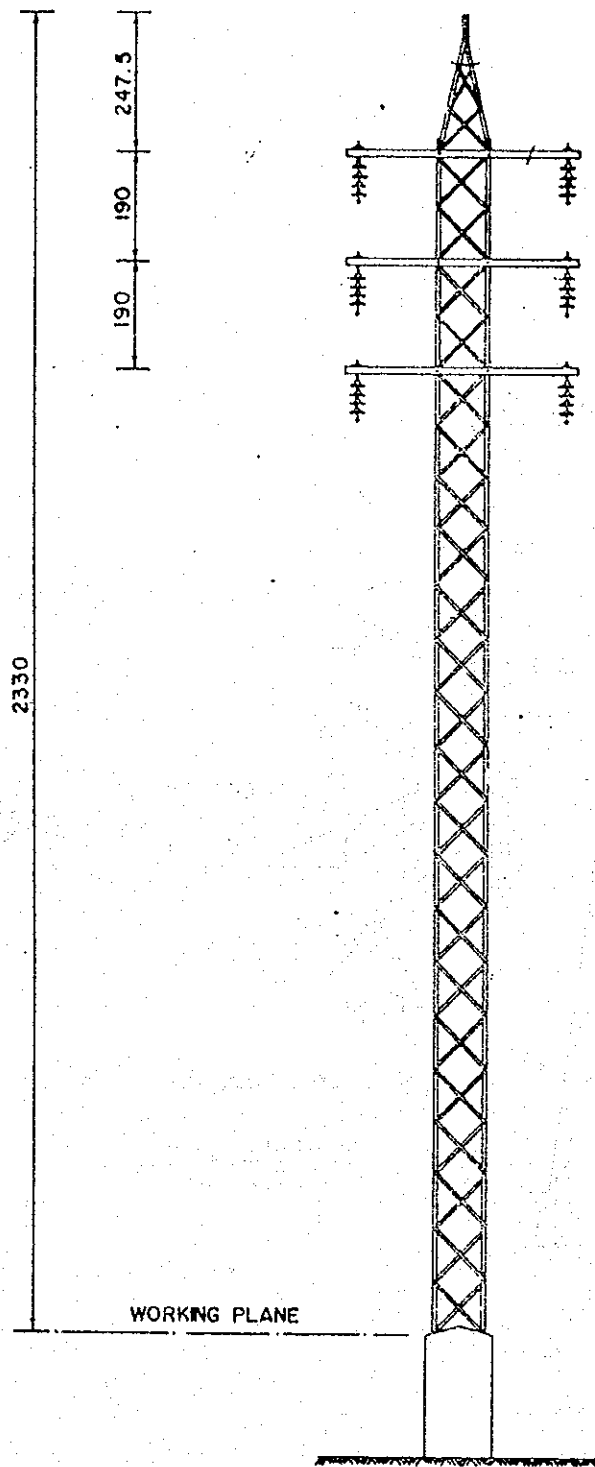




NOTE

DIMENSIONS ARE IN CENTIMETER.

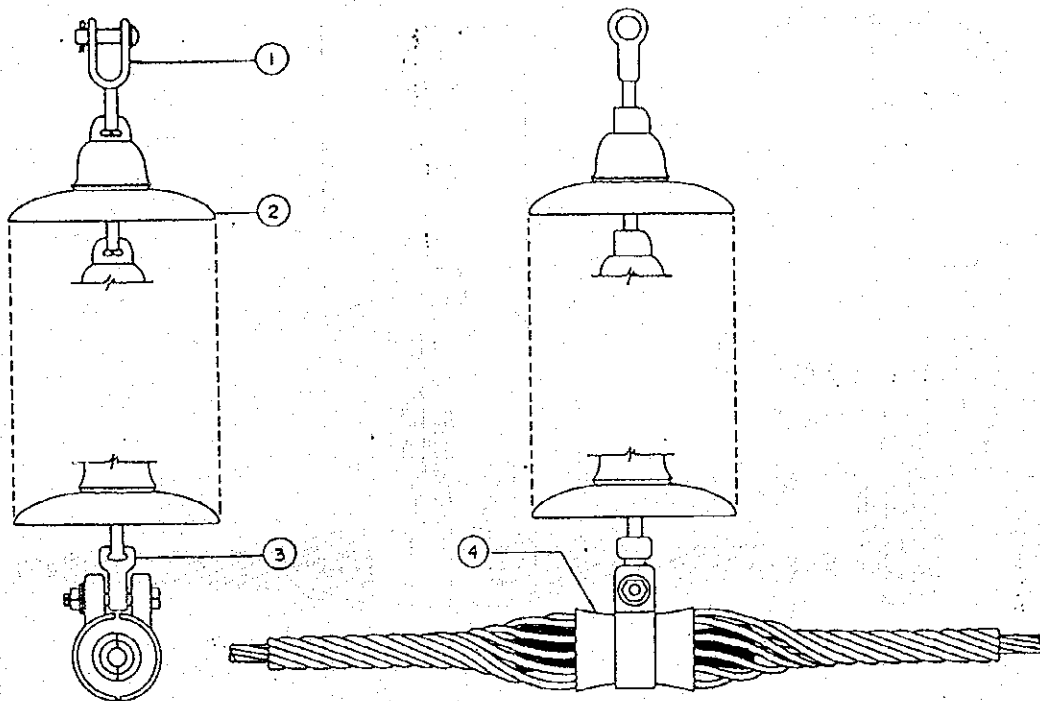
Appendix 3.3-5 69kV Construction Steel Tower Type C



NOTE.

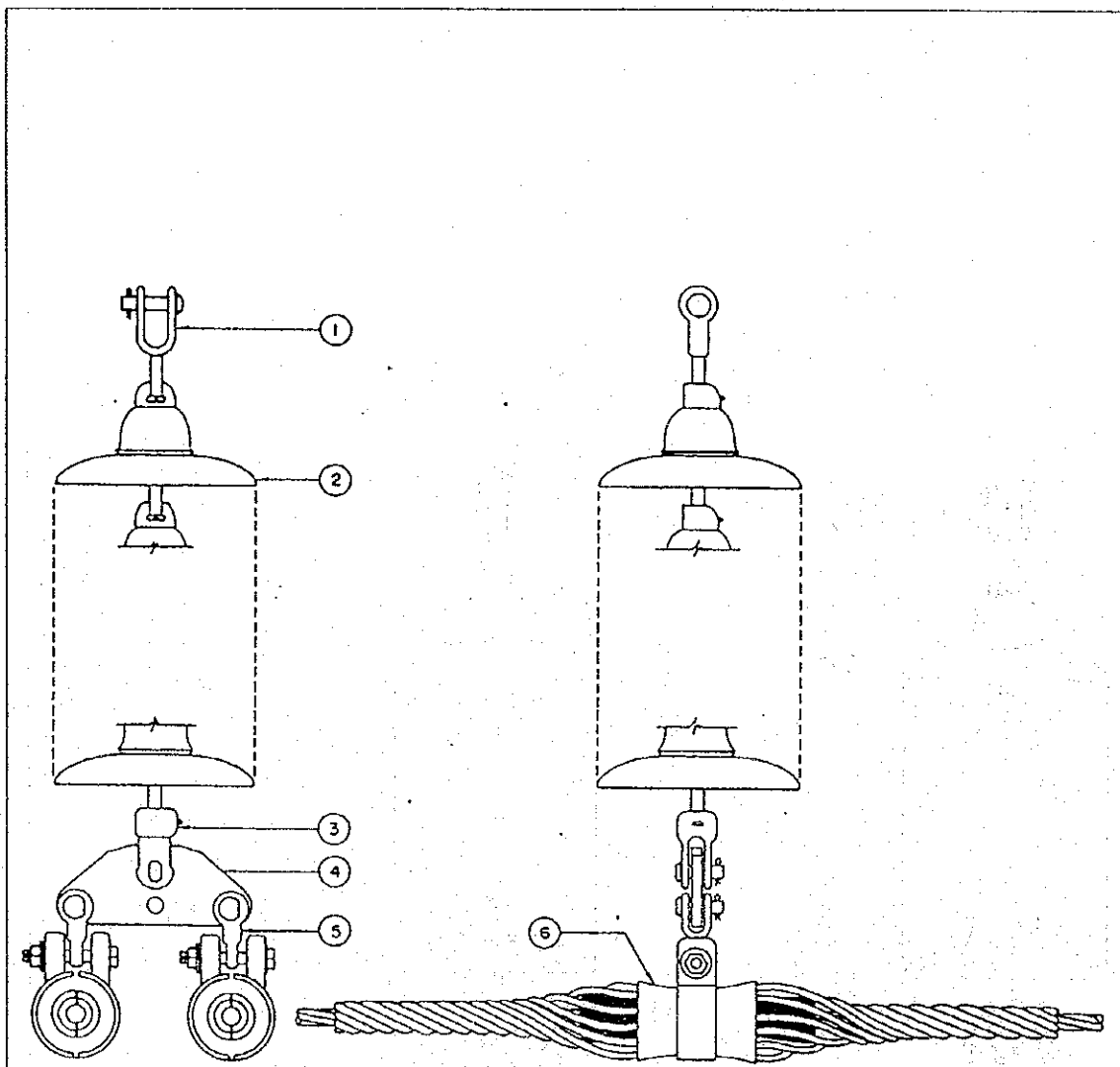
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Appendix 3.3-6 69kV Construction Steel Tower Type D



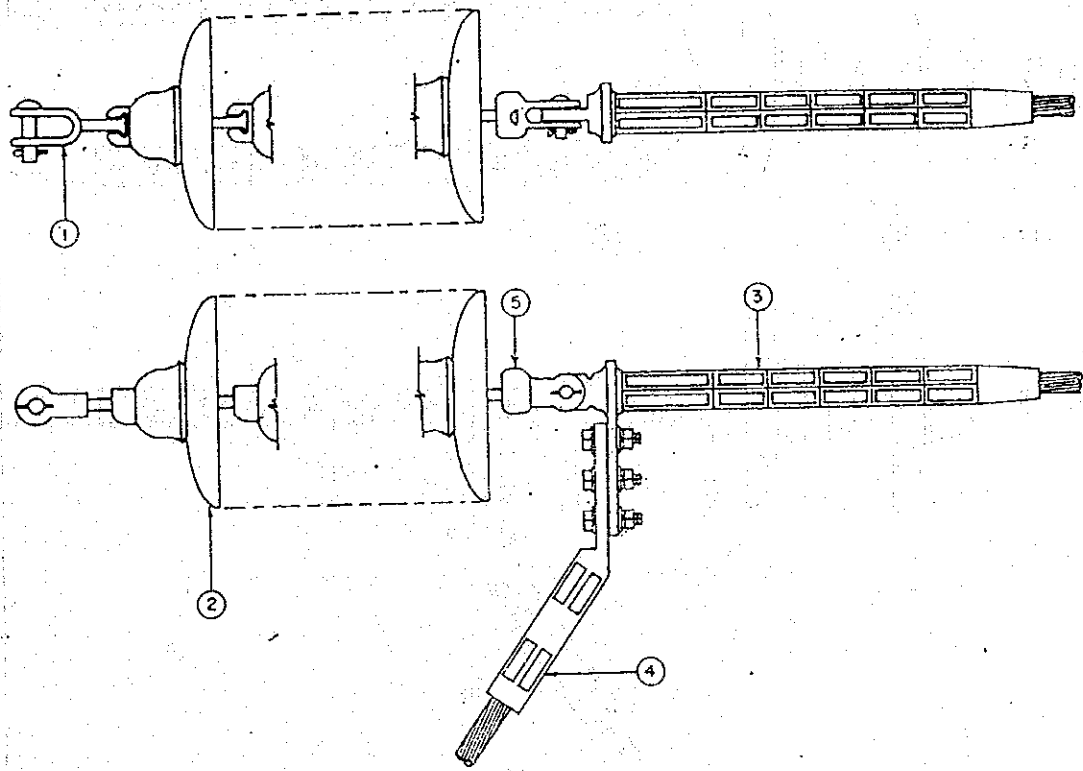
BILL OF MATERIAL							
ITEM NO.	CODE NO.	REQUIREMENTS					DESCRIPTION
		DETAIL NO.					
		1A	1B	1C	1D	1E	
1	182 - 523	-	1	1	1	1	CLEVIS, BALL, TYPE B
2	161 - 523	2	4	6	7	8	INSULATOR, SUSPENSION TYPE NEMA CLASS 52-3
3	183 - 522	1	1	1	1	1	SOCKET, EYE
4	132 - 008	1	1	1	1	1	PREFORMED, ARMOR GRIP SUSPENSION, FOR 795 MCM. AA.

Appendix 3.3-7 Insulator Assemblies NO.1



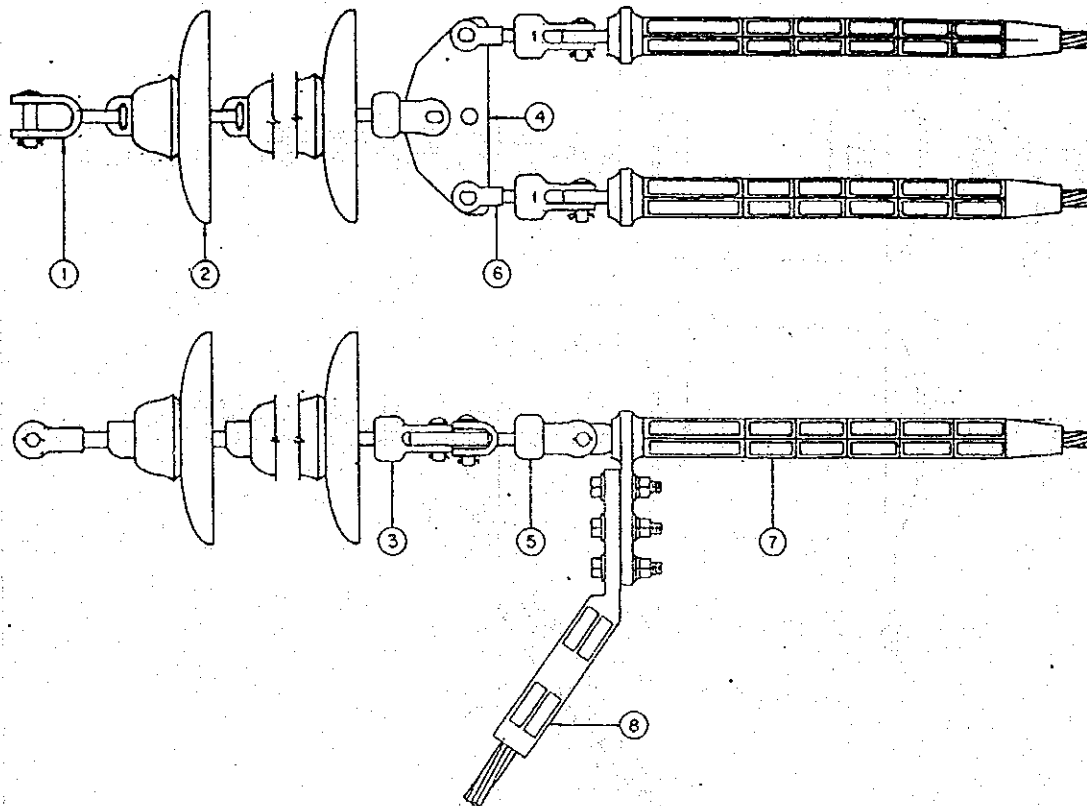
BILL OF MATERIAL						
ITEM NO.	CODE NO.	REQUIREMENTS			DESCRIPTION	
		DETAIL NO.				
		2A	2B	2C		
1	182 - 523	-	1	1	CLEVIS, BALL, TYPE B	
2	161 - 523	2	4	6	INSULATOR, SUSPENSION TYPE NEMA CLASS 52-3	
3	180 - 523	1	1	1	SOCKET, CLEVIS, TYPE B	
4	188 - 800	1	1	1	PLATE, SPACER	
5	181 - 001	2	2	2	CLEVIS, EYE	
6	132 - 008	2	2	2	PREFORMED, ARMOR GRIP SUSPENSION, FOR 795 MCM. AA.	

Appendix 3.3-8 Insulator Assemblies NO. 2



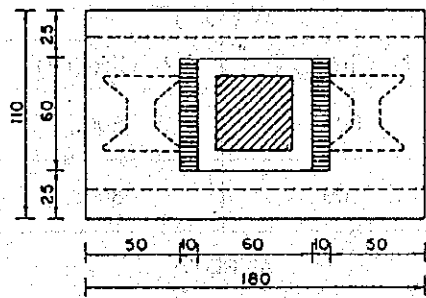
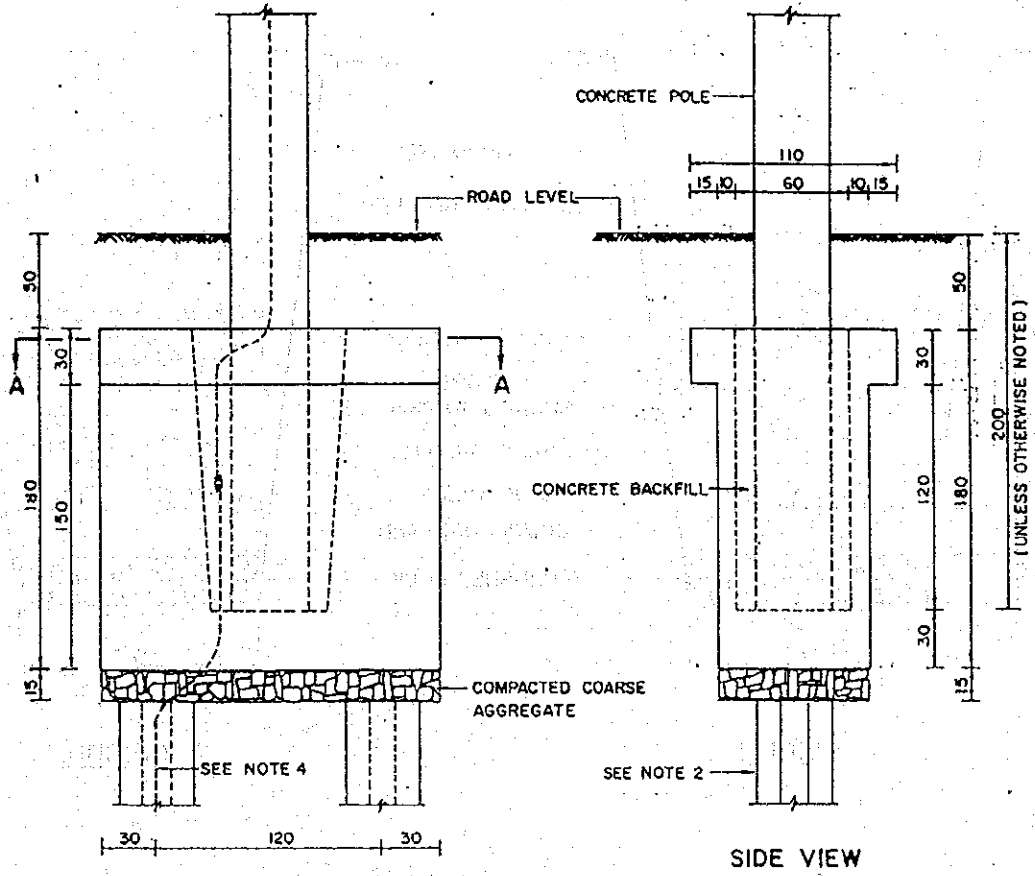
BILL OF MATERIAL						
ITEM NO.	CODE NO.	REQUIREMENTS			DESCRIPTION	
		DETAIL NO.				
		5A	5B	5C		
1	182-523	1	1	1	CLEVIS, BALL TYPE B.	
2	161-523	5	7	10	INSULATOR, SUSPENSION TYPE NEMA CLASS 52-3	
3	187-805	1	1	1	CONNECTOR, DEADEND, COMPRESSION TYPE, I-T FOR 795 MCM.AA.	
4	187-809	1	1	1	CONNECTOR, JUMPER, COMPRESSION TYPE, ANGLE FOR 795 MCM.AA.	
5	180-523	1	1	1	SOCKET, CLEVIS, TYPE B	

Appendix 3.3-9 Insulator Assemblies NO.5



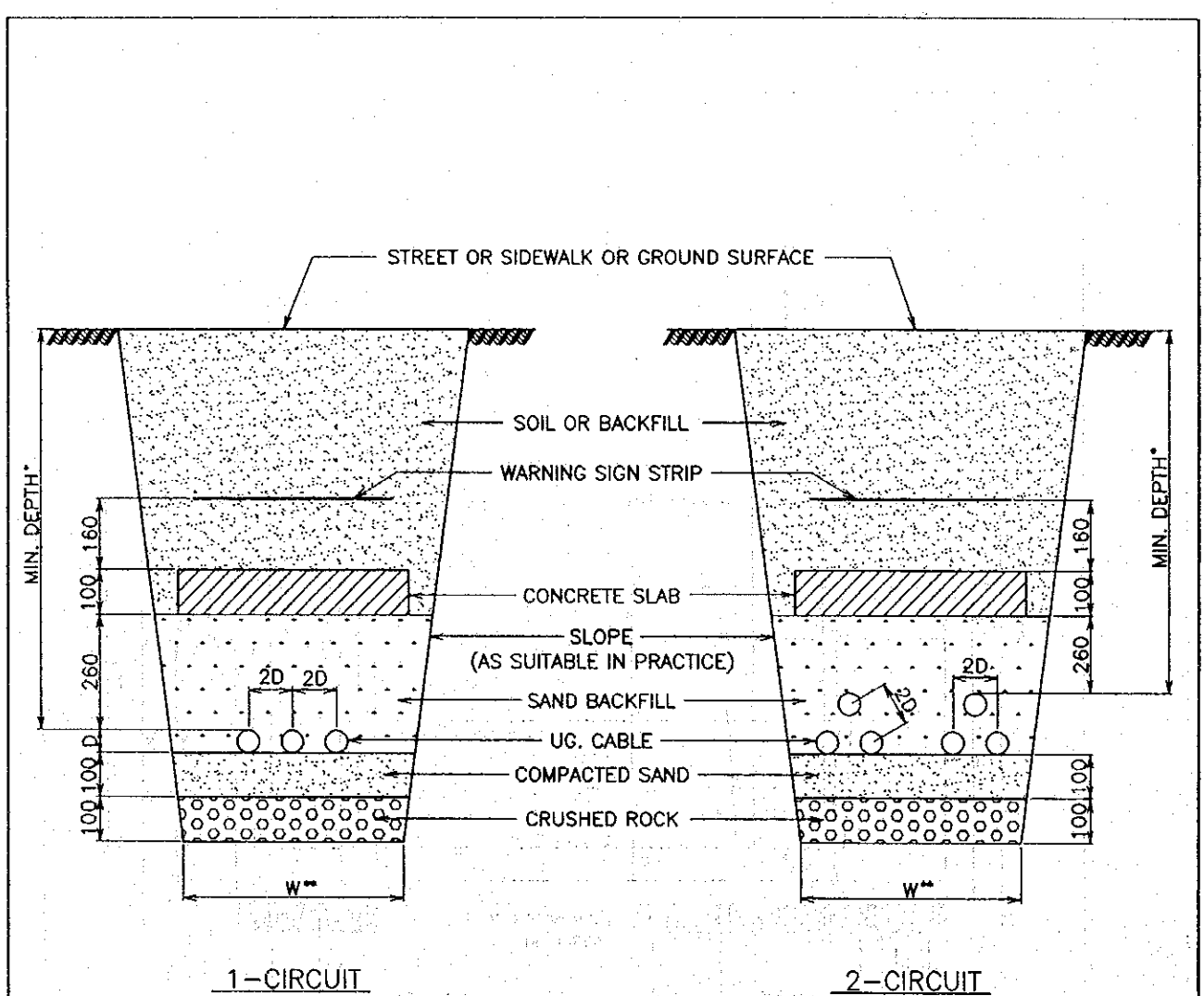
BILL OF MATERIAL					
ITEM NO.	CODE NO.	REQUIREMENTS			DESCRIPTION
		6A	6B	6C	
1	182-528	1	1	1	CLEVIS, BALL, TYPE K
2	161-528	5	7	10	INSULATOR, SUSPENSION TYPE NEMA CLASS 52-8
3	180-528	1	1	1	SOCKET, CLEVIS, TYPE K
4	188-800	1	1	1	PLATE, SPACER
5	180-523	2	2	2	SOCKET, CLEVIS, TYPE B
6	182-523	2	2	2	CLEVIS, BALL, TYPE B
7	187-805	2	2	2	CONNECTOR, DEADEND, COMPRESSION TYPE, I-T, FOR 795 MCM. AA.
8	187-809	2	2	2	CONNECTOR, JUMPER, COMPRESSION TYPE, ANGLE, FOR 795 MCM. AA.

Appendix 3.3-10 Insulator Assemblies NO. 6



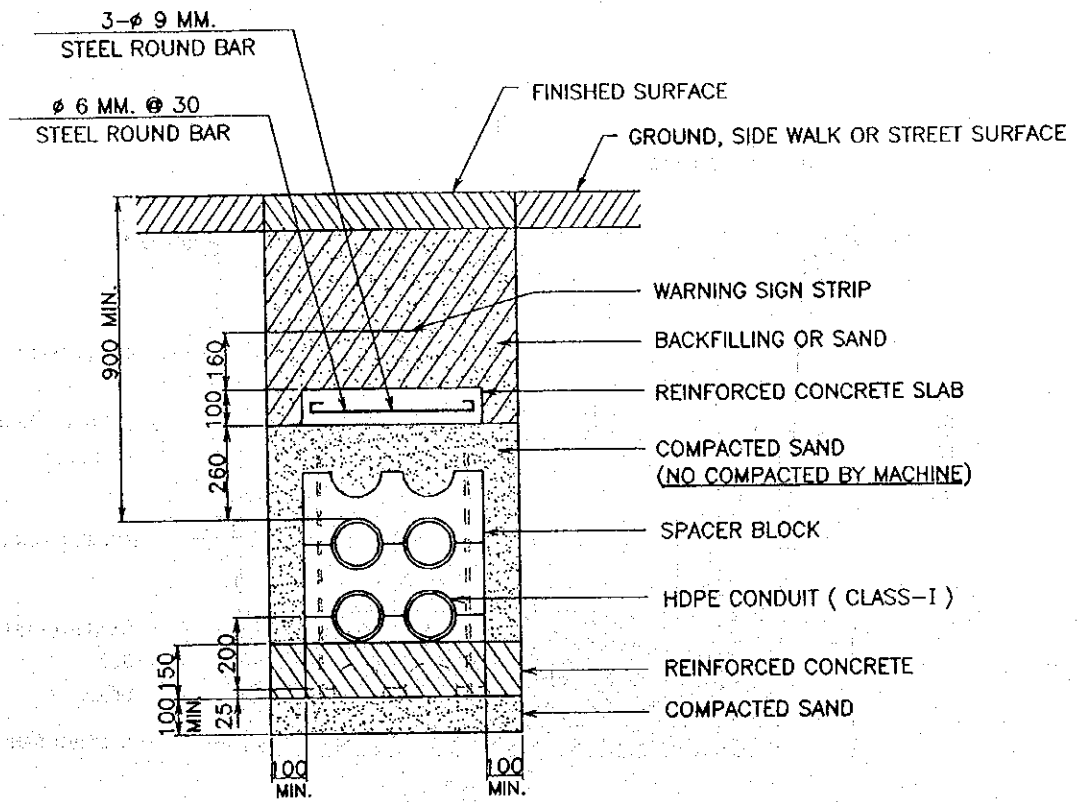
NOTES

1. SEE DWG. NO. 120-068 SH. NO. 1 FOR MORE DETAIL OF CONSTRUCTION
2. APPLICATION SEE CHART IN SH. NO. 9 FOR BENDING MOMENT REQUIRED
3. DIMENSIONS ARE IN CM.
4. SEE DETAIL NO. 28 FOR GROUND ASSEMBLY

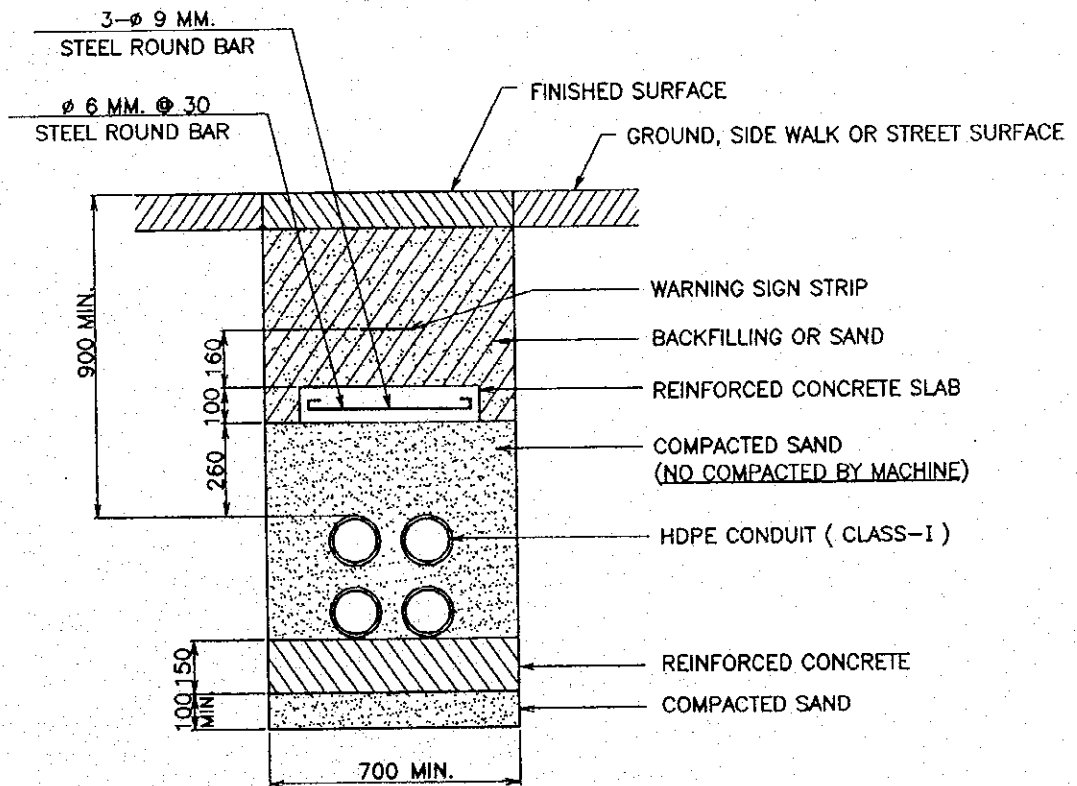


CABLE LAYING	MIN. DEPTH* (MM.)	W (MM.)**	
		1-CIRCUIT	2-CIRCUIT
UNDER ROAD OR STREET	1200	500	800
UNDER SIDEWALK	900	500	800
CUSTOMER AREA	900	AS REQ'D	

Appendix 3.3-12 Direct Buried Cable Laying (Primary & Subtransmission Construction)

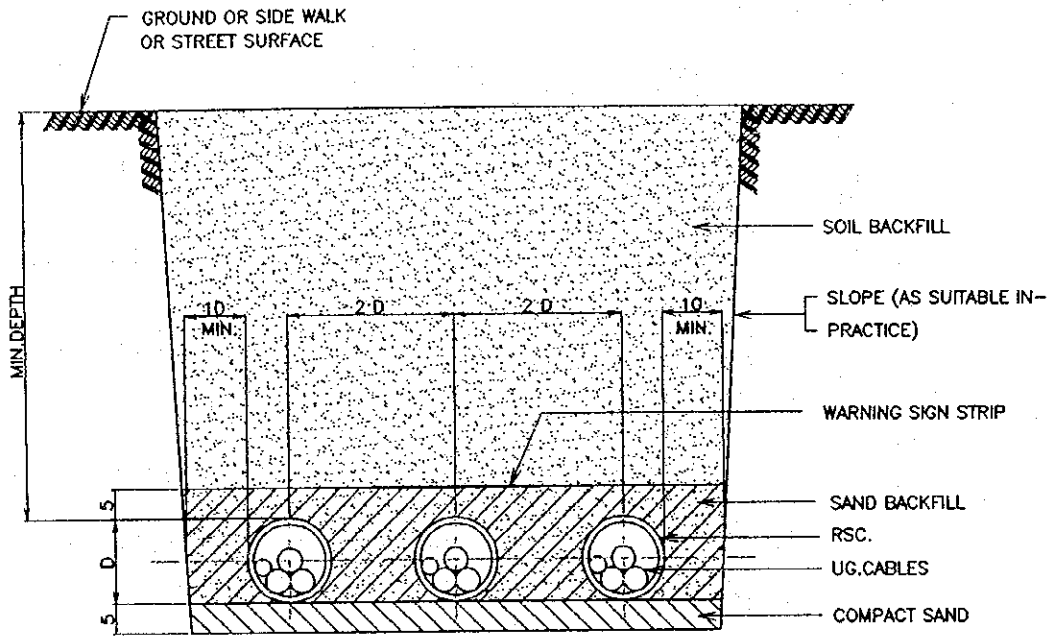


SECTION A-A



SECTION B-B

Appendix 3.3-13 HDPE Duct Bank (Primary & Subtransmission Construction)



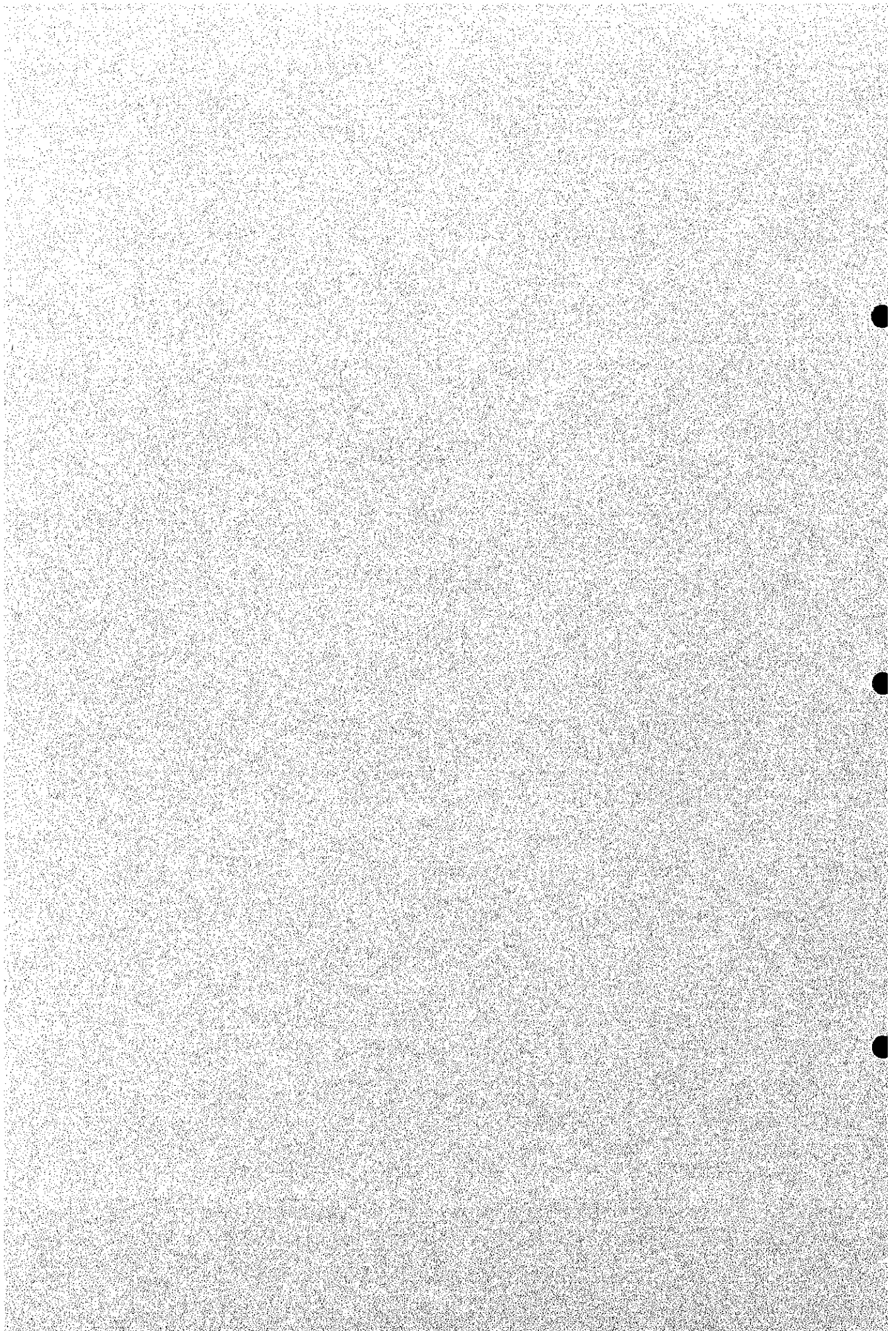
Appendix 3.3-14 Cable Laying in RSC (UG. Secondary Construction)

APPENDIX

for

CHAPTER 6

(6.3-1)



Appendix 6.3-1 Load and Installed Capacity of Distribution Substations (Planning Year = 2016)

No	Substation	Voltage (KV)	MEA Original Plan for FY 2011			2018 before Extension			IDA Study Team Plan for FY 2018			Space of Capacity (MW)
			Capacity (MW)	coincident (MW)	utilization factor (%)	Capacity (MW)	non-coinc. (MW)	Increase (%)	Capacity (MW)	Bank configuration	utilization factor (%)	
1	Bangka	69-12	0	0	0.00	0	0	0.00	0	0	0.00	0
2	Bangka	69-24	120	48.20	40.27	120	48.20	40.27	120	48.20	40.27	0
3	Bangka	115-24	115.24	81.21	70.24	115.24	81.21	70.24	115.24	81.21	70.24	0
4	Bangka	69-12	0	0	0.00	0	0	0.00	0	0	0.00	0
5	Bangka	69-24	180	78.90	65.34	180	78.90	65.34	180	78.90	65.34	0
6	Bangka	115-24	115.24	73.34	64.31	115.24	73.34	64.31	115.24	73.34	64.31	0
7	Bangka	69-12	0	0	0.00	0	0	0.00	0	0	0.00	0
8	Bangka	69-24	90	40.56	34.16	90	40.56	34.16	90	40.56	34.16	0
9	Bangka	115-24	115.24	73.34	64.31	115.24	73.34	64.31	115.24	73.34	64.31	0
10	Bangka	69-12	0	0	0.00	0	0	0.00	0	0	0.00	0
11	Bangka	69-24	180	78.90	65.34	180	78.90	65.34	180	78.90	65.34	0
12	Bangka	115-24	115.24	73.34	64.31	115.24	73.34	64.31	115.24	73.34	64.31	0
13	Bangka	69-12	0	0	0.00	0	0	0.00	0	0	0.00	0
14	Bangka	69-24	180	78.90	65.34	180	78.90	65.34	180	78.90	65.34	0
15	Bangka	115-24	115.24	73.34	64.31	115.24	73.34	64.31	115.24	73.34	64.31	0
16	Bangka	69-12	0	0	0.00	0	0	0.00	0	0	0.00	0
17	Bangka	69-24	180	78.90	65.34	180	78.90	65.34	180	78.90	65.34	0
18	Bangka	115-24	115.24	73.34	64.31	115.24	73.34	64.31	115.24	73.34	64.31	0
19	Bangka	69-12	0	0	0.00	0	0	0.00	0	0	0.00	0
20	Bangka	69-24	180	78.90	65.34	180	78.90	65.34	180	78.90	65.34	0
21	Bangka	115-24	115.24	73.34	64.31	115.24	73.34	64.31	115.24	73.34	64.31	0
22	Bangka	69-12	0	0	0.00	0	0	0.00	0	0	0.00	0
23	Bangka	69-24	180	78.90	65.34	180	78.90	65.34	180	78.90	65.34	0
24	Bangka	115-24	115.24	73.34	64.31	115.24	73.34	64.31	115.24	73.34	64.31	0
25	Bangka	69-12	0	0	0.00	0	0	0.00	0	0	0.00	0
26	Bangka	69-24	180	78.90	65.34	180	78.90	65.34	180	78.90	65.34	0
27	Bangka	115-24	115.24	73.34	64.31	115.24	73.34	64.31	115.24	73.34	64.31	0
28	Bangka	69-12	0	0	0.00	0	0	0.00	0	0	0.00	0
29	Bangka	69-24	180	78.90	65.34	180	78.90	65.34	180	78.90	65.34	0
30	Bangka	115-24	115.24	73.34	64.31	115.24	73.34	64.31	115.24	73.34	64.31	0
31	Bangka	69-12	0	0	0.00	0	0	0.00	0	0	0.00	0
32	Bangka	69-24	180	78.90	65.34	180	78.90	65.34	180	78.90	65.34	0
33	Bangka	115-24	115.24	73.34	64.31	115.24	73.34	64.31	115.24	73.34	64.31	0
34	Bangka	69-12	0	0	0.00	0	0	0.00	0	0	0.00	0
35	Bangka	69-24	180	78.90	65.34	180	78.90	65.34	180	78.90	65.34	0
36	Bangka	115-24	115.24	73.34	64.31	115.24	73.34	64.31	115.24	73.34	64.31	0
37	Bangka	69-12	0	0	0.00	0	0	0.00	0	0	0.00	0
38	Bangka	69-24	180	78.90	65.34	180	78.90	65.34	180	78.90	65.34	0
39	Bangka	115-24	115.24	73.34	64.31	115.24	73.34	64.31	115.24	73.34	64.31	0
40	Bangka	69-12	0	0	0.00	0	0	0.00	0	0	0.00	0
41	Bangka	69-24	180	78.90	65.34	180	78.90	65.34	180	78.90	65.34	0
42	Bangka	115-24	115.24	73.34	64.31	115.24	73.34	64.31	115.24	73.34	64.31	0
43	Bangka	69-12	0	0	0.00	0	0	0.00	0	0	0.00	0

No.	ABB	Substation	2011 Original Plan for FY 2011				2016 before Expansion				JICA Study Test Plan for FY 2016				Space of Capacity (MW)			
			Volume (CV)	Capacity (MW)	non-incident (MW)	utilization (factor)	Capacity (MW)	non-incident (MW)	utilization (factor)	Increase (MW)	utilization (factor)	Bank configuration	Capacity (MW)	non-incident (MW)		utilization (factor)		
43	WC	Wangmai	2	40	1	60	72.2	1.74	102.53	72.2	2	40	1	60	140	49.11	192.53	72.2
44	WC	Wangmai	2	40	1	60	72.2	1.74	102.53	72.2	2	40	1	60	140	49.11	192.53	72.2
45	WT	Wangmaeng 1	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
46	WT	Wangmaeng 2	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
47	WT	Wangmaeng 3	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
48	WT	Wangmaeng 4	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
49	WT	Wangmaeng 5	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
50	WT	Wangmaeng 6	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
51	WT	Wangmaeng 7	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
52	WT	Wangmaeng 8	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
53	WT	Wangmaeng 9	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
54	WT	Wangmaeng 10	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
55	WT	Wangmaeng 11	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
56	WT	Wangmaeng 12	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
57	WT	Wangmaeng 13	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
58	WT	Wangmaeng 14	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
59	WT	Wangmaeng 15	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
60	WT	Wangmaeng 16	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
61	WT	Wangmaeng 17	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
62	WT	Wangmaeng 18	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
63	WT	Wangmaeng 19	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
64	WT	Wangmaeng 20	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
65	WT	Wangmaeng 21	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
66	WT	Wangmaeng 22	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
67	WT	Wangmaeng 23	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
68	WT	Wangmaeng 24	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
69	WT	Wangmaeng 25	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
70	WT	Wangmaeng 26	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
71	WT	Wangmaeng 27	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
72	WT	Wangmaeng 28	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
73	WT	Wangmaeng 29	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
74	WT	Wangmaeng 30	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
75	WT	Wangmaeng 31	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
76	WT	Wangmaeng 32	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
77	WT	Wangmaeng 33	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
78	WT	Wangmaeng 34	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
79	WT	Wangmaeng 35	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
80	WT	Wangmaeng 36	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
81	WT	Wangmaeng 37	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
82	WT	Wangmaeng 38	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
83	WT	Wangmaeng 39	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2
84	WT	Wangmaeng 40	2	60	1	60	72.2	1.74	102.53	72.2	2	60	1	60	120	59.34	179.75	72.2

Appendix 6.3-1 Load and Installed Capacity of Distribution Substations (Planning Year = 2016)

No.	Substation	Voltage (KV)	2011 Original Plan for FY 2011			2016 before Expansion			JICA Study Plan for FY 2016			Space of Capacity (kVA)
			Capacity (MVA)	coincident (MW)	utilization factor (%)	Capacity (MVA)	coincident (MW)	utilization factor (%)	Capacity (MVA)	coincident (MW)	utilization factor (%)	
01	Thammasat	66-24	180	78.20	43.4	180	78.20	43.4	180	78.20	43.4	0.00
02	Thonburi	66-24	140	65.50	46.8	140	65.50	46.8	140	65.50	46.8	0.00
03	Pongtong	66-24	80	31.35	39.3	80	31.35	39.3	80	31.35	39.3	0.00
04	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
05	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
06	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
07	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
08	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
09	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
10	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
11	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
12	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
13	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
14	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
15	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
16	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
17	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
18	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
19	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
20	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
21	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
22	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
23	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
24	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
25	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
26	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
27	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
28	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
29	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00
30	Phra Prachin	66-24	180	85.85	47.7	180	85.85	47.7	180	85.85	47.7	0.00

Appendix 6.3-1 Load and Installed Capacity of Distribution Substations (Planning Year = 2016)

No	Substation	Voltage (KV)	NEA Original Plan for FY 2011				2016 before Expansion				JICA Study Team Plan for FY 2016				Space of Capacity (MW)	
			Capacity (MW)	non-incident (MW)	utilization factor (%)	Bank configuration	Capacity (MW)	non-incident (MW)	Increase (MW)	utilization factor (%)	Capacity (MW)	non-incident (MW)	utilization factor (%)	Bank configuration		
191	191	115.24	170	51.35	68.03	55.0	28.91	2.85	63.1	2	50	120	53.11	76.91	53.2	
192	192	69.12	170	55.42	71.27	58.4	71.40	1.40	64.5	3	40	120	60.50	71.30	61.5	
Total			28,120	12,645.85	16,362.11	57.8	28,120	19,029.55	3.10	67.7			29,410	14,373.67	19,923.85	55.1

Diversity Factor
Power Factor

1.1818
0.9190

Number of Bank
Number of Substation
Ratio #/0

501
192
2.6094

