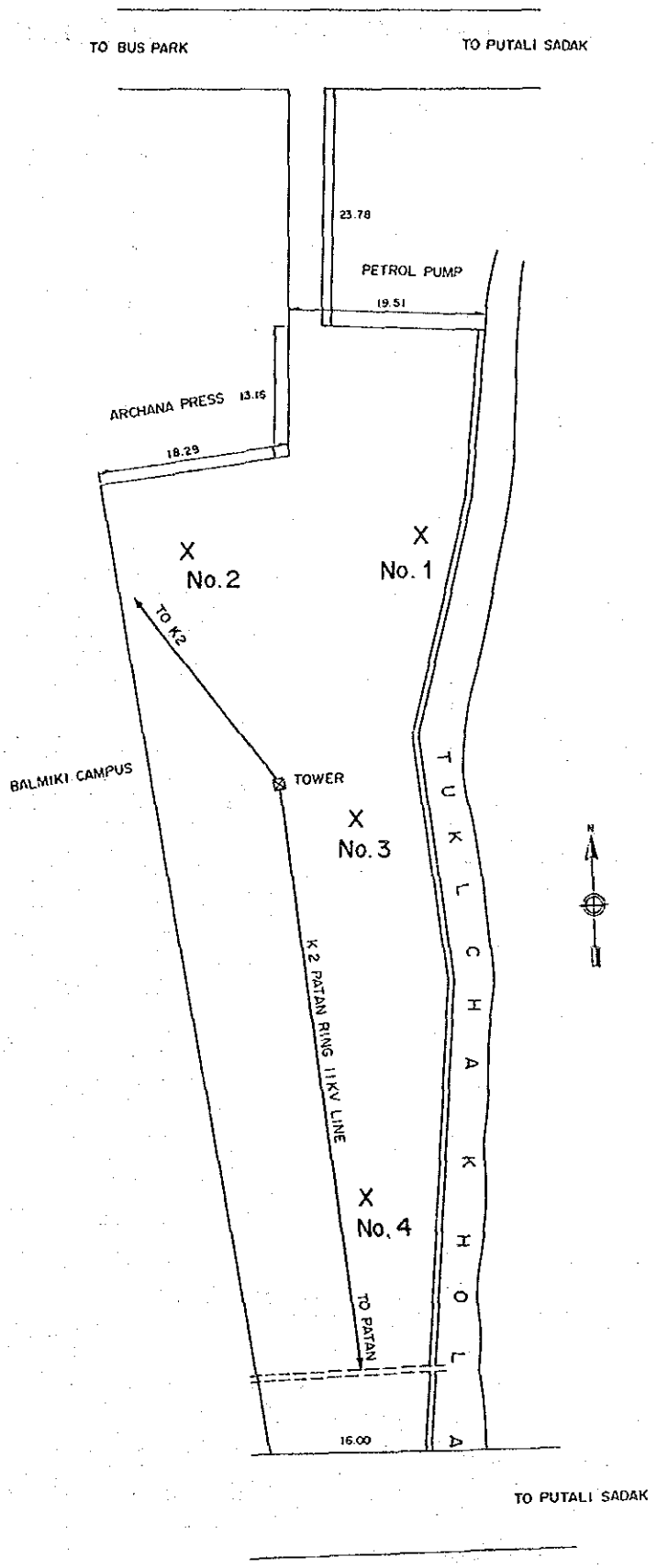


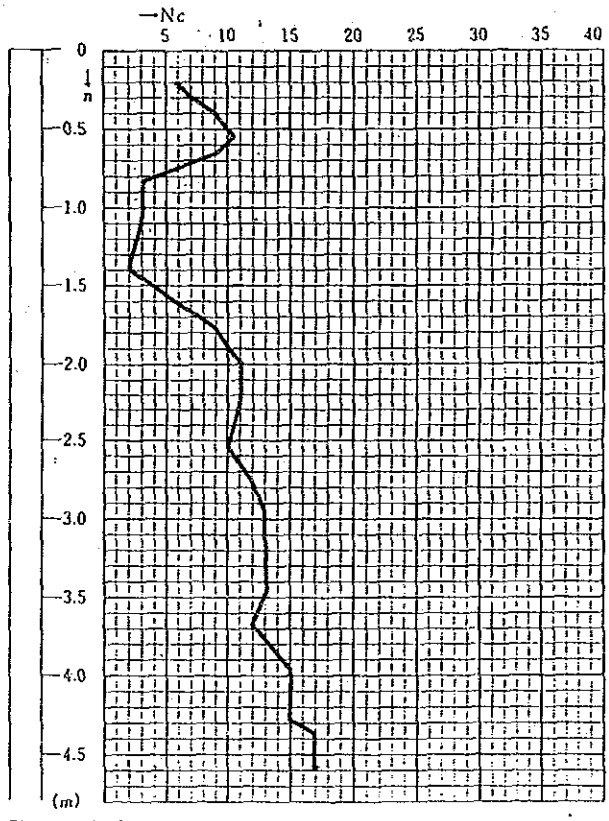
MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 6 (1/17) Soil Investigation Point at K3 Substation

SOIL INVESTIGATION RECORD

Point No.	1	Place	K3 S/S

Date	18 / 6 / '91

Hitting Nos. N (Nos.)	Penetration Depth h (cm)	Penetration $d = h_n - h_{n-1}$	$Nc = \frac{N}{d} \times 10$
0	6		
7	17	11	6
8	28	11	7
8	38	10	8
9	46	8	11
10	54.5	7.5	11
7	65.5	10	7
9	76	10.5	9
5	85	9	6
3	94	9	3
2	102	8	3
3	113.5	11.5	3
4	129.5	14	3
2	139.5	10	2
2	146.5	7	3
5	156.5	10	5
8	166	9.5	8
10	177	11	9
10	187	10	10
9	197	10	9
10	206	9	11
10	216	10	10
11	226	10	11
12	236	10	12
12	246	10	12
10	256	10	10
10	266	10	10
12	276	10	12
13	286	10	13
13	296	10	13
10	305	9	11
20	321	16	13
21	337	16	13
10	345	8	13
20	361	16	13
10	370	9	11
20	385	15	13
20	398	13	15
13	407	9	14
15	418	11	14
15	428	10	15
17	438	10	17
17	448	10	17
17	458	10	17



Nc Value Conversion Table

N \ h	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0
1	20	10	7	5	4	3	3	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	40	20	13	10	8	7	6	5	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1	1	1
3	[redacted]	30	20	15	12	10	9	8	7	6	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2
4	[redacted]	40	27	20	16	13	11	10	9	8	7	7	6	6	5	5	5	4	4	4	4	4	3	3	3	3	3	2	3	3
5	[redacted]	50	33	25	20	17	14	13	11	10	9	8	8	7	7	6	6	6	5	5	5	5	4	4	4	4	4	3	3	3
6	[redacted]	[redacted]	40	30	24	20	17	15	13	12	11	10	9	9	8	8	7	7	6	6	6	5	5	5	5	5	4	4	4	4
8	[redacted]	[redacted]	[redacted]	40	32	27	23	20	18	16	15	13	12	11	11	10	9	9	8	8	8	7	7	7	6	6	6	6	6	5
10	[redacted]	[redacted]	[redacted]	50	40	33	29	25	22	20	18	17	15	14	13	13	12	11	11	10	10	9	9	8	8	8	7	7	7	7
15	[redacted]	[redacted]	[redacted]	[redacted]	60	50	43	38	33	30	27	25	23	21	20	19	18	17	16	15	14	14	13	12	12	12	11	11	10	10
20	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	50	44	40	36	33	31	28	27	25	24	22	21	20	19	18	17	17	16	15	15	14	14	13

(Example) In case of 5 nos. hitting with penetration 8 cm , Nc value is 6.

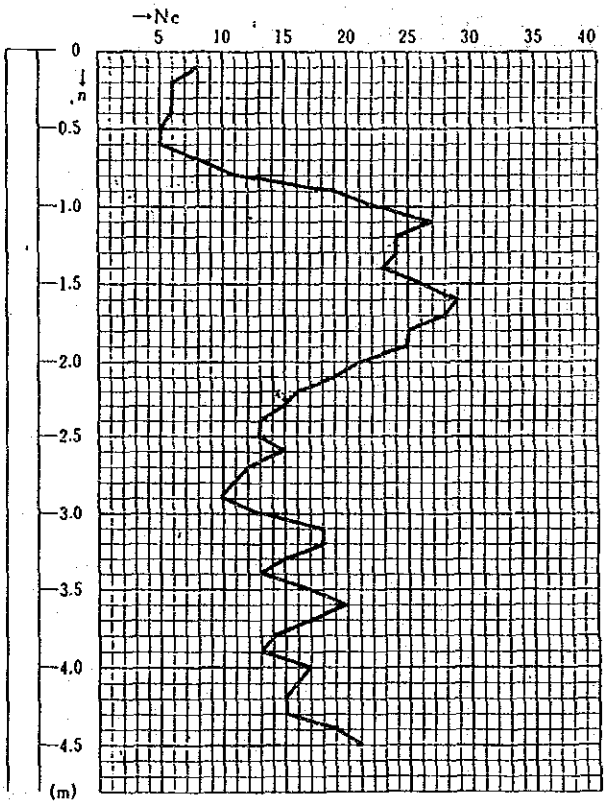
MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 6 (2/17) Soil Investigation Record at K3 Substation (Point No.1)

SOIL INVESTIGATION RECORD

Point No.	2	Place	K3 S/S

Date	18 / 6 / '91

Hitting Nos. N (Nos.)	Penetration Depth h (cm)	Penetration $d = h_n - h_{n-1}$	$Nc = \frac{N}{d} \times 10$
0	0		
8	10	10	8
6	20	10	6
6	30	10	6
6	40	10	6
5	50	10	5
5	60	10	5
8	70	10	8
11	80	10	11
19	90	10	19
22	100	10	22
27	110	10	27
24	120	10	24
24	130	10	24
23	140	10	23
26	150	10	26
29	160	10	29
28	170	10	28
25	180	10	25
25	190	10	25
21	200	10	21
19	210	10	19
16	220	10	16
15	230	10	15
13	240	10	13
13	250	10	13
15	260	10	15
12	270	10	12
11	280	10	11
10	290	10	10
13	300	10	13
18	310	10	18
18	320	10	18
15	330	10	15
13	340	10	13
17	350	10	17
20	360	10	20
17	370	10	17
14	380	10	14
13	390	10	13
17	400	10	17
16	410	10	16
15	420	10	15
15	430	10	15
19	440	10	19
21	450	10	21



Nc Value Conversion Table

N \ d	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0
1	20	10	7	5	4	3	3	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	40	20	13	10	8	7	6	5	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1	1	1
3	[illegible]	30	20	15	12	10	9	8	7	6	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2
4	[illegible]	40	27	20	16	13	11	10	9	8	7	7	6	6	5	5	5	4	4	4	4	4	3	3	3	3	3	2	3	3
5	[illegible]	50	33	25	20	17	14	13	11	10	9	8	8	7	7	6	6	6	5	5	5	5	4	4	4	4	4	3	3	3
6	[illegible]	[illegible]	40	30	24	20	17	15	13	12	11	10	9	9	8	8	7	7	6	6	6	5	5	5	5	5	4	4	4	4
8	[illegible]	[illegible]	[illegible]	40	32	27	23	20	18	16	15	13	12	11	11	10	9	9	8	8	8	7	7	7	6	6	6	6	6	5
10	[illegible]	[illegible]	[illegible]	50	40	33	29	25	22	20	18	17	15	14	13	13	12	11	11	10	10	9	9	8	8	8	7	7	7	7
15	[illegible]	[illegible]	[illegible]	[illegible]	60	50	43	38	33	30	27	25	23	21	20	19	18	17	16	15	14	14	13	12	12	12	11	11	10	10
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	50	44	40	36	33	31	28	27	25	24	22	21	20	19	18	17	17	16	15	15	14	14	13

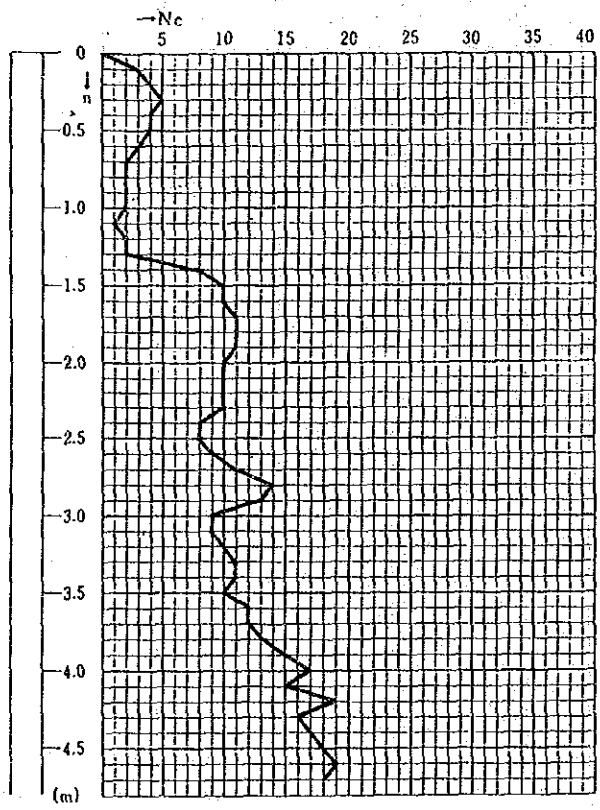
(Example) In case of 5 nos. hitting with penetration 8 cm , Nc nalue is 6.

MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 6 (3/17) Soil Investigation Record at K3 Substation (Point No.2)

SOIL INVESTIGATION RECORD

Point No.	3	Place	K3 S/S	Date	21 / 6 / '91

Hitting Nos. N (Nos.)	Penetration Depth h (cm)	Penetration $d=h_n-h_{n-1}$	$Nc=\frac{N}{d}\times 10$
0	0	0	0
3	10	10	3
4	20	10	4
5	30	10	5
4	40	10	4
4	50	10	4
3	60	10	3
2	70	10	2
2	80	10	2
2	90	10	2
2	100	10	2
1	110	10	1
2	120	10	2
2	130	10	2
8	140	10	8
10	150	10	10
10	160	10	10
11	170	10	11
10	180	10	11
11	190	10	11
10	200	10	10
10	210	10	10
10	220	10	10
10	230	10	10
8	240	10	8
8	250	10	8
9	260	10	9
11	270	10	11
14	280	10	14
13	290	10	13
9	300	10	9
9	310	10	9
10	320	10	10
11	330	10	11
11	340	10	11
10	350	10	10
12	360	10	12
12	370	10	12
13	380	10	13
15	390	10	15
17	400	10	17
15	410	10	15
19	420	10	19
16	430	10	16
17	440	10	17
18	450	10	18
19	460	10	19
18	470	10	18



Nc Value Conversion Table

N \ h	0.5	1.0 : 1.5	2.0 : 2.5	3.0 : 3.5	4.0 : 4.5	5.0 : 5.5	6.0 : 6.5	7.0 : 7.5	8.0 : 8.5	9.0 : 9.5	10.0 : 10.5	11.0 : 11.5	12.0 : 12.5	13.0 : 13.5	14.0 : 14.5	15.0
1	20	10 : 7	5 : 4	3 : 3	3 : 2	2 : 2	2 : 2	1 : 1	1 : 1	1 : 1	1 : 1	1 : 1	1 : 1	1 : 1	1 : 1	1
2	40	20 : 13	10 : 8	7 : 6	5 : 4	4 : 4	3 : 3	3 : 3	3 : 2	2 : 2	2 : 2	2 : 2	2 : 2	2 : 1	1 : 1	1
3	[illegible]	30 : 20	15 : 12	10 : 9	8 : 7	6 : 5	5 : 5	4 : 4	4 : 4	3 : 3	3 : 3	3 : 3	2 : 2	2 : 2	2 : 2	2
4	[illegible]	40 : 27	20 : 16	13 : 11	10 : 9	8 : 7	7 : 6	6 : 5	5 : 5	4 : 4	4 : 4	4 : 3	3 : 3	3 : 3	2 : 3	3
5	[illegible]	50 : 33	25 : 20	17 : 14	13 : 11	10 : 9	8 : 8	7 : 7	6 : 6	6 : 5	5 : 5	5 : 4	4 : 4	4 : 4	3 : 3	3
6	[illegible]	[illegible] : 40	30 : 24	20 : 17	15 : 13	12 : 11	10 : 9	9 : 8	8 : 7	7 : 6	6 : 6	5 : 5	5 : 5	5 : 4	4 : 4	4
8	[illegible]	[illegible] : [illegible]	40 : 32	27 : 23	20 : 18	16 : 15	13 : 12	11 : 11	10 : 9	9 : 8	8 : 8	7 : 7	7 : 6	6 : 6	6 : 6	5
10	[illegible]	[illegible] : [illegible]	50 : 40	33 : 29	25 : 22	20 : 18	17 : 15	14 : 13	13 : 12	11 : 11	10 : 10	9 : 9	8 : 8	8 : 7	7 : 7	7
15	[illegible]	[illegible] : [illegible]	[illegible] : 60	50 : 43	38 : 33	30 : 27	25 : 23	21 : 20	19 : 18	17 : 16	15 : 14	14 : 13	12 : 12	12 : 11	11 : 10	10
20	[illegible]	[illegible] : [illegible]	[illegible] : [illegible]	[illegible] : [illegible]	50 : 44	40 : 36	33 : 31	28 : 27	25 : 24	22 : 21	20 : 19	18 : 17	17 : 16	15 : 15	14 : 14	13

(Example) In case of 5 nos. hitting with penetration 8 cm , Nc value is 6.

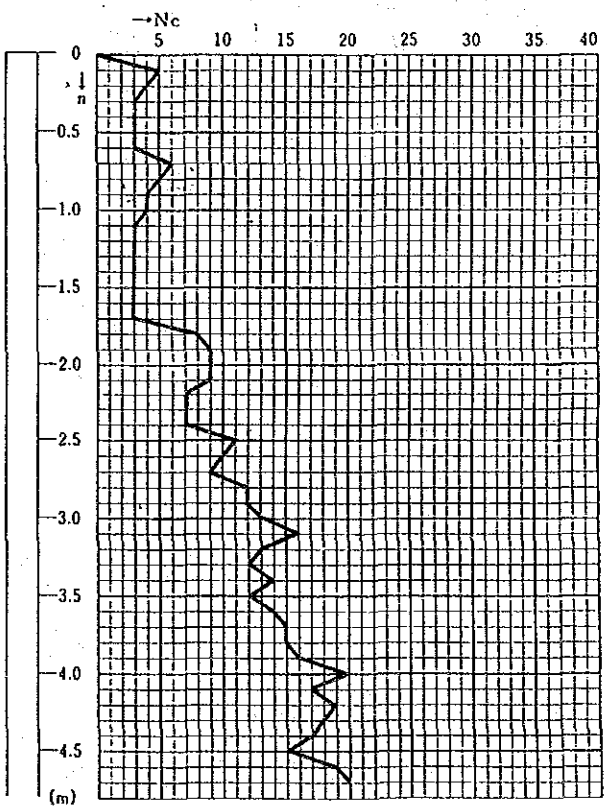
MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 6 (4/17) Soil Investigation Record at K3 Substation (Point No.3)

SOIL INVESTIGATION RECORD

Point No.	4	Place	K3 S/S

Date	21 / 6 / '91

Hitting Nos. N (Nos.)	Penetration Depth h (cm)	Penetration $d=h_n-h_{n-1}$	$Nc=\frac{N}{d}\times 10$
0	0	0	0
5	10	10	5
4	20	10	4
3	30	10	3
3	40	10	3
3	50	10	3
3	60	10	3
6	70	10	6
5	80	10	5
4	90	10	4
4	100	10	4
3	110	10	3
3	120	10	3
3	130	10	3
3	140	10	3
3	150	10	3
3	160	10	3
3	170	10	3
8	180	10	8
9	190	10	9
9	200	10	9
9	210	10	9
7	220	10	7
7	230	10	7
7	240	10	7
11	250	10	11
10	260	10	10
9	270	10	9
12	280	10	12
12	290	10	12
13	300	10	13
16	310	10	16
13	320	10	13
12	330	10	12
14	340	10	14
12	350	10	12
14	360	10	14
15	370	10	15
15	380	10	15
16	390	10	16
20	400	10	20
17	410	10	17
19	420	10	19
18	430	10	18
17	440	10	17
15	450	10	15
19	460	10	19
20	470	10	20

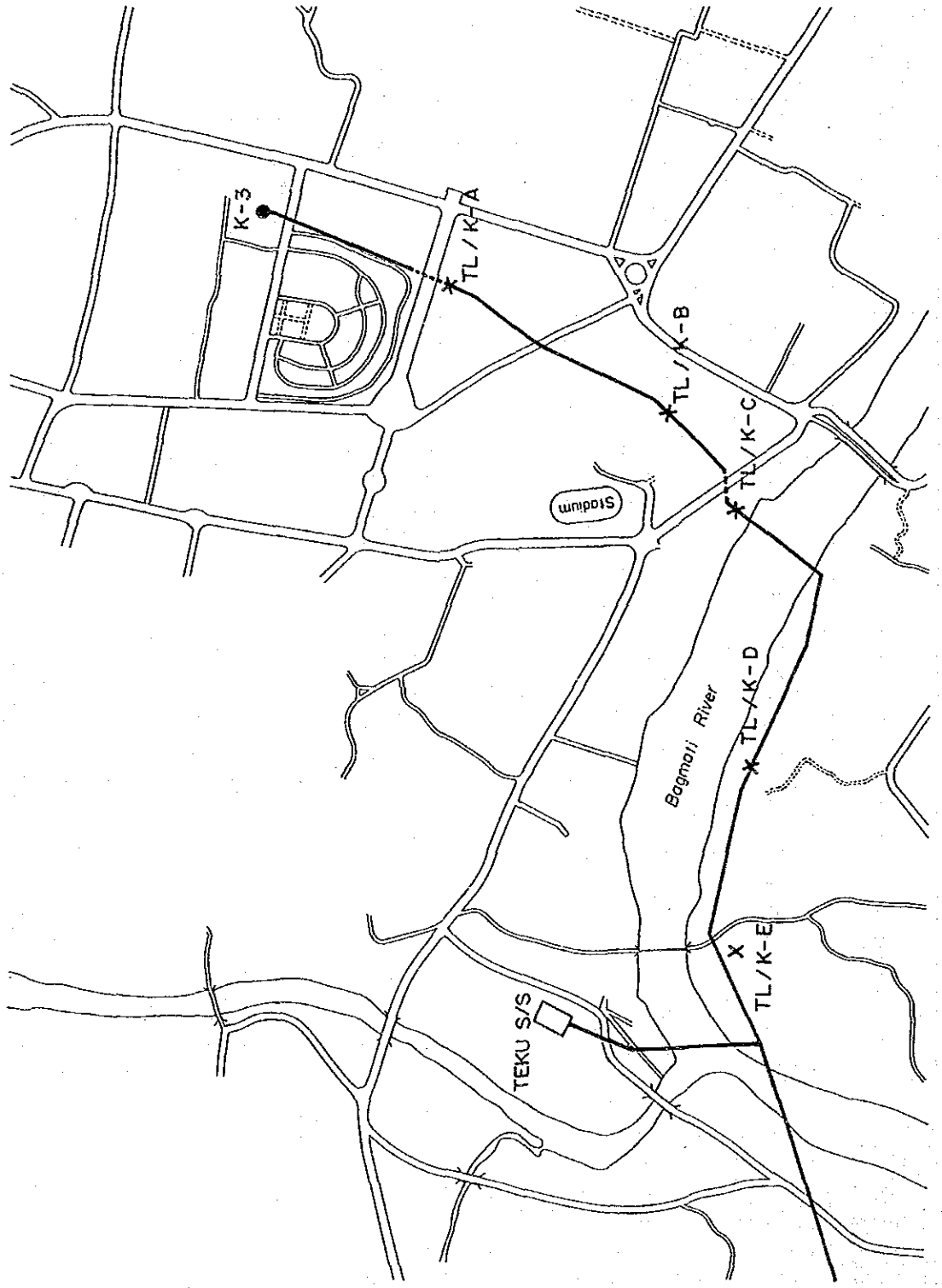


Nc Value Conversion Table

N \ d	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0
1	20	10	7	5	4	3	3	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	40	20	13	10	8	7	6	5	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1	1	1
3	[illegible]	30	20	15	12	10	9	8	7	6	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2
4	[illegible]	40	27	20	16	13	11	10	9	8	7	7	6	6	5	5	5	4	4	4	4	4	3	3	3	3	3	2	3	3
5	[illegible]	50	33	25	20	17	14	13	11	10	9	8	8	7	7	6	6	6	5	5	5	5	4	4	4	4	4	3	3	3
6	[illegible]	[illegible]	40	30	24	20	17	15	13	12	11	10	9	9	8	8	7	7	6	6	6	5	5	5	5	5	4	4	4	4
8	[illegible]	[illegible]	[illegible]	40	32	27	23	20	18	16	15	13	12	11	11	10	9	9	8	8	8	7	7	7	6	6	6	6	6	5
10	[illegible]	[illegible]	[illegible]	50	40	33	29	25	22	20	18	17	15	14	13	13	12	11	11	10	10	9	9	8	8	8	7	7	7	7
15	[illegible]	[illegible]	[illegible]	[illegible]	60	50	43	38	33	30	27	25	23	21	20	19	18	17	16	15	14	14	13	12	12	12	11	11	10	10
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	50	44	40	36	33	31	28	27	25	24	22	21	20	19	18	17	17	16	15	15	14	14	13

(Example) In case of 5 nos. hitting with penetration 8 cm , Nc nalue is 6.

MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 6 (5/17) Soil Investigation Record at K3 Substation (Point No.4)



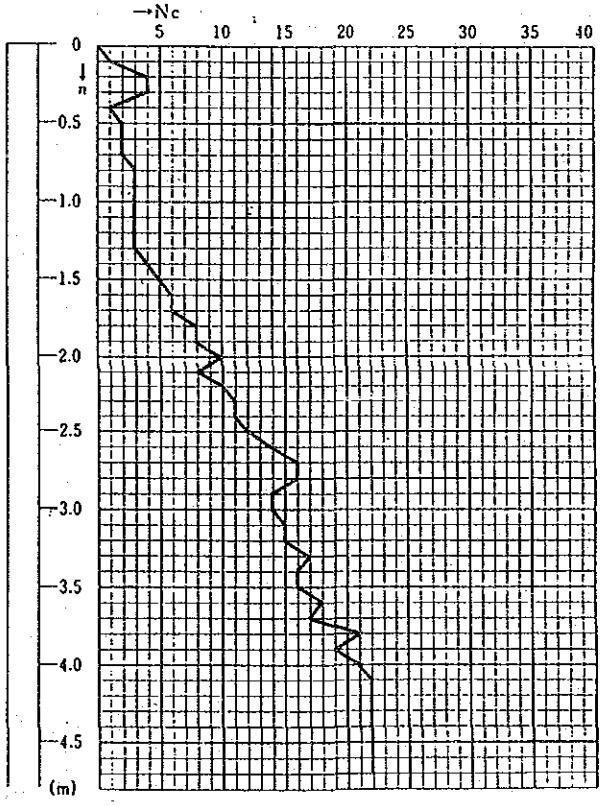
MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 6 (6/17) Location of Soil Investigation Place on TEKU - K3 66kV Transmission Line

SOIL INVESTIGATION RECORD

Point No.	1	Place	TL/K-A

Date	21 / 6 / '91

Hitting Nos. N (Nos.)	Penetration Depth h (cm)	Penetration $d=h_n-h_{n-1}$	$Nc=\frac{N}{d}\times 10$
0	0		
1	10	10	1
4	20	10	4
4	30	10	4
1	40	10	1
2	50	10	2
2	60	10	2
2	70	10	2
3	80	10	3
3	90	10	3
3	100	10	3
3	110	10	3
3	120	10	3
3	130	10	3
4	140	10	4
5	150	10	5
6	160	10	6
6	170	10	6
8	180	10	8
8	190	10	8
10	200	10	10
8	210	10	8
10	220	10	10
11	230	10	11
11	240	10	11
12	250	10	12
14	260	10	14
16	270	10	16
16	280	10	16
14	290	10	14
14	300	10	14
15	310	10	15
15	320	10	15
17	330	10	17
16	340	10	16
16	350	10	16
18	360	10	18
17	370	10	17
21	380	10	21
19	390	10	19
21	400	10	21
22	410	10	22
22	420	10	22
22	430	10	22
22	440	10	22
22	450	10	22
22	460	10	22
22	470	10	22



Nc Value Conversion Table

N \ h	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0
1	20	10	7	5	4	3	3	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	40	20	13	10	8	7	6	5	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1	1	1
3	[redacted]	30	20	15	12	10	9	8	7	6	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2
4	[redacted]	40	27	20	16	13	11	10	9	8	7	7	6	6	5	5	5	4	4	4	4	4	3	3	3	3	3	2	3	3
5	[redacted]	50	33	25	20	17	14	13	11	10	9	8	8	7	7	6	6	6	5	5	5	5	4	4	4	4	4	3	3	3
6	[redacted]	[redacted]	40	30	24	20	17	15	13	12	11	10	9	9	8	8	7	7	6	6	6	5	5	5	5	5	4	4	4	4
8	[redacted]	[redacted]	[redacted]	40	32	27	23	20	18	16	15	13	12	11	11	10	9	9	8	8	8	7	7	7	6	6	6	6	6	5
10	[redacted]	[redacted]	[redacted]	50	40	33	29	25	22	20	18	17	15	14	13	13	12	11	11	10	10	9	9	8	8	8	7	7	7	7
15	[redacted]	[redacted]	[redacted]	[redacted]	60	50	43	38	33	30	27	25	23	21	20	19	18	17	16	15	14	14	13	12	12	12	11	11	10	10
20	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	50	44	40	36	33	31	28	27	25	24	22	21	20	19	18	17	17	16	15	15	14	14	13

(Example) In case of 5 nos. hitting with penetration 8 cm , Nc value is 6.

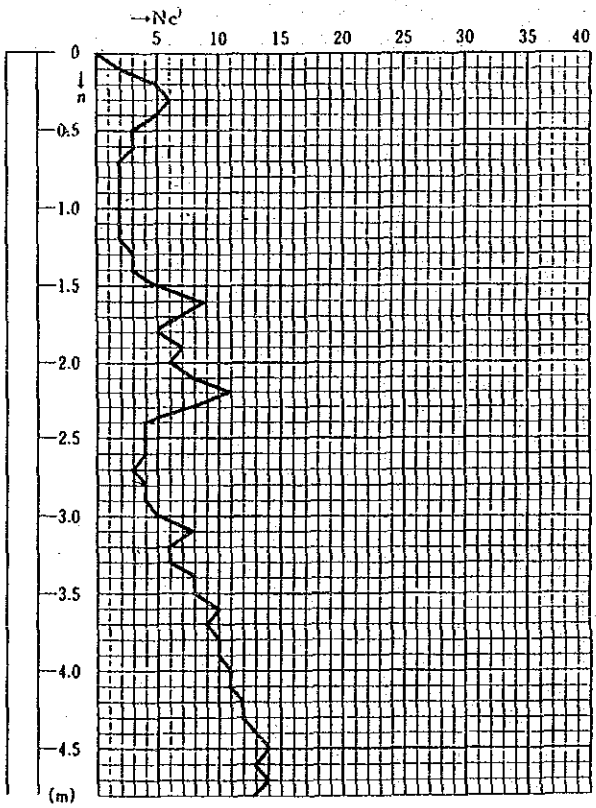
MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 6 (7/17) Soil Investigation Record on TEKU - K3 66kV T/L (TL/K - A)

SOIL INVESTIGATION RECORD

Point No.	1	Place	TL/K-B

Date	21 / 6 / '91

Hitting Nos. N (Nos.)	Penetration Depth h (cm)	Penetration $d = h_n - h_{n-1}$	$Nc = \frac{N}{d} \times 10$
0	0	0	0
2	10	10	2
5	20	10	5
6	30	10	6
5	40	10	5
3	50	10	3
3	60	10	3
2	70	10	2
2	80	10	2
2	90	10	2
2	100	10	2
2	110	10	2
2	120	10	2
3	140	10	3
5	150	10	5
9	160	10	9
7	170	10	7
5	180	10	5
7	190	10	7
6	200	10	6
8	210	10	8
11	220	10	11
8	230	10	8
4	240	10	4
4	250	10	4
4	260	10	4
3	270	10	3
3	280	10	3
4	290	10	4
5	300	10	5
8	310	10	8
6	320	10	6
6	330	10	6
8	340	10	8
8	350	10	8
10	360	10	10
9	370	10	9
10	380	10	10
10	390	10	10
11	400	10	11
11	410	10	11
12	420	10	12
12	430	10	12
13	440	10	13
14	450	10	14
13	460	10	13
14	470	10	14
13	480	10	13
3	130	10	3



Nc Value Conversion Table

N \ d	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0
1	20	10	7	5	4	3	3	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	40	20	13	10	8	7	6	5	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1	1	1
3	[illegible]	30	20	15	12	10	9	8	7	6	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2
4	[illegible]	40	27	20	16	13	11	10	9	8	7	7	6	6	5	5	5	4	4	4	4	4	3	3	3	3	3	2	3	3
5	[illegible]	50	33	25	20	17	14	13	11	10	9	8	8	7	7	6	6	6	5	5	5	5	4	4	4	4	4	3	3	3
6	[illegible]	[illegible]	40	30	24	20	17	15	13	12	11	10	9	9	8	8	7	7	6	6	6	5	5	5	5	5	4	4	4	4
8	[illegible]	[illegible]	[illegible]	40	32	27	23	20	18	16	15	13	12	11	11	10	9	9	8	8	8	7	7	7	6	6	6	6	6	5
10	[illegible]	[illegible]	[illegible]	50	40	33	29	25	22	20	18	17	15	14	13	13	12	11	11	10	10	9	9	8	8	8	7	7	7	7
15	[illegible]	[illegible]	[illegible]	[illegible]	60	50	43	38	33	30	27	25	23	21	20	19	18	17	16	15	14	14	13	12	12	12	11	11	10	10
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	50	44	40	36	33	31	28	27	25	24	22	21	20	19	18	17	17	16	15	15	14	14	13

(Example) In case of 5 nos. hitting with penetration 8 cm , Nc nalue is 6.

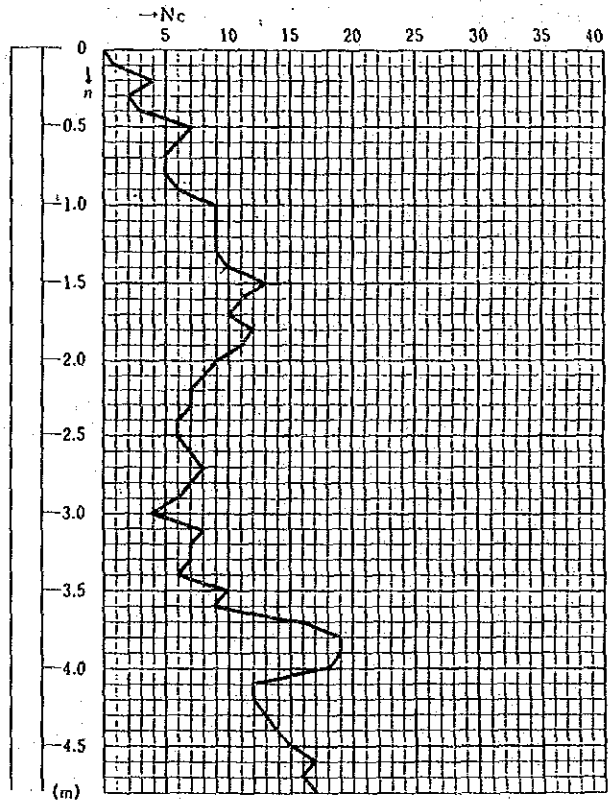
MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 6 (8/17) Soil Investigation Record on TEKU - K3 66kV T/L (TL/K - B)

SOIL INVESTIGATION RECORD

Point No.	1	Place	TL/K-C

Date	/ / '91

Hitting Nos. N (Nos.)	Penetration Depth h (cm)	Penetration $d = h_n - h_{n-1}$	$Nc = \frac{N}{d} \times 10$
0	0		
1	10	10	1
4	20	10	4
2	30	10	2
3	40	10	3
7	50	10	7
6	60	10	6
5	70	10	5
5	80	10	5
6	90	10	6
9	100	10	9
9	110	10	9
9	120	10	9
9	130	10	9
10	140	10	10
13	150	10	13
11	160	10	11
10	170	10	10
12	180	10	12
11	190	10	11
9	200	10	9
8	210	10	8
7	220	10	7
7	230	10	7
6	240	10	6
6	250	10	6
7	260	10	7
8	270	10	8
7	280	10	7
6	290	10	6
4	300	10	4
8	310	10	8
7	320	10	7
7	330	10	7
6	340	10	6
10	350	10	10
9	360	10	9
16	370	10	16
19	380	10	19
19	390	10	19
18	400	10	18
12	410	10	12
12	420	10	12
13	430	10	13
14	440	10	14
15	450	10	15
17	460	10	17
16	470	10	16
17	480	10	17



Nc Value Conversion Table

N \ h	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0
1	20	10	7	5	4	3	3	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	40	20	13	10	8	7	6	5	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1	1	1
3	[illegible]	30	20	15	12	10	9	8	7	6	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2
4	[illegible]	40	27	20	16	13	11	10	9	8	7	7	6	6	5	5	5	4	4	4	4	4	3	3	3	3	3	2	3	3
5	[illegible]	50	33	25	20	17	14	13	11	10	9	8	8	7	7	6	6	6	5	5	5	5	4	4	4	4	4	3	3	3
6	[illegible]	[illegible]	40	30	24	20	17	15	13	12	11	10	9	9	8	8	7	7	6	6	6	5	5	5	5	5	4	4	4	4
8	[illegible]	[illegible]	[illegible]	40	32	27	23	20	18	16	15	13	12	11	11	10	9	9	8	8	8	7	7	7	6	6	6	6	6	5
10	[illegible]	[illegible]	[illegible]	50	40	33	29	25	22	20	18	17	15	14	13	13	12	11	11	10	10	9	9	8	8	8	7	7	7	7
15	[illegible]	[illegible]	[illegible]	[illegible]	60	50	43	38	33	30	27	25	23	21	20	19	18	17	16	15	14	14	13	12	12	12	11	11	10	10
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	50	44	40	36	33	31	28	27	25	24	22	21	20	19	18	17	17	16	15	15	14	14	13

(Example) In case of 5 nos. hitting with penetration 8 cm , Nc value is 6.

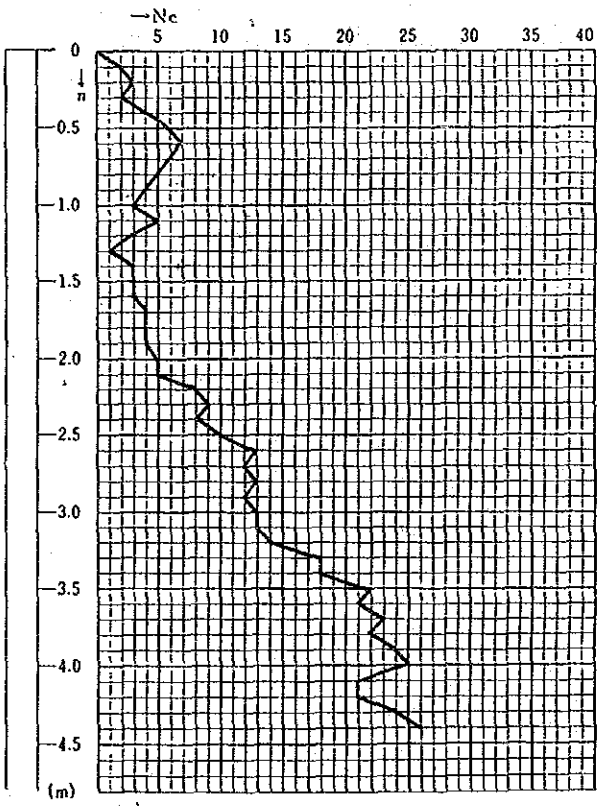
MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 6 (9/17) Soil Investigation Record on TEKU - K3 66kV T/L (TL/K - C)

SOIL INVESTIGATION RECORD

Point No.	1	Place	TL/K- D

Date	21 / 6 / '91

Hitting Nos. N (Nos.)	Penetration Depth h (cm)	Penetration $d = h_n - h_{n-1}$	$Nc = \frac{N}{d} \times 10$
0	0	0	0
2	10	10	2
3	20	10	3
2	30	10	2
4	40	10	4
6	50	10	6
7	60	10	7
6	70	10	6
5	80	10	5
4	90	10	4
3	100	10	3
5	110	10	5
3	120	10	3
1	130	10	1
3	140	10	3
3	150	10	3
3	160	10	3
4	170	10	4
4	180	10	4
4	190	10	4
5	200	10	5
5	210	10	5
8	220	10	8
9	230	10	9
8	240	10	8
10	250	10	10
13	260	10	13
12	270	10	12
13	280	10	13
12	290	10	12
13	300	10	13
13	310	10	13
14	320	10	14
10	330	10	10
10	340	10	10
22	350	10	22
21	360	10	21
23	370	10	23
22	380	10	22
24	390	10	24
25	400	10	25
21	410	10	21
21	420	10	21
24	430	10	24
26	440	10	26



Nc Value Conversion Table

N \ h	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0
1	20	10	7	5	4	3	3	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	40	20	13	10	8	7	6	5	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1	1	1
3	[illegible]	30	20	15	12	10	9	8	7	6	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2
4	[illegible]	40	27	20	16	13	11	10	9	8	7	7	6	6	5	5	5	4	4	4	4	4	3	3	3	3	3	2	3	3
5	[illegible]	50	33	25	20	17	14	13	11	10	9	8	8	7	7	6	6	6	5	5	5	5	4	4	4	4	4	3	3	3
6	[illegible]	[illegible]	40	30	24	20	17	15	13	12	11	10	9	9	8	8	7	7	6	6	6	5	5	5	5	5	4	4	4	4
8	[illegible]	[illegible]	[illegible]	40	32	27	23	20	18	16	15	13	12	11	11	10	9	9	8	8	8	7	7	7	6	6	6	6	6	5
10	[illegible]	[illegible]	[illegible]	50	40	33	29	25	22	20	18	17	15	14	13	13	12	11	11	10	10	9	9	8	8	8	7	7	7	7
15	[illegible]	[illegible]	[illegible]	[illegible]	60	50	43	38	33	30	27	25	23	21	20	19	18	17	16	15	14	14	13	12	12	12	11	11	10	10
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	50	44	40	36	33	31	28	27	25	24	22	21	20	19	18	17	17	16	15	15	14	14	13

(Example) In case of 5 nos. hitting with penetration 8 cm , Nc value is 6.

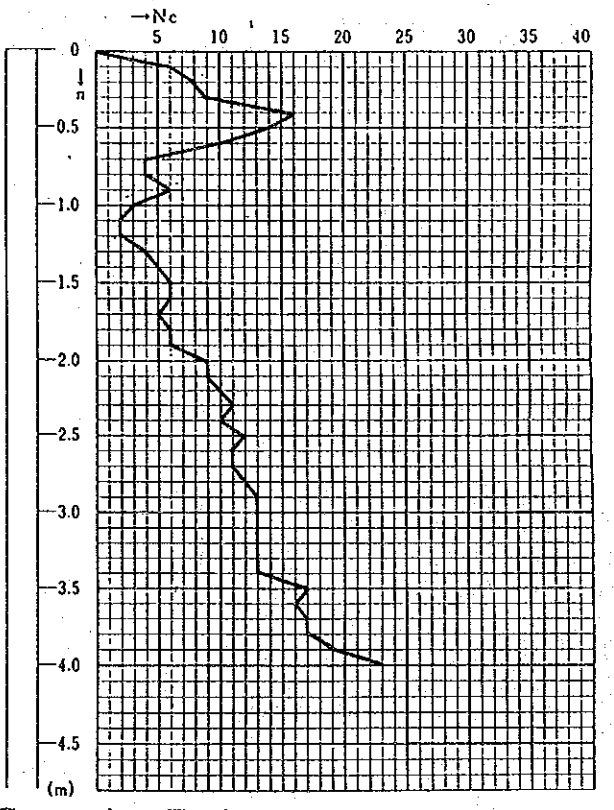
MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 6 (10/17) Soil Investigation Record on TEKU - K3 66kV T/L (TL/K - D)

SOIL INVESTIGATION RECORD

Point No.	1	Place	TL / K -E

Date	23 / 6 / '91

Hitting Nos. N (Nos.)	Penetration Depth h (cm)	Penetration $d = h_n - h_{n-1}$	$Nc = \frac{N}{d} \times 10$
0	0	0	0
6	10	10	6
8	20	10	8
9	30	10	9
16	40	10	16
16	50	10	16
10	60	10	10
4	70	10	4
4	80	10	4
4	90	10	4
3	100	10	3
2	110	10	2
2	120	10	2
4	130	10	4
5	140	10	5
6	150	10	6
6	160	10	6
5	170	10	5
6	180	10	6
6	190	10	6
9	200	10	9
9	210	10	9
10	220	10	10
11	230	10	11
10	240	10	10
12	250	10	12
11	260	10	11
11	270	10	11
12	280	10	12
13	290	10	13
13	300	10	13
13	310	10	13
13	320	10	13
13	330	10	13
13	340	10	13
17	350	10	17
16	360	10	16
17	370	10	17
17	380	10	17
19	390	10	19
23	400	10	23
23	410	10	23
23	420	10	23

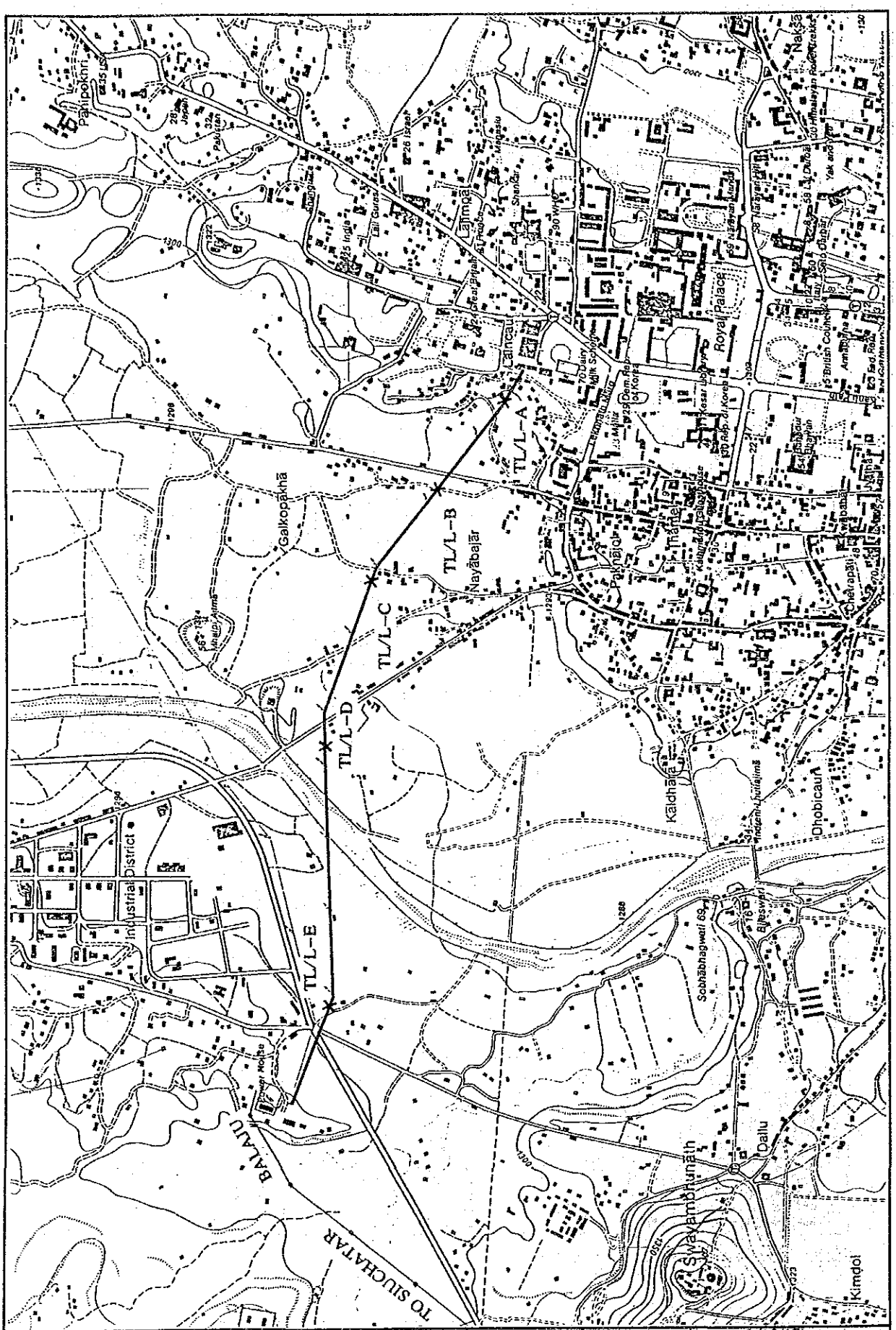


Nc Value Conversion Table

N \ d	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0
1	20	10	7	5	4	3	3	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	40	20	13	10	8	7	6	5	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1	1	1
3	[illegible]	30	20	15	12	10	9	8	7	6	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2
4	[illegible]	40	27	20	16	13	11	10	9	8	7	7	6	6	5	5	5	4	4	4	4	4	3	3	3	3	3	2	3	3
5	[illegible]	50	33	25	20	17	14	13	11	10	9	8	8	7	7	6	6	6	5	5	5	5	4	4	4	4	4	3	3	3
6	[illegible]	[illegible]	40	30	24	20	17	15	13	12	11	10	9	9	8	8	7	7	6	6	6	5	5	5	5	5	4	4	4	4
8	[illegible]	[illegible]	[illegible]	40	32	27	23	20	18	16	15	13	12	11	11	10	9	9	8	8	8	7	7	7	6	6	6	6	6	5
10	[illegible]	[illegible]	[illegible]	50	40	33	29	25	22	20	18	17	15	14	13	13	12	11	11	10	10	9	9	8	8	8	7	7	7	7
15	[illegible]	[illegible]	[illegible]	[illegible]	60	50	43	38	33	30	27	25	23	21	20	19	18	17	16	15	14	14	13	12	12	12	11	11	10	10
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	50	44	40	36	33	31	28	27	25	24	22	21	20	19	18	17	17	16	15	15	14	14	13

(Example) In case of 5 nos. hitting with penetration 8 cm , Nc value is 6.

MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 6 (11/17) Soil Investigation Record on TEKU - K3 66kV T/L (TL/K - E)



MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 6 (12/17) Location of Soil Investigation Place on BALAJU - LAINCHAUR 66kV Transmission Line

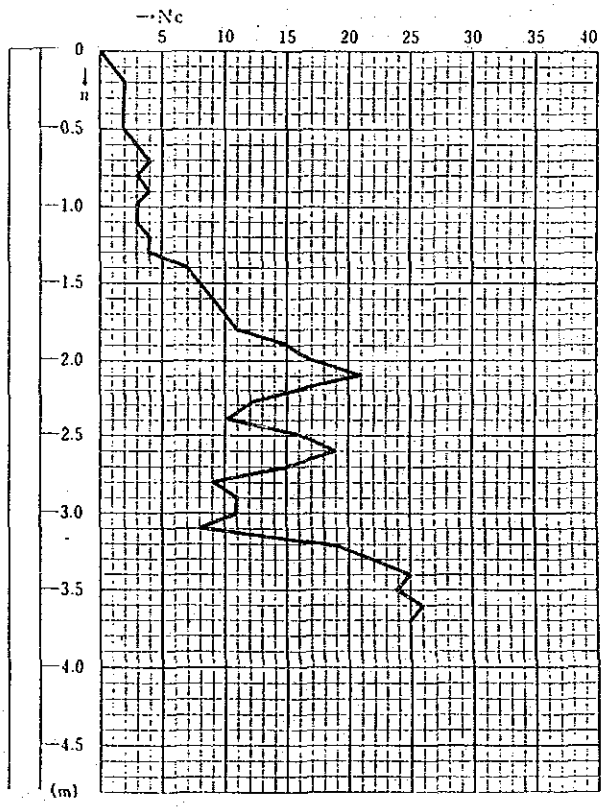
SOIL INVESTIGATION RECORD

Point No.	1	Place	TL/L-A

Date	23 / 6 / '91

Hitting Nos. N (Nos.)	Penetration Depth h (cm)	Penetration $d = h_n - h_{n-1}$	$Nc = \frac{N}{d} \times 10$
0	0	0	0
1	10	10	1
2	20	10	2
2	30	10	2
2	40	10	2
2.	50	10	2
3	60	10	3
4	70	10	4
3	80	10	3
4	90	10	4
3	100	10	3
3	110	10	3
4	120	10	4
4	130	10	4
7	140	10	7
8	150	10	8
9	160	10	9
10	170	10	10
11	180	10	11
15	190	10	15
17	200	10	17
21	210	10	21
16	220	10	16
12	230	10	12
10	240	10	10
16	250	10	16
19	260	10	19
15	270	10	15
9	280	10	9
11	290	10	11
11	300	10	11
8	310	10	8
19	320	10	19
22	330	10	22
25	340	10	25
24	350	10	24
26	360	10	26

25	370	10	25



Nc Value Conversion Table

N \ h	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0
1	20	10	7	5	4	3	3	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	40	20	13	10	8	7	6	5	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1	1	1
3	[illegible]	30	20	15	12	10	9	8	7	6	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2
4	[illegible]	40	27	20	16	13	11	10	9	8	7	7	6	6	5	5	5	4	4	4	4	4	3	3	3	3	3	2	3	3
5	[illegible]	50	33	25	20	17	14	13	11	10	9	8	8	7	7	6	6	6	5	5	5	5	4	4	4	4	4	3	3	3
6	[illegible]	[illegible]	40	30	24	20	17	15	13	12	11	10	9	9	8	8	7	7	6	6	6	5	5	5	5	5	4	4	4	4
8	[illegible]	[illegible]	[illegible]	40	32	27	23	20	18	16	15	13	12	11	11	10	9	9	8	8	8	7	7	7	6	6	6	6	6	5
10	[illegible]	[illegible]	[illegible]	50	40	33	29	25	22	20	18	17	15	14	13	13	12	11	11	10	10	9	9	8	8	8	7	7	7	7
15	[illegible]	[illegible]	[illegible]	[illegible]	60	50	43	38	33	30	27	25	23	21	20	19	18	17	16	15	14	14	13	12	12	12	11	11	10	10
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	50	44	40	36	33	31	28	27	25	24	22	21	20	19	18	17	17	16	15	15	14	14	13

(Example) In case of 5 nos. hitting with penetration 8 cm , Nc nalue is 6.

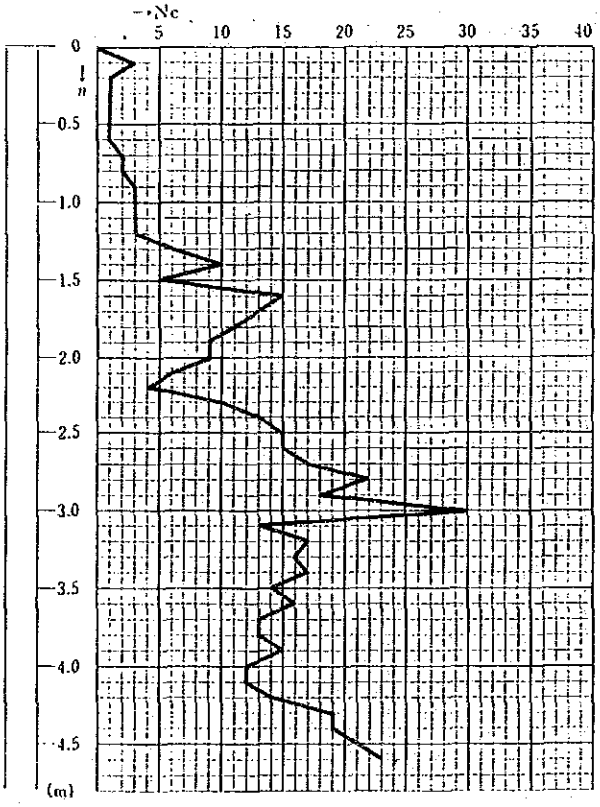
MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 6 (13/17) Soil Investigation Record on BALAJU - LAINCHAUR T/L (TL/L - A)

SOIL INVESTIGATION RECORD

Point No.	1	Place	TL/L-B

Date	23 / 6 / '91

Hitting Nos. N (Nos.)	Penetration Depth h (cm)	Penetration $d = h_n - h_{n-1}$	$Nc = \frac{N}{d} \times 10$
0	0	0	0
3	10	10	3
1	20	10	1
1	30	10	1
1	40	10	1
1	50	10	1
1	60	10	1
2	70	10	2
2	80	10	2
3	90	10	3
3	100	10	3
3	110	10	3
3	120	10	3
6	130	10	6
10	140	10	10
5	150	10	5
15	160	10	15
13	170	10	13
11	180	10	11
9	190	10	9
9	200	10	9
6	210	10	6
4	220	10	4
10	230	10	10
13	240	10	13
15	250	10	15
15	260	10	15
17	270	10	17
22	280	10	22
18	290	10	18
30	300	10	30
13	310	10	13
17	320	10	17
16	330	10	16
17	340	10	17
14	350	10	14
16	360	10	16
13	370	10	13
13	380	10	13
15	390	10	15
12	400	10	12
12	410	10	12
14	420	10	14
19	430	10	19
19	440	10	19
21	450	10	21
23	460	10	23



Nc Value Conversion Table

N \ h	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0
1	20	10	7	5	4	3	3	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	40	20	13	10	8	7	6	5	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1	1	1
3	[illegible]	30	20	15	12	10	9	8	7	6	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2
4	[illegible]	40	27	20	16	13	11	10	9	8	7	7	6	6	5	5	5	4	4	4	4	4	3	3	3	3	3	2	3	3
5	[illegible]	50	33	25	20	17	14	13	11	10	9	8	8	7	7	6	6	6	5	5	5	5	4	4	4	4	4	3	3	3
6	[illegible]	[illegible]	40	30	24	20	17	15	13	12	11	10	9	9	8	8	7	7	6	6	6	5	5	5	5	5	4	4	4	4
8	[illegible]	[illegible]	[illegible]	40	32	27	23	20	18	16	15	13	12	11	11	10	9	9	8	8	8	7	7	7	6	6	6	6	6	5
10	[illegible]	[illegible]	[illegible]	50	40	33	29	25	22	20	18	17	15	14	13	13	12	11	11	10	10	9	9	8	8	8	7	7	7	7
15	[illegible]	[illegible]	[illegible]	[illegible]	60	50	43	38	33	30	27	25	23	21	20	19	18	17	16	15	14	14	13	12	12	12	11	11	10	10
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	50	44	40	36	33	31	28	27	25	24	22	21	20	19	18	17	17	16	15	15	14	14	13

(Example) In case of 5 nos. hitting with penetration 8 cm , Nc nalue is 6.

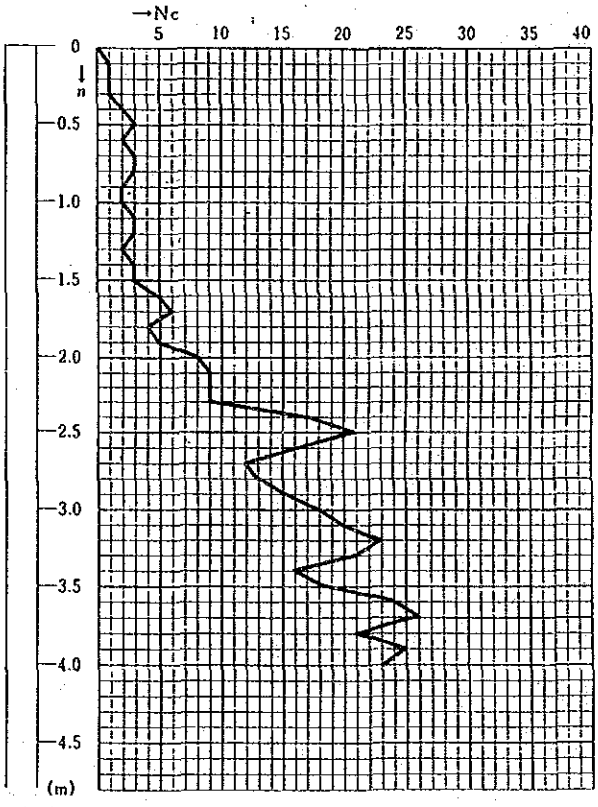
MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 6 (14/17) Soil Investigation Record on BALAJU - LAINCHAUR T/L (TL/L - B)

SOIL INVESTIGATION RECORD

Point No.	1	Place	TL/L-C

Date	24 / 6 / '91

Hitting Nos. N (Nos.)	Penetration Depth h (cm)	Penetration $d = h_n - h_{n-1}$	$Nc = \frac{N}{d} \times 10$
0	0	0	0
1	10	10	1
1	20	10	1
1	30	10	1
2	40	10	2
3	50	10	3
2	60	10	2
3	70	10	3
3	80	10	3
2	90	10	2
2	100	10	2
3	110	10	3
3	120	10	3
2	130	10	2
3	140	10	3
3	150	10	3
5	160	10	5
6	170	10	6
4	180	10	4
5	190	10	5
8	200	10	8
9.	210	10	9
9.	220	10	9
9	230	10	9
17	240	10	17
21	250	10	21
16	260	10	16
12	270	10	12
13	280	10	13
15	290	10	15
18	300	10	18
20	310	10	20
23	320	10	23
21	330	10	21
16	340	10	16
19	350	10	19
24	360	10	24
26	370	10	26
21	380	10	21
25	390	10	25
23	400	10	23



Nc Value Conversion Table

N \ d	0.5	1.0 : 1.5	2.0 : 2.5	3.0 : 3.5	4.0 : 4.5	5.0 : 5.5	6.0 : 6.5	7.0 : 7.5	8.0 8.5	9.0 : 9.5	10.0 : 10.5	11.0 : 11.5	12.0 : 12.5	13.0 : 13.5	14.0 : 14.5	15.0
1	20	10 : 7	5 : 4	3 : 3	3 : 2	2 : 2	2 : 2	1 : 1	1 1	1 : 1	1 : 1	1 : 1	1 : 1	1 : 1	1 : 1	1
2	40	20 : 13	10 : 8	7 : 6	5 : 4	4 : 4	3 : 3	3 : 3	3 2	2 : 2	2 : 2	2 : 2	2 : 2	2 : 1	1 : 1	1
3	[illegible]	30 : 20	15 : 12	10 : 9	8 : 7	6 : 5	5 : 5	4 : 4	4 4	3 : 3	3 : 3	3 : 3	2 : 2	2 : 2	2 : 2	2
4	[illegible]	40 : 27	20 : 16	13 : 11	10 : 9	8 : 7	7 : 6	6 : 5	5 5	4 : 4	4 : 4	4 : 3	3 : 3	3 : 3	2 : 3	3
5	[illegible]	50 : 33	25 : 20	17 : 14	13 : 11	10 : 9	8 : 8	7 : 7	6 6	6 : 5	5 : 5	5 : 4	4 : 4	4 : 4	3 : 3	3
6	[illegible]	[illegible]	40	30 : 24	20 : 17	15 : 13	12 : 11	10 : 9	9 : 8	8 7	7 : 6	6 : 6	5 : 5	5 : 5	5 : 4	4 : 4	4
8	[illegible]	[illegible]	[illegible]	40 : 32	27 : 23	20 : 18	16 : 15	13 : 12	11 : 11	10 : 9	9 : 8	8 : 8	7 : 7	7 : 6	6 : 6	6 : 6	5
10	[illegible]	[illegible]	[illegible]	50 : 40	33 : 29	25 : 22	20 : 18	17 : 15	14 : 13	13 : 12	11 : 11	10 : 10	9 : 9	8 : 8	8 : 7	7 : 7	7
15	[illegible]	[illegible]	[illegible]	[illegible]	60	50 : 43	38 : 33	30 : 27	25 : 23	21 : 20	19 : 18	17 : 16	15 : 14	14 : 13	12 : 12	12 : 11	11 : 10	10
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	50 : 44	40 : 36	33 : 31	28 : 27	25 : 24	22 : 21	20 : 19	18 : 17	17 : 16	15 : 15	14 : 14	13

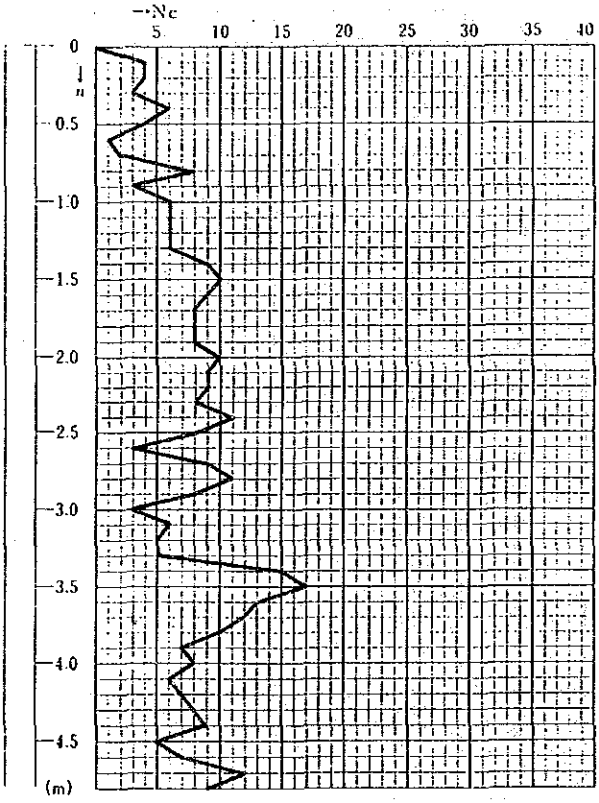
(Example) In case of 5 nos. hitting with penetration 8 cm , Nc nalue is 6.

MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 6 (15/17) Soil Investigation Record on BALAJU - LAINCHAUR T/L (TL/L - C)

SOIL INVESTIGATION RECORD

Point No.	1	Place	TL/L-D	Date	24 / 6 / '91

Hitting Nos. N (Nos.)	Penetration Depth h (cm)	Penetration $d = h_n - h_{n-1}$	$Nc = \frac{N}{d} \times 10$
0	0	0	0
4	10	10	4
4	20	10	4
3	30	10	3
6	40	10	6
4	50	10	4
1	60	10	1
2	70	10	2
8	80	10	8
3	90	10	3
6	100	10	6
6	110	10	6
6	120	10	6
6	130	10	6
9	140	10	9
10	150	10	10
9	160	10	9
8	170	10	8
8	180	10	8
8	190	10	8
10	200	10	10
9	210	10	9
9	220	10	9
8	230	10	8
11	240	10	11
8	250	10	8
3	260	10	3
9	270	10	9
11	280	10	11
8	290	10	8
3	300	10	3
6	310	10	6
5	320	10	5
5	330	10	5
15	340	10	15
17	350	10	17
13	360	10	13
12	370	10	12
10	380	10	10
7	390	10	7
8	400	10	8
6	410	10	6
7	420	10	7
8	430	10	8
9	440	10	9
5	450	10	5
7	460	10	7
12	470	10	12
9	480	10	9
10	490	10	10



Nc Value Conversion Table

N \ d	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0
1	20	10	7	5	4	3	3	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	40	20	13	10	8	7	6	5	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1	1	1
3	[illegible]	30	20	15	12	10	9	8	7	6	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2
4	[illegible]	40	27	20	16	13	11	10	9	8	7	7	6	6	5	5	5	4	4	4	4	4	3	3	3	3	3	2	3	3
5	[illegible]	50	33	25	20	17	14	13	11	10	9	8	8	7	7	6	6	6	5	5	5	5	4	4	4	4	4	3	3	3
6	[illegible]	[illegible]	40	30	24	20	17	15	13	12	11	10	9	9	8	8	7	7	6	6	6	5	5	5	5	5	4	4	4	4
8	[illegible]	[illegible]	[illegible]	40	32	27	23	20	18	16	15	13	12	11	11	10	9	9	8	8	8	7	7	7	6	6	6	6	6	5
10	[illegible]	[illegible]	[illegible]	50	40	33	29	25	22	20	18	17	15	14	13	13	12	11	11	10	10	9	9	8	8	8	7	7	7	7
15	[illegible]	[illegible]	[illegible]	[illegible]	60	50	43	38	33	30	27	25	23	21	20	19	18	17	16	15	14	14	13	12	12	12	11	11	10	10
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	50	44	40	36	33	31	28	27	25	24	22	21	20	19	18	17	17	16	15	15	14	14	13

(Example) In case of 5 nos. hitting with penetration 8 cm , Nc value is 6.

MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 6 (16/17) Soil Investigation Record on BALAJU - LAINCHAUR T/L (TL/L - D)

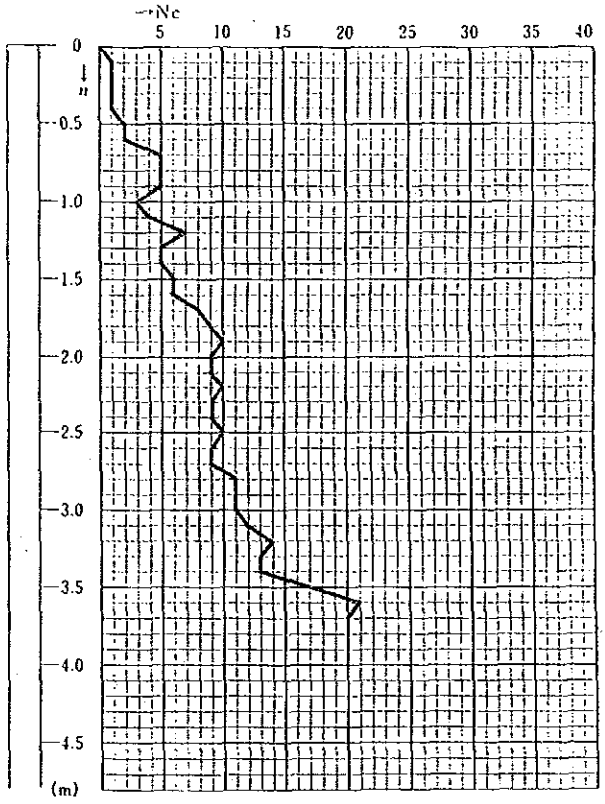
SOIL INVESTIGATION RECORD

Point No.	1	Place	TL/L-E

Date	24 / 6 / '91

Hitting Nos. N (Nos.)	Penetration Depth h (cm)	Penetration $d = h_n - h_{n-1}$	$Nc = \frac{N}{d} \times 10$
0	0	0	0
1	10	10	1
1	20	10	1
1	30	10	1
1	40	10	1
2	50	10	2
2	60	10	2
5	70	10	5
5	8	10	5
5	90	10	5
3	100	10	3
4	110	10	4
7	120	10	7
5	130	10	5
5	140	10	5
6	150	10	6
6	160	10	6
8	170	10	8
9	180	10	9
10	190	10	10
9	200	10	9
9	210	10	9
10	220	10	10
9	230	10	9
9	240	10	9
10	250	10	10
9	260	10	9
9	270	10	9
11	280	10	11
11	290	10	11
11	300	10	11
12	310	10	12
14	320	10	14
13	330	10	13
13	340	10	13
39	350	10	39
21	360	10	21

20	370	10	20
40	380	10	40

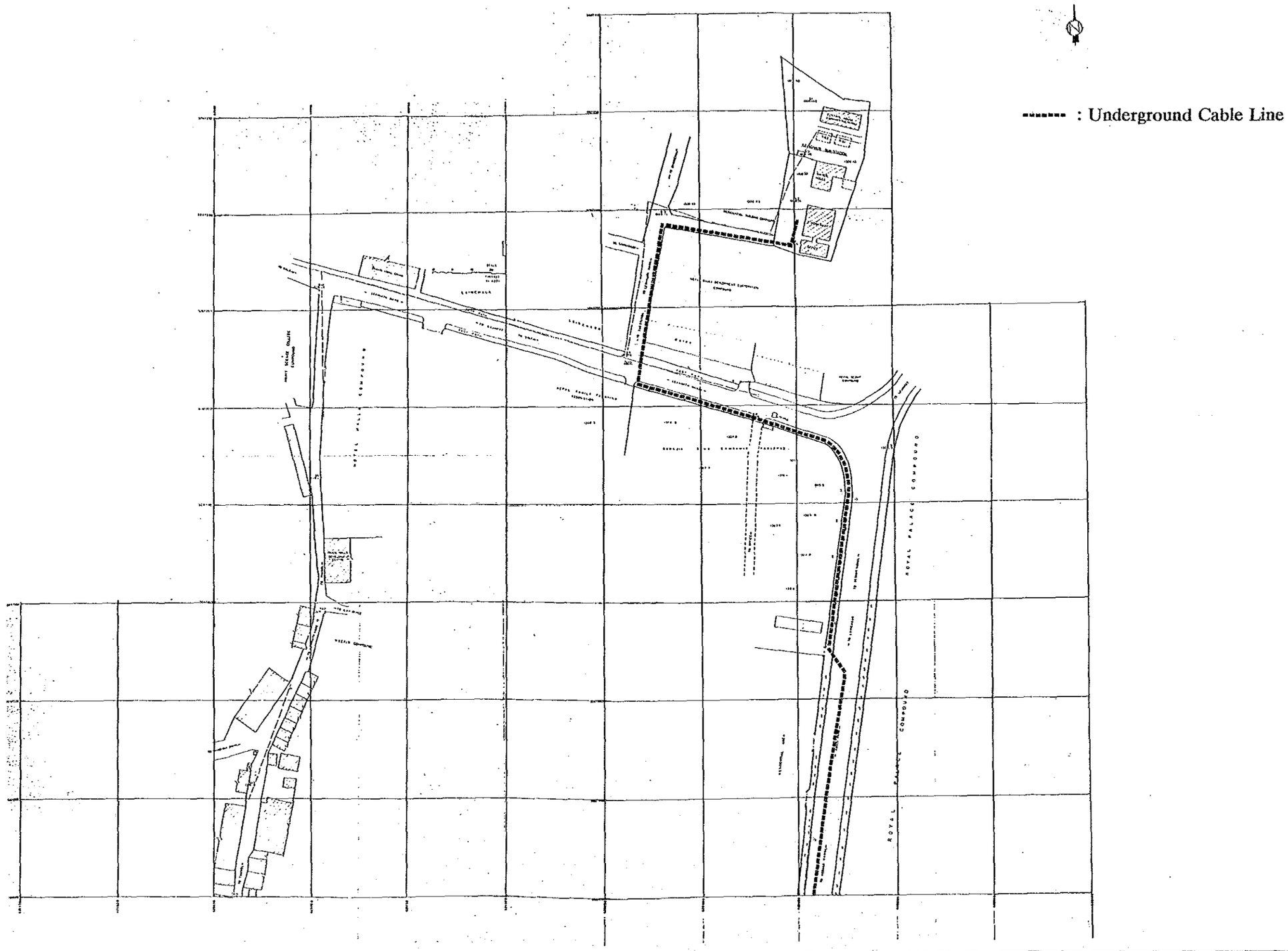


Nc Value Conversion Table

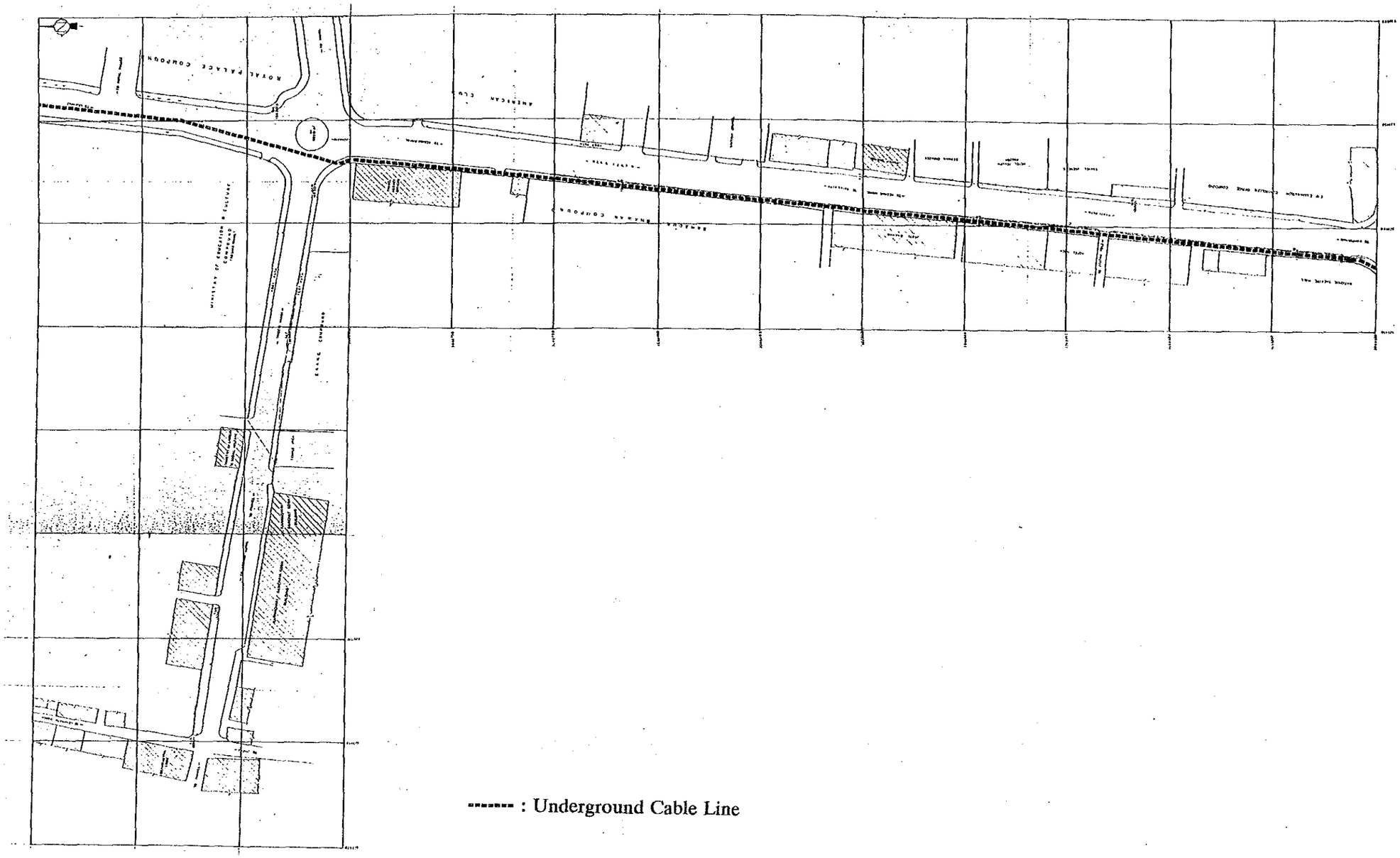
N \ d	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0
1	20	10	7	5	4	3	3	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	40	20	13	10	8	7	6	5	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1	1	1
3	[redacted]	30	20	15	12	10	9	8	7	6	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2
4	[redacted]	40	27	20	16	13	11	10	9	8	7	7	6	6	5	5	5	4	4	4	4	4	3	3	3	3	3	2	3	3
5	[redacted]	50	33	25	20	17	14	13	11	10	9	8	8	7	7	6	6	6	5	5	5	5	4	4	4	4	4	3	3	3
6	[redacted]	[redacted]	40	30	24	20	17	15	13	12	11	10	9	9	8	8	7	7	6	6	6	5	5	5	5	5	4	4	4	4
8	[redacted]	[redacted]	[redacted]	40	32	27	23	20	18	16	15	13	12	11	11	10	9	9	8	8	8	7	7	7	6	6	6	6	6	5
10	[redacted]	[redacted]	[redacted]	50	40	33	29	25	22	20	18	17	15	14	13	13	12	11	11	10	10	9	9	8	8	8	7	7	7	7
15	[redacted]	[redacted]	[redacted]	[redacted]	60	50	43	38	33	30	27	25	23	21	20	19	18	17	16	15	14	14	13	12	12	12	11	11	10	10
20	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	50	44	40	36	33	31	28	27	25	24	22	21	20	19	18	17	17	16	15	15	14	14	13

(Example) In case of 5 nos. hitting with penetration 8 cm , Nc value is 6.

MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 6 (17/17) Soil Investigation Record on BALAJU - LAINCHAUR T/L (TL/L - E)

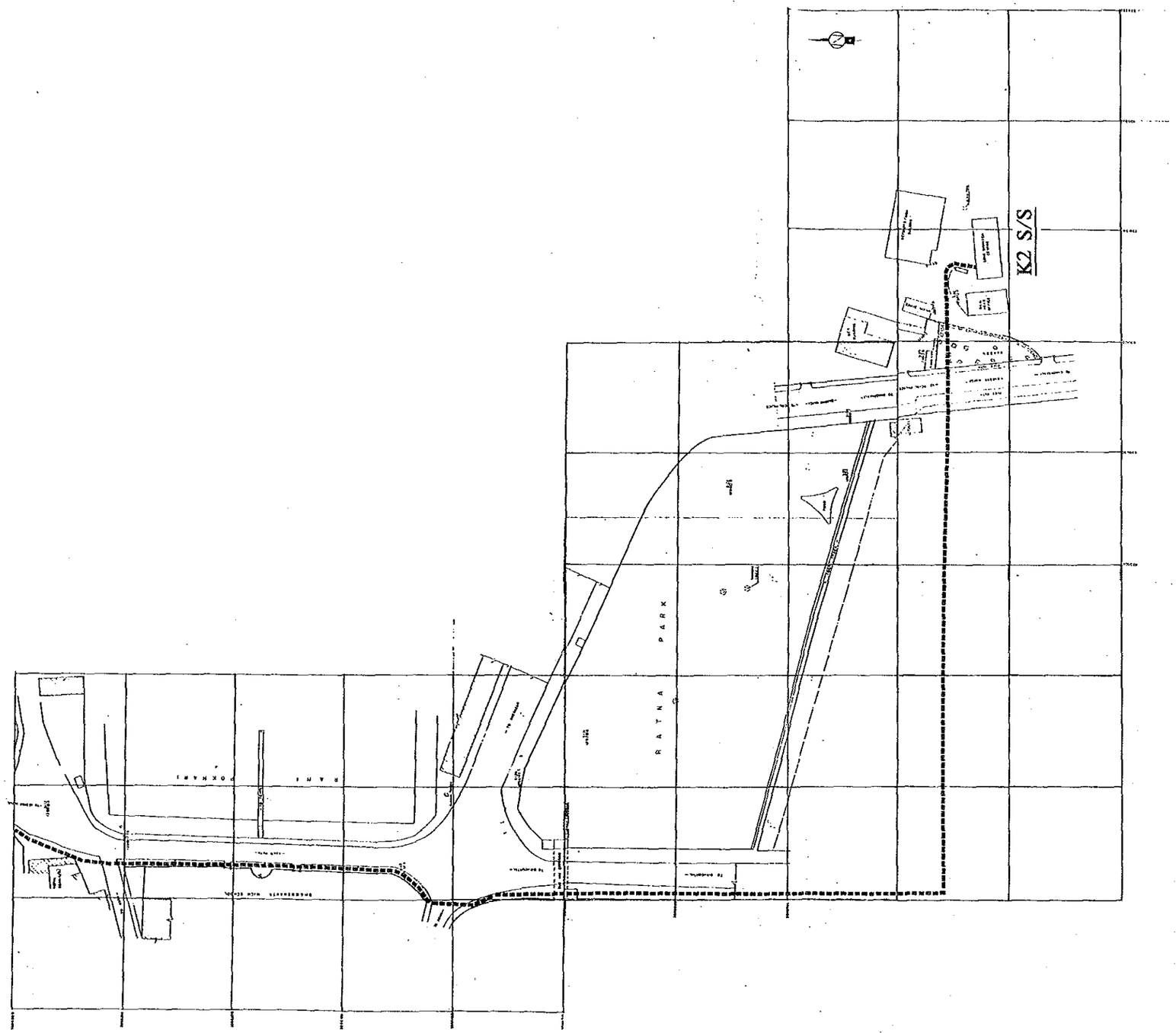


MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 7 (1/3) Detailed 11kV Underground Cable Line Route (Lainchaur-K2)



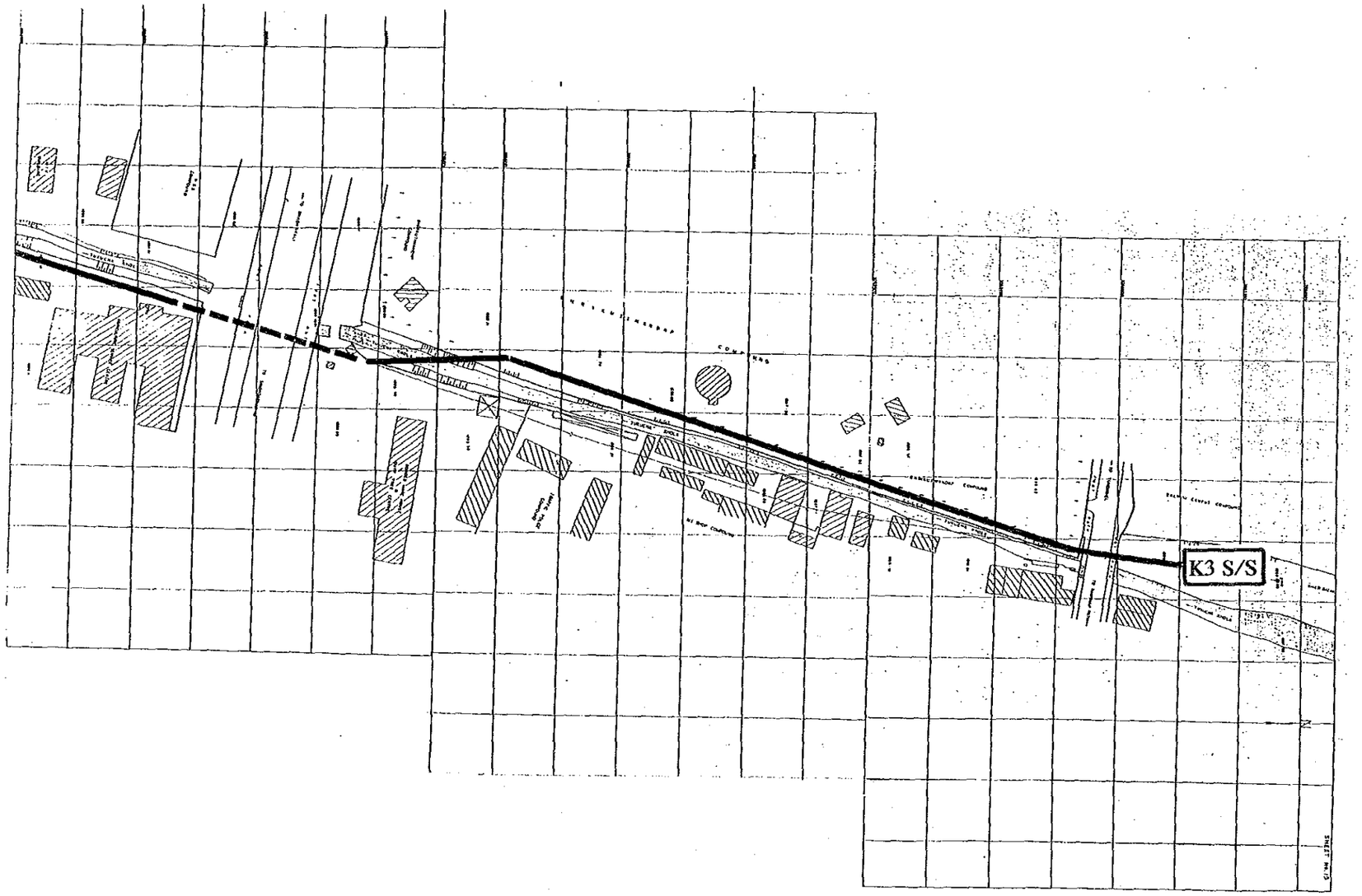
------- : Underground Cable Line

MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 7 (2/3) Detailed 11kV Underground Cable Line Route (Lainchaur-K2)

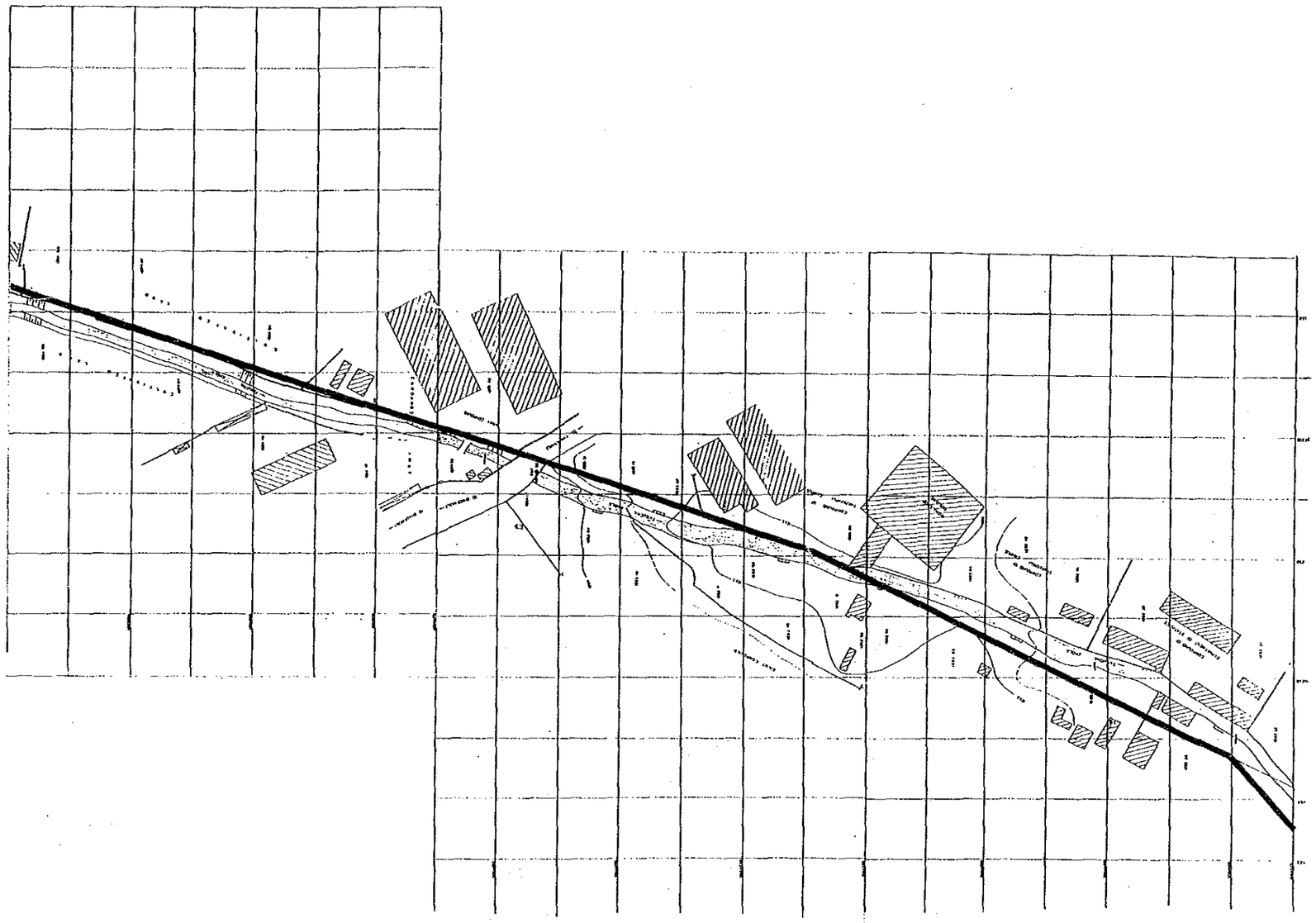


▪▪▪▪▪▪▪ : Underground Cable Line

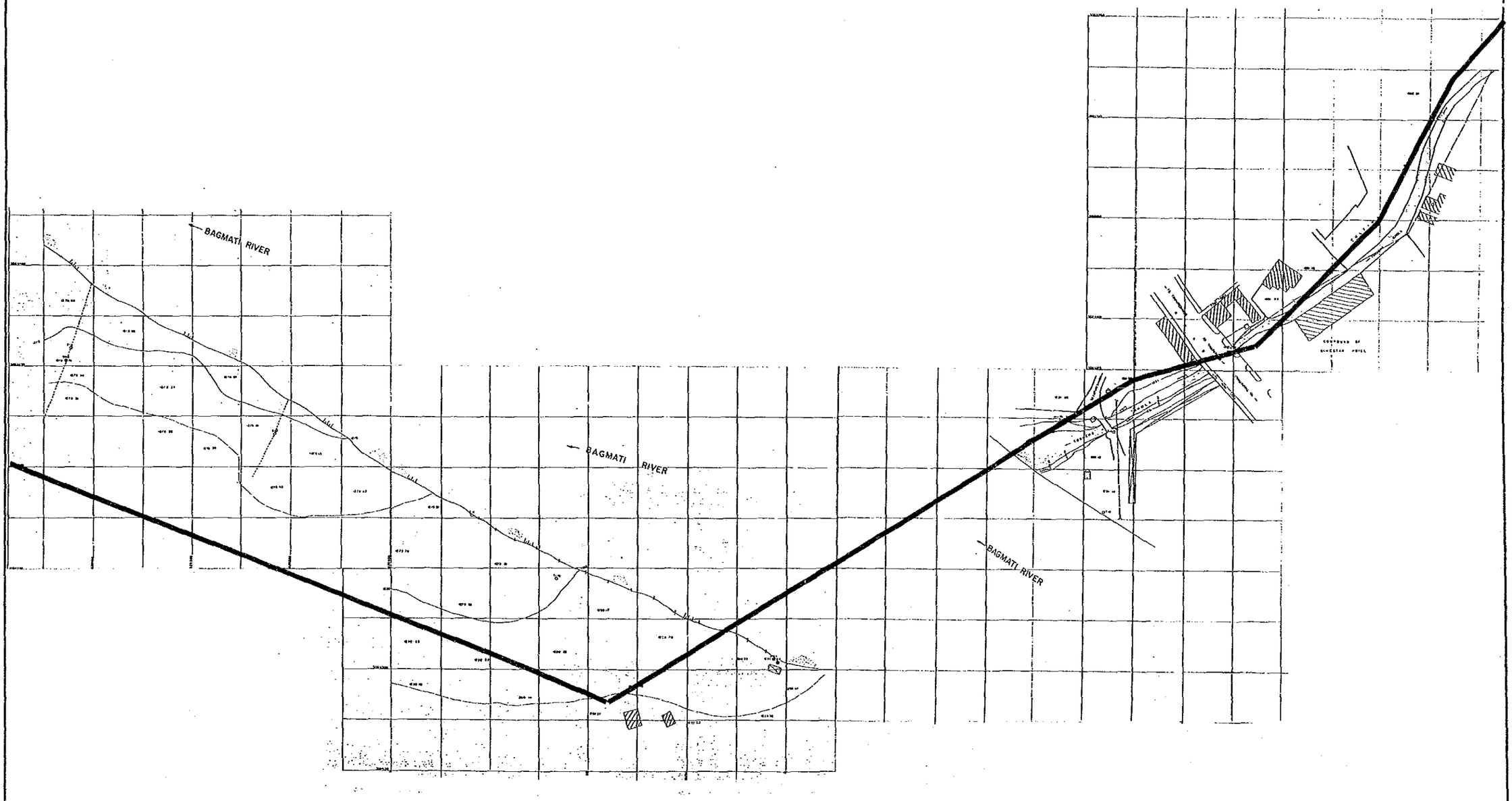
MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 7 (3/3) Detailed 11kV Underground Cable Line Route (Lainchaur-K2)



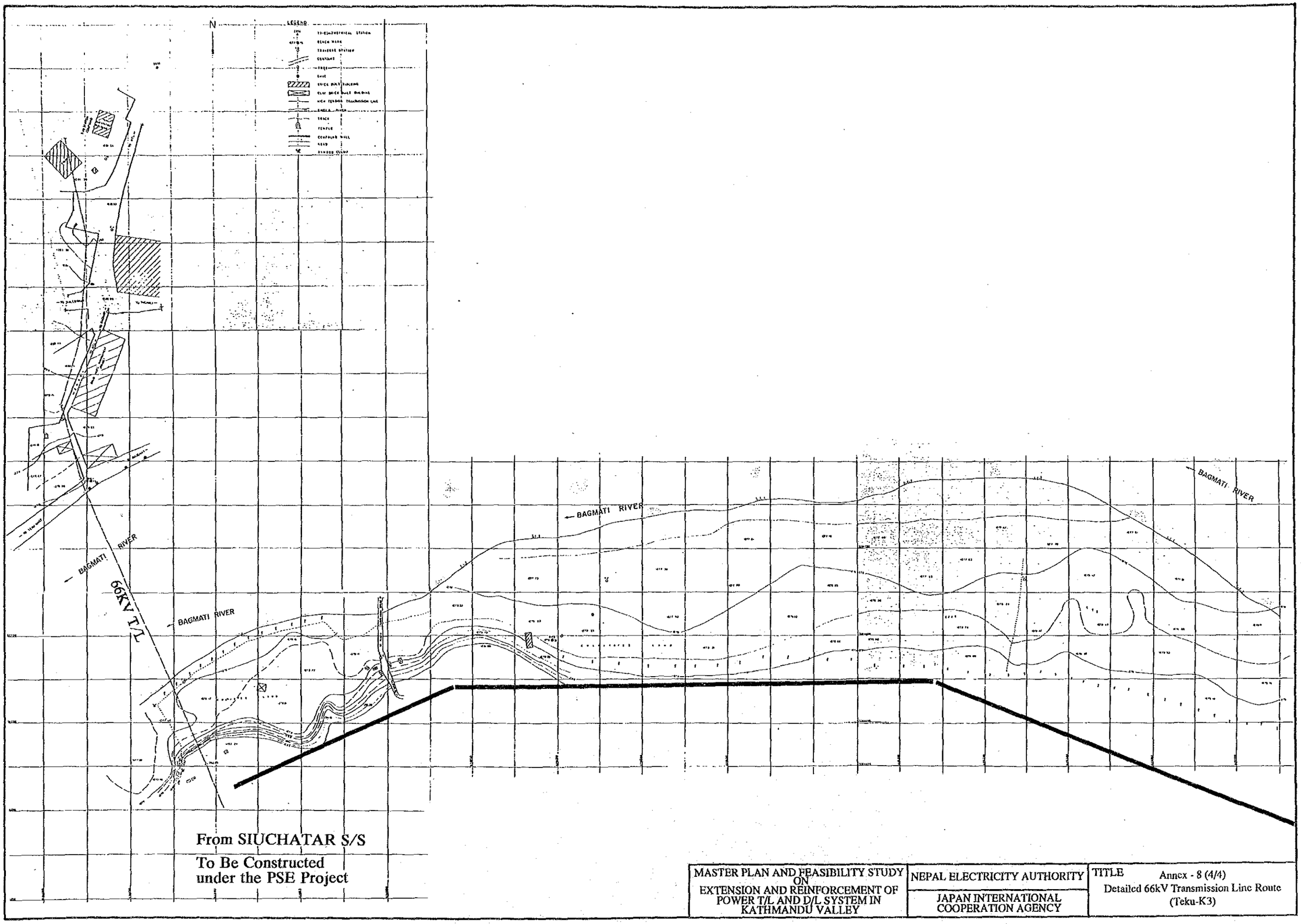
MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 8 (1/4) Detailed 66kV Transmission Line Route (Teku-K3)



MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 8 (2/4) Detailed 66kV Transmission Line Route (Teku-K3)



MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 8 (3/4) Detailed 66kV Transmission Line Route (Teku-K3)



MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER T/L AND D/L SYSTEM IN KATHMANDU VALLEY	NEPAL ELECTRICITY AUTHORITY JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Annex - 8 (4/4) Detailed 66kV Transmission Line Route (Teku-K3)

MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER TRANSMISSION AND DISTRIBUTION SYSTEM IN KATHMANDU VALLEY

MINUTES OF MEETING

DATE : October 2 and 3, 1991
PLACE : NEA Head Office
ATTENDANTS : Annex-1

I) Draft Final Report

On the Draft Final Report of the captioned study which have been submitted NEA on October 1, 1991 (hereinafter called as "the Report"), a series of discussion between the officials of NEA (herinafter called as "NEA") and JICA study team (hereinafter called as "the Team") has been held, and the following matters were mutually confirmed by both the parties.

1.1) General Comments

The study results incorporated in the Report have been explained by the Team and the Report have been accepted by NEA, provided that the undermentioned minor modifications should be made.

1.2) Existing Underground Cables between Lainchaur and K2 (Section 4.3.4, Item (1), Page 4-15)

The damaged underground cable line between Lainchaur and K2 had been restored by NEA in middle of 1991. This matter should be added in the Report.

1.3) Minimum Ground Clearance of 11kV Line (Section 10.5, Page 10-2)

The minimum ground clearance of 11kV overhead line should be as follow:

- 11kV line above general terrain ..... 6.1 m

- 11kV line above main road at crossing point .... 6.6 m

1.4) Number of 11kV Cables between Lainchaur and K2 to be newly Installed
(Section 11.3, Page 11-9)

Number of underground single core cables should be of four(4) including spare.

1.5) Power Factor Meter
(Section 11.5.2, Page 11-13)

Power factor meter should be additionally provided on the Ring Main and Out-going Feeder cubicles.

1.6) Type of 11kV Circuit Breaker
(Section 11.5.2, Page 11-14)

The circuit breaker to be installed at the Old Patan, Old Chabel and Royal Palace switching stations should be of vacuum type, taking into account the available space for installation. For other substations, SF6 or vacuum type will be used.

For circuit breakers, adequate quantity of spare parts should be considered in design stage.

1.7) Number of 11kV Cubicles to be Installed
(Section 11.5.4, Page 11-15 & -16)

Number of 11kV cubicles to be installed under this project (Phase-1) should be as follow:

		Exist.	Proposed	Revised
a)	Royal Palace			
	- Ring main line	2	2	2
	- Transformer 1ry circuits	2	2	2
	- Out-going feeders	1(1)	1	1
	- Spare feeders	-	1	1
	Total	5(1)	6	6
b)	Old Chabel			
	- Ring main line	4(2)*1	4	4
	- Out-going feeders	5(2)	5	5
	- Feeder to be used *2	-	2	2
	- Spare feeder	1	1	1
	- Bus coupler	-	1	1
	- Station service transformer	-	1	1
	Total	10(4)	14	14

c) Old Patan

- Ring main line	6(4)	2	2
- Out-going feeders	6	4	6
- Feeder to be used	-	2	2
- Spare feeder	-	-	2
- Bus coupler	-	1	1
- Station service transformer	-	1	1
Total	12(4)	11	14

Notes : *1: Two out of four cubicles not used at present.
*2: Cubicles to be needed for this project.

1.8) 11kV Cubicles of K3 Substation
(Section 11.6.1, Page 11-18)

The following correction shall be made:

a) The words of the 7th line from the bottom, "sin Clause 11.5.2(c)" shall be read as "in Section 11.5.2".

b) The words of 5th line from the bottom, "Clause 11.5.2(4)" shall be read as "Section 11.5.2".

c) The 4th line from the bottom shall be read as "- ten out-going feeders, comply with the specifications in the Section 11.5.2".

d) The words of the bottom line, "Clause 11.5.2(f)" shall be read as "Section 11.5.2".

1.9) Maintenance Tools and Equipment
(Section 12.3.7, page 12-18)

Maintenance tools and equipment should be as follows:

a) Tools

Hydraulic compressor for conductor joints.....	5 sets
Chain block : 5 tons..	5 nos.
Lever block : 1 ton	5 nos.
Hand operation winch : 1 ton	5 sets
Snatch block : 100 mm dia.	25 nos.
Wire tensioner : 1.5 ton	25 nos.
Tension meter : 1 ton	5 sets
Aluminum pulley : 300 mm dia.	50 sets
Aluminum pulley : 120 mm dia.	50 sets

b) Vehicles

4WD working truck with auger crane and insulated elevator bucket	5 nos.
3 ton pick-up truck (heavy duty)	5 nos.

Light maintenance vehicles ..... 2 nos.

c) VHF Radio Equipment
VHF radio equipment ..... 25 sets
VHF antenna and pole ..... 5 sets

d) Measuring Equipment
Meger ..... 10 nos.
Earth tester ..... 10 nos.
Clamp tester ..... 10 nos.
Phase meter ..... 10 nos.
Volt detector ..... 10 nos.
Cable fault locator ..... 1 set

1.10) Arrangement of 11kV Poles
(Fig. 12.7)

Vertical arrangement of conductors is not NEA's standard. Other alternative should be considered.

II) Power Sector Efficiency Project (PSEP)

Present situation of implementation of the Reinforcement and Upgrading of HV System in the Kathmandu Valley under the Power Sector Efficiency Project(hereinafter called as "PSEP") has been confirmed as follow:

2.1) Tender Document

A draft tender document for the PSEP had been submitted to NEA in May 1991. The tender document is now finalizing in accordance with comments of IDA and NEA, and it is expected to be submitted in October 1991.

2.2) Construction Schedule

Tender for supply and erection of HV system is planned to be announced by the end of October 1991 after final review of revised tender document by IDA.

For contract award, six(6) months will be needed. Then, twenty-four (24) months are estimated for construction including survey, design, manufacturing, testing, delivering and erection.

2.3) Provision for K3 Substation

Provisions for future extension of the 66kV system to the planned K3 substation have been discussed with IDA and

consultant for the PSEP by NEA in accordance with the minutes of meeting held in June and July of 1991 for this study, and mutually agreed by the parties as follow:

a) Circuit breaker(s) will be added on the 66kV transmission line circuit(s), if fund is available as a result of tender.

b) Provisions for tapping 66kV double circuit transmission line to K3 substation will be provided on the tower as required.

III) Other On-going Projects

3.1) Restoration of Lainchaur Substation

The restoration works of the Lainchaur substation damaged by fault of 11kV cubicle is under way by the financial assistance of KfW. The works include not only 66kV switchgear equipment but also 11kV switchgear equipment for power distribution, and have been ordered to AEG who is a same manufacturer of the damaged 66kV equipment.

3.2) Second Circuit of Siuchatar-Patan Line

Necessary materials such as conductors and insulators have been procured by NEA's own finance. Erection works will be started soon and is scheduled to be completed before coming January when maximum peak demand usually is recorded.

IV) Other Matters

NEA explained to the team that NEA has initiated procedures to procure land for K3 substation. The site for the K3 substation will be either as proposed in the Report or inside the exhibition ground.

Mr. Y. Miyagawa Team Leader JICA Study Team	Mr. R.C.L. Pradhan Director-in Chief Distribution and Consumer Services Directorate

KTM-902F ANNEX-1 : ATTENDANTS LIST

Name of Attendants	Position	October 2	October 3
Nepal Electricity Authrity (NEA)			
Mr. R.C.L Pradhan	Director-in Chief Distrbution and Consumer Services Directorate	x	
Mr. S.B. Pun	Director Bagmati Department	x	
Dr. M.R. Tuladhar	Director Technical Service	x	x
Mr. B.B. Dungana	Director Power Sector Efficiency Pro.		x
Mr. K.G. Shrestha	Manager Power Sector Efficiency Pro.	x	x
Mr. P.N. Sharma	Manager Kathmandu Division	x	
Mr. M.P. Upadhaya	Manager Lalitpur-Bhaktapur-Kavre Div.	x	
Mr. T.M. Shakya	Deputy Manager Technical Service Dep.	x	x
Mr. K.P. Koirala	Deputy Manager Kathamndu Center	x	
Mr. R.C. Pandey	Deputy Manager Kathamndu East	x	
Mr. D.P. Bhattarai	Deputy Manager Lalitpur	x	
Mr. G.P. Shrestha	Deputy Manager Bhaktapur	x	
JICA			
Mr. M. Suda	Natural Resources Division Mining & Industrial Planning and Survey Department	x	x
JICA Study Team			
Mr. Y. Miyagawa	Team Leader	x	x
Mr. Y. Sunagawa	Specialist for Substation	x	x
Mr. T. Fukuchi	Specialist for Transmission Line	x	x

Subjects of Meeting

Oct. 2 : Draft final report
Oct. 3 : Power Sector Efficiency Project and other on-going Project

MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER TRANSMISSION AND DISTRIBUTION SYSTEM IN KATHMANDU VALLEY

MINUTES OF MEETING

Date : June 14,17,18,19,27, July 2 and 4, 1991
Place : JICA Study Team Office (LDC Building)
Attendants : (See Annex-1)

Through a series of discussion between the officials of NEA (hereinafter called as "NEA") and JICA Study Team (hereinafter called as "the Team"), the following matters were mutually confirmed by both the parties.

Committed HV Reinforcement/Upgrading Works in the Kathmandu Valley

HV reinforcement/upgrading works have been identified under the Power Sector Efficiency Project (herein after called as "PSEP") and the scope of works of PSEP are summarized in ANNEX-2.

Note : Appraisal for PSEP has been completed by IDA, but till July 4, 1991 loan agreement of PSEP between HMGN and IDA has not been signed.

In this connection, the following were mutually confirmed :

(1) Lainchaur Substation

a) Restoration of 66kV GIS and 11kV feeder cubicles, which got fire in July 1990, has been requested to the KfW for implementation.

b) NEA will request KfW for the provision for extension of 66kV line bay for the second circuit line between Balaju and Lainchaur under the above restoration works(a).

(2) New Chabel Substation

a) According to the results of power flow analysis made by the Team (see ANNEX-3), upgrading of transformer capacity will be required after 1995/96.

b) Replacement of the 11kV existing feeder cubicles should be made at the time of upgrading transformer capacity, because its rated breaking current capacity of 11kV CB will be less than the calculated short circuit current after the year 2000.

(3) Balaju Substation

The Team recommended to install line bays with circuit breakers at both the ends of the second circuit line between Balaju and Lainchaur for the future reinforcement.

NEA agreed to explore possibility of the implementation of this recommendation with KfW.

(4) Teku Substation

a) The Siuchatar-Teku transmission line shall be of double circuit taking into account the reliability of power supply to the central area of Kathmandu city, and 66kV GIS circuit breakers for both the line circuits at least at Teku shall also be provided under PSEP.

NEA agreed to consider this proposal, if funds are available.

b) Provision for future extension to the K-3 substation shall be made on tower to be constructed for the Siuchatar-Teku line under PSEP.

NEA agreed.

(5) New Bhaktapur-New Chabel Line

a) NEA has a plan of changing the scope of works of the New Bhaktapur-New Chabel line as follows :

(i) The double circuit line fed from New Bhaktapur substation will be connected to the existing 66kV Devighat-New Chabel line at near Burhanilkanth taking into account future construction of 132kV substation in the area.

(ii) For that purpose, the 66kV line bay to be installed in the New Chabel substation will be shifted to the planned New Bhaktapur substation.

b) Further power flow analysis will be done on the basis of the above NEA's plan.

(6) Addition of the Second Circuit line on the Siuchatar - Patan Line

Addition of the second circuit line on the Siuchatar-

Patan line will be done by NEA by March 1992.

HV Reinforcement/Extension Works to be undertaken by the Team for The Feasibility Study

(7) Power Flow Analysis

For the determination of facilities to be undertaken as urgent works for the feasibility study, the power flow analysis of the system in 1995/96 was conducted under the condition that PSEP's works mentioned in above item (1) including additional stringing of the second circuit line on towers between Siuchatar and Patan will have been completed as scheduled by 1995/96.

The results of the system analysis are illustrated on ANNEX-3.

(8) HV Reinforcement/Extension Works for the Feasibility Study.

According to the above-mentioned power flow analysis, the following reinforcement works will be needed by 1995/96, and will be undertaken for further feasibility study.

a) Replacement of the existing 66/11kV, 10MVA transformers at Balaju substation by 18MVA transformers.

In this connection, NEA pointed out that due to rearrangement of the 11kV Ring Main as feeder lines the load will be shifted to New Chabel substation. Therefore, the possibility of overloading of New Chabel substation transformer is possible. So NEA requested the Team to analyze this problem through power flow analysis and determine whether transformer capacity should be added at Balaju or New Chabel. The feasibility study should be conducted accordingly.

b) Augmentation of 132/66kV, 37.8MVA transformer at the Siuchatar substation.

c) Replacement of 11kV feeder cubicles of which the rated breaking current of circuit breaker may be less than the calculated short-circuit current.

d) The second circuit line between Balaju and Lainchaur.

(9) Feasibility Study on K-3 Substation

The substation plays very important role for power demand increase in the central area of Kathmandu city. Therefore, a feasibility level design, cost estimate and technical and economical justification will be

conducted,

(10) Underground Cables between Lainchaur and K-2

Existing 11kV underground cables are more than 25 years old and they have been repeatedly repaired. Therefore, feasibility level design, cost estimate and economical justification for additional 11 kV underground cables will be conducted in order to increase power supply reliability to the central area of Kathmandu.

For that purpose, NEA is requested to make ground survey along the proposed route given on ANNEX-4 and to send to the Team by the end of July 1991. The scale of drawing should be 1:500.

Distribution System Reinforcement for the Feasibility Study

(11) 11kV Feeders Reinforcement Plans proposed in the Interim Report

Reinforcement plans have been confirmed through discussion with each Division staff and site visit, and the plans are summarized in ANNEX-5.

(12) Distribution Reinforcement/Extension Proposed by NEA

Reinforcement and extension of the existing distribution system have additionally been proposed by NEA and its details have been confirmed through discussion with each Division staff and site visit (see ANNEX-6).

HV Transmission and Substation System

(13) Capacity of 66/11kV Transformer

Capacity of 66/11kV transformer should be 18MVA.

(14) Replacement of 11kV Cubicles at Patan Diesel

New 11kV feeder cubicles will be installed on the first floor of the Sunkosi substation after dismantling the existing cubicles. However, a control panel for these cubicles will be installed in the control room of New Patan substation.

Note : Dismantling works of the existing switchgear on the first floor of the Sunkosi control building are not included in the scope of works of PSEP.

(15) Type of 11kV Circuit Breakers

Vacuum or SF6 type circuit breakers are preferable for

NEA taking into account the past experience in operation. No bulk oil and minimum oil content type will be allowed for the future extension and reinforcement.

(16) Rated Breaking Current of 11kV Circuit Breakers

The rated breaking current of 11kV circuit breaker shall be equal to or more than 20kA. The recommendable rated breaking current will be studied by short-circuit analysis of envisaged future extension.

(17) General Layout Drawing of Royal Palace Switching Station

A general layout drawing of the Royal Palace switching station should be provided by NEA and sent to the Team by the end of July 1991.

Distribution System

(18) 11kV Feeder Cubicles for New 11kV Feeder Line

The following three(3) new feeders are planned to be additionally fed from the existing substation and switching stations:

a) Patan-Thanagau (Pharping Line)

A new feeder will be fed from the Sunkosi substation where new 11kV switchgear will be installed under the Project as explained in the above item (14).

b) Chabel-Gokarna Ban (Boudha Jorpati Line)

A new feeder will be fed from the Old Chabel switching station of which the existing 11kV cubicles will be replaced with new ones under the Project.

c) Siuchatar-Earth Station (Thankot Line)

For feeding a new 11kV feeder from the Siuchatar substation, the 11kV cubicle for Kalanki or Kalimati line will be used, because customers on these lines may be served from the 66kV Teku substation after its completion.

(19) Design Criteria for Distribution System Project

Agreed design criteria for the distribution system are shown in ANNEX-7.

(20) Extent of LT Reinforcement and Improvement under Project

Works under taken in the Project excludes service wires to customers and metering system, which will be implemented by NEA.

(21) Works undertaken by NEA for the Project

Following facilities should be provided by NEA in advance of site erection of Contractor(s).

(a) right of way for construction of the works

(b) permission for right of construction of the underground cable works

(c) removals of telecommunication cables from existing power poles of which replacement will be made.

(d) all necessary procedures of tax exemption for import of materials and equipment for the Project and tools and vehicles of Contractor(s) required for execution of the Project, subjected to the approval of HMGN.

Jul. 6, 1991

Mr. Y. Miyagawa
Team Leader
JICA Study Team

5th July 1991.

Mr. R.C.L. Pradhan
Director-in Chief
Distribution and Consumer
Services Directorate

KTM-902

ANNEX-1 : ATTENDANTS LIST

Name of Attendants	Position	June						July	
		14	17	18	19	27	27	2	4
Nepal Electricity Authrity (NEA)									
Mr. R.C.L Pradhan	Director-in Chief Distrbution and Consumer Services Directorate								x
Mr. S.B. Pun	Director Bagmati Department							x	
Dr. M.R. Tuladhar	Director Technical Service	x	x	x			x	x	x
Mr. B.B. Dungana	Director Power Sector Efficiency Pro.	x							
Mr. N.T. Bhutia	Director System Planning	x		x			x		x
Mr. K.G. Shrestha	Manager Power Sector Efficiency Pro.	x							x
Mr. P.N. Sharma	Manager Kathmandu Division		x						
Mr. M.P. Upadhaya	Manager Lalitpur-Bhaktapur-Kavre Div.		x						
Mr. D.R. Bhattarai	Manager Technical Service Dep.					x			
Mr. D. Basnet	Manager Loss Reduction Project				x				
Mr. T.M. Shakya	Deputy Manager Technical Service Dep.	x	x	x	x	x		x	x
Mr. C.B. Bajracharya	Deputy Manager Kathamndu West		x			x			
Mr. K.P. Koirala	Deputy Manager Kathamndu Center		x			x			
Mr. R.C. Pandey	Deputy Manager Kathamndu East		x			x			
Mr. D.P. Bhattarai	Deputy Manager Lalitpur		x			x			
Mr. G.P. Shrestha	Deputy Manager Bhaktapur		x			x			
Mr. D.S. Paudel	Assist. Manager Kavre					x			
Counterparts									
Mr. S.K. Gurung	Assist. Manager Technical Service Dep.								x
Mr. M. Shrestha	Engineer Technical Service Dep.								x
JICA Study Team									
Mr. Y. Miyagawa	Team Leader	x	x	x	x	x	x	x	x
Mr. K. Nakajima	Specialist for Distribution System	x	x		x	x		x	x
Mr. Y. Sunagawa	Specialist for substation	x	x	x	x		x	x	x
Mr. T. Fukuchi	Specialist for Transmission Line	x	x		x		x	x	x

Subjects of Meeting

June 14 : Committed HV reinforcement works in Kathmandu Valley
June 17 : Distribution system, mainly 11kV feeder lines
June 18 : HV power transmission system in Kathmandu Valley
June 19 : Loss reduction program
June 27 : Distribution system
June 27 : HV power transmission system
July 02 : HV power transmission and distribution system
July 04 : HV power transmission and distribution system

KTM-903

ANNEX-2 : SCOPE OF WORKS OF POWER SECTOR EFFICIENCY PROJECT (PSEP)

SUBSTATION	Description of Works
1) Lainchar	a) Dismantling existing transformers (2x10MVA) b) Transportation of transformers to Bhaktapur c) Instalation of new transformers (2x15/18MVA) d) Replacement of CTs for transformer circuits
2) New Chabel	a) Adjunction of one 66kV line bay b) Modification of existing line bays
3) Bhaktapur	New 66/11kV substation a) 66/11kV 2x10MVA transformers (shifted) b) Two 66kV transformer bays c) Three 66kV line bays d) One bus bar e) Two station service transformers f) One 11kV indoor metal enclosed switchgear (SF6, 15 cubicles) g) One control building inclu. site preparation
4) Sunkosi	a) Replacement of the existing line trap
5) New Baneswar	a) Adjunction of one transformer (18MVA) b) Adjunction of one 66kV transformer bay c) Adjunction of one 11kV transformer incoming bay d) Modification of existing line bays
6) Patan	a) Adjunction of one 66kV line bay (Siuchatar-2) b) Reshaping of 66kV New Baneswar line bay c) Modification of 66kV Siuchatar-1 line bay
7) Siuchatar	a) Adjunction of two 132kV line bays b) Adjunction of two 66kV line bays c) Modification of existing line bays
8) Balaju	a) Modification of existing 66kV line bays
9) Trisuli	a) Reshaping of two existing line bays and bus bar
10) Teku	New 66kV substation(GIS or air insulated metalclad) a) Two 66kV Transformer bays b) One 66kV line bays (without CB) c) One 66kV bus bar d) Two station service transformers e) One 11kV metal enclosed switchgear (SF6, 21 cubicles) f) shifting all 11kV feeders to new switchgear
11) Devighat	a) Modification of 66kV New Chabel bay

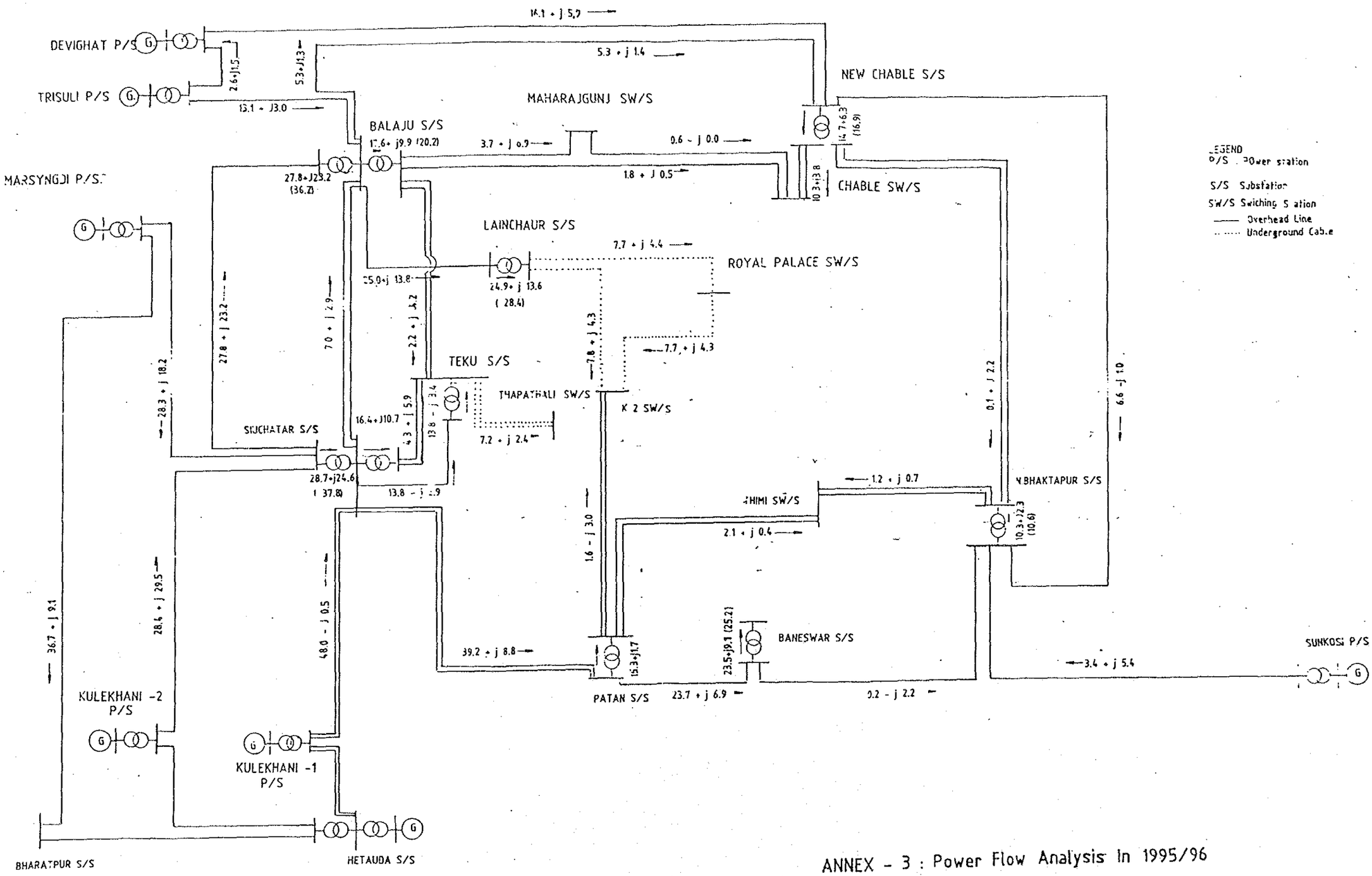
Source : Draft Tender Document, Volume 1/4 = Commercial Clauses

KTM-903B

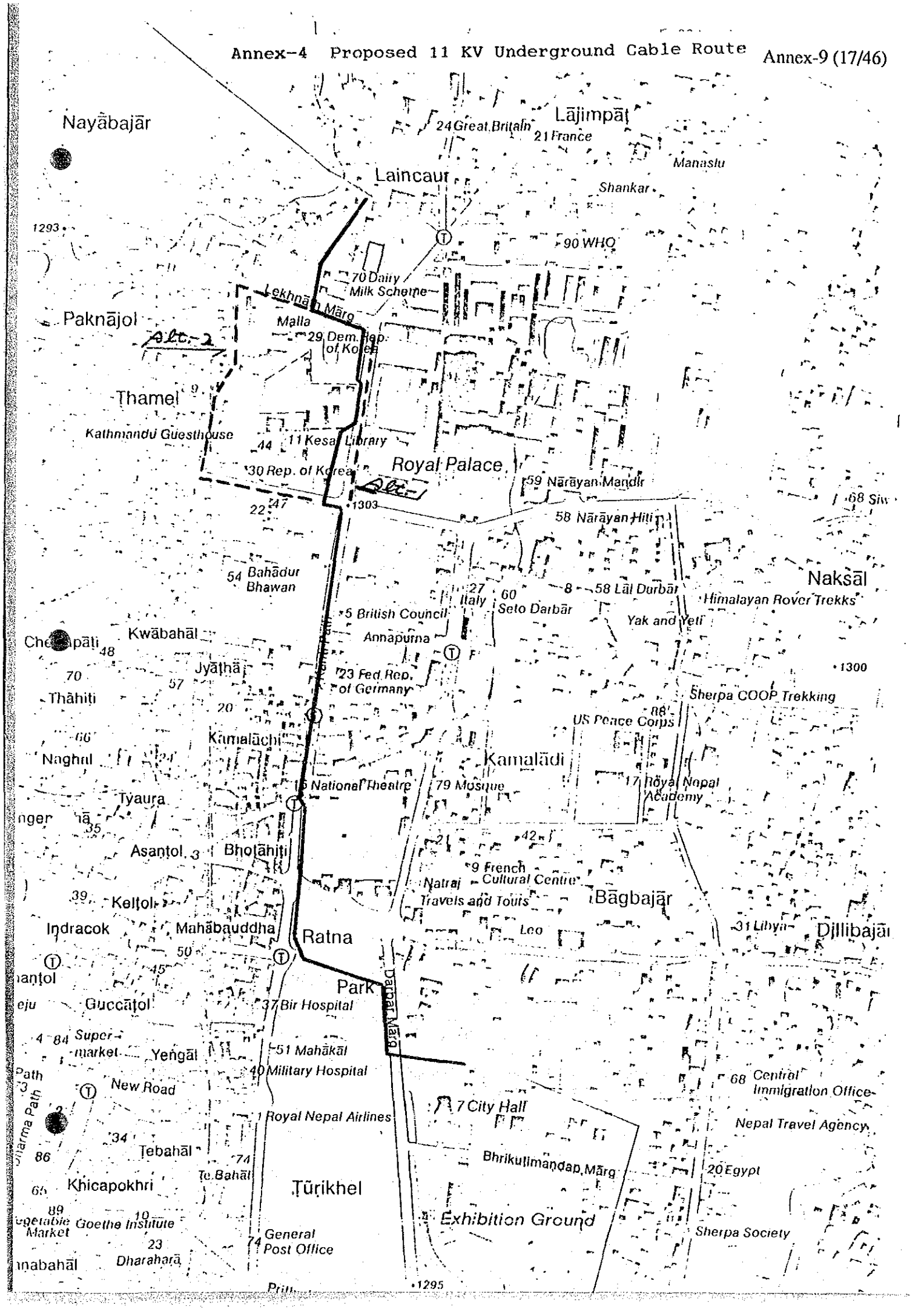
ANNEX-2 : SCOPE OF WORKS OF POWER SECTOR EFFICIENCY PROJECT (TRANSMISSION LINE)

SECTION From	SECTION To	LENGTH (km)	SPECIFICATION
1) New Bhaktapur	New Chabel	10.5	a) 132kV (initially 6 b) Double circuit c) ACSR Bear conducto
2) Diversion of 66kV Sunkosi line to New Bhaktapur substation		1.75	a) 132kV (initially 6 b) Double circuit c) ACSR Bear conducto
3) Diversion of 132kV Marsyangdi line to Siuchtar substation		1.15	a) 132kV b) Double circuit c) ACSR Bear conducto
4) Siuchatar	Teku	4.05	a) 66kV b) Double circuit c) ACSR Bear conducto

Source : Draft Tender Document, Volume 1/4 = Commercial Clause



ANNEX - 3 : Power Flow Analysis In 1995/96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21 France
Manaslu
Laincaur
Shankar
1293
90 WHO
70 Dairy Milk Scheme
Lekhnāth Mārg
Paknājol
Malla
29 Dem. Rep. of Korea
Alt-2
Thamel
Kathmandu Guesthouse
44
11 Kesar Library
30 Rep. of Korea
Royal Palace
59 Nārāyan Mandir
68 Siw
22
47
1303
58 Nārāyan Hiti
54 Bahādur Bhawan
27 Italy
60 Seto Darbār
8
58 Lāl Durbār
Naksāl
Himalayan Rover Trekks
5 British Council
Yak and Yeti
Kwābahāl
Annapūrna
48
Jyāṭhā
70
57
23 Fed. Rep. of Germany
1300
Thāhiṭi
20
Sherpa COOP Trekking
88
US Peace Corps
66
Kamalāchi
Naghal
Kamalādi
15 National Theatre
79 Mosque
17 Royal Nepal Academy
Tyaura
35
Asaṇṭol
3
Bholāhiṭi
2
42
9 French Cultural Centre
Natraj Travels and Tours
Bāgbajār
39
Kelṭol
Indracok
Mahābauddha
Ratna
Leo
31 Libya
Dillibajār
50
45
Park
Darbar Mārg
Guccāṭol
37 Bir Hospital
4
84
Super-market
Yeṅgāl
51 Mahākāl
40 Military Hospital
New Road
68 Central Immigration Office
7 City Hall
1 Royal Nepal Airlines
Nepal Travel Agency
34
Tebahāl
86
74
Te.Bahāl
Bhrikutimandap Mārg
20 Egypt
Khicapokhri
Tūṛikhel
89
10
Goethe Institute
Exhibition Ground
Sherpa Society
23
Dharahara
74
General Post Office
1295

ANNEX-5

REINFORCEMENT PLANS FOR 11KV DISTRIBUTION FEEDERS

(A) LALITPUR POWER DIVISION

(1) Godawari-1 and Godawari-2 feeders with supply modification and construction of a new 11kV line as well as addition of section switches and auto-reclosers

(2) Pharping Feeder with construction of a new line up to Thanagau

(3) Upgrade of the existing underground cables being laid down between Patan Diesel Station and New Patan substation : (to be examined)

(B) KATHMANDU EAST POWER DIVISION

(1) Boudha-Jorpati feeder with construction of a new line up to Gokarna Ban

(2) Sundarijal feeder to be replaced with a new line up to Jagdol and construction of a new line along the load via Gokarneswar and Nayapati up to junction of another Sundarijal feeder from Bramhakhel

(3) Construction of a new line from Boudha-Jorpati line at Baralgau to the existing branch line of Sundarijal feeder at vicinity of Gokarneswar

(4) Baneswar feeder to be replaced with a new line from Chabel substation to its junction of Tangal feeder from K2 switching station

(C) KATHMANDU CENTRAL POWER DIVISION

(1) Interconnection of Nayabazar feeder and Budhanilakantha feeder along the ring road around Maharajgunj

(2) Improvement of feeders in the center of town

(D) BHAKTAPUR POWER DIVISION

(1) Nagarkot feeder reinforced by a new double circuit line between Bhaktapur switching station and a junction of Byasi feeder and extension of Byasi feeder up to another Nagarkot feeder at Kharipati

(2) Replacement of Nagarkot feeder in the section of Cangunarayan and Bramhakhel

(3) Construction of a new feeder from New Bhaktapur substation to the existing branch line of Airport feeder from new Baneswar substation

(E) KATHMANDU WEST POWER DIVISION

(1) Construction of a new feeder along the existing Thankot feeder up to earth station at Balambu

(2) B.I.D feeder to be reinforced with an additional feeder from Balaju substation

(3) Upgrade of the existing 3.3kV system in Kirtipur and around Swayambu temple to 11kV system

(4) Tahachal feeder to be altered to underground cable

(5) Interconnection between Dharmasthali feeder and Swayambhu feeder from Balaju substation for separation of local load from BID feeder

Note: Plans of the above (2) and (4) are to be undertaken by NEA at its expenses.
The above (3) plan will not be implemented but some improvement will be conducted with some materials and equipment supplied under the Project.

(F) OTHERS

Partial reinforcement and improvement of the existing feeders and branch lines will be implemented in each Power Division with extension of lines, addition of distribution transformers, switches and other equipment under the Project. Necessary materials and equipment proposed by NEA should be examined carefully by the Team.

In addition to the above reinforcement and improvement, proposed multi-switching facilities for increase of operational reliability should be examined by the Team.
Locations of the multi-switching facilities proposed by NEA are as follows:

(1) Balambu (near earth station) on Thankot feeder
(2) Khokna on Pharping feeder
(3) Thaiba on Godawari-1 feeder
(4) Manmniju on Dharamthali feeder
(5) Bramhakhel on Sungarijal feeder

ANNEX-6

REINFORCEMENT AND EXTENSION OF LOW TENSION SYSTEM

Extension and improvement of the existing LT lines are required for reduction of voltage drops and excessive technical energy loss in each Power Division. Tentative items and quantities of materials and equipment required for the purpose are estimated as follows:

Tentative Quantity

	KATH. CENTRAL Q'TY	KATH. EAST Q'TY	KATH. WEST Q'TY	LALIT-PUR Q'TY	BHAKTA-PUR Q'TY	TOTAL Q'TY
ACSR Dog (km) w/accessories	0	250	0	170	20	440
Rabbit (km) w/accessories	0	146	18	102	12	278
U/G CBL 35 mm2 w/accessories	1.1	0	0	0	0	1.1
60 mm2 w/accessories	0	0	0	0.1	0	0.1
100 mm2 w/accessories	0	0	0	0	0	0
O/H CBL 100 mm2 w/accessories	0	0	2.5	0	7	9.5
Pole w/accessories	50	500	70	1,350	90	2,060
11kV D.O.S (pcs)	0	0	100	0	0	100

MATERIAL REQUIREMENT
FOR IMPROVEMENT OF DISTRIBUTION SYSTEM IN KATHMANDU VALLEY

PARTICULARS	QUANTITY							REMARKS
	CENTRAL	EASTERN	WESTERN	PATAN	BHAKATPUR	TOTAL	Unit	
1 Transformer								
a. 200 KVA	13	10	15	17	6	61	No.	
b. 100 KVA	18	15	10	25	14	82	No.	
c. 50 KVA	0	15	10	11	24	60	No.	
d. 25 KVA	5	5	5	10	10	35	No.	
e. 15 KVA	0	0	0	6	6	12	No.	
Sub Total	36	45	40	69	60	250		
2 MCCB with Box								
a. 400 A	35	0	0	20	7	52	No.	
b. 300 A	38	10	15	7	2	72	No.	
c. 200 A	0	0	0	30	50	80	No.	
d. 175 A	68	15	10	52	6	151	No.	
e. 100 A	0	15	10	57	69	151	No.	
f. 50 A	10	10	10	15	15	60	No.	
Sub Total	131	40	35	166	134	506		
3 Pole								
a. 11 m	130	100	150	250	200	830	No.	
b. 9 m	200	200	250	550	480	1680	No.	
Sub Total	330	300	400	800	680	2510		
4 ACSR								
a. 0.03	15	15	15	85	60	190	Km.	
b. 0.05	40	20	25	55	35	175	Km.	
c. 0.10	20	10	0	25	5	60	Km.	
Sub Total	75	45	40	165	100	425		
5 Drop-Out Fuse +Lightning Arrestor	100	50	50	210	110	520	Set	
6 Transformer Platform	36	45	40	69	60	250	No.	
7 Hardwares+Insulators +Earthing set							Set	

8 Cables 1100 V							
a. 300 sq.mm.	0	0	0	0.5	0.5	1	Km.
b. 240 sq.mm.	1	0	0	0	0	1	Km.
c. 150 sq.mm.	3	0	0	2	2	7	Km.
d. 100 sq.mm.	2	0	0	0	0	2	Km.
e. 95 sq.mm.	5	0	0	0	0	5	Km.
f. 50 sq.mm.	11	3	0	4	3	21	Km.
g. 35 sq.mm.	0	0	0	2	2	4	Km.
h. 25 sq.mm.	40	5	0	0	0	45	Km.
i. 25 sq.mm.(2C)	20	0	0	0	0	20	Km.
Sub Total	82	8	0	8.5	7.5	106	
9 Armoured cable 1100 V							
a. 100 mm.	2	0	0	0	0	2	Km.
b. 50 mm.	2	0	0	0	0	2	Km.
Sub Total	4	0	0	0	0	4	
10 Concentric Cable							
a. 6 sq.mm.	15	0	0	0	0	15	Km.
b. 25 sq.mm.	30	0	0	0	0	30	Km.
Sub Total	45	0	0	0	0	45	
11 HV XLP Cable, 11000 V							
With termination Kit							
a. 100 sq.mm.	5	1	0	2.5	2	10.5	Km.
b. 150 sq.mm.	0	0	0	0.5	0	0.5	Km.
c. 200 sq.mm.	5	0	0	0	0.5	5.5	Km.
d. 240 sq.mm.	0	0	0	1	0	1	Km.
e. 300 sq.mm.	10	0	0	0	0	10	Km.
Sub Total	20	1	0	4	2.5	27.5	
12 D-Iron+Shackle							
+Insulators, etc.							Set.
(5% of Pole cost)							
Sub-Total							

13 Other items

a.11 kV Sectionalizing Switch	50	Set
b.11 kV Insulated Cables for overhead lines	30	Km
c.Tools and Equipments	One Lot.	
d.Vehicles	As reqd.	
e.Communication Equipments	15	Set

Note :Locations to be identifed during constructions

ANNEX-7

DESIGN CRITERIA

(1) *Local Climatic Condition*

Climatic records in the Kathmandu Valley are summarized in the attached table. Referring to the last 2 phase projects for Reinforcement Project of Kathmandu Valley Distribution Network, same conditions will be applied for design of facilities in this Project.

Minimum ambient temperature	:	- 5 deg.C
Maximum ambient temperature	:	40 deg.C
Average ambient temperature	:	20 deg.C

Maximum wind velocity to be applied for the Project is assumed at 25 m/s, since extremely highest wind velocity recorded in the Kathmandu International Airport was 52 knots (equivalent 26.75 m/s) and the velocity has been applied for the last 2 phase Projects without any trouble.

(2) Maximum Design Wind Pressures

Following wind pressures are taken on the projected areas.

(a) conductors and wires	:	35 kg/sq.m
(b) lattice structures	:	55 kg/sq.m
(c) tubular structures	:	31 kg/sq.m
(d) insulators and hardware	:	55 kg/sq.m
(e) equipment	:	100 kg/sq.m

(3) Assumption of Sag Computation

Sags of overhead conductors will be computed under the following assumptions.

(a) maximum conductor temperature to be 60 deg.C taking account of temperature rise due to current flow

(b) minimum conductor temperature to be 0 deg.C, although ambient minimum temperature is minus 5 deg.C, taking

account of such case that maximum wind blow at extremely minimum air temperature is very rare.

(c) EDS (Every Day Stress) to be computed at 20 deg.C

(d) minimum factor of safety of conductor stress at maximum wind pressure at 0 deg.C to be 2.5 or EDS to be 4 against its ultimate tensile strength.

(4) Minimum Factors of Safety

(a) structures, tubular poles, other kinds of supports against their ultimate strengths 2.5

(b) conductors against their ultimate tensile strengths 2.5

(c) insulator sets against their breaking strengths ... 2.5

(d) foundations of structures and support under the simultaneous maximum loads against ultimate ground bearing capacity 2.5

(5) Minimum Clearances Required

Following clearances will be maintained minimum from bare conductors:

(a) above general terrain ..... 5.0 m
(b) above road surface at road crossing ..... 6.0 m
(c) separation between 11kV bare conductor and LT bare conductor ..... 1.0 m
(d) separation between 11kV bare conductor and LT insulated cable ..... 0.8 m
(e) 11kV phase spacing of bare conductors ..... 0.8 m
(f) vertical spacing between 11kV bare conductors ... 1.0 m
(g) 11kV phase spacing of cables ..... 0.4 m
(h) LT phase spacing of conductors(cables) ..... 0.3 m

(6) Standards Applied

Materials and equipment will be designed, manufactured and

tested in accordance with the requirements of JIS, JEC, BS, IEC or other international standards.

Erection of the facilities will be executed in conformity to NEA's practices and regulations and rules enforced in Nepal. Safety measures to workers and public will be especially and severely controlled under the Project.

Frequent power interruption and traffic control will be required for the Works, which NEA is to arrange.

MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER TRANSMISSION AND DISTRIBUTION SYSTEM IN KATHMANDU VALLEY

MINUTES OF MEETING

Date: February 26 to March 6, 1991
Place: Nippon Koei Head Office
Attendants:

NEA	Dr. M. R. Tuladhar
	Mr. S. B. Pun
JICA Study Team	Mr. Y. Miyagawa
	Mr. Y. Iwase
	Mr. T. Fukuchi
	Mr. T. Akahoshi

Through a series of discussion between the officials of NEA (hereinafter called as "NEA") and the JICA Study Team (hereinafter called as "the Team"), the following matters were discussed and mutually confirmed by both the parties.

1) Demand Forecast

The methdology and results of national and areawise demand forecast have been explained by the Team.
The demand forecast made by the Team is acceptable for NEA for the purpose of establishing master plan for the reinforcement and extension of the power transmission and distribution system in the Kathmandu Valley.
In this connection, it was informed by NEA that the highest peak demand in 1990/91 was 197MW, including export to India of 2.8MW, which was recorded at 18:02 P.M. on Dec. 28, 1990.

2) Power Transmission System

2.1) Supporting structure of 66kV Balaju-Lainchaur Line

Reconstruction of double circuit line has been proposed by the Team and accepted by NEA. However, supporting structure of the line (steel pole, panzar mast or steel tower) will be further examined by the Team during feasibility study.

2.2) Unit Capacity of 66/11kV Transformer

Regarding the unit capacity of 66/11kV transformer, NEA pointed out that the maximum capacity of 66/11kV transformer to be installed in the Kathmandu Valley is 18MVA. However, the Team proposed 20MVA, 3-phase transformers for new substations taking into account its construction cost, transportation limit and standard capacity widely used.

NEA agreed to the Team's proposal.

2.3) Timing of Creation of New Bhaktapur Substation

NEA requested to put the construction timing of the New Bhaktapur substation in 1991/92 taking into account its urgent necessity.

The Team agreed to NEA's request.

2.4) Voltage of 66kV New Bhaktapur-New Chabel Line

A 66kV single-circuit line has been proposed by the Team for the following reasons:

a) Firstly, a 66kV ring system will be established in order to improve power supply conditions not only in Bhaktapur area but also in Baneswar area.
b) Adoption of 132kV design to the line seems not to be economical, because of forecasted demand density in the eastern Kathmandu.

NEA has no objection to the Team's proposal for present analysis. However they also pointed out that there is the possibility of constructing this line on 132kV double-circuit design due to probable right-of-way problems.

2.5) Interconnection between Siuchatar and Balaju substations by 132kV line

Firstly, new construction of a 132kV single-circuit line between both substations has been proposed by the Team. However, it is agreed that interconnection of both substations is made by pi type connection of Marsyangdi line to the Siuchatar substation taking into account the difficulty of rearrangement of GIS of the Balaju substation and its cost.

NEA has no objection to the Team's proposal.

2.6) Sequence of Construction of Teku and K3 Substations

The Team proposed to construct K3 substation which is located in the center of Kathmandu City prior to the upgrading of Teku switching station in order to improve overloading of underground cables from Lainchaur to K2 switching station and to achieve the reliable power supply in the central area.

NEA appreciated the proposed plan and indicated strongly the necessity for early creation of 66/11kV K3 subtstation.

2.7) Site of 66kV K3 Substation

The following two sites are informed as available land space for the K3 substation.

a) Southern corner of the Exhibition Ground
b) Site near Balmiki Campus (north of the Exhibition Ground)

These substation sites will be investigated in detail during feasibility study by the Team.

2.8) Overhead Line for K3 Substation

NEA suggested that an overhead line will be allowed upto Prithvi Path (Singha Durbar-Bhadrakari Road).

This matter will be further studied during site investigation for feasibility study.

2.9) Installation of Static Condenser

The Team explained that the power flow analysis has been done on the basic assumption of 90% power factor as assumed by EDF. It was however agreed that necessity of static condenser will be examined during feasibility study in accordance with the actual recorded power factor.

2.10) Future Augmentation of 66/11kV Transformers at New Bhaktapur Substation

For future augmentation of transformers at 132/66/11kV substations, NEA reguested to adopt 132/11kV transformers instead of 66/11kV, and the Team agreed to their proposal.

2.11) 132kV Switchgear Layout of Chapagaon Substation

Double T-branch connection will be adopted for the Chapagaon substation taking into account of its construction cost and importance.

2.12) Rehabilitation of Lainchaur-K2 Underground Cable

It is confirmed again that replacement of the underground cable between Lainchaur and K2 switching stations is urgently required and its replacement is a basis of power flow analysis as confirmed during site investigation in Kathmandu (November 1990).

2.13) 66kV Banepa Substation

Creation of 66/11kV Banepa substation (10MVA) is added to the proposed sequence of investment in order to improve power supply conditions in the area (1997/98).

2.14) Urgent Works to be Undertaken by the World Bank

According to the information of NEA, which is verbally informed in the end of February 1991, the following sub-projects will be undertaken by the World Bank and these are presently under design by the consultant.

Substation

a) Replacement of 66/11kV transformers at Lainchaur
b) Creation of 66/11kV New Bhaktapur substation including extension of 66kV line bay at New Chabel
c) Augmentation of 66/11kV transformer at New Baneswar
d) Replacement of line trap at Sunkosi
e) Extension and reshaping of Patan substation for 2nd circuit of Siuchatar-Patan line and Patan-New Baneswar line
f) Extension of Siuchatar substation for 132kV incoming feeders from Marsyangdi line and 66kV Siuchatar-Teku line
g) Modification of 66kV Balaju switchgear (communication system)
h) Addition of CB and reshaping of 66kV switchgear of Trisuli power station
i) Upgrading of Teku switching station to 66kV substation

Transmission Line

a) A 66kV single-circuit New Bhaktapur-New Chabel line (132kV double-circuit design, 15km)
b) 66kV incoming feeders from Sunkosi line to New Bhaktapur (2km)
c) 132kv incoming feeders from Marsyangdi line to Siuchatar (1km)
d) 66kV double-circuit Siuchatar-Teku line

In addition to the above works, 2nd circuit of 66kV Siuchatar-Patan line is scheduled to be erected by NEA.

3) Distribution System

3.1) Ring Main System

a) The Team explained that replacement and new addition of 11kV switchgear only are required for the reinforcement of the system, because overload and/or voltage drop conditions will be improved by the extension and reinforcement of the transmission system.

Therefore, a plan of replacement and new addition of 11kV cubicles will be given in the Interim Report.

NEA agreed to the Team's proposal.

b) NEA requested not to utilize bulk oil and minimum oil type cubicles, and the Team agreed to their request.

3.2) 11kV Distribution System

Reinforcement and extension plan of 11kV feeders by areas and/or feeders have been proposed by the Team on the basis of analysis on voltage drops, and mutually confirmed by both the parties as summarized in the attached list.

3.3) Low Voltage System

As mutually agreed by the previous meeting held in Kathmandu during site investigation, a plan of reinforcement of low voltage system will be studied in detail during feasibility study.

Mr. Y. Miyagawa
Team Leader
JICA Study Team

Dr. M. R. Tuladhar
Director
Technical Service Dept.
NEA

Mr. S. B. Pun
Director
Bagmati Dept.
NEA

ATTACHMENT OF MINUTES OF MEETING(1/2)

Area Name	Distribution Line	Substation/ Switching Station	Reinforcement Plan	Implementation Fiscal Year	Remarks
Chapagau	Godawari - 2	New Baneswar	New Construction of 11kV D/L, 3.6km in total route length, ACSR 0.1 Pole-mounted sectionalizing switch : 2 sets	1992/93	Modification of Patan Diesel S/S in 1992/93
Godawari	Godawari - 1	New Baneswar	Request the marble factory to provide the condenser set Pole-mounted sectionalizing switch : 1 set	N.A.	
Pharping	Pharping	Patan Diesel	New Construction of 11kV D/L, 2.4km in total route length, ACSR 0.1 Pole-mounted sectinalizing switch : 3 sets	1992/93	Modification of Patan Diesel S/S in 1992/93
Chapagau	Godawari - 2	New Baneswar	New Construction of 11kV D/L, 0.2km in total route length, ACSR 0.1	1998/99	New Construction of Chapagau S/S in 1998/99
Godawari	Godawari - 1	New Baneswar	New Construction of 11kV D/L, 1.7km in total route length, ACSR 0.1 Reconductoring (ACSR 0.05 to ACSR 0.1) of 11kV D/L, 1.7km in total route length	1998/99	New Construction of Chapagau S/S in 1998/99
Pharping	Pharping	Patan Diesel	New Construction of 11kV D/L, 2.5km in total route length, ACSR 0.1 Reconductoring (ACSR 0.05 to ACSR 0.1) of 11kV D/L, 3.2km in total route length	1998/99	New Construction of Chapagau S/S in 1998/99
Thankot	Thankot	Siuchatar	New Construction of 11kV D/L, 4.0km in total route length, ACSR 0.1 Reconductoring (ACSR 0.1 to ACSR 0.2) of 11kV D/L, 3.8km in total route length Reconductoring (ACSR 0.05 to ACSR 0.1) of 11kV D/L, 3.6km in total route length Pole-mounted sectionalizing switch : 2 sets	1993/94	
Kiritipur	Ropeway (Kirtipur)	Siuchatar	New Construction of 11kV D/L, 1.1km in total route length, ACSR 0.1 Pole-mounted sectionalizing switch : 1 set	1995/96	After gradingup of Teku S/S
Dharmasthali	Dharmasthali	Balaju	New Construction of 11kV D/L, 2.4km in total route length, ACSR 0.1 Reconductoring(ACSR 0.05 to ACSR 0.1) of 11kV D/L, 3.0km in total route length Pole-mounted sectionalizing switch : 1 set	1993/94	
Budhanilkantha	Budhanilkantha	Maharajgunj	Reconductoring (ACSR 0.05 to ACSR 0.1) of 11kV D/L, 3.0km in total route length Pole-mounted sectionalizing switch : 1 set	1998/99	

ATTACHMENT OF MINUTES OF MEETING(2/2)

Area Name	Distribution Line	Substation/ Switching Station	Reinforcement Plan	Implementation Fiscal Year	Remarks
Sundarijal	Sundarijal	New Chabel	Reconductoring (ACSR 0.025 to ACSR 0.1) of 11kV D/L, 8.7km in total route length Pole-mounted sectionalizing switch : 2 sets	1998/99	
Boudha-Jorpati	Boudha-Jorpati	New Chabel	New Construction of 11kV D/L, 3.9km in total route length, ACSR 0.1 Reconductoring (ACSR 0.05 to ACSR 0.1) of 11kV D/L, 4.0km in total route length Pole-mounted sectionalizing switch : 1 set	1992/93	
Nagarkot	Nagarkot	Bhaktapur	New Construction of 11kV D/L, 4.3km in total route length, ACSR 0.1 Reconductoring (ACSR 0.05 to ACSR 0.1) of 11kV D/L, 1.8km in total route length	1995/96	
Bhaktapur	Byasi	Bhaktapur	Reconductoring (ACSR 0.1 to ACSR 0.2) of 11kV D/L, 3.0km in total route length, ACSR 0.2 Pole-mounted sectionalizing switch : 1 set	2000/01	Establish ring system with Brick factory line
Bhaktapur	Brick factory	Bhaktapur	Reconductoring (ACSR 0.1 to ACSR 0.2) of 11kV D/L, 1.6km in total route length, ACSR 0.2	2000/01	Establish ring system with Byasi line
Baneswar	Airport	New Baneswar	The countermeasure has been already taken by NEA.	N.A.	
Baneswar	Baneswar	New Baneswar	New Construction of 11kV D/L, 1.4km in total route length, ACSR 0.1 Pole-mounted sectionalizing switch : 2 sets	2000/01	
Baneswar	Baneswar	Chabel	Reconductoring (ACSR 0.05 to ACSR 0.1) of 11kV D/L, 2.4km in total route length Pole-mounted sectionalizing switch : 1 set	1995/96	
Patan	Patan	Patan Diesel	New Construction of 11kV D/L, 1.1km in total route length, ACSR 0.1 Pole-mounted sectionalizing switch : 1 set	2000/01	From New Baneswar S/S
Patan	Radio Nepal	Patan Diesel	Reconductoring (ACSR 0.03 to ACSR 0.1) of 11kV D/L, 1.8km in total route length Pole-mounted sectionalizing switch : 1 set	2000/01	
Balaju	B. I. D.	Balaju	New Construction of 11kV D/L, 1.0km in total route length, ACSR 0.1 Reconductoring (ACSR 0.05 to ACSR 0.1) of 11kV D/L, 1.3km in total route length Pole-mounted sectionalizing switch : 2 sets	1993/94	Establish ring system

MASTER PLAN AND FEASIBILITY STUDY ON EXTENSION AND REINFORCEMENT OF POWER TRANSMISSION AND DISTRIBUTION SYSTEM IN KATHMANDU VALLEY

MINUTES OF MEETING

Date	:	October 22, November 02 and 11, 1990
Place	:	JICA Study Team's Office (Baneswor)
Attandants	:	(see Table 1)

Through a series of discussion between the officials of NEA and the JICA Study Team (hereinafter called as "the Team"), the following matters were mutually confirmed by both the parties.

The Study

(1) Objectives of the Study and Schedule

a) To establish a master plan for the ten (10) years from 1991 to 2000 for the extension and reinforcement of the power transmission and distribution system in the Kathmandu Valley, and

b) To perform feasibility study on the power transmission and distribution facilities which will be selected in the master plan study as an urgent and important reinforcement countermeasures to be implemented within the coming five (5) years.

In this fiscal year (1990/91), the Master Plan Study for the ten (10) years will be performed.

66 kV K3 and Teku Substation

(2) K3 Substation

As for K3 S/S site, three sites were selected as shown in the attached Fig.1.Among these sites, a corner of the Exhibition Ground (Site-B) is the most preferable taking into account of its construction cost and accessibility.In case the overhead crossing over the Singadurbar Bridge is unacceptable, Site-C is preferred.

Topographic survey (1/200, 0.5 m contour) of these sites shall be done by NEA as soon as possible.

(3) Route of Siuchatar-K3 Line

A double circuit line will be routed along Balkhu river, Bagmati river and Tukucha river as shown in Fig.2. For this line the possibility of 132 kV construction will also be explored.

For the section between K3 S/S and Bagmati river, the existing route of 11 kV K2-Patan ring main line will be used.For that purpose, prior to the commencement of the construction work of this section, underground cables between Lainchaur S/S and K2 switching station shall be replaced by NEA with new one, which are very old and have been partially damaged at present.

(4) Upgrading of Teku Switching Station

NEA has a plan for upgrading the Teku switching station to 66/11 kV substation in order to improve overload of 11 kV ring main system in Kathmandu city area.

However, the Team recommended to upgrade the Teku switching station with the following order:

a) To construct K3 S/S and a new double circuit line from Siuchatar S/S to the K3 S/S.

b) To replace the existing 11 KV cubicles at Teku switching station.

c) To upgrade Teku switching station to 132/11 kV or 66/11 kV Substation and to construct incoming line (single pai connection) at the time when the ring main lines between Siuchatar and Teku are overloaded.

(5) Configuration of New Switchgear at Siuchatar Substation

T/L bays at the Siuchatar S/S for the new double circuit line will be provided as shown in Fig.3.

132 kV Siuchatar-Balaju Line

(6) Arrangement of 132 kV T/L Bay at Siuchatar

A 132 kV single circuit transmission line will be constructed between Siuchatar and Balaju S/S in order to improve overload of 132/66 kV transformer at Balaju S/S.

For that purpose, a bay shown in Fig.4 will be used. However, terminal structure for feeding line will be constructed outside the existing 66 kV lines and connected to the T/L bay by power cables.

(7) Route of 132 kV Siuchatar-Balaju Line

The Siuchatar-Balaju line will be routed northern side of the existing 132 kV Marsyangdi line and 66 kV Siuchatar-Balaju line.

(8) Additional 132 kV Switchgear at Balaju

As pointed out in the EDF's report, the existing 132 kV switchgear has no possibility for extension i.e. no provision for the extension of the 132 kV GIS.

Therefore, construction of new 132 kV switchgear has to be considered.

66 kV Bhaktapur Substation

(9) Place of Bhaktapur Substation

Several industries are under construction along the main road between Kathmandu and Bhaktapur, and rapid load demand increase is expected in this Thimi-Bhaktapur area.

Therefore, construction of a new 66/11 kV substation is urgently needed not only in order to improve present problem of voltage drop on 11 kV system but also supplying stable electric power to these industries.

Place of the Bhaktapur S/S shall be selected from the following points of view:

a) Accessibility for transporting heavy equipments.

b) Enough bearing capacity of soil for setting transformers.

c) Enough space for future extension, i.e. 132 kV and/or 220 kV system.

d) Near demand center, etc.

In this connection, NEA is required to select proper site and to conduct topographical survey.

(10) 66 kV New Chabel-Bhaktapur Line

To form a loop of the 66 kV power supply system around Kathmandu city, a 66 kV single circuit New Chabel-Bhaktapur line shall be constructed.

For this line, adoption of 132 kV design will not be agreeable, because at New Chabel S/S, there is no space for installing 132/66 kV switching equipment and transformers.

In case of upgrading the New Chabel S/S to 132 kV S/S, long time outage of power supply from the New Chabel S/S is needed for erection works.

(11) Additional Second Single Circuit Line between Patan and Bhaktapur

To strengthen the 66 kV loop system, a second single circuit line shall be added between Patan and Bhaktapur. This line will not be tapped to the existing Baneswor substation.

(12) Configulation of Outgoing Feeder Line for Patan-Bhaktapur Line

The existing 66 kV single circuit Sunkosi line between the Patan S/S and the Ring Road will be replaced by double circuits or four circuits towers taking into account of the future extension of 66 kV system to Thaibu and Capagau area, because surrounding area of this section is fully occupied by houses.

This erection work shall be conducted after the completion of the 66 kV New Chabel-Bhaktapur line in order to continue power supply to the Baneswor S/S via the Bhaktapur S/S.

(13) Patan Substation

The existing 66 kV switchyard constructed under the Sunkosi project will be fully rearranged and most of switching equipment will be replaced with new ones.

Kavre Area

(14) 66 kV Banepa Substation

The present extreme voltage drop of 11 kV line is caused by its long distance power transmission from Kathmandu via Thimi and Bhaktapur. This problem will be remarkably improved after construction of the Bhaktapur S/S.

Power Flow Analysis

(15) Power Supply System in Kathmandu Valley

For power system analysis, it will be assumed that NEA has implemented the following modifications:

a) Reconstruction of the 66 kV Lainchaur S/S.

b) Replacement of transformers at Lainchaur S/S.

c) Replacement of underground cables between Lainchaur S/S and K2 switching station.

d) Patan-Teku ring main line will be used for supplying power to Thapathali switching station.

e) Connection of Balaju-Trisuli and New Chabel-Devighat lines as planned by NEA.

(16) Additional Generation Plants for System Analysis

For covering power deficit of the system, a swing machine will be considered at the Hetauda S/S for computer calculation.

Sub-projects

(17) Sub-projects Requested by NEA

NEA requested the major sub-projects for the extension and reinforcement of the Kathmandu system as summarized in Table 2.

These sub-projects will be considered as candidates of alternatives for the extension and reinforcement of the system in course of the master plan study.

(18) 11 kV and Low Voltage Distribution System

The details of 11 kV and low voltage distribution system will be decided in the Feasibility Study.

Y. Miyagawa
Team Leader
JICA Study Team

Mr. T.B. Pradhanang
Director-in Chief
Distribution and Consumer
Services Directorate

Table 1 Attendants List

Nepal Electricity Authority (NEA):

Mr. K.C. Thakur	Managing Director
Mr. T.B. Pradhanang	Director-in Chief
Dr. M.R. Tuladhar	Director, Technical Servic Department
Mr. S.B. Pun	Director, Bagmati Department
Mr. N.T. Bhutiya	Director, System Control Department
Mr. B.B. Dhungana	Director, Transmission Line Grid
Mr. K.G. Shrestha (Partial)	Deputy Manager, KTM Central Division
Mr. M.B. Pradhan (Partial)	Deputy Manager, KTM West Division
Mr. S.P. Upadhya (Partial)	Manager, Lalitpur/Bhaktapur Division
Mr. K.L. Joshi (Partial)	Deputy Manager, KTM East Division
Mr. K.K. Manandhar	Engineer
Mr. M. Shrestha	Engineer

JICA Study Team

Mr. Y. Miyagawa	Team Leader
Mr. Y. Iwase	Specialist for Load Forecast
Mr. T. Fukuchi	Specialist for Transmission System
Mr. T. Akahoshi	Specialist for Distribution System
Mr. Y. Ishizuka	Economist

Table 2 Sub-projects Requested by NEA

I. Central Kathmandu Area

1) 66/11 KV Substation
   a) Teku (Grading up the existing switching station)
   b) K3 (near Exhibition Ground)
   c) Burhanilkantha

2) Switching Station and/or Multi-circuit Station
   a) Burankhel (Multi-circuit station)
   b) Bhimsensthan (-ditto-)
   c) Mahaboudha (-ditto-)
   d) Supermarket (-ditto-)
   e) Lagan (-ditto-)
   f) Sanu Gaucharan (Switching Station)

3) Upgrading Switching Station
   a) Maharajgunj

II. Western Kathmandu Area

1) 66/11 KV Substation
   a) Himal Cement Factory (Present capacity: 5000 KVA)
   b) Thankot

2) Switching Station
   a) Dharmasthali

3) Reconductoring
   a) Siuchatar-Thankot feeder (0.05 sq-inch)

III. Eastern Kathmandu Area

1) Switching Station
   a) Bramhakhel

2) Upgrading Switching Station
   a) Baneswor (Extension)
   b) Old Chabel (Extension)

IV. Lalitpur Area

1) 66/11 KV Substation
   a) Thaib
   b) Saibu

2) Switching Station
   a) Pulchowk (near NEA Divsion office) using K2-Patan ring main line.
   b) Capagau
   c) Harisiddhi
   d) Bhainsepati

3) Upgrading 11 KV Switchgear (OCB)
   a) Old Patan

V. Bhaktapur Area
1) 66/11 kV Substation
   a) Bhaktapur

2) Upgrading Switching Station
   a) Thimi

3) Reconductoring
   a) Airport-Katunje feeders (0.1 sq-inch, 6 km)

VI. Kavre Area
1) 66/11 KV Substation
   a) Banepa

2) 11 KV Line
   a) Banepa-Panchkhal
   b) Reconductoring of Bhaktapur-Banepa line

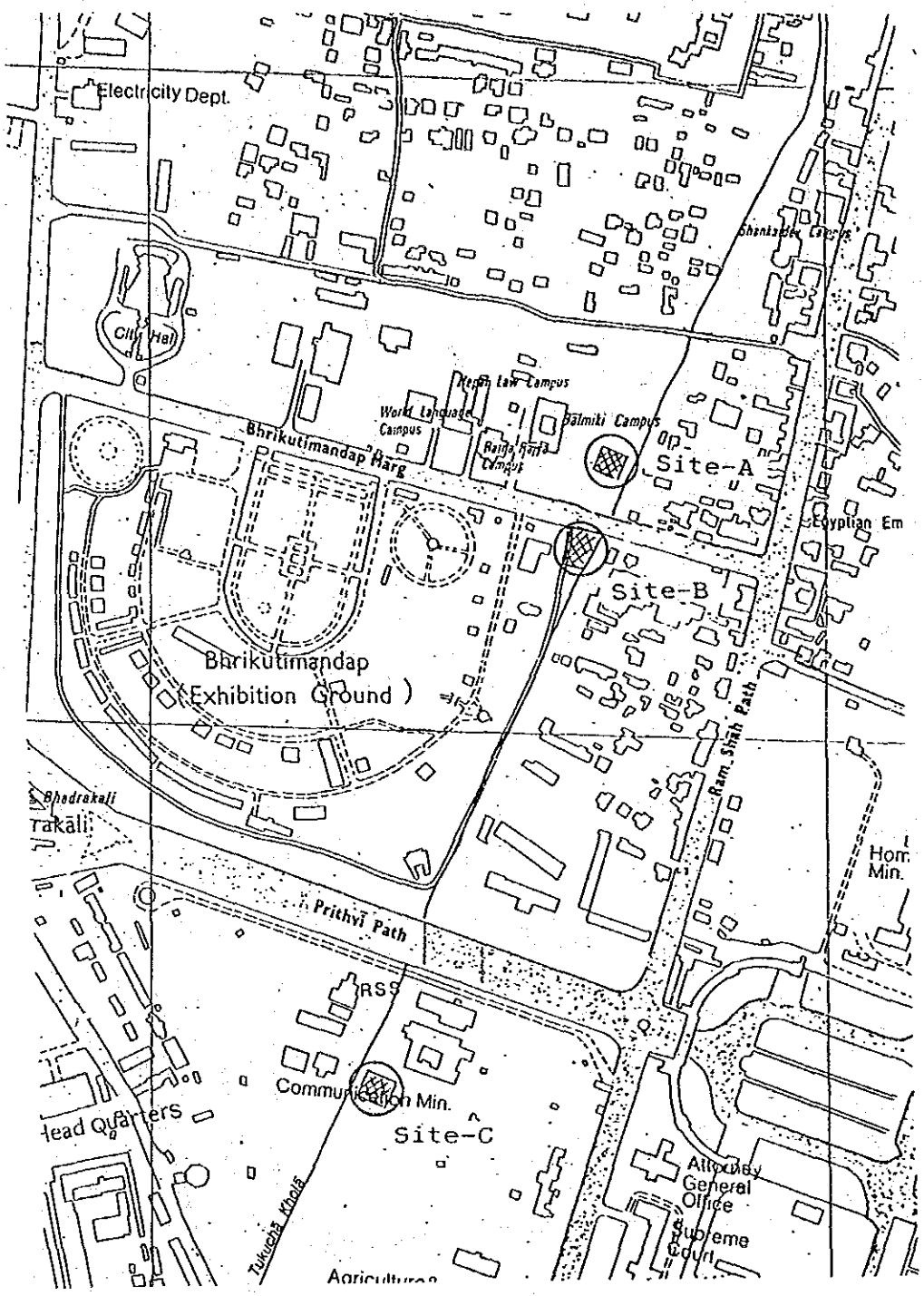

Fig.1 New Kathmandu Substation Site

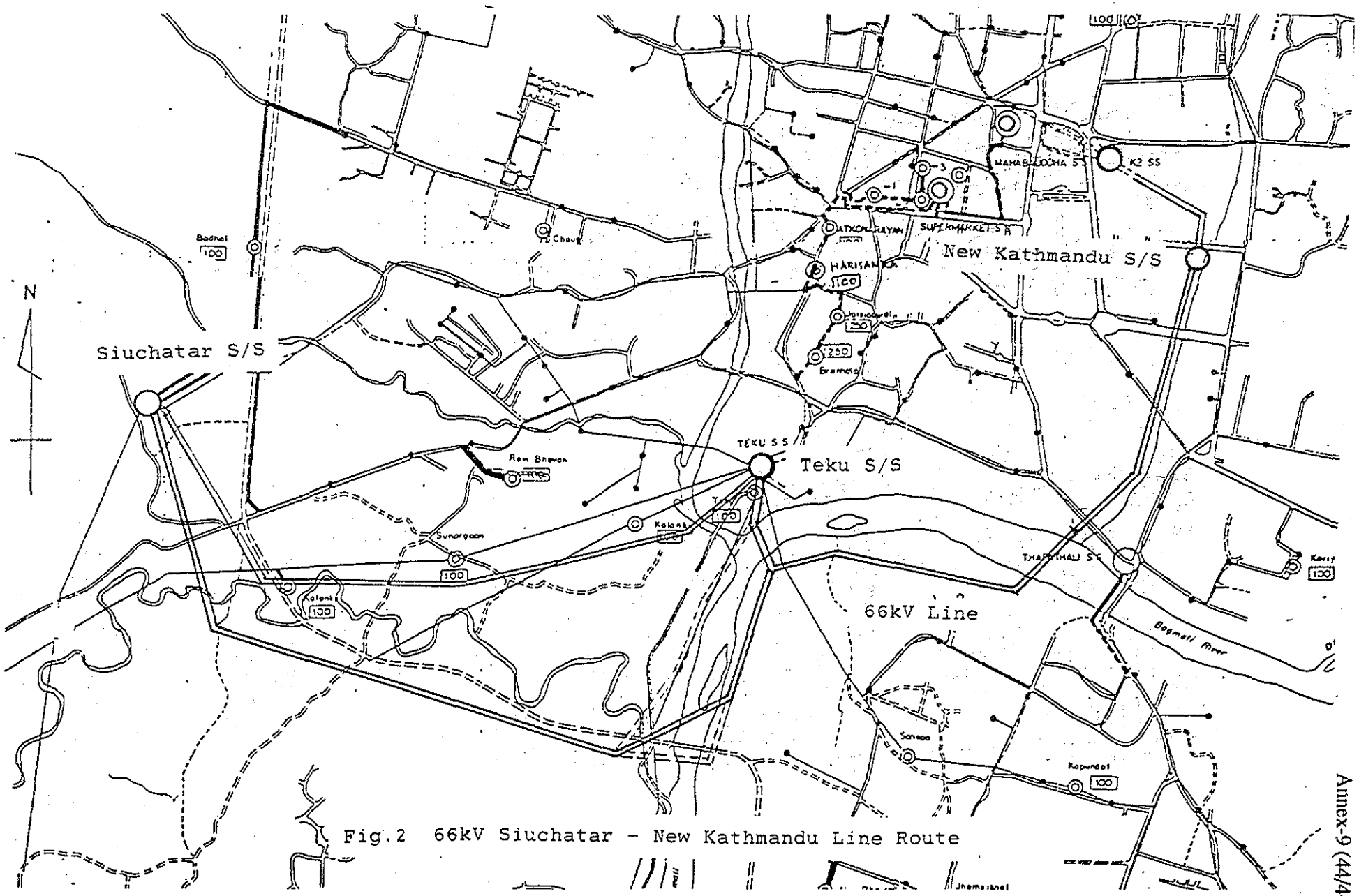

Fig.2 66kV Siuchatar - New Kathmandu Line Route

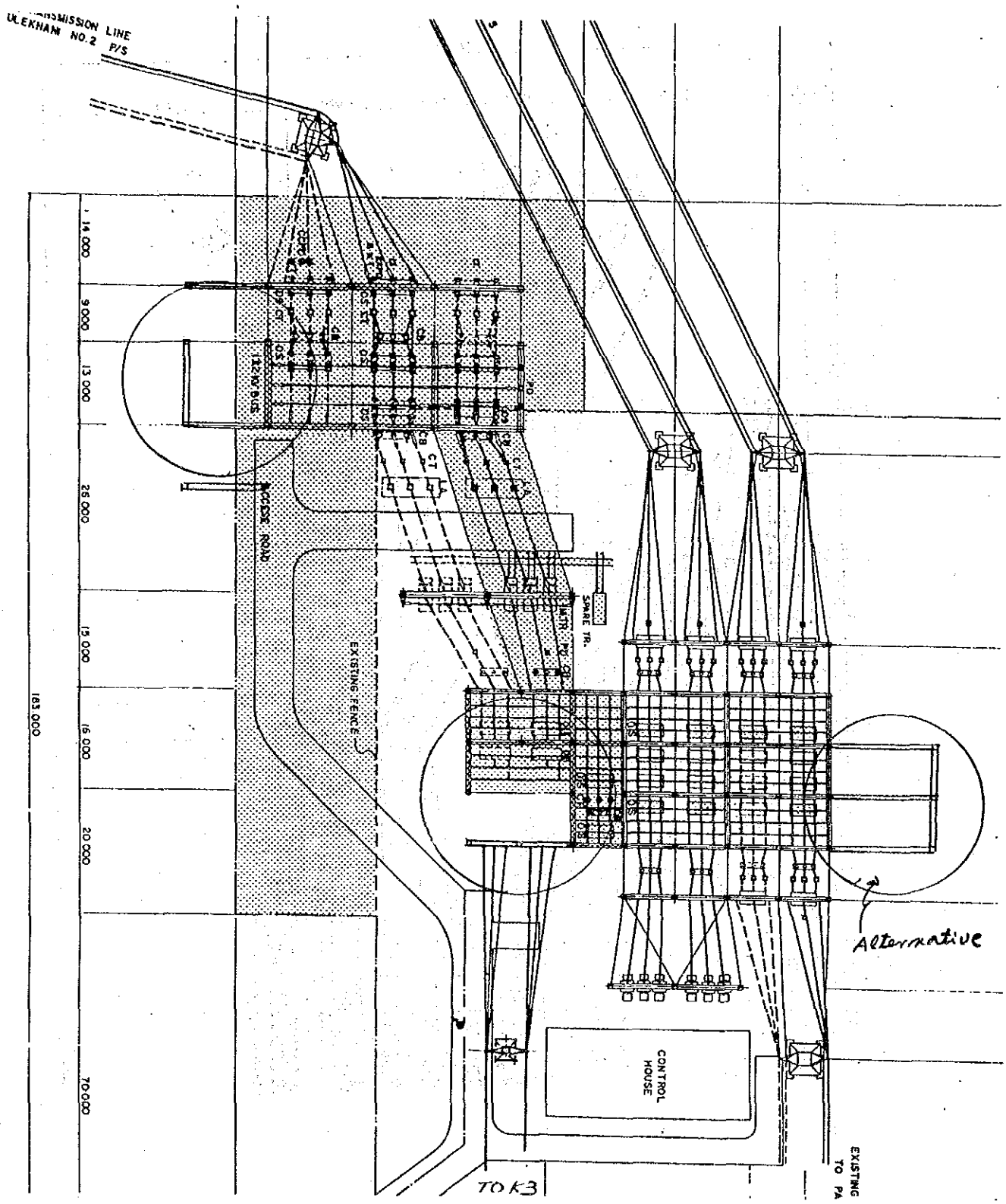

Fig.3 66kV T/L Bays at Siuchatar Substation

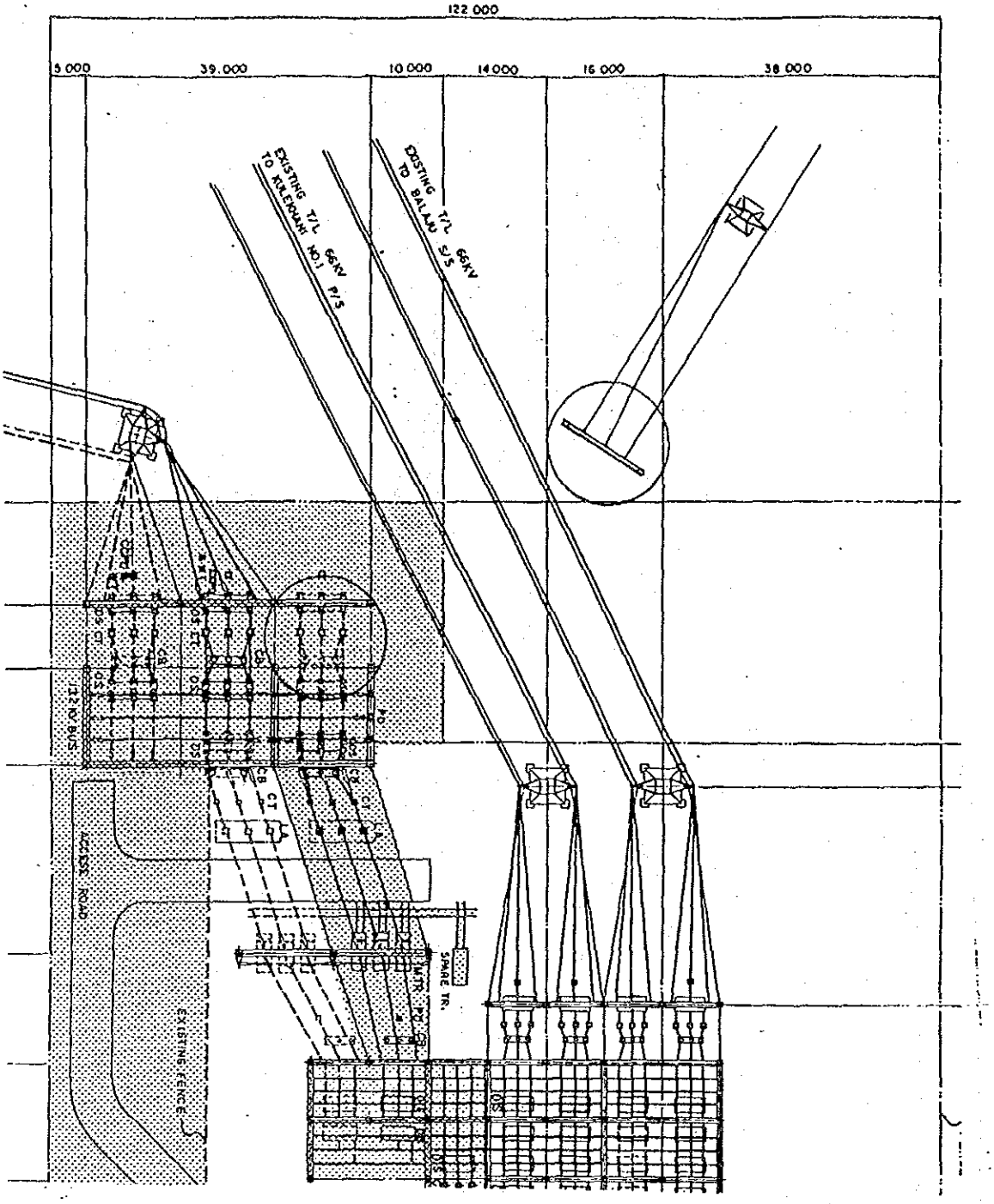

Fig.4 132kV T/L Bay at Siuchatar Substation

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