b) Investment Cost = (Work Volume) x (Unit Price)

Estimated Unit Price for TOT Work = 1,500 Baht / Distribution Point

c) Effect

$$Eex3 = Fpp \times Rex \times Rdp$$

Eex3 : Expected Percentage Reduction of the Drop Wire Faults

Fpp : $\frac{\text{No. of Drop Wire Faults occurred between Poles}}{\text{Total No. of Drop Wire Faults}} = 0.6$

Rex : Assumed Percentage Reduction of the Drop Wire Faults by shorten the Length of the Drop Wires = $\frac{2}{3}$

4) Replacement of the Drop Wires with Secondary Cables

a) Work Volume

$$Wdc = \frac{Nsub \times (1 - Nid) \times (1 - Rdp) \times (Ldw - Lex)}{Ruc} \text{ (Pair-km)}$$

Wdc : Installation Volume of Secondary Cable

Ldw : Average Length of the Existing Drop Wires

BMA = 110m

Provincial Area = 220m

Ldw : Expected Average Length of the Drop Wires after Replacement = 40m

Ruc : Maximum Using Rate of the Secondary Cable Pairs = 0.7

b) Investment Cost = (Work Volume) x (Unit Price)

Estimated Unit Price for TOT Work = 3,500 Baht / Pair-km

Estimated Unit Price for Contract Work = 5,800 Baht / Pair-km

c) Effect

$$Eex4 = Fpp \times Rex \times (1 - Rdp)$$

5) Renewal of the Drop Wires

a) Work Volume

Wdw = Nsub x (1 - Nid) x Pdw (Drop Wires)

Wdw : Number of Drop Wires to be replaced
Pdw : Percentage of the Drop Wires to be replaced

b) Investment Cost = (Work Volume) x (Unit Price)

Estimated Unit Price for TOT Work = 250 Baht / Drop Wire
Estimated Unit Price for Contract Work = 650 Baht / Drop Wire

c) Effect

For this estimation, it is assumed that the rehabilitation is carried out in order of high fault ratio area.

Eex5 = Fdw(Pdw) - Fex5 x Pdw x Rph

Eex5 : Expected Percentage Reduction of the Drop Wire Faults
Fdw(Pdw) : Percentage Share of the Drop Wire Faults in Pdw(%) of the Existing Drop Wires.
This is given by Table 2.2.3-3.
Fex5 : Expected Rate of the Drop Wire Faults after the Rehabilitation.
This is set at the average level of the faults in 30% from better side of the existing drop wires.

$$Fex5 = \frac{\sum_{Psc=70\%}^{Psc=100\%} \text{Percent Share of the Faults}}{30} = \frac{(1 - 0.92) \times 100}{30} = 0.27$$

Rph : Percentage Share of the Drop Wire Faults on the Dropping Part

$$Pph = \frac{\text{No. of the Drop Wire Faults occurred on the Dropping Part}}{\text{Total No. of the Drop Wire Faults}}$$

= 0.4

Table 2.2.3-3 Distribution of the Repaired Drop Wire Faults in the Krungkasem Exchange Area

No. of Repairs in one Cabinet Area	No. of Cabinet Areas	Total No. of Repairs	Cumulative No. of Cabinet Areas	Cumulative No. of Repairs
43	1	43	0.01	0.05
42	0	0	0.01	0.05
41	0	0	0.01	0.05
40	1	40	0.02	0.11
39	0	0	0.02	0.11
38	1	38	0.03	0.15
37	0	0	0.03	0.15
36	0	0	0.03	0.15
35	0	0	0.03	0.15
34	0	0	0.03	0.15
33	0	0	0.03	0.15
32	0	0	0.03	0.15
31	1	31	0.04	0.19
30	0	0	0.04	0.19
29	1	29	0.06	0.23
28	0	0	0.06	0.23
27	0	0	0.06	0.23
26	1	26	0.07	0.26
25	1	25	0.08	0.29
24	0	0	0.08	0.29
23	0	0	0.08	0.29
22	2	44	0.10	0.35
21	0	0	0.10	0.35
20	1	20	0.11	0.38
19	0	0	0.11	0.38
18	1	18	0.12	0.40
17	0	0	0.12	0.40
16	2	32	0.14	0.44
15	0	0	0.14	0.44
14	0	0	0.14	0.44
13	1	13	0.16	0.46
12	4	48	0.20	0.52
11	3	33	0.23	0.56
10	6	60	0.30	0.63
9	5	45	0.36	0.69
8	3	24	0.39	0.72
7	6	42	0.46	0.77
6	8	48	0.54	0.84
5	10	50	0.66	0.90
4	7	28	0.73	0.93
3	11	33	0.86	0.98
2	9	18	0.96	1.00
1	1	1	0.97	1.00
0	3	0	1.00	1.00
Total	90	789		

Source : Repair Records in the Krungkasem Exchange Area (1991.10 - 1992.3)

6) Replacement of the Public Telephone Sets

a) Work Volume and Effect

The number of telephone sets to be changed with good ones are estimated as shown in Table 2.2.3-4.

Table 2.2.3-4 Result of the Estimation for the BMA

Type	A	B	C	D	E	F	G	H	I	J	K
52TH	4,127		665	168	63	0	375	375	665	169	2.3
BELL	6,243		1,018	254	52	0	205	205	1,018	169	0.6
106TH	7,964	5	1,293	324	87	3	269	259	1,298	178	1.8
106TH1	5,690	27	840	231	41	2	177	169			
106TH2	9,269	708	634	377	288	8	764	743	1,342	190	12.4
107TH2	16,078	2,184	383	654	116	2	177	174			
107TH3	129		21	5	6	0	1,144	1,144	21	169	0.3
771TH1	1,109		170	45	-		438	438	170	169	0.8
771TH2	485		80	20	-		438	438	80	169	0.4
?	24		2	1							
107TH1	1,442	167		59	26	2	443	409	167	309	0.3
UI88/TA	6,214	900	180	253	247	1	978	974	1,080	279	12.5
W14TH	38,505	7,517		1,566	476	46	304	275			
CARD	1,379		315	56	-			-			
F/POINT	463		69	19	-			-			
Total	99,121	11,508	5,670	4,031	1,402				5,841	1,798	31.4
Estimated Number of Fault on the Existing Tel. Sets $= \Sigma \{ (B + C) \times G \}$											5,990

A : Total Number of Public Telephone Sets in the BMA during October 1991 to March 1992 (Set-Month)

B : Number of Public Telephone Sets installed in the Booth in the BMA at the End of March 1992 (Sets)

C : Number of Coin Box Type Public Telephone Sets in the BMA at the End of March 1992 (Sets)

D : Assumed Total Number of Public Telephone Sets in the Krungkasem Exchange Area during October 1991 to March 1992 (Set-Month)

$$= \frac{\text{No. of Public Tel. in the BMA1}}{\text{No. of Public Tel. in the BMA}} \times \frac{\text{Total No. of Subscribers in the KKM}}{\text{Total No. of Subscribers in the BMA1}}$$

x (No. of Public Tel. in the BMA)

E : Total Number of Public Telephone Faults (Sub. Set Faults and Booth Troubles) in the Krungkasem Exchange Area occurred during October 1991 to March 1992

F : Total Number of Booth Troubles in the Krungkasem Exchange Area occurred during October 1991 to March 1992

G : Estimated Number of Faults per 1,000 Telephone Sets per Month

$$G = \frac{E}{D} \times 1{,}000$$

H : Estimated Number of Faults per 1,000 Telephone Sets per Month exclude Booth Troubles.

For the type of 771TH1 and 771TH2, the average value of the local call types are employed.

$$H = \frac{E - F}{D} \times 1{,}000$$

I : Number of Telephone Sets to be changed with Good Ones.

The types of telephone sets which have higher fault ratio are selected.

J : Expected Number of Faults per 1,000 Telephone Sets per Month after the Replacement

K : Expected Percentage Reduction of the Public Telephone Faults

$$K = \frac{(G - J) \times (B + C)}{\sum \{ (B + C) \times G \}}$$

For the Surrounding Area, the latest number of the public telephone sets by type were not obtained in the study period. The number of the public telephones in the Surrounding Area at the end of September 1990 is as follows. In this estimation, it is assumed that following number of the public telephone sets in are replaced.

Type	No. of Public Telephone Sets
Local	103
Combined	140
Other	74
Total	317

b) Investment Cost = (Work Volume) x (Unit Price)

Estimated Unit Price for Booth Type Telephone Set = 40,000 Baht / Set

Estimated Unit Price for Coin Box Type Telephone Set = 30,000 Baht / Set

Number of telephone sets to be replaced each year are set as shown in following Table.

Year	Booth Type	Coin Box Type	Total
1993	50	50	100
1994	1,000	1,000	2,000
1995	950	1,100	2,050
1996	0	2,008	2,008
Total	2,000	4,158	6,158

7) Replacement of the Protectors for the Public Telephones

a) Total number of protectors to be replaced is the same as total number of existing public telephones (17,178 + 317 = 17,495)

b) Investment Cost for the Replacement = (Work Volume) x (Unit Price)

Estimated unit price for TOT work = 250 Baht / Set

Work volume for TOT work is the same number of the telephone set replacement.

Estimated unit price for contract work = 500 Baht / Set

c) Effect

$Eex7 = Fte \times Pex$

Eex7 : Expected Percentage Reduction of the Public Telephone Faults

Fte : $\frac{\text{Number of Telephone Set Faults}}{\text{Total Number of Public Telephone Faults}} = 0.55$

Pex : Assumed Percentage Reduction of the Telephone Set Faults by Replacement of the Protectors = 10%

8) Facility Check and Consulting Service for the Customer Premises

a) Work Volume

Expected number of subscribers who can be checked their inside wires are estimated as follows:

Year	1	2	3
No. of Staffs for the Consulting Activity	2	2	2
No. of Maintenance Sections in the BMA	34	34	34
No. of Work Days a Month	20	20	20
No. of Month for the Consulting Activity	6	12	12
Expected No. of Subscribers to be Checked a Day per Staff	2	5	5
Expected No. of Subscribers who can be checked the Inside Wires in the BMA	16,320	81,600	81,600
Expected No. of Subscribers who can be checked the Inside Wires in the Surrounding Area	720	3,600	3,600

b) Cost for the Consulting Activity

Vehicle Cost = 250,000 Baht / Car x 68 team (the first year only)
Equipment and Tools = 20,000 Baht / Set x 68 team (the first year only)
Fuel and Maintenance Cost for above Two Items = 2,000,000 Baht / Year

c) Effect

Expected percentage reduction of the inside wire faults is estimated as follows:

i) Less than 10% of repaired inside wires experienced more than 2 times of the faults occurred during 6 months and share about 25% of the inside wire faults as shown in Table 2.2.3-5. These inside wires have experienced the faults every month. Therefore, if these inside wires will be fixed completely, 25% reduction of the inside wire faults can be expected.

ii) It is assumed that another inside wires have not experienced the faults frequently. Therefore, only few number of faults can be reduced by this measure for a while. Expected percentage reduction of the inside wire fault is more than 1% every year.

iii) Additionally, some subscriber set faults can be reduced by the consulting activity of TOT. It is expected that more than 30% of subscribers received the consulting change their telephone sets or handle their telephone set with care.

Table 2.2.3-5 Inside Wire Faults in the Krungkasem Exchange Area

Year / Month	A	B	C(%)	D	E	F(%)	G	H(%)
1991/ 10	156	3	1.9	173	20	11.6	24,220	0.64
1991/ 11	114	7	6.1	128	21	16.4	24,414	0.47
1991/ 12	62	4	6.5	68	10	14.7	24,637	0.25
1992/ 1	114	7	6.1	129	22	17.1	24,849	0.46
1992/ 2	101	6	5.9	109	14	12.8	24,972	0.40
1992/ 3	95	4	4.2	103	12	11.7		
Total	642	31	4.8	710	99	13.9		
Cumulate								
10	156	3	1.9	173	20	11.6	24,220	0.64
10 - 11	262	19	7.3	301	58	19.3	48,634	0.54
10 - 12	316	22	7.0	369	75	20.3	73,271	0.43
10 - 1	416	29	7.0	498	111	22.3	98,120	0.42
10 - 2	499	40	8.0	607	148	24.4	123,092	0.41
10 - 3	581	51	8.8	710	180	25.4		

Source : Repair Records in the Krungkasem Exchange Area (1991.10 - 1992.3)

A : Total Number of Repaired Inside Wires
= Total Number of Subscribers experienced Inside Wire Fault

B : Number of Inside Wires Repaired more than 2 Times

C : $\frac{B}{A} \times 100(\%)$

D : Total Number of Inside Wire Repairs

E : Number of Inside Wire Repairs on the Subscribers who have experienced the Repair more than 2 Times.

F : $\frac{E}{D} \times 100(\%)$

G : Number of Subscribers in the Krungkasem Exchange Area

H : $\frac{A}{G} \times 100(\%)$

2.3 Switching Facilities

2.3.2 Replacement Plan of Line Protectors with Priority

Table 2.3.2 Hardware Fault of SPC Switch in the BMA (1/2)

Priority (Implementation Year)	Exchange Office Name	Unit Name	"1989" TOTAL LIB	"1989" TOTAL OTH	Fault ratio	"1990" TOTAL LIB	"1990" TOTAL OTH	Fault ratio	"1991" TOTAL LIB	"1991" TOTAL OTH	Fault ratio	No. of Line Capacity
1	LAT KRABANG	LKG	155	3	3.38	78	3	1.70	80	2	1.75	3,820
	DON MUANG	DNM-2	63	8	0.37	42	1	0.25	205	11	1.20	14,240
(1993 Year)	BANG PHLI	BPL	233	3	1.59	236	9	1.61	145	3	0.99	12,192
	SAMUT PRAKAN	SPK-2	28	8	0.81	18	1	0.52	33	0	0.96	2,870
	BANG CHAN	BGC	64	3	0.40	70	7	0.44	151	3	0.95	13,192
	PU CHAO SAMING PHRAI	PSP-2	63	3	0.65	80	6	0.82	87	5	0.89	8,120
	ERRACHAI	ERC	86	9	0.36	81	3	0.34	211	10	0.88	19,970
	BANG KHAE	BGN-2	3	0	0.05	2	3	0.03	45	0	0.73	5,120
	KHLONG TOEI	KTI	40	16	0.81	13	8	0.26	32	3	0.65	4,096
	ON NUT	ONT	66	25	0.27	62	27	0.25	138	10	0.57	20,312
	PHRA PRADAENG	PPG-2	63	7	0.37	72	18	0.42	96	25	0.57	14,144
	BANG PU	BGU	8	0	0.13	21	2	0.34	31	1	0.50	5,120
	PAK KRET	PKK	35	9	0.13	44	12	0.23	82	9	0.42	16,288
	Sub total		907	94	0.54	819	100	0.49	133	82	0.80	139,484
2	LAT PHRAO 2	LTP-2	33	11	0.11	45	1	0.15	90	11	0.30	25,110
	BANG PHLAT	BGT-2	83	35	0.23	109	34	0.31	99	4	0.28	29,540
(1994 Year)	PHAHONYOTHIN	PYT-3	5	10	0.08	14	11	0.23	14	9	0.23	5,000
	LAT PHRAO 1	LTP1-2	16	5	0.08	29	12	0.15	39	7	0.20	15,960
	HUA MAK	HAM-2	10	10	0.04	14	16	0.06	47	3	0.19	20,384
	PHLOEN CHIT	PNC T-3	35	24	0.10	55	26	0.15	70	29	0.19	30,480
	CHAYAPHRUK	CYP-3	0	0	0.00	157	1	0.64	47	0	0.19	20,480
	Sub total		182	95	0.10	423	101	0.24	406	63	0.23	146,954
3	RAMINTHRA	RIT	57	15	0.30	13	2	0.07	35	9	0.18	15,925
	Bang Khae	BKE-2	7	2	0.05	8	2	0.05	26	4	0.18	12,192
(1995 Year)	RAT BURANA	RBN	24	25	0.11	43	9	0.20	38	5	0.18	17,984
	KHLONG CHAN	KGC-2	36	16	0.16	31	13	0.13	40	9	0.17	19,240
	SAMSEN	SMS-2	7	2	0.09	24	0	0.32	12	0	0.16	6,242
	NONG KHAEM	NGK	518	12	3.27	186	8	1.17	23	1	0.15	13,192
	SAMRAN RAT	SRR-4	46	14	0.14	68	24	0.21	45	12	0.14	26,640
	LAK SI	LKS-14	46	33	0.34	44	29	0.33	16	5	0.12	11,264
	BANG NA	BNA-2	15	4	0.08	20	2	0.11	21	10	0.11	15,240
	THUNG MAHAMEK	TMM-2	0	0	0.00	4	0	0.07	7	0	0.11	5,120
	PHRA KHANONG	PKG T6	92	33	0.36	24	34	0.09	29	12	0.11	21,360
	CHARAN SANITWONG	CSW-2	33	4	0.18	50	3	0.27	20	2	0.11	15,192
	Sub total		881	160	0.41	515	126	0.24	312	69	0.14	179,591

Table 2.3.2 Hardware Fault of SPC Switch in the BMA (2/2)

Priority (Implementation Year)	Exchange Office Name	Unit Name	"1989" TOTAL LIB	"1989" TOTAL OTH	Fault ratio	"1990" TOTAL LIB	"1990" TOTAL OTH	Fault ratio	"1991" TOTAL LIB	"1991" TOTAL OTH	Fault ratio	No. of Line Capacity
4	SATHUPRADIT	STD -2	8	2	0.04	16	3	0.09	17	2	0.10	14,862
	PATHU WAN	PTW -2	15	4	0.06	11	5	0.05	21	3	0.09	20,240
(1996 Year)	SURAWONG	SRW -4	21	8	0.07	13	3	0.04	23	6	0.08	25,360
	SUKHUMVIT	SKW	12	22	0.02	56	32	0.11	37	18	0.07	41,760
	TROK CHAN	TKC -2	9	5	0.06	7	8	0.04	11	4	0.07	13,192
	CHAENG WATTHANA	CWT	13	2	0.07	18	8	0.09	13	3	0.07	16,192
	NAWA NAKHON	NWN	17	10	0.28	16	1	0.27	4	0	0.07	5,000
	LAT YA	LTY T8	40	25	0.13	33	32	0.11	18	4	0.06	25,360
	BANG SU	BGS -2	22	7	0.14	13	5	0.08	8	0	0.05	13,192
	NGAM WONG WAN	NWW -2	21	31	0.07	32	16	0.10	16	12	0.05	26,591
	Sub total		178	116	0.07	215	113	0.09	168	52	0.07	201,749
5	ASOK DIN DAEN	ASD -2	13	9	0.04	28	9	0.08	15	3	0.04	28,480
	RANGSIT	RST	109	0	1.11	0	0	0.00	4	0	0.04	8,192
(1997 Year)	PHASHICHAROEN	PSN-2	0	0	0.00	0	0	0.00	3	0	0.01	20,480
	INTHAMARA	ITM -2	0	0	0.00	0	0	0.00	2	1	0.01	20,480
	THANON TOK	TNT -2	24	1	0.15	4	1	0.03	1	0	0.01	13,312
	KRUNG KASEM	KKM -3	0	0	0.00	0	0	0.00	0	0	0.00	16,384
	BANG PHLI BANG BO	BBB	0	0	0.00	0	0	0.00	0	0	0.00	600
	DAO KHANONG	DKN -2	0	0	0.00	0	0	0.00	0	0	0.00	13,312
	MUBAN SETTHAKIT	MSK	0	0	0.00	0	0	0.00	0	0	0.00	14,336
	BANG BUA THONG	BBT	0	0	0.00	0	0	0.00	0	0	0.00	5,120
	PATHUM THANI	PTT	8	0	0.08	0	0	0.00	0	0	0.00	8,192
	NONTHABURI	NTB-2	0	0	0.00	0	0	0.00	0	0	0.00	16,384
	THANYABURI	TYB	46	4	0.75	0	0	0.00	0	0	0.00	5,120
	BANG PHUN	BAN	0	0	0.00	0	0	0.00	0	0	0.00	5,120
	RAMKAMHANG	RKN	NA	NA	NA	NA	NA	NA	NA	NA	NA	11,776
	Sub total		200	14	0.09	32	10	0.01	25	4	0.01	187,288
	TOTAL		2348	479	0.23	2004	450	0.20	2247	270	0.22	855,066

Note:

No. of Line Capacity : Number of Line Capacity at the end of FY1991

Fault Ratio = (Total LIB Fault / 12 Month / No. of line capacity) x 1,000 Line Capacities

LIB : Line Interface Board

OTH : Other Board

APPENDIX

2.4 Transmission Network

2.4.1 Present State of Faults in the Transmission Network

1) Fault Data

For analyzing the present state of faults in the transmission network, the fault data from November 1991 to January 1992 are used as shown in Table 2.4.1-1, Table 2.4.1-2 and Table 2.4.1–3. For this purpose, the following methods are adopted.

Table 2.4.1-1 Fault Data (November, 1991)

Source - Sector of Transmission Network, TOT

Trans. system (Novemver 1991)	working circuits	Fault circuits	Fault cct. (m./cct.)	Fault cct. (m.x cct.)	Ability of Service
1. Microwave with Protection	41,476	4,071	102748.0000	426,159	99.9762
2. Microwave without Protection	18,722	2,202	343645.0000	643,374	99.9204
3. Prov. PCM Cable	2,208	250	134.8768	450,359	99.3087
Fault of Equipment		116	35.1757	55,399	99.9150
Fault of Cable		134	99.7010	394,960	99.3937
4. Prov. Optical Fibre Cable	11,482	359	94.8200	870,543	99.7805
Fault of Equipment		59	1.5230	13,983	99.9965
Fault of Cable		300	93.2940	856,560	99.7840
5. Prov. Coaxial Cable	2,204	***	***	***	***
Fault of Equipment		***	***	***	***
Fault of Cable		***	***	***	***
6. BMA PCM Cable	188,130	10,590	210.63	39,626,550	99.5124
Fault of Equipment		5,400	29.68	26,649,150	99.6721
Fault of Cable		2,910	28.49	12,977,400	99.8403
7. BMA Optical Fibre Cable	7,260	***	***	***	***Note. 1
Fault of Equipment					
Fault of Cable					
8. BMA Coaxial Cable	***	***	***	***	***Note. 1
Fault of Equipment					
Fault of Cable					
Total	271,482	17,472			
9 .Leased line (Whole Kingdom)	7,971	***	***	***	***Note. 1
Fault of Trans. Equipment					
Fault of Subs. Equipment					
The others					

Note,1; No report

Table 2.4.1-2 Fault Data (December, 1991)

Source - Sector of Transmission Network, TOT

Trans. system (December 1991)	working cct.	Fault cct.	Fault cct. (m./cct.)	Fault cct. (m.x cct.)	Ability of Service
1. Microwave with Protection	41,476	751	0.8141	33,767	99.9981
2. Microwave without Protection	18,722	768	20.0345	375,087	99.9204
					99.9536
3. Prov. PCM Cable	2,208	223	86.0733	190,050	99.8007
Fault of Equipment		151	45.8599	101,250	99.8938
Fault of Cable		72	40.2173	89	99.9069
4. Prov. Optical Fiber Cable	11,482	279	20.0006	229,647	99.9537
Fault of Equipment		9	0.3785	4,347	99.9991
Fault of Cable		270	19.6220	225,300	99.9545
5. Prov. Coaxial Cable	2,204	***	***	***	***
Fault of Equipment		***	***	***	***
Fault of Cable		***	***	***	***
6. BMA PCM Cable	188,130	10,050	126.70	23,836,200	99.7161
Fault of Equipment		6,810	56.45	10,619,820	99.8735
Fault of Cable		3,240	70.25	13,216,380	89.8426
7. BMA Optical Fiber Cable	7,260	***	***	***	***Note. 1
Fault of Equipment					
Fault of Cable					
8. BMA Coaxial Cable	***	***	***	***	***Note. 1
Fault of Equipment					
Fault of Cable					
Total	271,482	12,071			
9. Leased line (Whole Kingdom)	7,971	***	***	***	***Note. 1
Fault of Trans. Equipment					
Fault of Subs. Equipment					
The others					

Note, 1; No report

2) Data

- Since no fault of the optical fiber system in the BMA was reported, the analysis of the faults in the optical fiber system is made by the long distance and provincial optical fiber systems.

- Since no final detailed fault occurrence of the PCM cable system in the BMA was reported, the detailed analysis of the PCM cable system is made by the data in the provincial area.

Table 2.4.1-3 Fault Data (January, 1992)

Source - Sector of Transmission Network, TOT

Trans. system (January 1992)	working cct.	Fault cct.	Fault cct. (m./cct.)	Fault cct. (m.x cct.)	Ability of Service
1. Microwave with Protection	41,476	158	0.8163	33,360	99.9981
2. Microwave without Protection	18,722	256	8.4738	158,648	99.9810
3. Prov. PCM Cable	2,208	64	69.2527	152,910	99.8448
Fault of Equipment		58	33.4918	73,950	99.9249
Fault of Cable		6	35.7608	78,960	99.9198
4. Prov. Optical Fiber Cable	15,301	262	26.4963	405,420	99.9406
Fault of Equipment		***	***	***	***
Fault of Cable		262	26.4963	405,420	99.9406
5. Prov. Coaxial Cable	2,204	142	191.3793	421,800	99.5712
Fault of Equipment		***	***	***	***
Fault of Cable		142	191.3793	421,800	99.5712
6. BMA PCM Cable	188,130	8,010	67.94	12,781,200	99.8478
Fault of Equipment		7,260	42.61	8,016,788	99.9048
Fault of Cable		750	28.33	4,764,420	99.9432
7. BMA Optical Fiber Cable	7,260	***	***	***	***Note. 1
Fault of Equipment					
Fault of Cable					
8. BMA Coaxial Cable	***	***	***	***	***Note. 1
Fault of Equipment					
Fault of Cable					
Total	275,301	8,750			
9. Leased line (Whole Kingdom)	7,971	***	***	***	***Note. 1
Fault of Trans. Equipment					
Fault of Subs. Equipment					
The others					

Note, 1; No report

2.4.2 Availability of Transmission System.

The present state of the service quality of the transmission network is represented by the availability of the transmission network as shown in Table 2.4.2-1 and 2.4.2-2.

1) Availability of Transmission Network

The availability of the network, "A", is calculated as follows:

A = {1 - (fault channels x fault hours) / (all working channels x working hours)} x 100 (%)

Table 2.4.2-1 Availability of Transmission System in the Provincial Area (1992)

Source - Sector of Transmission Network, TOT

Month	Microwave with Protection (1+1)		Microwave with Protection (1+0)	
	Service Availability (%)	Average Fault Time (minute/circuit)	Service Availability (%)	Average Fault Time (minute/circuit)
Oct. 91'	99.9805	8.41	99.1300	41.26
Nov. 91'	99.9762	10.27	99.9700	34.36
Dec. 91'	99.9981	0.81	99.9700	20.03
Jan. 92'	99.9981	0.82	99.9900	8.47
Feb. 92'	99.9407	24.76	99.9600	5.03
Target	>99.6600	<150	>98.0000	<866.00
Month	PCM Cable (Province)		Optical Cable (Province)	
	Service Availability (%)	Average Fault Time (minute/circuit)	Service Availability (%)	Average Fault Time (minute/circuit)
Oct. 91'	99.8697	261.91	99.9211	34.06
Nov. 91'	99.3087	99.70	99.7808	93.29
Dec. 91'	99.8007	40.22	99.9578	19.62
Jan. 92'	99.8448	35.76	99.9406	26.49
Feb. 92'	99.9218	32.65	98.7379	520.83
Target	>98.0000	<866.00	>98.0000	<866.00

Table 2.4.2-2 Availability of Transmission System in BMA (1992)

Source - Sector of Transmission Network, TOT

Month	PCM Cable (BMA)	
	Service Availability (%)	Average Fault Time (minute/circuit)
Oct. 91'	99.8697	28.49
Nov. 91'	99.5124	68.98
Dec. 91'	99.7161	70.25
Jan. 92'	99.8478	25.33
Feb. 92'	99.8048	27.83
Target	>98.0000	<866.00

2) Target Figure for Maintenance Service

Table 2.3.1-4 and 2.3.1-5 show the target figures of maintenance service.

		Target figure	
1.	Microwave with protection	99.660	(%)
2.	Microwave without protection	98.000	(%)
3.	The other system	98.000	(%)
4.	Average fault hours = (minutes/circuits) (microwave with protection)	150.00	(minutes)
5.	Average fault hours = (minutes/circuits) (the other systems)	866.00	(minutes)

The availability figures of all facilities satisfy the maintenance target figures in both BMA and provincial area. However, the repair time of PCM cable system and optical fiber system generally take a long time. The main causes of faults in the provincial PCM cable system are cable troubles in which cables were cut off by road construction trucks and residential fire. Further more, it took long to restore the cable damages. Most transmission systems except them satisfy their maintenance target figures.

To use the availability of the facility for a measure of the maintenance service quality is a good way it seems that if another measurements are added, it can ensure this way for the service quality upgrade in the transmission network.

2.4.3 Analysis of Detailed Fault Data

As mentioned above, the transmission systems satisfy their service quality target figures. Some faults that have long fault hours are found in the data. To solve the problems, some detailed fault data were selected.

After verifying the four monthly reports (November 1991 through February 1992), the fault data in November 1991 and February 1992 were used for detailed analysis of this study because the fault data of these two months included all fault data required.

Table 2.4.3-1 to Table 2.4.3-4 show the detailed number of faults that occurred from November 1991 to February 1992. It seems that Table 2.4.3-1 and 2.4.3-4 include all faults. Therefore, the fault data in November 1991 and February 1992 were used to analyze the faults.

Table 2.4.3-1 Detail of the Faults (November 1991)

Source - Sector of Transmission Network, TOT

Span	Equipment Supplier	Fault Occured Month	Date of Fault Occured	Date of Fault Cleared	Total Fault Time (minutes)	Fault Occured Time	No. of Fault Circuits	Cause of Fault
Nov-91								
NMA - Phimai	NEC	11. '91	00.00.07.11.'91	10.00.07.11.'91	60	1	123	1*Breaker P/S = off
KBI - NRT	NEC	11. '91	06.06.22.11.'91	07.20.22.11.'91	74	1	43	1*Mitsui Co. maintains the antenna.
BKK - SNI	NEC	11. '91	00.00.15.11.'91	02.05.15.11.'91	125	1	180	1*Maintaine radio fre (1+1) to (1+0)
CNT - Manorom	NEC	11. '91	12.00.15.11.'91	13.00.15.11.'91	60	1	121	1*DC-DC converter bad contact. tx local OSC fault.
CNT - Manorom	NEC	11. '91	13.40.16.11.'91	15.15.16.11.'91	95	1	121	1*DC-DC converter bad contact. tx local OSC fault.
BKK - UBN	NEC	11. '91	11.45.14.11.'91	11.55.14.11.'91	10	1	140	1*bad contactswitch change over.
KKN - Chum Phae (etc.)	NEC	11. '91	00.00.15.11.'91	02.35.15.11.'91	155	1	380	1*Mitsui company maintain Branching from (1+1) to (1+0).
NAN - Tha Vangpha	NEC	11. '91	14.50.01.11.'91	15.20.01.11.'91	30	1	2	1*Rx = low level. Change feed horn.
STN - Laba (Thapae, Kuan Kaloe)	NEC	11. '91	17.00.09.11.'91	17.30.09.11.'91	30	1	19	1*Mitsui co. move antiena.
NAN - Tha Vangpha	NEC	11. '91	10.20.02.11.'91	13.00.02.11.'91	160	1	2	1*Rx = low level. Change feed horn.
AYA - Maharat	NEC	11. '91	15.43.23.11.'91	17.00.23.11.'91	142	1	3	1*Rx DPU fault.
MKM - Vapiphanthum	NEC	11. '91	07.03.15.11.'91	08.50.15.11.'91	107	1	10	1*Tx unit, change to spare one.
MKM - Nakhoon	NEC	11. '91	09.50.15.11.'91	10.30.15.11.'91	40	1	4	1*Tx unit, change to spare one.
MKM - Phayak Phoen	NEC	11. '91	11.00.15.11..91	13.00.15.11.'91	120	1	18	1*Tx unit, change to spare one.
UDN - Nongbua Lamphoo	NEC	11. '91	07.00.16.11.'91	11.30.16.11.'91	270	1	30	1*Rx fault
BNA - Taksipa	NEC	11. '91	15.10.02.11.'91	15.20.02.11.'91	10	1	10	2*It is much hot so that 34 MB barn.
PKT - Taksipa	NEC	11. '91	15.10.02.11.'91	15.20.02.11.'91	10	1	120	2*It's very hot so that 34 MB Mux unit occur alarm.
SNI - Koh Phangan	NEC	11. '91	14.45.10.11.'91	16.10.10.11.'91	85	1	180	2*VF INF unit, ALM unit, XMF unit. DC breaker = off.
CPN - Thasao	NEC	11. '91	07.15.27.11.'91	10.15.27.11.'91	180	1	60	2*DC breaker = off.
TRG - Kantang(Palaieu)	NEC	11. '91	00.00.29.11.'91	01.30.29.11.'91	90	1	60	2*Mitsui co. move Rack.
PLK - Sukhothai & Sawankhalok	NEC	11. '91	14.55.17.11.'91	15.10.17.11.'91	15	1		2*Fuse DC & mux.
NSN - Krok Phre (& other)	NEC	11. '91	18.40.21.11.'91	18.50.21.11.'91	10	1	358	2*Radio system is cut.
PRI - Sri Mahapho	NEC	11. '91	14.20.20.11.'91	15.00.20.11.'91	40	1	18	2*Breaker P/S = off
PRI - Aranya Prated	NEC	11. '91	15.30.20.11.'91	17.40.20.11.'91	130	1	189	2*bad contact switch change over
YST - Mahachaichana	NEC	11. '91	04.30.10.11.'91	13.00.11.11.'91	1,920	1	6	2*Fault cleared on twhile examine at Mux.
KKN - KSN	NEC	11. '91	13.15.05.11.'91	13.30.05.11.'91	15	1	282	2*Unit IFT 34 MB is found bad contact.
KKN - Paloonrat	NEC	11. '91	06.30.07.11.'91	09.30.07.11.'91	180	1	2	2*8 MB INF unit is fault.
Bampae NamSan	NEC	11. '91	07.10.18.11.'91	07.45.18.11.'91	35	1	27	2*DC breaker mux = off.
KKN - Ubonrat	NEc	11. '91	18.30.03.11.'91	10.00.04.11.'91	930	1	6	2*P/S of VF Mux.
PLK - Bang Ragam	NEC	11. '91	18.30.03.11.'91	10.00.04.11.'91	930	1	6	2*2M Mux RCV CH Fault.
CMI1 - CMI2	NEC	11. '91	00.00.21.11.'91	03.57.21.11.'91	237	1	59	2*Between 34 M Mux and 140 M Mux
LPG - PR5 - NAN	NEC	11. '91	02.08.23.11.'91	06.00.23.11.'91	232	1	989	2*Fuse DC of P/S of Mux Fault.
PBI - Photharam	SEL	11. '91	19.40.07.11.'91	01.00.08.11.'91	320	1	60	2*Bad contact of pre-group carrier unit.
PBI - Photharam	SEL	11. '91	15.10.11.11.'91	16.40.11.11.'91	90	1	60	2*Bad contact of pre-group carrier unit.
SNI - Koh Phangan	NEC	11. '91	07.45.10.11.'91	06.30.11.11.'91	1,365	1	22	2*VF INF unit. Cause of thunder bolt.
KRB - Kohlanta	NEC	11. '91	12.00.13.11.'91	14.15.14.11.'91	1,575	1	5	2*P/S DC 48 Volt Fault.
SRI - Donapud	NEC	11. '91	08.30.04.11.'91	20.00.04.11.'91	690	1	5	2*Conector of a terminal board fault.
KBI - Thong Phaphoom	MARCONI	11. '91	13.56.11.11.'91	14.59.11.11.'91	63	1	31	3*Fire surge to cable.
PLK - Thrap Phrira	NEC	11. '91	16.00.03.11.'91	17.15.03.11.'91	35	1	21	3*Main breaker cut off.
NRT - Khamom	NEC	11. '91	06.00.11.11.'91	08.25.11.11.'91	145	1	30	3*P/S trip.
NYK - Banna	NEC	11. '91	09.00.03.11.'91	15.10.04.11.'91	1,810	1	30	3*Bih cable & equipment Fault.
NYK - Banna	NEC	11. '91	06.39.05.11.'91	10.30.05.11.'91	231	1	30	3*Bih cable & equipment Fault.
UTT - Fagiha	NEC	11. '91	20.45.14.11.'91	17.30.14.11.'91	2,685	1	5	3*Fired cable between Kao Bannagram Fagiha.
TRG - Hoi Yod	NEC	11. '91	07.40.03.11.'91	12.00.03.11.'91	260	1	60	3*Cablefault is caused by a truck.
TRG - Hoi Yod	NEC	11. '91	10.50.05.11.'91	11.45.05.11..91	55	1	60	3*Cablefault is caused by a truck.
TRG - Hoi Yod	NEC	11. '91	17.40.28.11..91	13.00.29.11..91	1,160	1	60	3*Cablefault is caused by a truck.
PKT - Krathoo	MARCONI	11. '91	11.15.23.11.'91	15.00.25.11.'91	3,105	1	60	3*PCM Cable fault at the fire repeater No. 4.
KRB - Ow Lux	NEC	11. '91	16.00.27.11.'91	18.00.27.11.'91	120	1	54	3*Cable fault is caused by a truck.
KRB - Ow Lux	NEC	11. '91	13.00.30.11.'91	16.30.01.12.'91	1,650	1	66	3*Cable fault is caused by a truck.
PTN - Yarang	MARCONI	11. '91	11.00.18.11.'91	22.40.19.11.'91	2,140	1	4	3*Cable low user power feed both side.
CPN1 -CPN2	NEC	11. '91	14.50.28.11.'91	00.52.29.11.'91	602	1	180	5*1.Cable fault is caused by a truck.
CPN1 -CPN2	NEC	11. '91	05.25.29.11.'91	11.20.29.11.'91	355	1	180	5*1.Cable fault is caused by a truck.
CPN1 -CPN2	NEC	11. '91	15.59.29.11.'91	14.50.30.11.'91	1,371	1	180	5*1.Cable fault is caused by a truck.
SPB - Thungkok	FUJITSU	11. '91	11.33.26.11.'91	00.19.29.11.'91	3,646	1	120	5*Cable is cut by a truck.
KKN - NMA		11. '91	08.35.07.11.'91	08.50.07.11.'91	15	1	210	5*Power system is fault, battery = low voltage 48 V to 39 V.
KKN - NMA		11. '91	07.00.08.11.'91	08.15.08.11.'91	75	1	210	5*Power system is fault, battery = low voltage 48 V to 39 V.
BRM - Phut Thaisong		11. '91	19.30.10.11.'91	02.50.01.11.'91	440	1	90	5*Battery=low volt.
PBN - Nam Nao		11. '91	01.45.09.11.'91	07.40.09.11.'91	365	1	3	5*Solar cell=cut out, battery = low voltage.
PBN - Kao Bampaikhoog		11. '91	04.45.22.11.'91	07.20.22.11.'91	215	1	3	5*Solar cell=cut out, battery = low voltage.
UTT - Fagiha		11. '91	18.50.11.11.'91	07.53.12.11.'91	783	1	5	6*Solar cell=cut out, battery = low voltage.
LPG - Tean(Mae Phrig)		11. '91	05.43.03.11.'91	07.45.03.11.'91	122	1	19	6*Solar cell = cut out, battery = low voltage.
LPG - Tean(Mae Phrig)		11. '91	04.58.04.11.'91	06.50.04.11.'91	112	1	2	6*Solar cell = cut out, battery = low voltage.
LPG - Tean(Mae Phrig)		11. '91	21.35.04.11.'91	05.30.05.11.'91	475	1	2	6*Solar cell = cut out, battery = low voltage.
LPG - Tean(Mae Phrig)		11. '91	01.52.06.11.'91	06.43.06.11.'91	351	1	2	6*Solar cell = cut out, battery = low voltage.
PNA - Koh Yao		11. '91	18.50.09.11.'91	07.53.19.11.'91	14,750	1	4	6*Solar cell = cut out, battery = low voltage. fault Mux.
KBI - Koh Lanta		11. '91	06.00.11.11.'91	08.10.11.11.'91	130	1	5	6*Solar cell = cut out, battery = low voltage.
KBI - Koh Lanta		11. '91	12.00.13.11.'91	14.15.14.11.'91	1,575	1	5	6*Solar cell = cut out, battery = low voltage.
KBI - Koh Lanta		11. '91	07.00.18.11.'91	07.50.18.11.'91	50	1	5	6*Solar cell = cut out, battery = low voltage.
KBI - Koh Lanta		11. '91	07.00.19.11.'91	08.15.19.11.'91	75	1	5	6*Solar cell = cut out, battery = low voltage.
CMI - Doi Tung		11. '91	09.10.11.11.'91	10.11.11.'91	50	1	122	6*Fuse of charger fault.
LPG - PRB (NAN)		11. '91	09.45.28.11.'91	10.00.28.11'91	15	1	979	6*New rectifier is fault so that battery = low volt.
PKT - Taksipa (Thai Muang)		11. '91	20.20.17.11.'91	23.26.17.11.'91	186	1	120	6*DC breaker = off.
		11. '91	15.45.27.11.'91	16.00.27.11.'91	15	1	433	6*Fuse at DC box fault. Breaker at rectifier = off.
NMA - CPM		11. '91	07.00.08.11.'91	08.15.08.11.'91	75	1	946	6*Fired DC 48 V is not efficient use Radio & Mux.
KBI - Koh Lanta		11. '91	06.30.20.11.'91	07.35.20.11.'91	65	1	5	6*Solar cell = cut out, battery = low voltage.
KBI - Koh Lanta		11. '91	06.30.25.11.'91	08.10.25.11.'91	100	1	5	6*Solar cell = cut out, battery = low voltage.
SRI - Phra Phuthabat		11. '91	17.30.10.11.'91	22.45.10.11.'91	315	1	127	6*Relay is fault.
Subtotal						66	7,064	

Table 2.4.3-2 Detail of the Faults (December 1991)

Source - Sector of Transmission Network, TOT

Span	Equipment Supplier	Fault Occured Month	Date of Fault Occured	Date of Fault Cleared	Total Fault Time (minutes)	Fault Occured Time	No. of Fault Circuits	Cause of Fault
Dec-91								
KKN - Si Chomphu (Phu Wian	NEC	12. '91	09.45.31.12.'91	10.50.31.12.'91	65	1	3	1*Cleared during inspection.
KKN - Nong Rua	NEC	12. '91	16.50.31.12.'91	08.30.01.01.'92	940	1	4	1*Cleared during inspection.
TAK - Phop Phra (Umphang)	NEC	12. '91	05.30.21..12.'91	11.30.21.12.'91	360	1	11	1*Tx = low level
CCO - Phanom Sarakham	NEC	12. '91	03.42.09.12.'91	16.31.09.12.'91	769	1	4	2*2 MB cable were cut off at part between Trans. and Cabinet
SSK - Non Khun	NEC	12. '91	06.30.30.12.'91	11.15.30.12.'91	285	1	3	2*Fuse was cut off at Mux. #3-4.
SSK - Huai Thap Than	NEC	12. '91	22.30.30.12.'91	09.10.31.12.'91	640	1	2	2*P/F of Mux. was damaged.
KLN - Sahatsakhan	NEC	12. '91	09.30.14.12.'91	14.00.14.12.'91	270	1	2	2*8M CH unit was damaged.
PBN - Si Thep	NEC	12. '91	17.40.28.12.'91	01.25.30.12.'91	1,905	1	123	2*Electric current surge in line between Switch and Trans.
MSN - Mae Sariang, Mae La No	NEC	12. '91	18.28.09.12.'91	00.20.10.12.'91	352	1	3	2*Bad contact at 32 MB Mux.
RBR - Photharam	NEC	12. '91	11.20.20.12.'91	20.30.20.12.'91	550	1	58	2*Mux. SEL was damaged.
PLK - Sap Phaiwan	NEC	12. '91	10.00.26.12.'91	14.30.26.12.'91	270	1	21	3*Rx DEMO at PLK was damaged.
NAN - Na Mun	NEC	12. '91	04.30.12.12.'91	13,00.25.12.'91	19,230	1	1	3*Low voltage surge in line of PCM cable, P/S Mux., etc.
YLA - Yaha	NEC	12. '91	11.20.16.12.'91	11.30.17.12.'91	1,450	1	6	3*Repaired ground at Rep #1-9 and Adjusted voltage of power
SRI - Muak Lek	NEC	12. '91	01.30.09.12.'91	09.00.09.12.'91	450	1	123	3*Line terminal was damaged.
Sri - Kaeng Khoi	NEC	12. '91	14.40.11.12.'91	15.40.11.12.'91	60	1	68	3*Cable was cut off between rep #3-4.
Sri - Kaeng Khoi	NEC	12. '91	16.10.14.12.'91	12.00.15.12.'91	1,190	1	68	3*Cable was cut off between rep #3-4.
Thung Sang - KBI, NRT	NEC	12. '91	20.10.10.12.'91	12.30.14.12.'91	5,300	1	118	4*Cable was cut off at Thung Song.
PTN - Na Klua	NEC	12. '91	14.10.11.12.'91	06.20.12.12.'91	970	1	30	5*Cable was cut ohh at the north phathaya.
CBI - Phathaya	NEC	12. '91	04.00.30.12.'91	12.03.30.12.'91	483	1	9	5*E/O converter broke down.
NMA - Khok Kruat	NEC	12. '91	09.55.23.12.'91	05.40.25.12.'91	2,625	1	60	5*Cable was cut off by a big didder.
CPN - Ban Khok, Fak Tha	NEC	12. '91	09.00.05.12.'91	12.35.05.12.'91	215	1	180	5*CPN office repaired the cable permanentry.
UBN - Senangkha Nikhon	NEC	12. '91	06.30.23.12.'91	12.20.23.12.'91	350	1	2	6*Breaker change = off, main battery finished.
UTT - Ban Khok, Fak Tha	NEC	12. '91	03.03.04.12.'91	07.17.04.12.'91	254	1	5	6*Solar cell = cut off, battery = low voltage.
PBN - Nam Nao	NEC	12. '91	23.16.21.12.'91	09.00.22.12.'91	584	1	3	6*Solar cell = cut off, battery = low voltage.
UTT - Ban Khok, Fak Tha	NEC	12. '91	17.00.29.12.'91	11.00.30.12.'91	1,080	1	5	6*Solar cell = cut off, battery = low voltage.
UTT - Ban Khok	NEC	12. '91	03.50.31.12'91	09.00.31.12.'91	310	1	3	6*Solar cell = cut off, battery = low voltage.
CMI - Mae Ai, Phrao, Chiang I	NEC	12. '91	11.41.26.12.'91	15.05.26.12.'91	204	1	3	6*Solar cell = cut off, battery = low voltage.
LPG - Thoen, Mae Purik	NEC	12. '91	23.52.29.12.'91	11.30.29.12.'91	689	1	5	6*Solar cell = cut off, battery = low voltage.
NAN - Thung Chang, Chiang K	NEC	12. '91	05.30.29.12.'91	16.00.29.12.'91	630	1	1	6*Solar cell = cut off, battery = low voltage.
Nan - Pua, Tha Wang Pha	NEC	12. '91	18.00.29.12.'91	11.00.30.12.'91	1,020	1	2	6*Solar cell = cut off, battery = low voltage.
Subtotal						30	926	

Table 2.4.3-3 Detail of the Faults (January 1992)

Source - Sector of Transmission Network, TOT

Span	Equipment Supplier	Fault Occured Month	Date of Fault Occured	Date of Fault Cleared	Total Fault Time (minutes)	Fault Occured Time	No. of Fault Circuits	Cause of Fault
Jan-92								
CPN - Kaset Soubun, Nong Bu	NEC	01. '92	09.50.22.01.'92	10.30.23.01.'92	1,730	1	4	1*Tx DPU Fault.
SSK - Non Khun	NEC	01. '92	16.40.08.01.'92	10.50.09.01.'92	1,070	1	2	2*Fuse (DC) cut.
NKI - Seka	NEC	01. '92	19.20.08.01'92	15.30.09.01.'92	1,210	1	2	2*Mux at RACK is fault.
MSN (R) - Mae Sariang	NEC	01. '92	22.00.06.01.'92	14.47.09.01.'92	3,887	1	35	2*2 Mb system at Mae Hongson is fault.
PBI - Phatharam	SEL	01.' 92	05.00.21.01.'92	06.25.22.01.'92	1,525	1	58	2*Fault at mux, SEL socket of pilot gen. unit.
PBI - Phatharam	SEL	01.' 92	08.45.22.01.'92	13.30.22.01.'92	225	1	58	2*Fault at mux, SEL socket of pilot gen. unit.
HYI - CPN	NEC	01. 92	08.00.02.01.'92	11.30.02.01.'92	210	1	60	2*Equipment of T-mux is fault.
BRM - Hwai Rat	MARCONI	01. 92	10.40.28.01.'92	14.15.28.01.'92	215	1	30	3*Power feed for in Buriram is fault.
PLK - Sap Phraiwan (Khao Hua	NEC	01. 92	09.50.19.01.'92	10.30.20.01.'92	1,480	1	21	3*Fault at Rx unit demod unit.
NAN - Na Mun	NEC	01. 92	17.00.29.01.'92	12.00.30.01.'92	1,140	1	1	3*Fault at power supply of SIG mux . Beaker DC RACK of S
TRG - Huai Yat	NEC	01. 92	01.05.05.01.'92	11.00.06.01.'92	2,035	1	30	3*Line repeater No. 3 is fault.
PNG - Kapong	NEC	01. 92	14.15.16.01.'92	16.15.20.01.'92	5,880	1	6	3*Line repeater No. 3-4 is fault.
PTN - Yarang	MARCONI	01. 92	08.20.13.01.'92	11.40.22.01.'92	13,160	1	6	3*Fault at a lot of cable, repeater No. 3-7 faut by drop wire.
NRT - Thung Song	SEL	01.' 92	16.40.20.01.'92	15.50.21.01.'92	1,390	1	118	4*Fault cable at Thungsong R-T distance circuit.
NRT - Thung Song (R-T)	SEL	01.' 92	18.00.21.01.'92	18.10.22.01.'92	1,450	1	118	4*Fault cable at Thungsong R-T distance circuit.
NRT - Thung Soug (R-T)	SEL	01.' 92	15.00.24.01.'92	03.20.28.01'92	5,060	1	24	4*Fault cable at Thungsong R-T distance circuit.
RYG - Ban Chang	NEC	01. 92	14.27.07.01.'92	23.10.07.01.'92	523	1	48	5*Optical fiber is fault by a truckat Ban Chang.
RYG - Ban Chang (R-T)	NEC	01. 92	12.00.15.01.'92	03.10.16.01.'92	910	1	48	5*Optical fiber is fault by a truckat Ban Chang.
Phatthaya - Na Chom Thian	NEC	01. 92	10.10.09.01.'92	04.39.10.01.'92	1,109	1	180	5*Optical fiber is fault by a truckat Na Jomtein exchange.
NMA - Khok Kruat, etc.	Fujitsu	01. 92	13.52.30.01.'92	01.00.02.02.'92	3,548	1	30	5*Optical fiber is fault by a truck.
NSN - Takhli, etc.	Fujitsu	01. 92	17.41.26.01.'92	01.05.01.02.'92	7,464	1	60	
PRI - Sa Kaeo, Wang Nam Yen, etc.		01.' 92	03.35.20.01.'92	10.45.20.01.'92	430	1	256	6*Breaker trip in the mobile Exchange.
UTT - Ban Khok (Doi Kho)		01. 92	21.37.01.01.'92	15.50.01.02.'92	1,093	1	2	6*Solar ceii is cut out, battery low voltage.
UTT - Ban Khok (Doi Kho)		01. 92	08.05.04.01.'92	09.34.04.01.'92	89	1	2	6*Solar ceii is cut out, battery low voltage.
UTT - Ban Khok (Doi Kho)		01. 92	11.00.04.01.'92	12.00.04.01.'92	60	1	2	6*Solar ceii is cut out, battery low voltage.
UTT - Ban Khok (Doi Kho)		01. 92	03.50.05.01.'92	08.20.05.01.'92	270	1	2	6*Solar ceii is cut out, battery low voltage.
UTT - Ban Khok (Doi Kho)		01. 92	17.55.09.01.'92	08.20.10.01'92	865	1	2	6*Solar ceii is cut out, battery low voltage.
UTT - Ban Khok (Doi Kho)		01. 92	02.50.14.01.'92	08.17.14.01.'92	327	1	2	6*Solar ceii is cut out, battery low voltage.
UTT - Pak Tha (Ban Khok)		01. 92	01.25.01.01.'92	08.37.25.01.'92	732	1	1	6*Solar ceii is cut out, battery low voltage.
UTT - Pak Tha (Ban Khok)		01. 92	05.10.02.01.'92	15.00.02.01.'92	610	1	1	6*Solar ceii is cut out, battery low voltage.
UTT - Pak Tha (Ban Khok)		01. 92	08.00.04.01.'92	08.05.04.01.'92	5	1	1	6*Solar ceii is cut out, battery low voltage.
UTT - Nam Pat, Fak Khok, etc.		01. 92	00.00.04.01.'92	07.27.04.01.'92	447	1	3	6*Solar ceii is cut out, battery low voltage.
UTT - Nam Pat, Fak Khok, etc.		01. 92	22.40.05.01.'92	07.25.06.01.'92	525	1	3	6*Solar ceii is cut out, battery low voltage.
UTT - Nam Pat, Fak Khok, etc.		01.' 92	01.10.07.01.'92	07.20.07.01.'92	370	1	3	6*Solar ceii is cut out, battery low voltage.
UTT - Nam Pat, Fak Khok, etc.		01. 92	01.40.08.01.'92	07.40.08.01.'92	360	1	3	6*Solar ceii is cut out, battery low voltage.
UTT - Nam Pat, Fak Khok, etc.		01. 92	00.49.09.01.'92	07.45.09.01.'92	416	1	2	6*Solar ceii is cut out, battery low voltage.
UTT - Nam Pat, Fak Khok, etc.		01. 92	03.00.10.01.'92	07.30.10.01.'92	270	1	2	6*Solar ceii is cut out, battery low voltage.
PBN - Nam Nao (khao Ban , etc)		01. 92	03.45.08.01.'92	09.10.08.01.'92	325	3		6*Solar ceii is cut out, battery low voltage.
PBN - Nam Nao (khao Ban , etc)		01. 92	03.50.10.01.'92	07.40.10.01.'92	230	1	3	6*Solar ceii is cut out, battery low voltage.
PLK - Bang Rakam		01. 92	06.10.18.01.'92	10.30.18.01.'92	260	1	60	6*Fault at the mobile exchange.
Subtotal						42	1,289	

Table 2.4.3-4 Detail of the Faults (February 1992)

Source - Sector of Transmission Network, TOT

Feb-92								
SRI - LBI, SBR, Ban Mo, BKK	NEC	02. '92	15.35.25.02.'92	16.08.02.'92	32	1	894	1*Breaker DC in distribution board of Mux. broke down.
SRI - Non Saeng	NEC	02. '92	07.30.03.02.'92	09.50.03.02.'92	90	1	7	*Tx unit bad contact.
NKI - Pak Khat, Bung Kan	NEC	02. '92	15.55.19.02.'92	16.00.19.02.'92	5	1	6	*B-U converter unit bad contact.
NKI - Sa Phisai, Phon Charoen	NEC	02. '92	16.07.19.02.'92	16.40.19.02.'92	33	1	39	1*B-U converter unit bad contact.
	Fujitsu	02. '92	07.30.29.02.'92	07.36.29.02.'92	6	1	163	1*Tomen company improve the anntena.
	Fujitsu	02. '92	18.00.29.02.'92	18.05.29.02.'92	5	1	163	1*Tomen company improve the anntena.
BRM - Ban Krust, Prakhon Chai	NEC	02. '92	19.30.08.02.'92	19.40.08.02.'92	10	1	117	1*Receive alarm from N.H.
SRN - Pranet (Kap Choeng)	NEC	02. '92	17.50.10.02.'92	22.15.10.02.'92	265	1	15	1*ALM cont unit, Rx, DP unit is out of order.
NMA - KKN, UDN, BanLuam	NEC	02. '92	16.30.13.02.'92	21.30.14.02.'92	1,740	1	163	1*R-SW is out of order.
BKK (PKG) - UBN	NEC	02. '92	05.00.19.02.'92	09.55.19.02.'92	295	1	138	1*ALM cont unit, Rx, DP unit is out of order.
NSN - PBN, Chunsaen (NSNR)	NEC	02. '92	18.20.09.02.'92	19.00.09.02.'92	40	1	129	1*Connecting port of Rx, DPU unit is torn.
NSN - PBN, Chunsaen (NSNR)	NEC	02. '92	21.40.10.02.'92	01.05.11.02.'92	205	1	129	1*Connecting port of Rx, DPU unit is torn.
NSN - PBN, Chunsaen (NSNR)	NEC	02. '92	06.40.11.02.'92	08.50.11.02.'92	130	1	129	1*Connecting port of Rx, DPU unit is torn.
NSN - PBN, Chunsaen (NSNR)	NEC	02. '92	06.30.25.02.'92	07.15.25.02.'92	45	1	129	1*Connecting port of Rx, DPU unit is torn.
NSN - PBN, Chunsaen (NSNR)	NEC	02. '92	13.30.25.02.'92	13.43.25.02.'92	13	1	129	1*Connecting port of Rx, DPU unit is torn.
NSN - PBN, Chunsaen (NSNR)	NEC	02. '92	12.50.26.02.'92	14.20.26.02.'92	90	1	63	1*Connecting port of Rx, DPU unit is torn.
NSN - PBN, Chunsaen (NSNR)	NEC	02. '92	22.40.26.02.'92	22.55.26.02.'92	15	1	63	1*Connecting port of Rx, DPU unit is torn.
NSN - PBN, Chunsaen (NSNR)	NEC	02. '92	23.00.26.02.'92	23.05.26.02.'92	5	1	63	1*Connecting port of Rx, DPU unit is torn.
NSN - PBN, Chunsaen (NSNR)	NEC	02. '92	02.28.27.02.'92	06.40.27.02.'92	252	1	63	1*Connecting port of Rx, DPU unit is torn.
NSN - PBN, Chunsaen (NSNR)	NEC	02. '92	20.30.28.02.'92	22.39.28.02.'92	129	1	63	1*Connecting port of Rx, DPU unit is torn.
NSN - PBN, Chunsaen (NSNR)	NEC	02. '92	00.38.29.02.'92	10.34.29.02.'92	596	1	63	1*Connecting port of Rx, DPU unit is torn.
NAN - Chiang Klang	NEC	02. '92	21.00.05.02.'92	11.00.06.02.'92	840	1	35	*P/S of mux is out of order.
SRN - Si Khoraphum	NEC	02. '92	00.00.26.02.'92	03.00.26.02.'92	180	1	49	2*Mitsui company move some Rack.
NKI - Pak Khat	Fujitsu	02. '92	14.40.29.02.'92	17.20.29.02.'92	160	1	29	2*Some wire connector at group GR was cut off.
NSN - UTT	NEC	02. '92	06.15.03.02.'92	08.00.03.02.'92	105	1	279	2*P/S of Mux. broke down.
SRI - Don Phut	NEC	02. '92	22.00.04.02.'92	08.00.05.02.'92	600	1	5	*VF RCV unit break down.
SRI - Nong Saeng	NEC	02. '92	15.30.22.02.'92	20.30.22.02.'92	300	1	7	*Breaker in distributer bay is down.
YLA - Yaha	MARCONI	02. '92	12.00.12.02.'92	15.40.19.02.'92	10,300	1	1	*Cable leak into ground at No. 4-5 & cable is down at Rc. No
CBI - Phatthaya (Laem Chabang	NEC	02. '92	15.20.06.02.'92	06.15.07.02.'92	850	1	411	4*Optical fiber is cut off.
CBI - Phatthaya (Laem Chabang	NEC	02. '92	14.00.09.02.'92	10.15.10.02.'92	595	1	411	4*Optical fiber is cut off.
CBI - Phatthaya (Laem Chabang	NEC	02. '92	11.30.22.02.'92	21.48.22.02.'92	618	1	411	4*Optical fiber is cut off.
CBI - Si Racha (Bang Saen)	NEC	02. '92	14.00.09.02.'92	10.15.10.02.'92	1,215	1	78	4*OPC of Rx and Rx of Siracha is torn.
NMA - Khak Krat, Si Khiu, Sun	Fujitsu	02. '92	10.35.20.02.'92	22.44.20.02.'92	2,169	1	39	4*OPC is torn by a digging truck.
CMI - Mae Cho	Fujitsu	02. '92	01.38.10.02.'92	15.38.14.02.'92	6,600	1	1,024	4*OPC is torn by a digging truck.
CPN1 - CPN2	NEC	02. '92	14.30.11.02.'92	18.50.11.02.'92	260	1	180	4*OPC is torn by a digging truck.
CPN1 - CPN2	NEC	02. '92	09.47.18.02.'92	14.40.18.02.'92	293	1	180	4*OPC is torn by a digging truck.
PKT - Pa Tong	Fujitsu	02. '92	12.52.29.02.'92	00.30.04.03.'92	5,018	1	240	4*OPC is torn by a digging truck.
KBI - Thung Song	SEL	02. '92	14.45.15.02.'92	15.00.15.02.'92	15	1	35	5*Man made fault in moving construvtion.
NRT - Thung SongSEL		02. '92	16.50.15.02.'92	18.00.15.02.'92	70	1	118	5*Man made fault in moving construvtion.
NSN - PBN, Chun Saeng	SEL	02. '92	12.05.04.02.'92	13.00.04.02.'92	55	1	129	5*At connecting head of coaxial cable is oped.
NSN - PBN, Chun Saeng	SEL	02. '92	21.15.04.02.'92	23.30.04.02.'92	135	1	129	5*At connecting head of coaxial cable is oped.
NSN - PBN, Chun Saeng	SEL	02. '92	08.55.05.02.'92	10.35.05.02.'92	100	1	63	5*At connecting head of coaxial cable is oped.
NSN - PBN, Chun Saeng	SEL	02. '92	02.21.07.02.'92	03.20.07.02.'92	59	1	63	5*At connecting head of coaxial cable is oped.
NSN - PBN, Chun Saeng	SEL	02. '92	04.05.07.02.'92	04.25.07.02.'92	20	1	63	5*At connecting head of coaxial cable is oped.
SSK - UBN, Uthumphon Phisai	NEC	02. '92	04.25.28.02.'92	05.15.28.02.'92	50	1	611	6*AC current is not normal, charger cannot work.
SSK - UBN, Husi Thap Than	NEC	02. '92	04.25.28.02.'92	05.45.28.02.'92	80	1	79	6*AC current is not normal, charger cannot work.
MSN - Pai	Fujitsu	02. '92	19.40.19.02.'92	20.20.19.02.'92	40	1	17	6*Solar cell was cut out.
LPG Thoen, Mae Phrik (Khano	Fujitsu	02. '92	20.25.19.02.'92	20.30.19.02.'92	5	1	2	*Solar cell was cut out.
KBI - Thung Song		02. '92	07.00.10.02.'92	07.30.10.02.'92	30	1	35	6*Fuse DC supply load was cut off.
KBI - Kolanta		02. '92	16.00.25.02.'92	17.45.25.02.'92	105	1	105	6*Solar cell was cut off.
BKK - NRT		02. '92	10.03.14.02.'92	12.50.14.02.'92	167	1	167	6*Cabinet control of charger broke down.
MSN - Pai		02. '92	18.38.14.02.'92	16.10.17.02.'92	4,172	1	21	6*AC line surge comes into the exchange office.
KBI - Khlong Thom		02. '92	05.00.06.02.'92	08.40.06.02'92	220	1	21	6*Fuse DC is torn.
FLK - Bang Rakam		02. '92	02.00.27.02.'92	10.50.27.02.'92	530	1	60	6*Fault is at athe mobile exchange.
SubTotal						47	6,404	
Grand Total						185	15,683	

1) Analysis of the fault

Table 2.4.3-5 shows the fault in each facility selected from Table 2.4.3-1 and 2.4.3-4. In the table, the faults are classified into six categories. They are microwave system, multiplexer, PCM cable system, optical fiber system, coaxial cable system and power supply equipment.

Table 2.4.3-5 (a) Fault in Each Facility (November 1991 & February 1992)

Source - Sector of Transmission Network, TOT

Span	Equipment Supplier	Fault Occured Month	Date of Fault Occured	Date of Fault Cleared	Total Fault Time (minutes)	Fault Occured Time	No. of Fault Circuits	Cause of Fault
	NEC	02. '92	15.55.19.02.'92	16.00.19.02.'92	5	1	6	1*B-U converter unit bad contact.
	NEC	02. '92	23.60.26.02.'92	23.05.26.02.'92	5	1	63	1*Connecting port of Rx, DPU unit is torn.
	Fujitsu	02. '92	18.00.29.02.'92	18.05.29.02.'92	5	1	163	1*Tomen company improve the anntena.
	Fujitsu	02. '92	07.30.29.02.'92	07.36.29.02.'92	6	1	163	1*Tomen company improve the anntena.
BKK - UBN	NEC	11. '91	11.45.14.11.'91	11.55.14.11.'91	10	1	140	1*bad contactswitch change over.
	NEC	02. '92	19.30.08.02.'92	19.40.08.02.'92	10	1	117	1*Receive alarm from N.H.
	NEC	02. '92	13.30.25.02.'92	13.43.25.02.'92	13	1	129	1*Connecting port of Rx, DPU unit is torn.
	NEC	02. '92	22.40.26.02.'92	22.55.26.02.'92	15	1	63	1*Connecting port of Rx, DPU unit is torn.
STN - Lahu (Thapae, Kuan Kalong)	NEC	11. '91	17.00.09.11.'91	17.30.09.11.'91	30	1	19	1*Mitsui co. move anntena.
NAN - Tha Vangpha	NEC	11. '91	14.50.01.11.'91	15.20.01.11.'91	30	1	2	1*Rx = low level. Change feed horn.
SRI - LBI, BKK.	NEC	02. '92	15.35.25.02.'92	16.08.02.'92	32	1	894	1*Breaker DC in distribution board of Mux. broke down.
	NEC	02. '92	16.07.19.02.'92	16.40.19.02.'92	33	1	39	1*B-U converter unit bad contact.
	NEC	02. '92	18.20.09.02.'92	19.00.09.02.'92	40	1	129	1*Connecting port of Rx, DPU unit is torn.
MKM - Nakhoon	NEC	11. '91	09.50.15.11.'91	10.30.15.11.'91	40	1	4	1*Tx unit, change to spare one.
	NEC	02. '92	06.30.25.02.'92	07.15.25.02.'92	45	1	129	1*Connecting port of Rx, DPU unit is torn.
NMA - Phimai	NEC	11. '91	00.00.07.11.'91	10.00.07.11.'91	60	1	123	1*Breaker P/S = off
CNT - Manorom	NEC	11. '91	12.00.15.11.'91	13.00.15.11.'91	60	1	121	1*DC-DC converter bad contact. tx local OSC fault.
KBI - NRT	NEC	11. '91	06.06.22.11.'91	07.20.22.11.'91	74	1	43	1*Mithui Co. maintaine the anntena.
	NEC	02. '92	12.50.26.02.'92	14.20.26.02.'92	90	1	63	1*Connecting port of Rx, DPU unit is torn.
SRI -	NEC	02. '92	07.30.03.02.'92	09.50.03.02.'92	90	1	7	1*Tx unit bad contact.
CNT - Manorom	NEC	11. '91	13.40.16.11.'91	15.15.16.11.'91	95	1	121	1*DC-DC converter bad contact. tx local OSC fault.
MKM - Vapiphanthum	NEC	11. '91	07.03.15.11.'91	08.50.15.11.'91	107	1	10	1*Tx unit, change to spare one.
MKM - Phayk Phoen	NEC	11. '91	11.00.15.11.'91	13.00.15.11.'91	120	1	18	1*Tx unit, change to spare one.
BKK - SNI	NEC	11. '91	00.00.15.11.'91	02.05.15.11.'91	125	1	180	1*Maintaine radio fro (1+1) to (1+0)
	NEC	02. '92	20.30.28.02.'92	22.39.28.02.'92	129	1	63	1*Connecting port of Rx, DPU unit is torn.
	NEC	02. '92	06.40.11.02.'92	08.50.11.02.'92	130	1	129	1*Connecting port of Rx, DPU unit is torn.
AYA - Maharat	NEC	11. '91	15.43.23.11.'91	17.00.23.11.'91	142	1	3	1*Rx DPU fault.
KKN - Chum Phae (etc.)	NEC	11. '91	00.00.15.11.'91	02.35.15.11.'91	155	1	380	1*Mitsui company maintain Branching from (1+1) to (1+0).
NAN - Tha Vangpha	NEC	11. '91	10.20.02.11.'91	13.00.02.11.'91	160	1	2	1*Rx = low level. Change feed horn.
	NEC	02. '92	21.40.10.02.'92	01.05.11.02.'92	205	1	129	1*Connecting port of Rx, DPU unit is torn.
	NEC	02. '92	02.28.27.02.'92	06.40.27.02.'92	252	1	63	1*Connecting port of Rx, DPU unit is torn.
	NEC	02. '92	17.50.10.02.'92	22.15.10.02.'92	265	1	15	1*ALM cont unit, Rx, DP unit is out of order.
UDN - Nongbua Lamphoo	NEC	11. '91	07.00.16.11.'91	11.30.16.11.'91	270	1	30	1*Rx fault
	NEC	02. '92	05.00.19.02.'92	09.55.19.02.'92	295	1	138	1*ALM cont unit, Rx, DP unit is out of order.
	NEC	02. '92	00.38.29.02.'92	10.34.29.02.'92	596	1	63	1*Connecting port of Rx, DPU unit is torn.
	NEC	02. '92	16.30.13.02.'92	21.30.14.02.'92	1,740	1	163	1*R-SW is out of order.
SubTotal					5,479	36	3,924	Average fault time length per fault= 152 minutes Average number of fault circuits per fault = 109 circuits.
BNA - Taksipa	NEC	11. '91	15.10.02.11.'91	15.20.02.11.'91	10	1	10	2*It is much hot so that 34 MB burn .
PKT - Taksipa	NEC	11. '91	15.10.02.11.'91	15.20.02.11.'91	10	1	120	2*It's very hot so that 34 MB Mux unit occur alarm.
NSN - Krok Phre (& other)	NEC	11. '91	18.40.21.11.'91	18.50.21.11.'91	10	1	358	2*Radio system is cut.
PLK - Sukhothai & Sawankhalok	NEC	11. '91	14.55.17.11.'91	15.10.17.11.'91	15	1		2*Fuse DC & mux.
KKN - KSN	NEC	11. '91	13.15.05.11.'91	13.30.05.11.'91	15	1	282	2*Unit IFT 34 MB is found bad contact.
Banpae NamSan	NEC	11. '91	07.10.18.11.'91	07.45.18.11.'91	35	1	27	2*DC breaker mux = off.
PRI - Sri Mahapho	NEC	11. '91	14.20.20.11.'91	15.00.20.11.'91	40	1	18	2*Breaker P/S = off
SNI - Koh Phangan	NEC	11. '91	14.45.10.11.'91	16.10.10.11.'91	85	1	180	2*VF INF unit, ALM unit, XMT unit. DC breaker = off.
PBI - Photharam	SEL	11. '91	15.10.11.11.'91	16.40.11.11.'91	90	1	60	2*Bad contact of pre-group carrier unit.
TRG - Kantang(Palaieu)	NEC	11. '91	00.00.29.11.'91	01.30.29.11.'91	90	1	60	2*Mitsui co. move Rack.
	NEC	02. '92	06.15.03.02.'92	08.00.03.02.'92	105	1	279	2*P/S of Mux. broke down.
PRI - Aranya Praied	NEC	11. '91	15.30.20.11.'91	17.40.20.11.'91	130	1	189	2*bad contact switch change over
	Fujitsu	02. '92	14.40.29.02.'92	17.20.29.02.'92	160	1	29	2*Some wire connector at group GR was cut off.
KKN - Patonrat	NEC	11. '91	06.30.07.11.'91	09.30.07.11.'91	180	1	2	2*8 MB INP unit is fault.
CPN - Thasae	NEC	11. '91	07.15.27.11.'91	10.15.27.11.'91	180	1	60	2*DC breaker = off.
	NEC	02. '92	00.00.26.02.'92	03.00.26.02.'92	180	1	49	2*Mitsui company move some Rack.
LPG - PRE - NAN	NEC	11. '91	02.08.23.11.'91	06.00.23.11.'91	232	1	989	2*Fuse DC of P/S of Mux Fault.
CMI1 - CMI2	NEC	11. '91	00.00.21.11.'91	03.57.21.11.'91	237	1	59	2*Between 34 M Mux and 140 M Mux
	NEC	02. '92	15.30.22.02.'92	20.30.22.02.'92	300	1	7	2*Breaker in distributer bay is down.
PBI - Photharam	SEL	11. '91	19.40.07.11.'91	01.00.08.11.'91	320	1	60	2*Bad contact of pre-group carrier unit.
	NEC	02. '92	22.00.04.02.'92	08.00.05.02.'92	600	1	5	2*VF RCV unit break down.
SRI - Donpud	NEC	11. '91	08.30.04.11.'91	20.00.04.11.'91	690	1	5	2*Conector of a terminal board fault.
	NEC	02. '92	21.00.05.02.'92	11.00.06.02.'92	840	1	3	2*P/S of mux is out of order.
PLK - Bang Ragam	NEC	11. '91	18.30.03.11.'91	10.00.04.11.'91	930	1	6	2*2M Mux RCV CH Fault.
KKN - Ubonrat	NEC	11. '91	18.30.03.11.'91	10.00.04.11.'91	930	1	6	2*P/S of VF Mux.
SNI - Koh Phangan	NEC	11. '91	07.45.10.11.'91	06.30.11.11.'91	1,365	1	22	2*VF INF unit. Cause of thunder bolt.
KRB - Kohlanta	NEC	11. '91	12.00.13.11.'91	14.15.14.11.'91	1,575	1	5	2*P/S DC 48 Volt Fault.
YST - Mahachaichana	NEC	11. '91	04.30.10.11.'91	13.00.11.11.'91	1,920	1	6	2*Fault cleared on twhile examine at Mux.
	MARCONI	02. '92	12.00.12.02.'92	15.40.19.02.'92	10,300	1	1	2*Cable leak into ground at No. 4-5 & cable is down at Re. No. 6-7.
SubTotal					21,574	29	2,897	Average fault time length per fault=743 minutes Average fault circuits per fault = 100 circuits

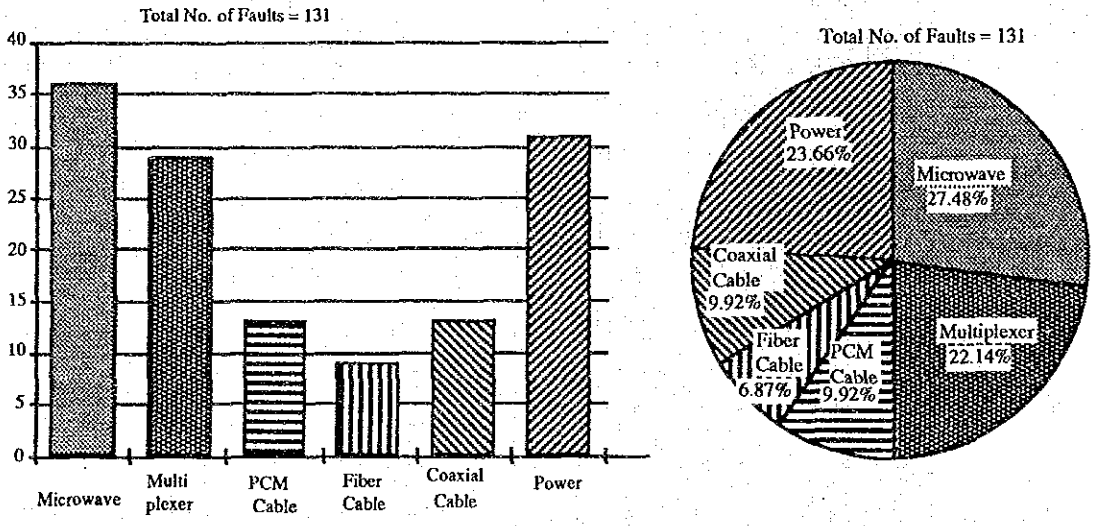
Table 2.4.3-5 (b) Fault in Each Facility (November 1991 & February 1992)

Source - Sector of Transmission Network, TOT

Span	Equipment Supplier	Fault Occured Month	Date of Fault Occured	Date of Fault Cleared	Total Fault Occured Time (minutes)	Fault No. of Occured Time	Fault Circuits	Cause of Fault
PLK - Thrup Phrirai	NEC	11. '91	16.00.03.11.'91	17.15.03.11.'91	35	1	21	3*Main breaker cut off.
TRG - Hoi Yod	NEC	11. '91	10.50.05.11.'91	11.45.05.11.,91	55	1	60	3*Cable fault is caused by a truck.
KBI - Thong Phaphoom	MARCONI	11. '91	13.56.11.11.'91	14.59.11.11.'91	63	1	31	3*Fire surge to cable.
KRB - Ow Lux	NEC	11. '91	16.00.27.11.'91	18.00.27.11.'91	120	1	54	3*Cable fault is caused by a truck.
NRT - Khanom	NEC	11. '91	06.00.11.11.'91	08.25.11.11.'91	145	1	30	3*P/S trip.
NYK - Banna	NEC	11. '91	06.39.05.11.'91	10.30.05.11.'91	231	1	30	3*Bth cable & equipment Fault.
TRG - Hoi Yod	NEC	11. '91	07.40.03.11.'91	12.00.03.11.'91	260	1	60	3*Cable fault is caused by a truck.
TRG - Hoi Yod	NEC	11. '91	17.40.28.11.,91	13.00.29.11.,91	1,160	1	60	3*Cable fault is caused by a truck.
KRB - Ow Lux	NEC	11. '91	13.00.30.11.'91	16.30.01.12.'91	1,650	1	66	3*Cable fault is caused by a truck.
NYK - Banna	NEC	11. '91	09.00.03.11.'91	15.10.04.11.'91	1,810	1	30	3*Bth cable & equipment Fault.
PTN - Yarang	MARCONI	11. '91	11.00.18.11.'91	22.40.19.11.'91	2,140	1	4	3*Cable low usee power feed both side.
UTT - Fagtha	NEC	11. '91	20.45.14.11.'91	17.30.14.11.'91	2,685	1	5	3*Fired cable between Kao Bannanum Fagtha.
PKT - Krathoo	MARCONI	11. '91	11.15.23.11.'91	15.00.25.11.'91	3,105	1	60	3*PCM Cable hault at the line repeater No. 4.
Sub Total					13,459	13	511	Average fault line length per fault= 1,121 routes-k Average number of circuits per fault = 39 circuits
	NEC	02. '92	14.30.11.02.'92	18.50.11.02.'92	260	1	180	4*OFC is torn by a digging truck.
	NEC	02. '92	09.47.18.02.'92	14.40.18.02.'92	293	1	180	4*OFC is torn by a digging truck.
	NEC	02. '92	14.00.09.02.'92	10.15.10.02.'92	595	1	411	4*Optical fiber is cut off.
	NEC	02. '92	11.30.22.02.'92	21.48.22.02.'92	618	1	411	4*Optical fiber is cut off.
	NEC	02. '92	15.20.06.02.'92	06.15.07.02.'92	850	1	411	4*Optical fiber is cut off.
	NEC	02. '92	14.00.09.02.'92	10.15.10.02.'92	1,215	1	78	4*OFC of Rx and Rx of Siracha is torn.
	Fujitsu	02. '92	10.35.20.02.'92	22.44.20.02.'92	2,169	1	39	4*OFC is torn by a digging truck.
	Fujitsu	02. '92	12.52.29.02.'92	00.30.04.03.'92	5,018	1	240	4*OFC is torn by a digging truck.
	Fujitsu	02. '92	01.38.10.03.'92	15.38.14.02.'92	6,600	1	1,024	4*OFC is torn by a digging truck.
Sub Total					17,618	9	2,971	Average fault line length per route= 3,957 routes-k Average fault circuits per fault = 330 circuits
	SEL	02. '92	14.45.15.02.'92	15.00.15.02.'92	15	1	35	5*Man made fault in moving construction.
KKN - NMA		11. '91	08.35.07.11.'91	08.50.07.11.'91	15	1	210	5*Power system is fault, battery = low voltage 48 V to 39 V.
	SEL	02. '92	04.05.07.02.'92	04.25.07.02.'92	20	1	63	5*At connecting head of coaxial cable is oped.
	SEL	02. '92	12.05.04.02.'92	13.00.04.02.'92	55	1	129	5*At connecting head of coaxial cable is oped.
	SEL	02. '92	02.23.07.02.'92	03.20.07.02.'92	59	1	63	5*At connecting head of coaxial cable is oped.
	SEL	02. '92	16.50.15.02.'92	18.00.15.02.'92	70	1	118	5*Man made fault in moving construction.
KKN - NMA		11. '91	07.00.08.11.'91	08.15.08.11.'91	75	1	210	5*Power system is fault, battery = low voltage 48 V to 39 V.
	SEL	02. '92	08.55.05.02.'92	10.35.05.02.'92	100	1	63	5*At connecting head of coaxial cable is oped.
	SEL	02. '92	21.15.04.02.'92	23.30.04.02.'92	135	1	129	5*At connecting head of coaxial cable is oped.
CPN1 -CPN2	NEC	11. '91	05.25.29.11.'91	11.20.29.11.'91	355	1	180	5*1.Cable fault is caused by a truck.
CPN1 -CPN2	NEC	11. '91	14.50.28.11.'91	00.52.29.11.'91	602	1	180	5*1.Cable fault is caused by a truck.
CPN1 -CPN2	NEC	11. '91	15.59.29.11.'91	14.50.30.11.'91	1,371	1	180	5*1.Cable fault is caused by a truck.
SPB - Thungkok	FUJITSU	11. '91	11.33.26.11.'91	00.19.29.11.'91	3,646	1	120	5*Cable is cut by a truck.
Sub Total					6,518	13	1,680	Average fault line length per fault = 501 routes-k Average number of circuits per fault = 129 circuits
	Fujitsu	02. '92	20.25.19.02.'92	20.30.19.02.'92	5	1	2	6*Solar cell was cut out.
		11. '91	15.45.27.11.'91	16.00.27.11.'91	15	1	433	6*Fuse at DC box fault, Breaker at rectifier = off.
LPG - PRB (NAN)		11. '91	09.45.28.11.'91	10.00.28.11'91	15	1	979	6*New rectifier is fault so that battery = low volt.
		02. '92	07.00.10.02.'92	07.30.10.02.'92	30	1	35	6*Fuse DC supply load was cut off.
	Fujitsu	02. '92	19.40.19.02.'92	20.20.19.02.'92	40	1	17	6*Solar cell was cut out.
SSK - UBN	NEC	02. '92	04.25.28.02.'92	05.15.28.02.'92	50	1	611	6*AC current is not normal, charger cannot work.
CMI - Doi Tung		11. '91	09.10.11.11.'91	10.11.11.'91	50	1	122	6*Fuse of charger fault.
KBI - Koh Lanta		11. '91	07.00.18.11.'91	07.50.18.11.'91	50	1	5	6*Solar cell = cut out, battery = low voltage.
KBI - Koh Lanta		11. '91	06.30.20.11.'91	07.35.20.11.'91	65	1	5	6*Solar cell = cut out, battery = low voltage.
NMA - CPM		11. '91	07.00.08.11.'91	08.15.08.11.'91	75	1	946	6*Fired DC 48 V is not efficient use Radio & Mux.
KBI - Koh Lanta		11. '91	07.00.19.11.'91	08.15.19.11.'91	75	1	5	6*Solar cell = cut out, battery = low voltage.
SSK - UBN	NEC	02. '92	04.25.28.02.'92	05.45.28.02.'92	80	1	79	6*AC current is not normal, charger cannot work.
KBI - Koh Lanta		11. '91	06.30.25.11.'91	08.10.25.11.'91	100	1	5	6*Solar cell = cut out, battery = low voltage.
		02. '92	16.00.25.02.'92	17.45.25.02.'92	105	1	105	6*Solar cell was cut off.
LPG - Tean(Mae Phrig)		11. '91	04.58.04.11.'91	06.50.04.11.'91	112	1	2	6*Solar cell = cut out, battery = low voltage.
LPG - Tean(Mae Phrig)		11. '91	05.43.03.11.'91	07.45.03.11.'91	122	1	19	6*Solar cell = cut out, battery = low voltage.
KBI - Koh Lanta		11. '91	06.00.11.11.'91	08.10.11.11.'91	130	1	5	6*Solar cell = cut out, battery = low voltage.
BKK - NST		02. '92	10.03.14.02.'92	12.50.14.02.'92	167	1	167	6*Cabinet control of charger broke down.
PKT - Takuipa (Thai Muang)		11. '91	20.20.17.11.'91	23.26.17.11.'91	186	1	120	6*DC breaker = off.
PBN - Kao Bampakchong		11. '91	04.45.22.11.'91	07.20.22.11.'91	215	1	3	6*Solar cell=cut out, battery = low voltage.
		02. '92	05.00.06.02.'92	08.40.06.02'92	220	1	21	6*Fuse DC is torn.
SRI - Phra Phuthabat		11. '91	17.30.10.11.'91	22.45.10.11.'91	315	1	127	6*Relay is fault.
LPG - Tean(Mae Phrig)		11. '91	01.52.06.11.'91	06.43.06.11.'91	351	1	2	6*Solar cell = cut out, battery = low voltage.
PBN - Nam Nao		11. '91	01.45.09.11.'91	07.40.09.11.'91	365	1	3	6*Solar cell=cut out, battery = low voltage.
BRM - Phut Thaisong		11. '91	19.30.10.11.'91	02.50.01.11.'91	440	1	90	6*Battery=low volt.
LPG - Tean(Mae Phrig)		11. '91	21.35.04.11.'91	05.30.05.11.'91	475	1	2	6*Solar cell = cut out, battery = low voltage.
		02. '92	02.00.27.02.'92	10.50.27.02.'92	530	1	60	6*Fault is at the mobile exchange.
UTT - Fagtha		11. '91	18.50.11.11.'91	07.53.12.11.'91	783	1	5	6*Solar cell=cut out, battery = low voltage.
KBI - Koh Lanta		11. '91	12.00.13.11.'91	14.15.14.11.'91	1,575	1	5	6*Solar cell = cut out, battery = low voltage.
		02. '92	18.38.14.02.'92	16.10.17.02.'92	4,172	1	21	6*AC line surge comes into the exchange office.
PNA - Koh Yao		11. '91	18.50.09.11.'91	07.53.19.11.'91	14,750	1	4	6*Solar cell = cut out, battery = low voltage, fault Mux.
Sub Total					25,663	31	4,005	Average fault line length per fault = 828 routes-k Average number of circuits per fault = 129 circuits
Grand Total					90,311	131	15,591	Average fault line length per route = 689 routes-k Average number of circuits per fault = 122 circuits

- Number of Fault Occurrences and Fault Ratio

The numbers of fault occurrences within two months are 131 as shown in Figure 2.4.3-1 (a). The fault ratios of the classified six categories are shown in Figure 2.4.3-1 (b). The three highest fault ratios are those of microwave, multiplexer and power supply system. They occupy more than 73 percent of all faults. Their main causes are power supply panels.



(a) Number of Faults in Each Equipment (b) Fault Ratios of the Facilities

Figure 2.4.3-1 Number of Faults in Each Equipment (November 1991 & February 1992)

b) Fault Hours

Figure 2.4.3-2 shows the fault hours of each equipment. Three highest average trouble hours are those of optical fiber, PCM cable and power supply system. They exceed 800 (13 hours) minutes per a fault. Their main causes are as follows :

- Fixing a cut off cable usually takes a long time, because it takes a long time to dig up and to splice the damaged cable.
- Recovering a power supply system that is located in a remote area takes a long time, because it takes long time to go to the area.

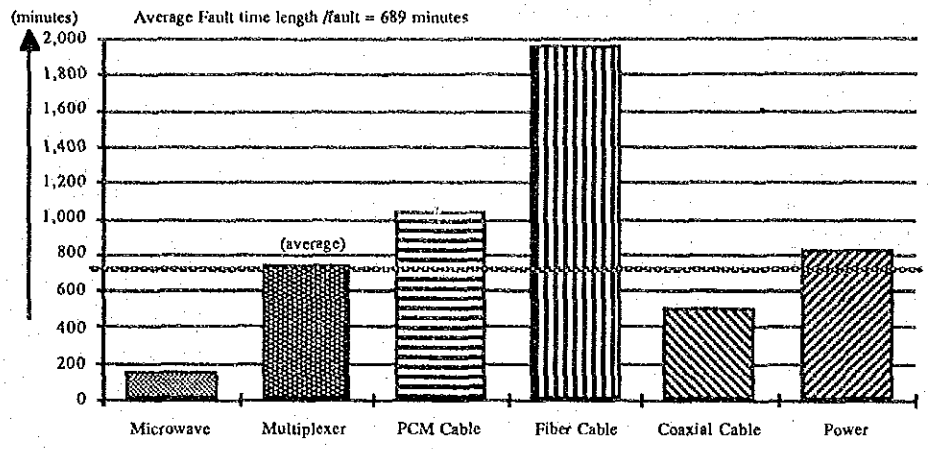


Figure 2.4.3-2 Fault Hours of Each Equipment (November 1991 & February 1992)

2.4.4 Lease Line Testing System (LLTS)

The work flow of the LLTS has been described in the main text. The concept of the function is described in this section.

Required Main Function

1) Subscriber Line Test

This equipment is required to provide the following function for testing subscriber lines.

- insulation resistance
- loop resistance of the subscriber line
- transmission loss of the subscriber line
- Noise

2) Transmission Link Test

This equipment is required to provide the following function for testing transmission links.

- transmission loss of the subscriber line
- Noise

- attenuation of transmission frequency
- quantizing noise
- error bit ratio

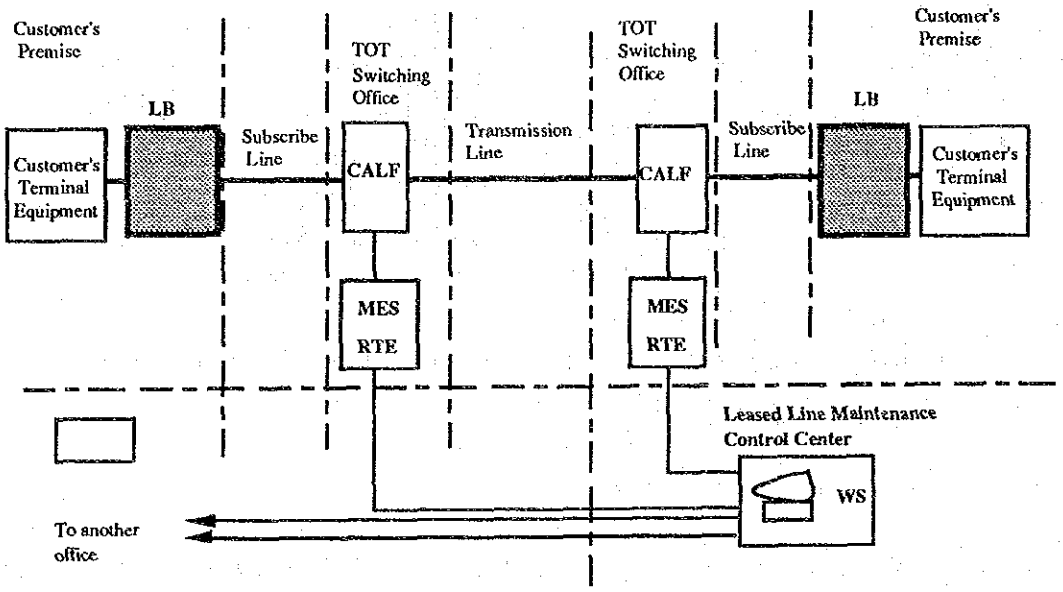


Figure 2.4.4-1 Configuration of LLTS

2.4.5 Loop-back Devise (LLTS)

The configuration of a loop-back device is shown in Figure 2.3.3. Functions of the loop-back device is as follows.

1) Normal Time

In the normal time, the relays in the devices do not work. Contact points of the relays are separated so that the leased lines are connected to customer terminal equipment. The relays in the leased lines do not disturb the transmitting the communications of the leased lines.

2) Testing Time

The RTE adds DC voltage to a sending line so that the relays work after the CADF connects the RTE to a leased line. Contact points of the relays, therefore, are connected

to "on" position by the relay work. Both sending line and receive lines make up loop-back in the customer side.

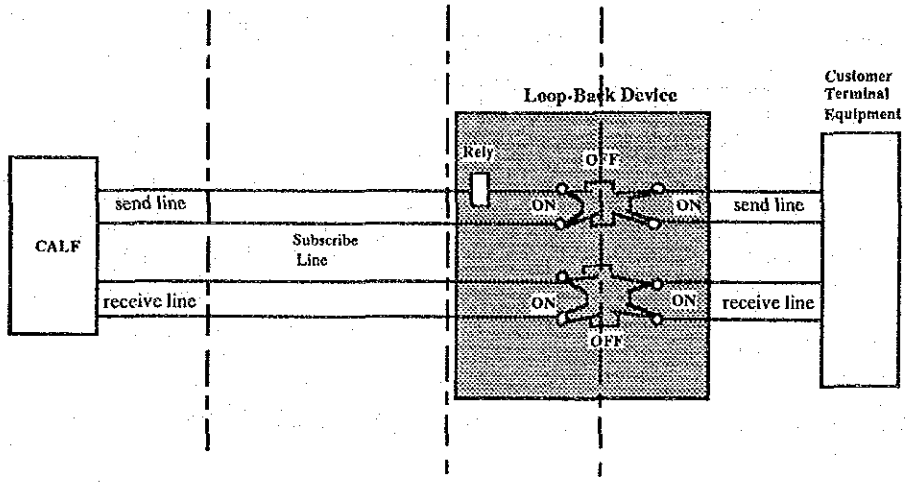


Figure 2.4.4-2 Function of Loop-back Device

2.4.6 Definition of Extraordinary Fault

This section defines extraordinary faults. It shows how NTT manages the extraordinary faults in disasters, abnormal traffic congestion and big subscriber faults. The following description is arranged from the regulation related extraordinary faults in NTT. The necessary explanation and definition are attached to each term, however, they are neglected in the description below.

1) Definition of the Extraordinary Fault

Faults that are treated as extraordinary faults are shown in Table 2.4.4-1.

Table 2.4.4-1 Definition of Extraordinary Fault

Magnitude of the Fault \ The Service Degradation	Large Scale	Small Scale
Large Scale	Magnitude (A class, B class, Semi A class, Semi B class)	Questionable to be an extra ordinary fault (informed to the head quarters or regional offices).
Small Scale	Faults defined to be informed to the head quarters or regional offices.	

Note; 1. Faults in the bold block are treated as extraordinary fault.
2. Normal fault is defined that can clearly be recognized from the extraordinary fault in first stage.

2) Fault to be Reported to the Head Quarter and the Regional Offices

a) To be Reported to the Head Quarter

i) A class fault.
ii) Semi-A class fault.
iii) Fault defined to be informed to the head quarter.

b) To be Reported to the Regional Offices

i) Faults selected in 4.2.1.
ii) B class fault.
iii) Semi-B class fault.
iv) Fault defined to be informed to the regional offices.

3) Contents of the Extraordinary Fault (Arrangement)

Some examples of the extraordinary faults defined in NTT are shown Table 2.4.4-2.

Table 2.4.4-2 Contents of Extraordinary Fault in NTT

A Class Fault	B Class Fault	Remarks
A-1 (1) Exceeding 1,000 subscribers are unable to make calls or take calls in one switching area. (2) Incoming and outgoing traffic is stopped by fault down of common control system in all units in a local tandem switching office. Note: 1. Incoming and outgoing traffic is stopped because of traffic congestion in trunk circuits, traffic congestion in the switching facility and abnormal traffic and extraordinary congestion. 2. Extraordinary congestion occurs by disasters and abnormal situation in the society.	B-1 (1) Exceeding 500 but less than 1,000 subscribers are unable to make calls or take calls in one switching area. (2) All subscribers in one switching office that accommodates less than 500 subscribers are unable to communicate with each other. (3) A Remote Switching Unit that accommodates more than 500 subscribers is unable to communicate with its the main switching unit.	Exceed 30 minutes
A-2 (1) Exceeding 1,000 subscribers in one switching office are unable to communicate with subscribers in another areas.	B-2 (1) Exceeding 500 but less than 1,000 subscribers are unable to communicate with subscribers in another area. (2) One switching office that accommodates less than 500 subscribers become isolated from another switching offices by incoming and outgoing traffic being stopped.	Exceed 30 minutes
A-3 (1) A PC (SC, TC) transit switching is unable to communicate with another offices by fault down of common control system in all units in the office.	B-3 (1) All direct circuits in a PC (SC, TC) office become faulted own.	Exceed 30 minutes
A-6 (Television program relay service) (1) Sending program of another company by miss operation. (2) Fault in the relay service except (1).		Exceed 3 minutes Exceed 10 minutes
(Faults defined to be informed to the head quarters or regional offices) (1) A system fault in a transmission route that is classified to the first route and second route.	(1) A fault that exceeds 300 circuits in a junction transmission route. (2) A system fault in a transmission route that is classified to the third and fourth route.	Exceed 60 minutes
(Faults defined to be informed to the head quarters or regional offices) (1) Big data communication system to which NTT directly offers the maintenance in the nation wide area. (2) Fault in big pilot number of subscribers such as governmental offices, public offices, public safety offices, etc. (3) Broad band leased line (48 kHz, 240 kHz) used in transmitting newspaper. (4) Fault of telephones for police, fire and ambulance use.	(1) A data communication system to which NTT directly offers the maintenance service in the regional area. (2) Fault in big pilot number customers except that is reported to the head quarters. (3) Broad band leased line (12 kHz) used by government offices. (4) Fault in radio broad casting program relay service.	Exceed 30 minutes Exceed 30 minutes Exceed 30 minutes Exceed 30 minutes

2.5 Operation and Maintenance

Enhancement of the customer services quality has become more important not only in improving facility fault ratio but also in establishing of suitable maintenance system for reducing the fault ratio. Hence, a primary focus will be on improvement of a fault repair system in the "Outside Plant Maintenance" section, "Switching Maintenance" section and "Transmission Maintenance" section.

2.5.1 Present State

1) Outside Plant Maintenance Section

a) Organization Structures for Fault Repair

Figure 2.5.1-1 and 2.5.1-2 show the present organization of the outside plant maintenance field in TOT. However, at present TOT has a reorganization plan in this study area for the purpose of decentralization to enhance the customer services quality.

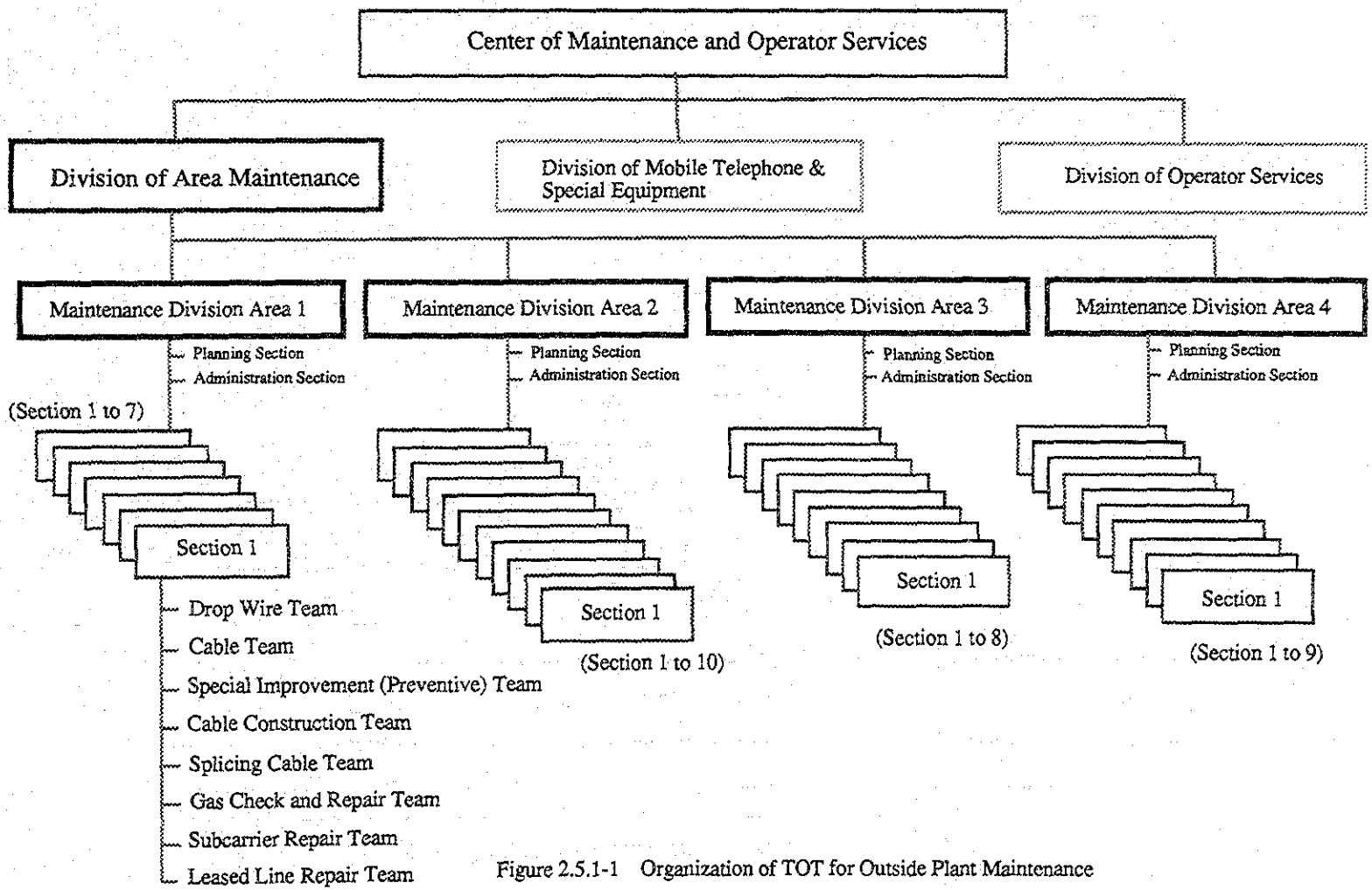


Figure 2.5.1-1 Organization of TOT for Outside Plant Maintenance

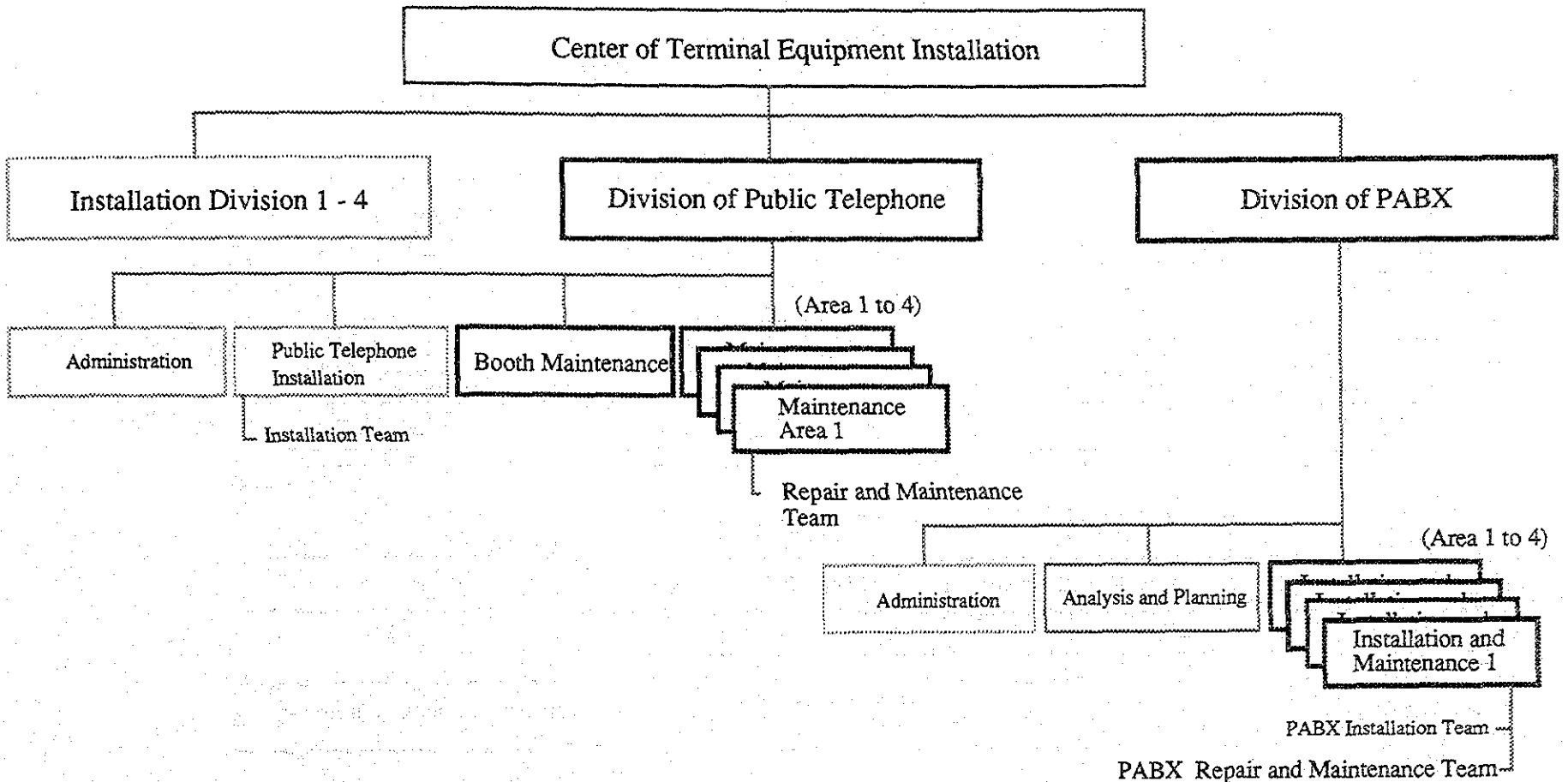


Figure 2.5.1-2 Organization Chart of Public Telephone and PABX Field

b) Job Description for Fault Repair

i) Division of Area Maintenance

The job description in the division of area maintenance is as follows.

- Planning and work performance analysis section is responsible for:
  - analyzing & checking maintenance performance,
  - coordinating with other work units,
  - making maintenance plans,
  - work estimation to prepare personnel, vehicle equipment, work place and other demands concerned with budget on the basis of production standard.

- Maintenance section is responsible for:
  - repair follow-ups and control,
  - articles using control,
  - coordinating with other work units concerned about network adjustment,
  - network adjustment and design, and making work other in case of emergency,
  - network construction as designed in above,
  - field maintenance,
  - leased lines repairing.

- Vehicle section is responsible for:
  - financial and budgetary management,
  - vehicle management,
  - accident management,
  - minor repairing and spare parts management,
  - vehicles using control.

- Complaint service section is responsible for:
  - complaint receiving, testing and informing maintenance teams to correct faults,
  - follow-up correction faults and informing subscribers when it will be effective in use, or that it takes irregularly too much time for repairing,

- collecting, summarizing and analyzing maintenance performance data.

ii) Maintenance Section

The main job description in the maintenance section (end office) is as follows.

- maintaining PCM, cables, gas pressurization equipment cable terminals and drop wires,
- faults repairing as complaints repeat,
- adjusting and checking drop wires, cable terminals, cables which cause faults,
- procuring and controlling the use of articles,
- making work orders for network adjustment.

- Drop wire maintenance teams are responsible for:
  - drop wire and telephone station repairs,
  - connecting drop wires to the cables terminals,
  - collecting information to adjust drop wire,
  - reporting repair performance.

- Cable maintenance teams are responsible for:
  - cable repairing,
  - holding cable terminals additionally to reduce drop wire faults or installing drop wires,
  - cable installation to reduce fault,
  - cutting over and cable transfer coordinating,
  - work performance report.

- Gas work teams are responsible for:
  - gas pressurization checking,
  - analyzing to find out leaks,
  - gas pressurized cable history management.

c) Charge of the Works for Fault Repairs in the Local Networks

Figure 2.5.1-3 shows the charge of works for fault repairs in the local networks.

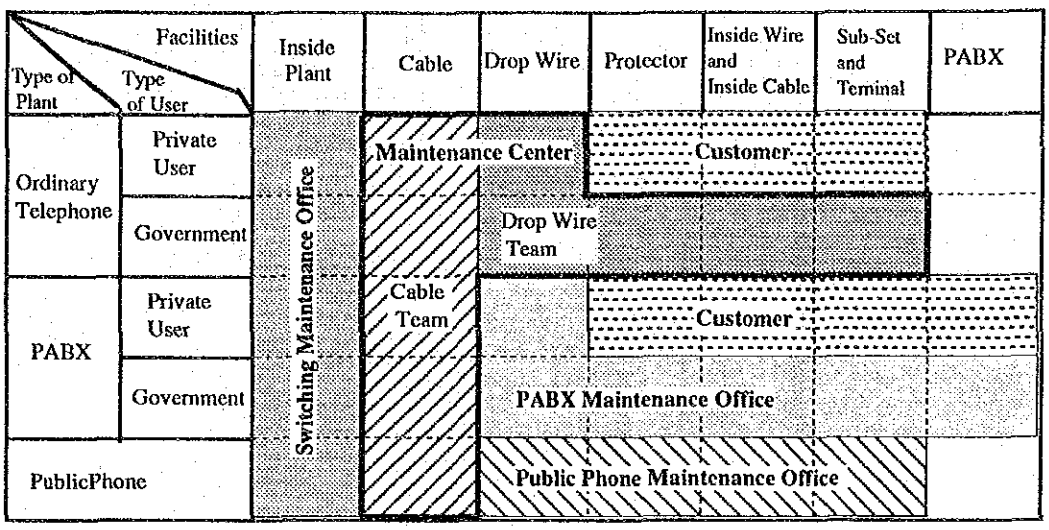


Figure 2.5.1-3 Charge of Work for Fault Repair in Local Network

As mentioned above, the charge of the work for fault repairs in the local networks mainly is divided into 6 groups. First is the "Switching Maintenance Group". Second is the "Drop Wire Group" in outside plant maintenance field. Third is the "Cable Maintenance Group" in outside plant maintenance field. Forth is the "PABX Maintenance Group". Fifth is the "Public Telephone Maintenance Group". The last is the "Customer". Customer means if a fault occurs at a protector point, inside wire (cable), terminal, responsibility of the fault repair rests on the customer side.

d) Planning Flow for Maintenance in Outside Plant Field

Figure 2.5.1-4 shows a planning flow for maintenance in the outside plant field. The work flow for the rehabilitation and the preventive plans is as follows.

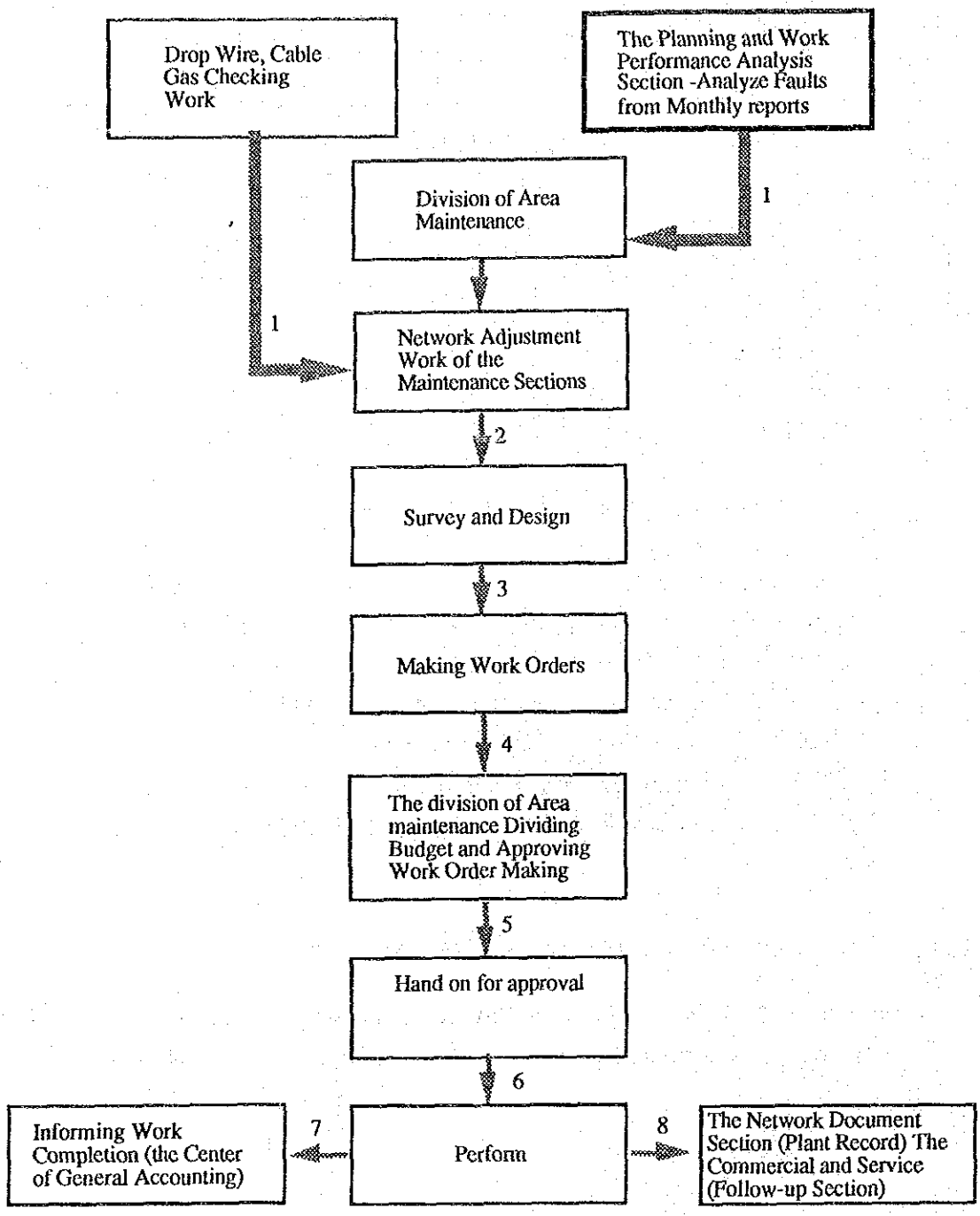


Figure 2.5.1-4 Planning Flow for Maintenance

The maintenance performance is informed by the "Monthly Maintenance Report". The report is a TOT official report. The fault data is originally based on complaint records in the 17 complaint centers.

When the section makes rehabilitation and preventive plans, it is not clear what data the section plan is based in. These plans can be made on the basis of the Monthly Maintenance Reports. However, the Monthly Maintenance Reports do not analyze the maintenance performance. They inform no more than a fault history of each fault.

e) The Standard Number of Teams and Employees of TOT for Fault Repairs

The standard number of teams and employees for fault repairs in TOT is as follows. The important thing is to understand a standard of TOT staff allocation to grasp the fault repair system.

i) Drop Wire Repair Team

A drop wire repair job in TOT is dealt by two persons. They are a technician and a worker. The standard for team allocation is as follows.

$$L\ (4{,}400) = \frac{C \cdot D \cdot W}{F}$$

where

L: Number of connected lines for maintenance per team
C: Number of basic connected lines for setting a fault target, 1000 assumed
D: Number of repairs in a day, 10 assumed
W: Working days in a month, 22 days assumed
F: Number of target fault per 1000 connected lines in TOT, 50 in a month assumed

ii) Cable Repair Team

A cable repair job in TOT is dealt by three persons. They are two technicians (chief and assistant) and a worker. The standard for team allocation is as follows.

$$L\ (8{,}250) = \frac{C \cdot D \cdot W}{F}$$

where

L: Number of connected lines for maintenance per team
C: Number of basic connected lines for setting a fault target, 1000 assumed
D: Number of repairs in a day, 3 assumed
W: Working days in a month, 22 days assumed

F: Number of target faults per 1000 connected lines in TOT, 8 in a month assumed

iii) Special Improvement (Preventive) Team

A preventive job in TOT is dealt by five persons. They are two technicians (chief and assistant) and three workers. TOT allocates one team to each section.

iv) Cable Construction Team

A construction job in TOT is dealt by seven persons. They are two technicians (chief and assistant), four workers and a driver. TOT allocates one team to each of two sections. They usually work with splicing cable teams.

v) Splicing Cable Team

A splicing cable job in TOT is dealt by five persons. They are two technicians (chief and assistant), and three workers. TOT allocates one team to each of two sections. They usually work with cable construction team.

vi) Gas Check and Repair Team

A gas check and its repair job in TOT is dealt by five persons. They are two technicians (chief and assistant) and three workers. TOT allocates one team to each of one section.

vii) Sub carrier Repair Team

A sub carrier repair job in TOT is dealt by three persons. They are two technicians (chief and assistant) and a worker. TOT allocates one team to each section.

viii) Leased Line Repair Team

A leased line repair job in TOT is dealt by three persons. They are two technicians (chief and assistant) and a worker. TOT allocates one team to each section.

ix) PABX Repair and Maintenance Team

A PABX repair and maintenance job in TOT is dealt by three persons. They are two technicians (chief and assistant) and a worker. The standard for team allocation is as follows.

$$L\ (2{,}200) = \frac{C \cdot D \cdot W}{F}$$

where

L: Number of connected lines for maintenance per team
C: Number of basic connected lines for setting a fault target, 1000 assumed
D: Number of repairs in a day for repair, 5 assumed
W: Working days in a month, 22 days assumed
F: Number of target faults per 1000 connected lines in TOT, 50 in a month assumed

x) Public Telephone Repair and Maintenance Team

A Public telephone repair and maintenance job in TOT is dealt by two persons. They are one technician (chief) and one worker. The standard for team allocation is as follows.

500 Coin Box and 100 Booth per 1 team

xi) Booth Maintenance Team

Only booth maintenance job in TOT is dealt by two persons. They are one technician (chief) and one worker. The standard for team allocation is as follows.

100 Booth per 1 team

f) Complaint Center (17)

The complaint centers belong to the division of area maintenance. The centers receive complaints from customers of each maintenance area. There are four complaint centers (Krung Kasem, Phrakhanong, Thonburi and Laksi) in the BMA.

i) Work Flow

Figure 2.5.1-5 shows work flow in complaint center (17 ABC).

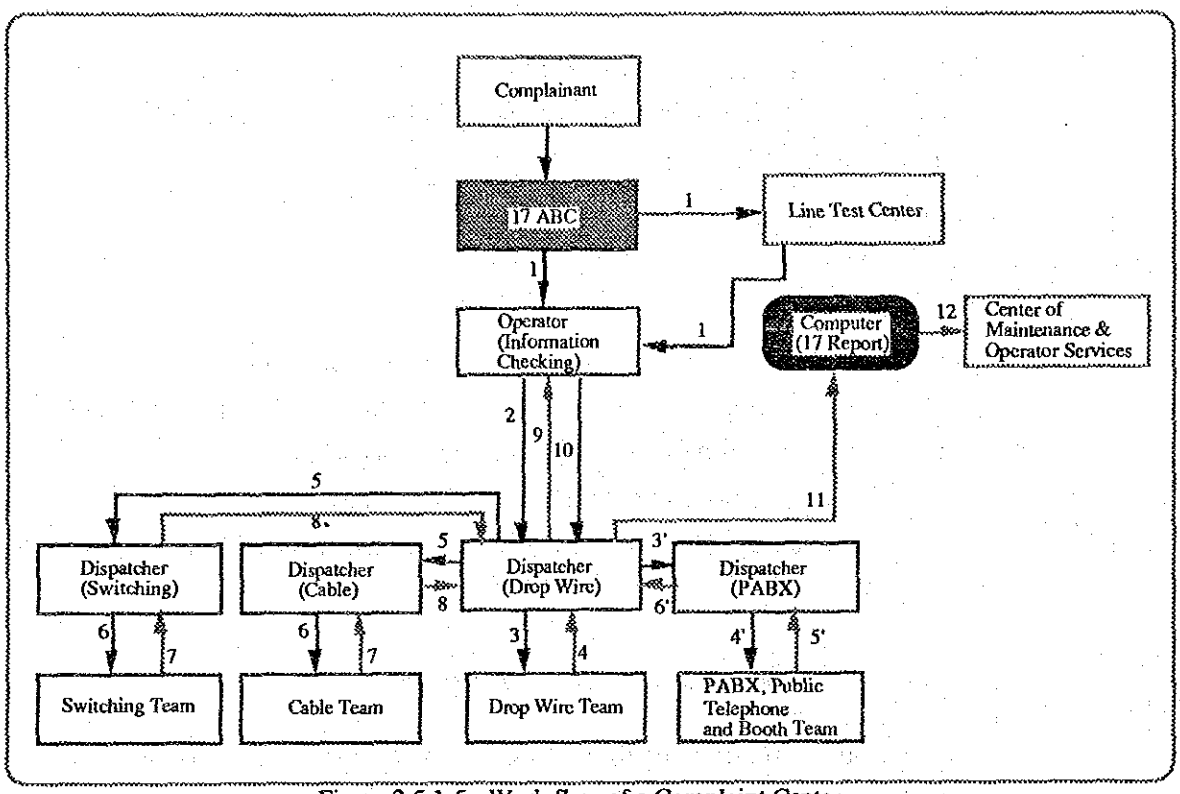


Figure 2.5.1-5 Work flow of a Complaint Center

1. An operator records the fault telephone numbers and characteristics on a complaint card. In case of XB lines, 17 booth is used to test the center-to-test lines and the result is recorded on the card for SPC. The operator sends the card to the line test center to test line conditions. Then, the card is sent to a checking official.

2. He will "cut the card" by sorting out lines of each exchange, cutting out repeated complaints, canceling repair lines due to bill dept., temporality ceasing telephone use, down cable and lines tested good. Then only real fault lines are left. These numbers are sent to a drop wire dispatcher. If its cause is PABX, public telephone and booth, the dispatcher will pass to a PABX dispatcher.

3. Taking out the history card of the fault number, the dispatcher records primary information and the result of the line testing on the history card. It will be then placed on the board in order to be handed out to the drop wire team of the maintenance field concerned.

3' If fault cause is in PABX, public telephone, drop wire dispatcher will pass to PABX dispatcher.

4. After receiving the fault numbers, the team goes out to repair. When the work is completed, the team reports to the dispatcher about the repair result, date and time.

4' The PABX dispatcher sends a PABX and public telephone team.

5. If the drop wire team cannot find the fault within their responsible maintenance area, the drop wire dispatcher transfers the work to the cable or switching dispatcher.

5' The PABX and public telephone team repairs the fault and sends back the result to the PABX dispatcher.

6 The cable or switching dispatcher assigns the work to the cable or switching team to repair.

6' The PABX dispatcher forwards the result to the drop wore dispatcher.

7. If the repair is successful, the team reports the repair result to their dispatcher.

8. The cable or switching dispatcher forwards the result to the drop wire dispatcher.

9. The drop wire dispatcher informs the test desk for a repeating test.

10. The test desk reports the result of the repeating test to the drop wire dispatcher. If it still shows a fault, he sends the card back to the team to repair again.

11. After the dispatcher receives a test OK from the operator (test desk), the dispatcher records fault information and repair performance on the certain form, and sends it to the sector of management information system.

12. The sector of management information system will input the fault data in computer and make a monthly report on maintenance statistics.

ii) Management of Customer Records

At present, management of customer records in the 17 complaint center still depends on manual work. When a staff despatches a repair team, keeps fault history on the customer records, the leading part is paper work. The system cannot correctly reflects official maintenance (fault) performance paper after faults are repaired. Because the maintenance performance report is dealt by computer on the basis of fault information from the 17 center. Actually, the data error rate sent to the computer is very high (about 30%). The cause may be manual management.

g) Environment of Maintenance Activity

i) Labor Productivity

A suitable staff allocation for the fault repair system is an important issue. Because fault repair activities mostly depend on manpower. The establishment of a proper staffing system is indispensable for realizing successful maintenance operations. Even if TOT has a great facility plan and the most advanced facilities, no organization can function without adequate human resources and a maintenance management system.

- Ordinary Telephone

Figures 2.5.1-6 and 2.5.1-7 show the number of connected lines per employee and fault repairs per employee in ordinary fault maintenance field. The maintenance area 1 is the lowest. Especially, the number of faults per employee is significantly different between the maintenance area 4 and the area 1.

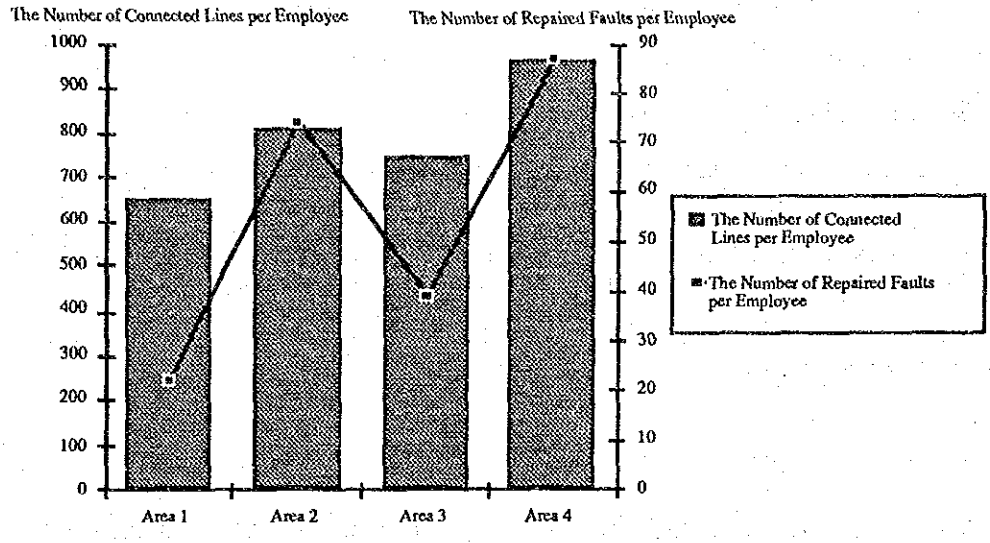


Figure 2.5.1-6 Number of Connected Lines per Employee and Number of Repaired Faults per Employee (Ordinary)

Source: The number of connected lines: Center of Maintenance and Operator Services of TOT, February, 1992

The number of faults: Division of Computer Operations of TOT, August, 1991 to January, 1992

The number of employees: Division of Area Maintenance of TOT, February, 1992

Note: The number of fault is a monthly mean for 6 months

The number of employees is applied to the number of employees engaged in maintenance works except administrators.

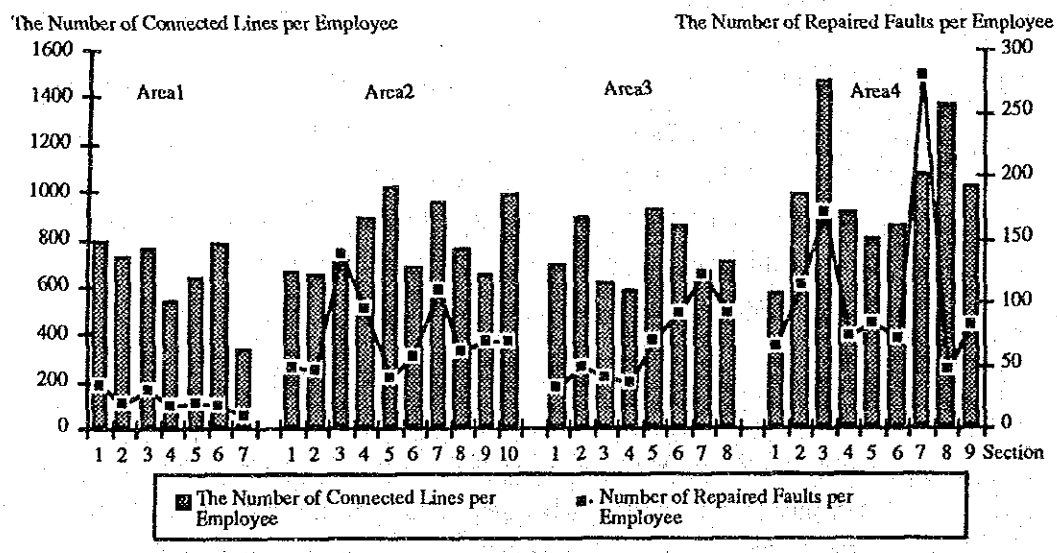


Figure 2.5.1-7 Number of Connected Lines per Employee and Number of Repaired Faults per Employee in each Section (Ordinary)

- PABX Field

Figure 2.5.1-8 shows the number of connected lines per employee and repaired faults per employee in the PABX fault maintenance field. The maintenance area 3 is lower than other areas. Especially, there exist outstanding differences between the maintenance area 3 and the area 4 in the number of faults per employee.

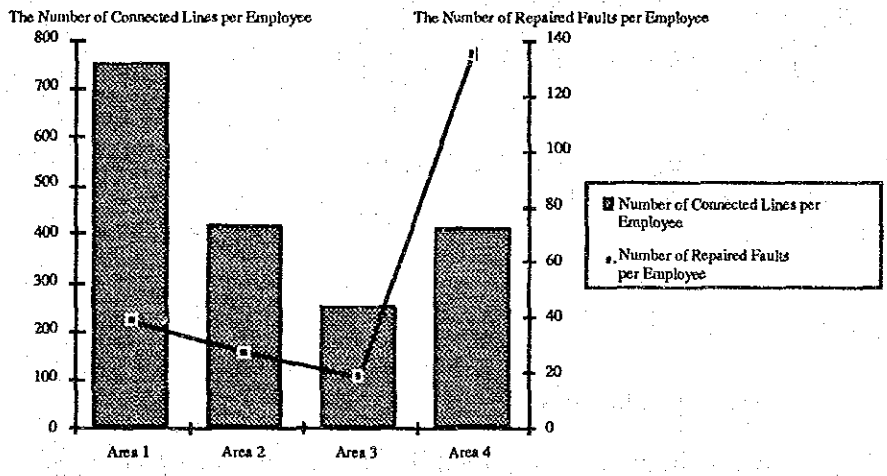


Figure 2.5.1-8 Number of Connected Lines per Employees and Number of Repaired Faults per Employee of each Section (PABX)

Note: The number of employees is applied the number of maintenance employees in Division of PABX

- Public Telephone

Figure 2.5.1-9 shows the number of connected lines per employee and repaired faults per employee in the public telephone maintenance field. Both indexes in the maintenance area 1 are higher than those in other areas.

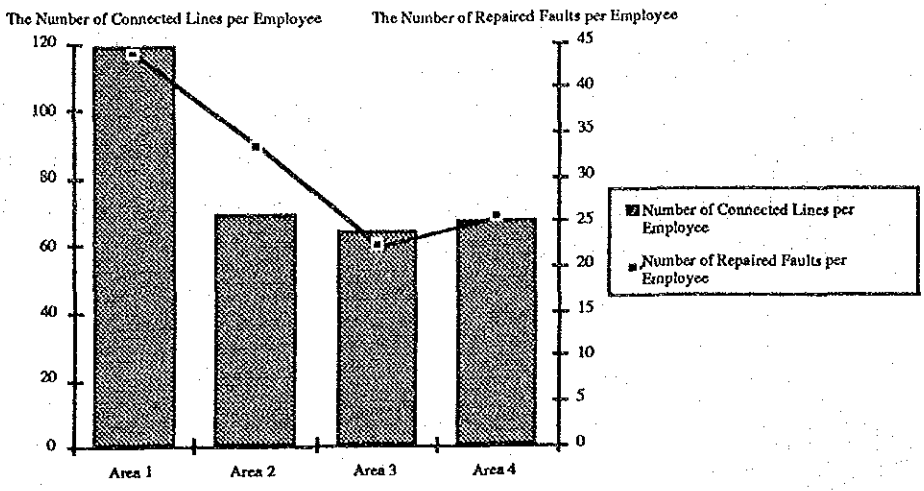


Figure 2.5.1-9 Number of Connected Lines per Employee and Number of Repaired Faults per Employee of each Section (Public Telephone)

ii) Customer Service Situation

- Ordinary Telephone

A very important thing for TOT is to make fault repairing time shorter hour in order to increase the customer service quality. Figures 2.5.1-10 and 2.5.1-11 show required days for recovering faults in the ordinary telephone maintenance field. The rate of fault recovery within one day is about 90% in the BMA. However, the rates in the maintenance area 4 and 1 are lower than other areas. From this situation and Figure 2.5.1-6, the maintenance area 4 does not enough manpower compared with other areas. It becomes more clear from Figure 2.5.1-12.

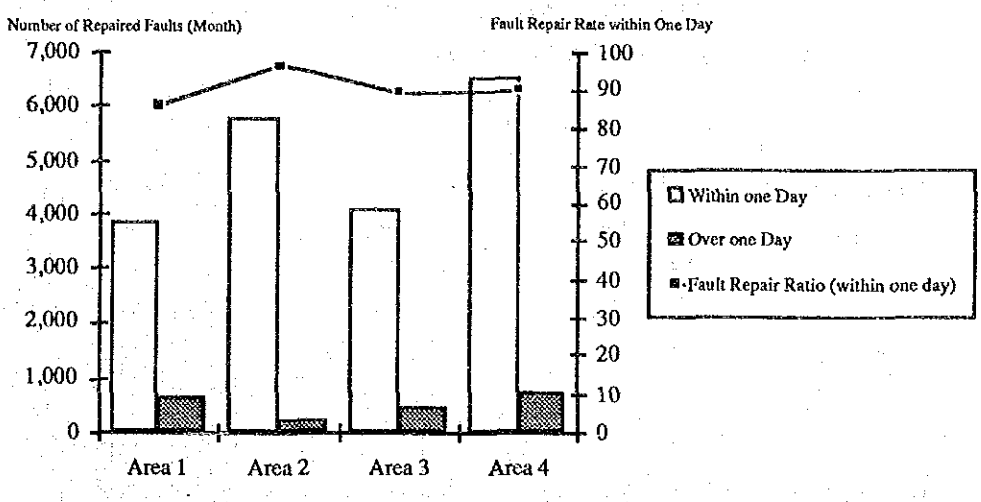


Figure 2.5.1-10 Required Days for Recovering Faults in Each Maintenance Areas (Ordinary)

Source: The days required for fault recovery: Maintenance Monthly Report of TOT, August, 1991 to January, 1992

Note: The days required for fault recovery in TOT is defined as days from receiving a complaint to recovering the fault.

The days required for fault recovery are monthly means of 6 months

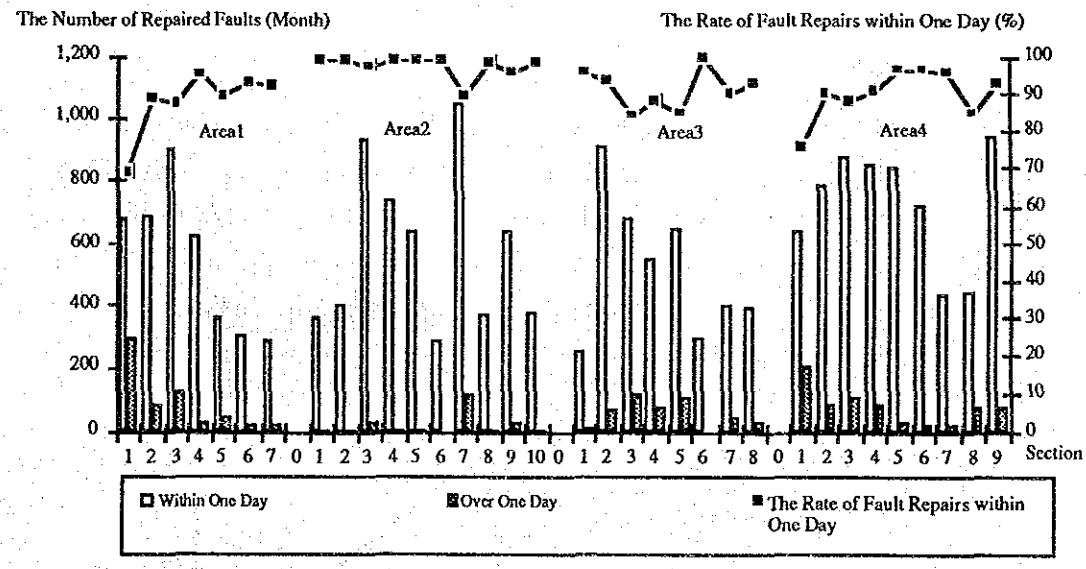


Figure 2.5.1-11 Required Days for Recovering Faults in Each Maintenance Sections (Ordinary)

Figure 2.5.1-12 shows the number of recovered fault within one day per team, and the number of faults for a month. Especially, these exist outstanding differences between the maintenance area 1 and 4 on the viewpoint of the number of recovered faults per team. On the average, the maintenance area 1 has three (3) repaired faults per day, the maintenance

area 4 is about eight (8) repaired faults per day. Labor productivity in the maintenance area 4 is the highest.

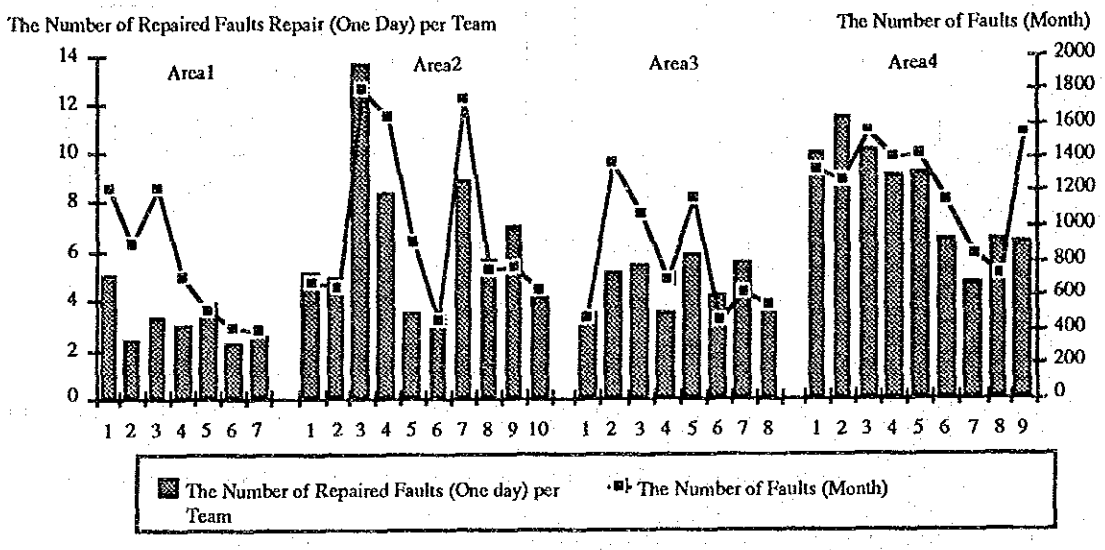


Figure 2.5.1-12 Number of Repaired faults (within One Day) per Team and Number of Faults
Note: The teams are applied the drop wire and cable team for maintenance.

- PABX

Figure 2.5.1-13 shows the required days for recovering faults in the PABX field. The rate of fault recovery within one day is about 70%. The maintenance area 4 is the lowest (about 50%). However, from Figure 2.5.1-8, this area may be in a serious situation for fault repair activities because the number of faults per employee in the maintenance area 4 is higher than other areas.

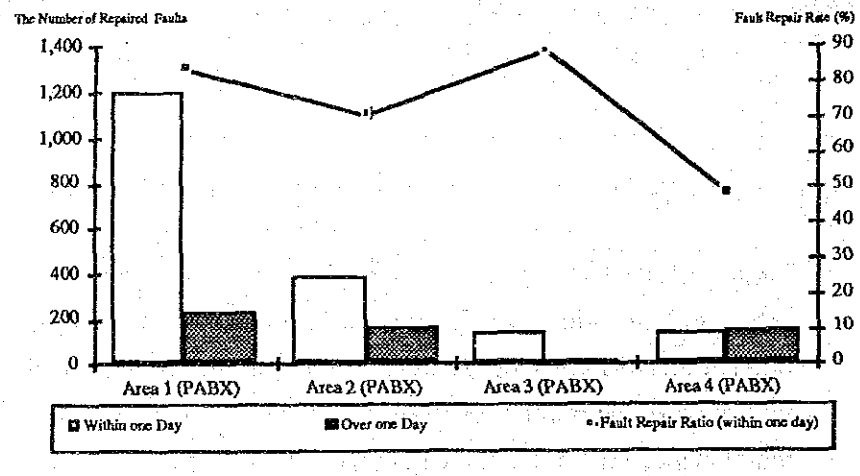


Figure 2.5.1-13 Required Days for Recovering Faults (PABX)

- Public Telephone

Figure 2.5.1-14 shows the required days for recovering faults in the public telephone field. The rate of fault recovery within one day is about 90%. However, the maintenance area 4 is lower than other areas.

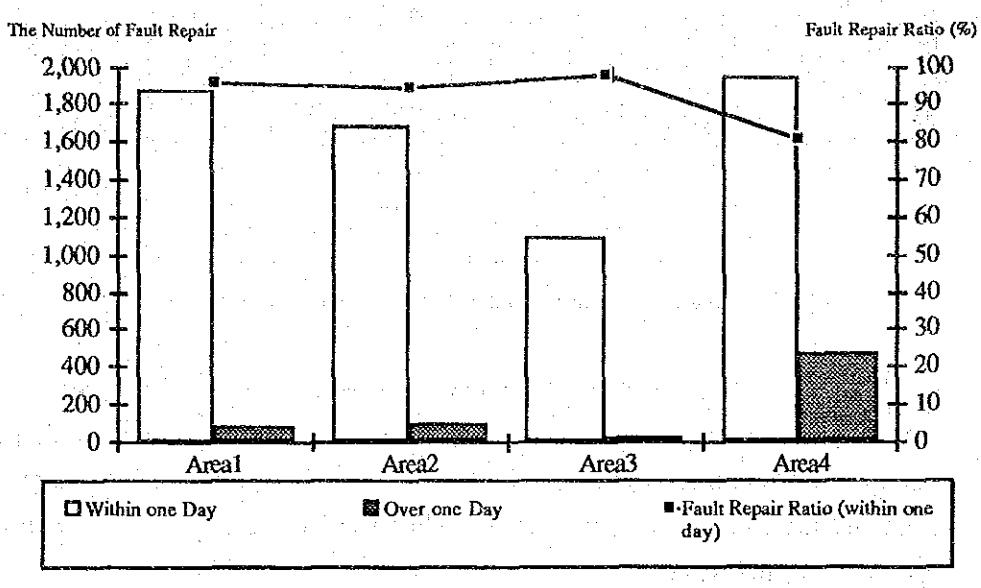


Figure 2.5.1-14 Required Days for Recovering Faults (Public Telephone)

The fault repair activity of public telephone is the most important matter to TOT which has many waiting applicant. The goal of the public utility enterprises is to provide the better quality and sufficient quantity of the services for the nation constantly. If TOT cannot provide same level of services anywhere in the BMA, for inappropriate allocation of the staff, it immediately needs to improve.

h) Status of Dispatches to Customer's Premises

At present, TOT does not repair customer premise such as protectors, inside wires and terminals except government use. Because TOT transferred inside-house facilities (from protector to terminals) to its customers about five (5) years ago. However, when a fault occurs, a drop wire team dispatched to a fault point (see Figure 2.5.1-15). Because TOT cannot distinguish a fault point between TOT side and customer side. The drop wire team moves out to a next repair work place without repairing the fault.

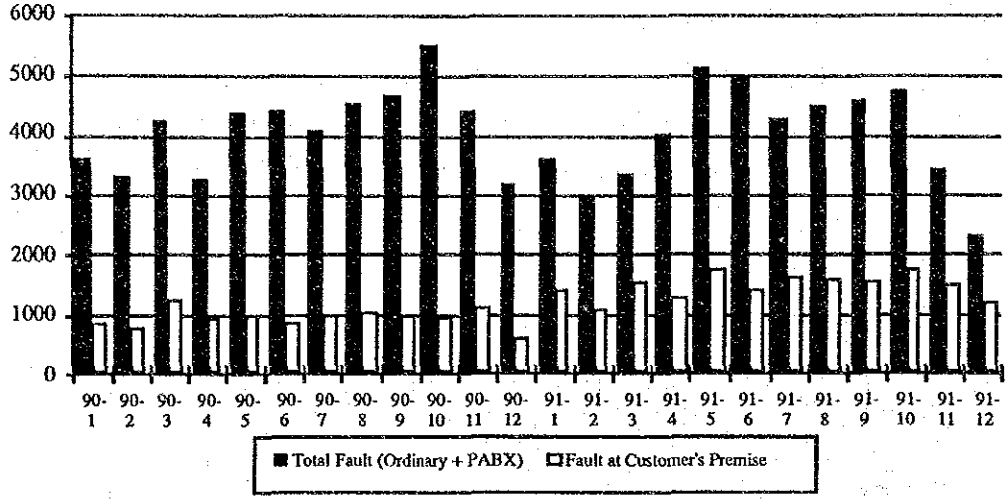


Figure 2.5.1-15 Status of Fault in Customer's Premise (Maintenance Area 1)

The dispatch situation in the maintenance area 1 is shown in Figure 2.5.1-15. Recently, the rate has been gradually increasing. The number of dispatches occupies no less than 30 % in the total number of dispatches. The same can be assumed for other maintenance areas. This needs to be improved to establish an efficient dispatch system.

i) Situation of Materials

The supply-demand situation of spare parts of the outside plant maintenance field is mostly satisfactory except in the public telephone maintenance field.

- Status of Materials Condition in Public Telephone Maintenance Field

There are many broken public telephone sets in the storehouse of the TOT public telephone maintenance office. Because the repair center does not have enough spare parts for repairing, therefore, end offices cannot send them to the repair center.

At present, TOT replaces public telephone sets from Italian-made public telephone sets to Japanese-made public telephone sets in the BMA. However, TOT has not spare parts for the Japanese-made public telephone sets. Because the terms of a contract between TOT and the Japanese-supplier does not include an item about buying spare parts. From this situation, when a public telephone set is broken, TOT cannot help replacing new public telephone sets. It will take longer time to repair them but also cost more for buying new ones.

- Shortage of Delivery System

  In the outside plant maintenance field, when stock of spare parts runs short, repair teams must go to the stock center of TOT to obtain spare parts. This materials management system in TOT is uneconomical and inefficiency in the sense of wasting repair time.

j) Situation of Manpower

During the field survey, the Study Team was told that there were not enough maintenance people in each outside plant section. It was also told that 25% to 50% of the maintenance staffs work overtime on Saturdays and Sundays. On the other hand, they do not work overtime (after 4:00 P.M.) on weekdays.

TOT has a plan to recruit more people than ever before. The two million line expansion project in the BMA are carried out by private sector using BTO method during 1992 to 1996. It can be foreseen that the present work volume of each department in TOT will not increase except the commercial departments (it is not clear whether TOT will take care of the maintenance work of drop wires expanded in the seventh project or the private firm will do it). When the fault ratio will go down after this, the required number of staff for maintenance will also go down.

k) Situation of Working Environment

In order to actively promote improvement of the fault ratio, TOT needs to adopt a policy to improve the working environment. An establishment of safety management must be a key item in promoting the new working environment.

At present, the Department of Human Resource is about to establish this system. A situation of deaths and injures has been reported since last year. The following are the number of casualties on duty in 1991.

The number of people dead	2 people.
The number of people injured	29 people.

2) Switching Section

SPC switches will replace all the existing XB switches before FY 2000. They will gradually enhance the offerings of many kinds of new services. And many hardware functions will be replaced by software. Therefore, skills and knowledge of software will become more important for the fault repair staffs.

a) Organization Structure for Fault Repair

Figure 2.5.1-16 shows the present switching maintenance organization for fault repair.

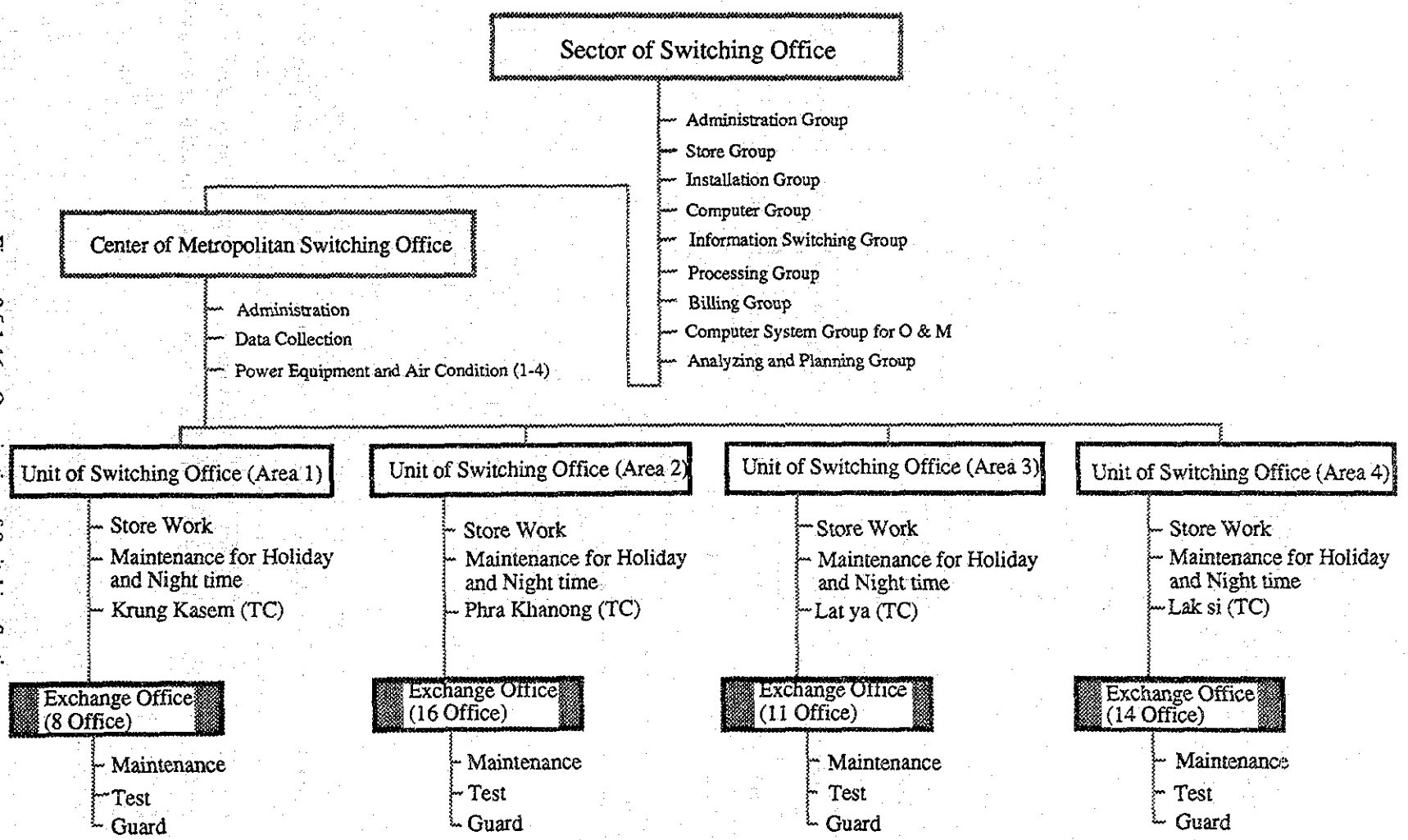


Figure 2.5.1-16 Organization of Switching Section

Figure 2.5.1-16 Organization of Switching Office for Maintenance

b) Job Description for Fault Repair

The job description in the switching maintenance section is shown in Table 2.5.1-1. The authority and responsibility for maintaining the SPC switches have gone down to each exchange (end) office.

Table 2.5.1-1 Work Item for SPC Switches Maintenance

Job Category	Work Item	Exchange Office	Maintenance Center
Alarm Supervision	ALDP / AALP Supervision	0	0
	Autonomous Message Supervision		
Routine Fault Supervision	Autonomous Message Supervision		
	Preventive Routine Test	0	
Subscribers Complaints Treatment	Reception of Complaint Calls and Test	*	*
Routine Maintenance	Routine Inspection of Equipment	0	
Trouble Repair	Trouble Shooting	0	
	Various Replacement Work	0	0
Emergency Processing	Action of System Emergency	0	
Management	File Management	0	
	Spare Part Stock Control	0	0
	Maintenance Statistics	0	

Note: 0 means under operations, * means under preparations

TOT is constructing a decentralized work scheme for enhancing the customer service quality. However, TOT adopts a centralization policy. Because the Study Team did not hear that the switching maintenance section has a concrete centralization plan. The decentralization policy is hopeful to be adopted to the sections which directly contact with customers such as commercial and outside plant sections.

c) Work Flow of Fault Repair Performance

Figure 2.5.1-17 shows a work flow of fault repair performance in the switching field.

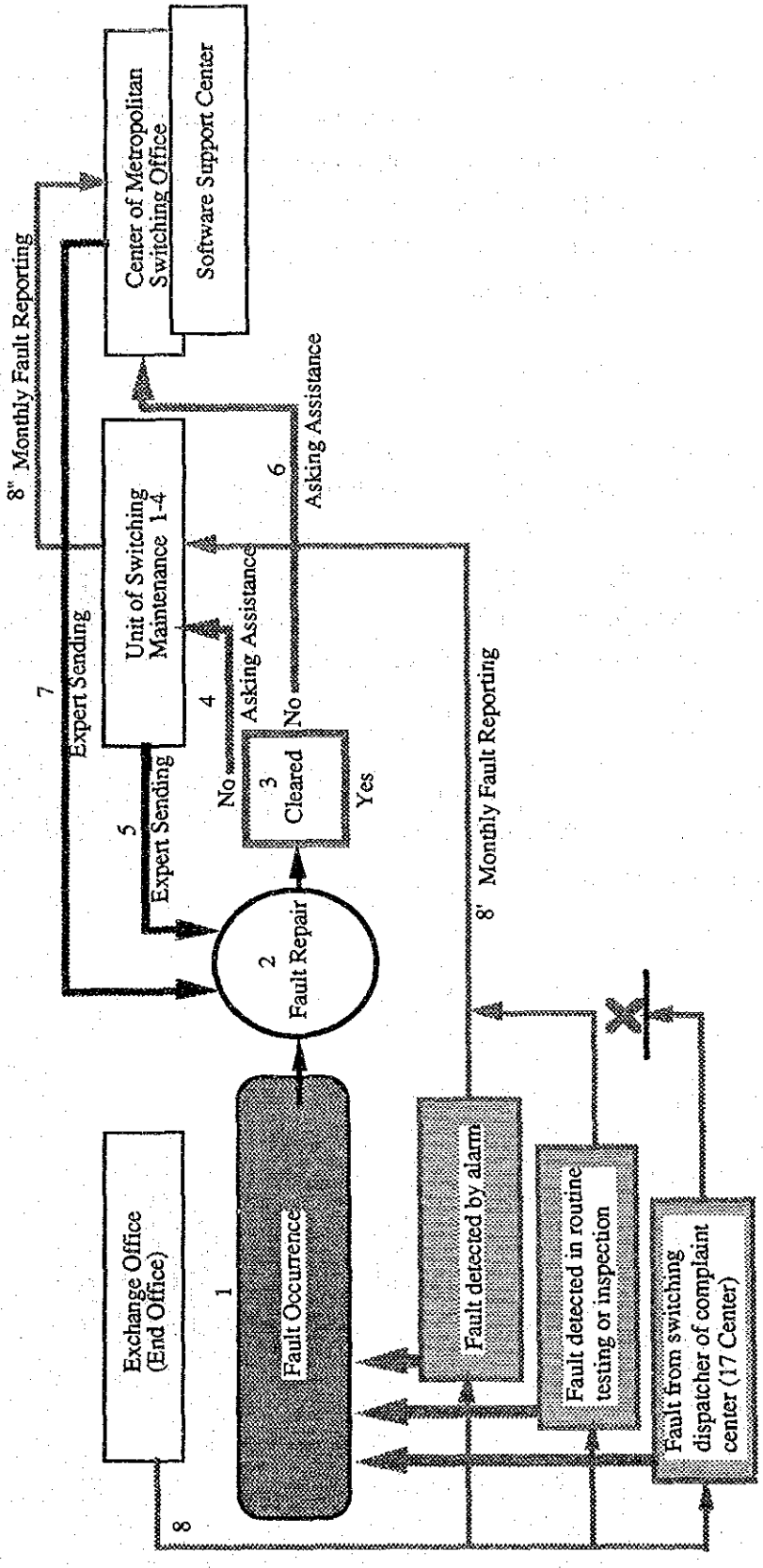


Figure 2.5.1-17 Work Flow for Fault Repair

If the staff of an exchange (end) office cannot recover a fault by themselves, then they ask for a help to the staff of the upper supporting system by phone. However, after recovery, the staff of upper supporting section give little explanation to the end office staff about the repair work (the contents of problem, the cause and recovery method etc.). If the same fault occurs in the exchange office, the staff will not be able to recover the fault again.

d) Maintenance Performance Report

Figure 2.5.1-18 shows a relationship between causes of fault detection and fault reports. The section issues two kind of fault performance reports. One is the "Switching Monthly Report" on the basis of faults detected by alarm (A) and routine test (B). The other is the "Official Monthly Report" of TOT of fault performance based on fault information (C) from the complaint center. A substantial part of the fault repairs in the switching section is shown as Figure 2.5.1-19.

When the section makes a maintenance plan such as a replacement plan, they only use the "Switching Monthly Report". However, no reporting from exchange office is unavailable in this section.

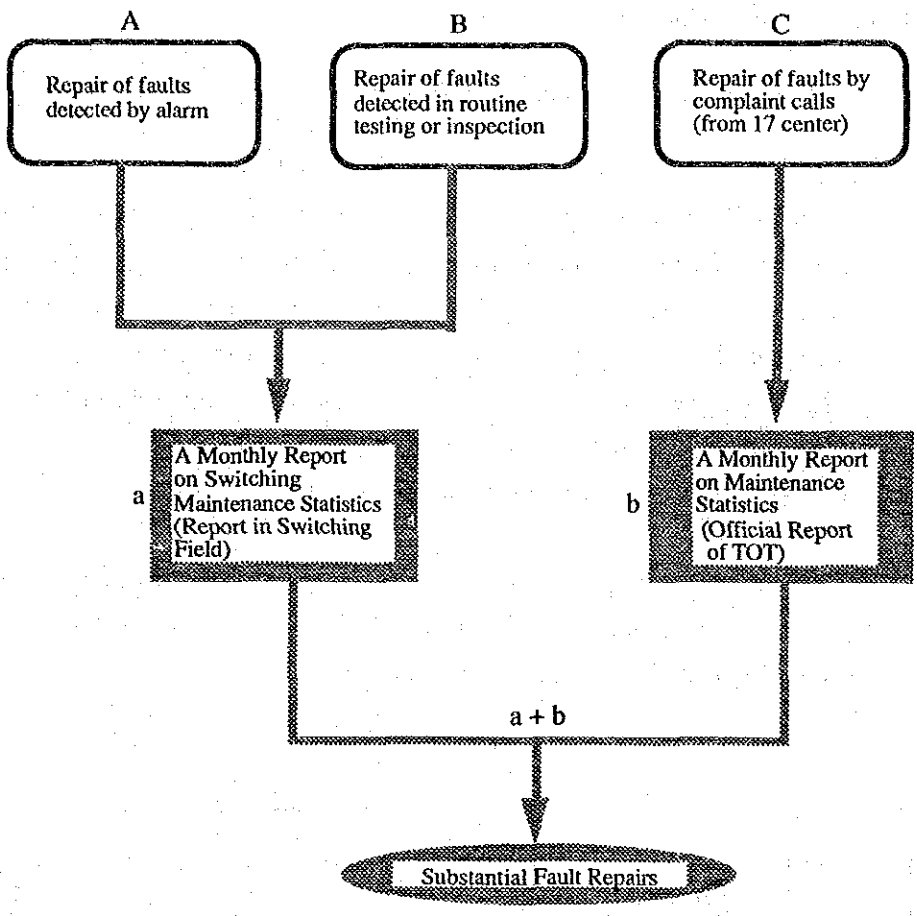


Figure 2.5.1-18 Relationship between Causes of Fault Detection and Fault Reports.

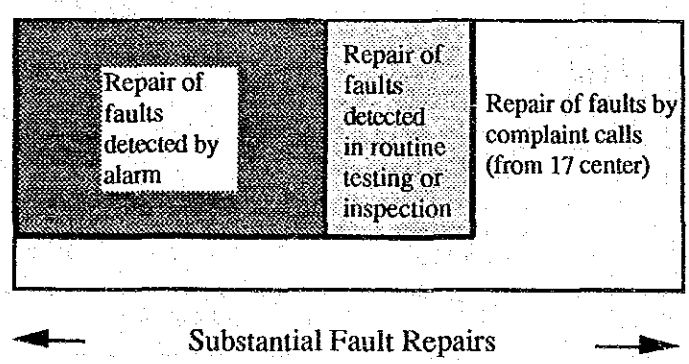


Figure 2.5.1-19 Substantial Fault Repairs

e) Environment of Maintenance Activity

- Number of Faults and Number of Fault Repairs per Employee

Figure 2.5.1-20 shows the number of XB switch faults and the number of fault repairs in XB switches per employee of each exchange office in the BMA. If there are differences the number of fault repairs per employee among the exchange offices, the Study Team cannot correct by improving the staff allocation. Because maintenance systems are different between switching and outside plant sections, the switching section has many routine works such as routine tests. Therefore, the Study Team cannot clearly mention whether imbalance in staffing situation in this section exists or not.

On the other hand, the Study Team is concerned about the clear differences between the maintenance area 1 and other areas. Because the Figure is based on the data in the official monthly maintenance reports.

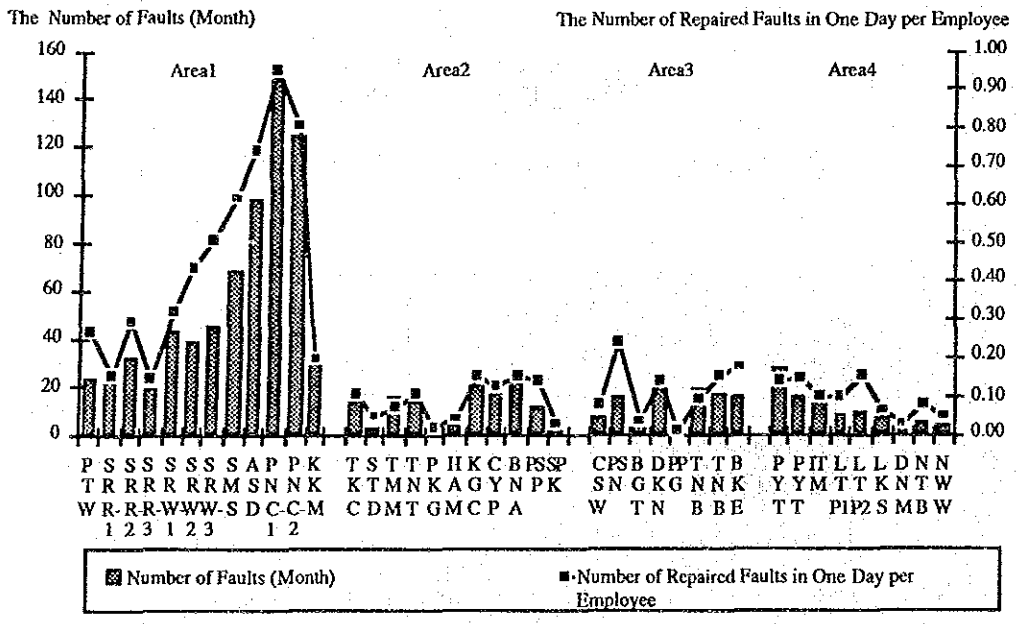


Figure 2.5.1-20 Number of Faults per Employee and Number of Repaired Faults per Employee (XB)

Source: The number of faults: Division of Computer Operations of TOT, November, 1991 to March, 1992

The number of employees: Sector of Switching Office of TOT, 1991

Note: The number of faults is the monthly mean for 5 months.

The number of employees is the number of employees engaged in maintenance work except the employees engaged in administration and operation works

Figure 2.5.1-21 shows the number of the SPC switches faults and the number of SPC switches repaired faults per employee of each exchange offices in the BMA. The difference in the number of repaired faults per employee can be observed again between the area 1 and other areas. Hence, the reporting method between the maintenance area 1 and other areas is doubtful to be the same.

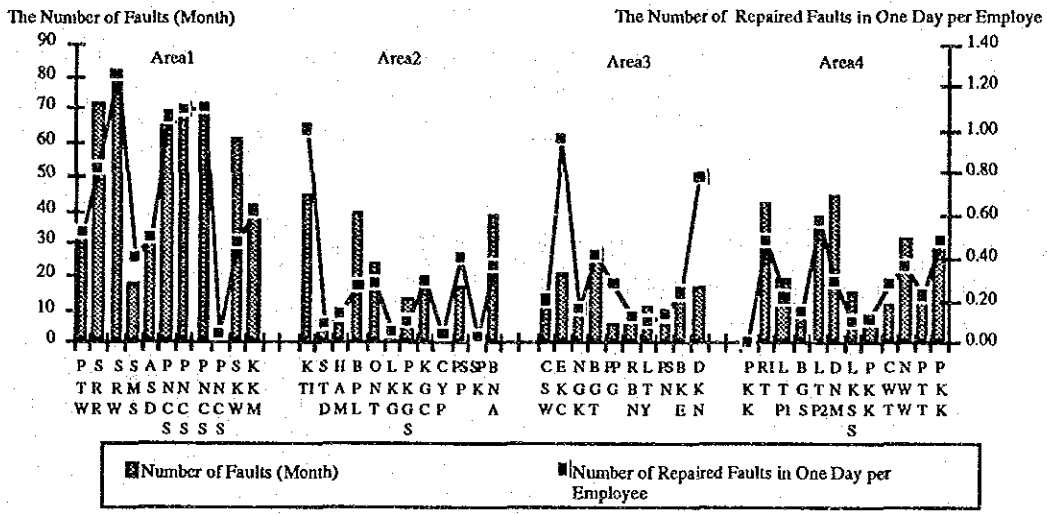


Figure 2.5.1-21 Number of Faults and Repaired Faults per Employee (SPC)

- Required Hours for Recovering Fault

Figures 2.5.1-22 and 2.5.1-23 show the required hours for recovering faults and the percentage shares. It is, on the average, about 15 hours.

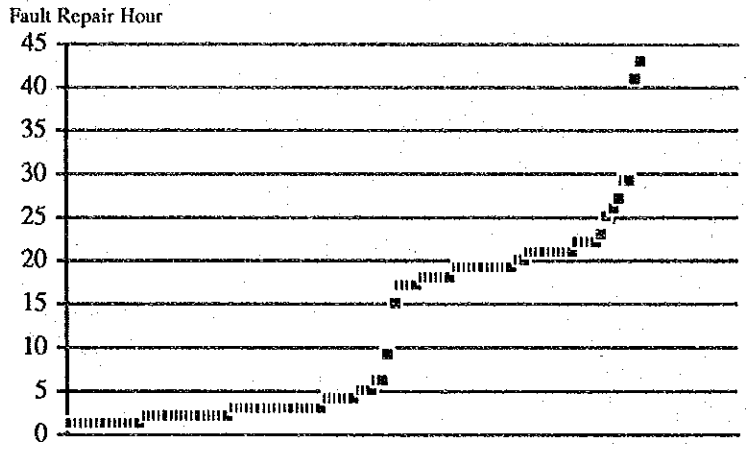


Figure 2.5.1-22 Required Hours for Recovering Faults

Source: Division of Computer Operations of TOT, October, 1991 to March, 1992, KKM area
Note: The number of hours required for fault recovery is the monthly mean of 6 months

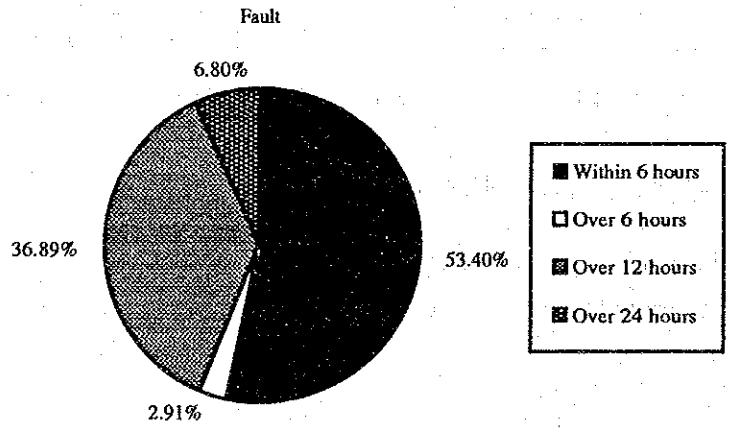


Figure 2.5.1-23 Percentage Shares of Required Hours for Recovering Faults

f) Shortage of Spare Parts for SPC Switches

Most exchange offices are in serious shortage condition for spare parts for the SPC switches. The spare parts (package) are expensive and many in kinds. It is difficult for every exchange office to stock all spare parts. The primary places for keeping the packages are Unit of Switching Office in each maintenance area.

Once a package fault occurs in an exchange office, maintenance staff inquires to Unit of Switching Office and other exchange office by phone. Even Unit of Switching Office does not often stock the required packages.

At present, TOT is making free contracts with its suppliers about procurement of spare parts, TOT said that it takes about 6 months for waiting period from request to receipt. In a sense, it may be unavoidable situation. Because a supplier does not hope to have many stocks. therefore, it can be assumed that they start its production after receiving the order.

There are different management methods about keeping spare part records in exchange offices. Some exchange offices have still taken a manual spare parts records because TOT does not have a standard form for keeping spare parts records.

3) Transmission Section

a) Maintenance Organization

TOT has already reorganized the telecommunications operation in 1991 for providing better telecommunications services to customers as shown in Figure 2.5.1-24.

Employees of the transmission section in the provincial areas belong to the provincial telecommunication center. However, the transmission sector in the Sector of Telecommunication Network supports them from view point of engineering designs and transmission maintenance techniques.

The transmission sector in TOT, therefore, entirely controls the domestic transmission network in the whole kingdom. It seems that this is a better system to offer the telecommunications services in good condition to the customers.

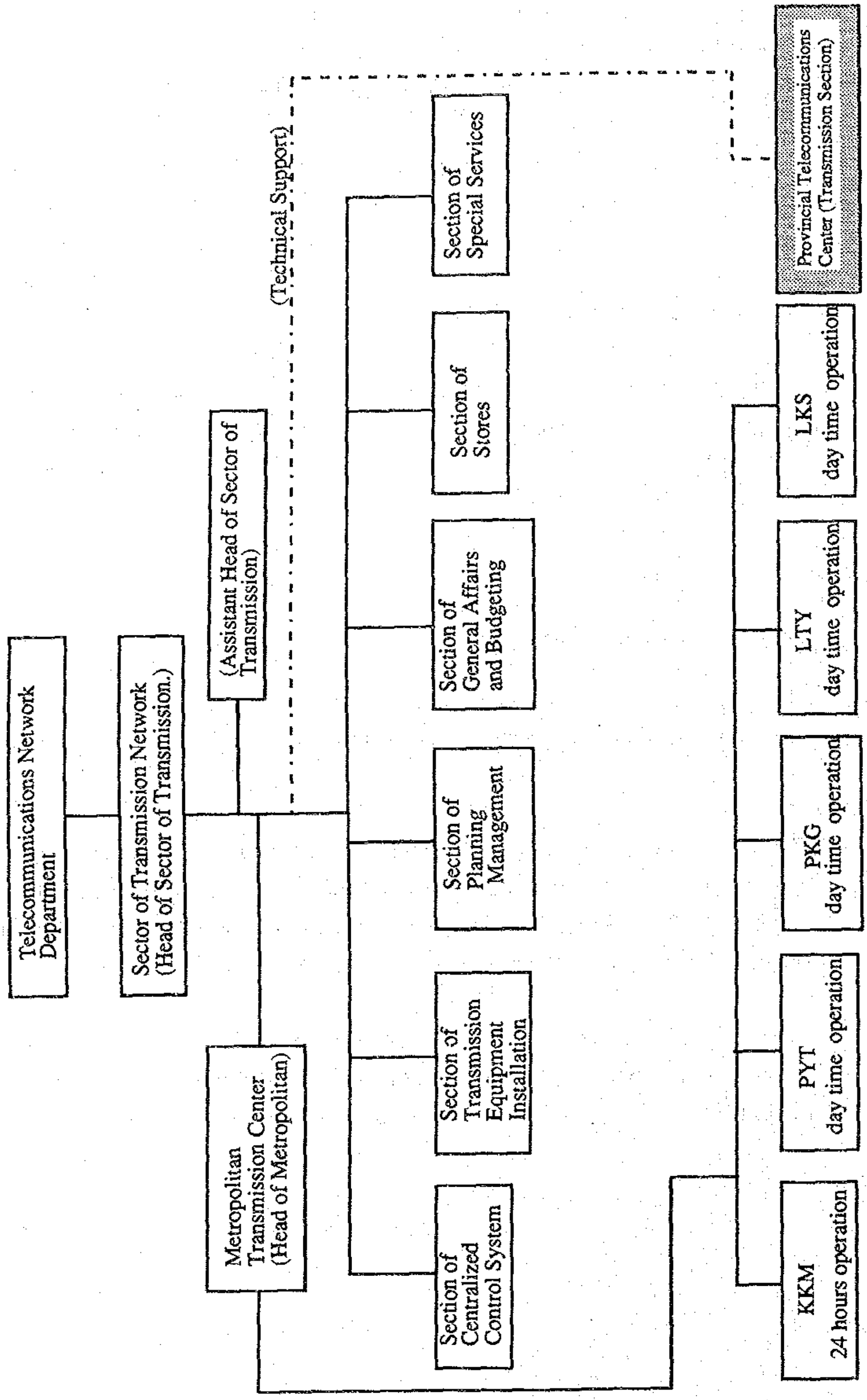


Figure 2.5.1-24 Organization for Transmission Network

b) Maintenance Management Activity

The maintenance management system is explained by the following flow as shown in Figure 2.5.1-25.

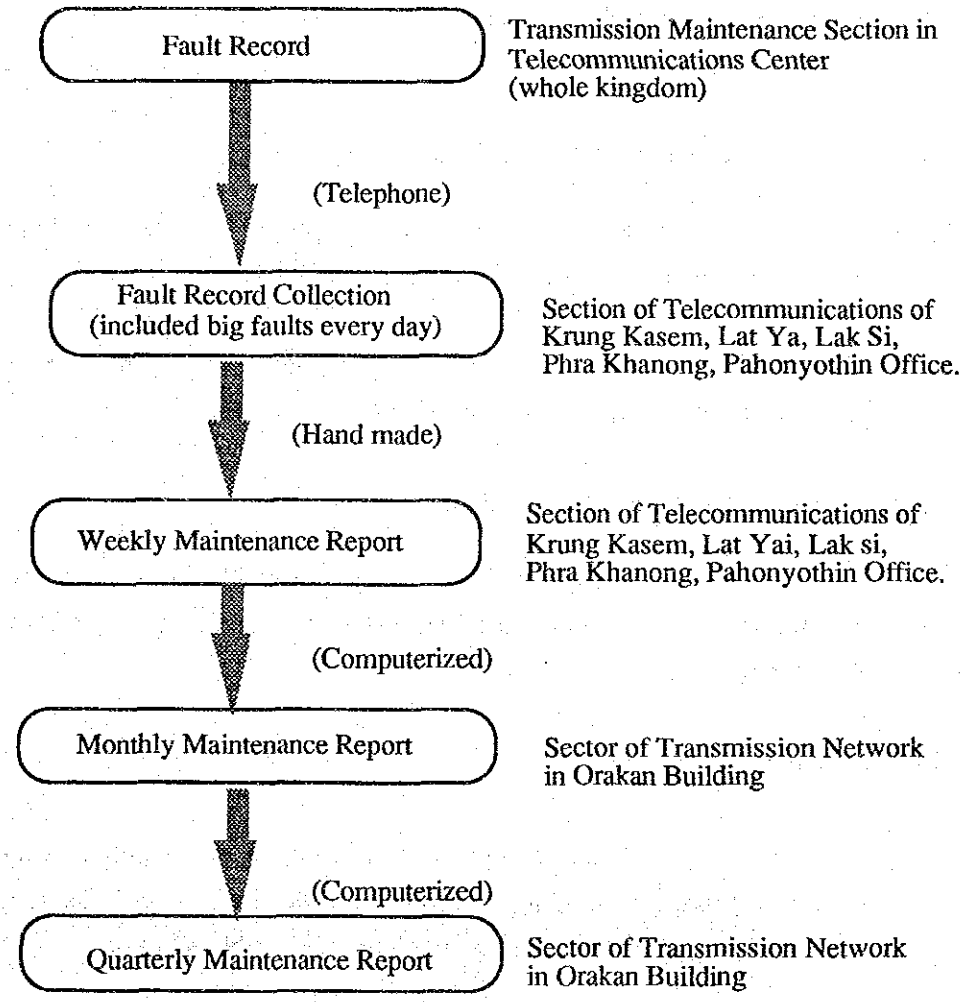


Figure 2.5.1-25 Maintenance Management System

i) Collection of daily fault data

Faults are reported by telephones from all transmission sections every day to the telecommunications maintenance section of the Bangkok Metropolitan maintenance centers. There are four offices in the BMA.

ii) Weekly Maintenance Report

Each maintenance center in the BMA issues a weekly report on the basis of the daily reports once a week. The weekly report is a hand written document.

iii) Monthly Statistic Maintenance Report

The transmission sector issues a monthly report on the basis of the weekly reports sent from each maintenance center in the BMA. The making of this report is computerized.

iv) Quarterly Statistic Management Report

The transmission sector issues a quarterly report on the basis of the monthly reports. The making of this report is computerized.

The monthly reports are used for both maintenance service management and plant control activities of the transmission section in TOT.

c) Quality Test for Trunk Telephone Circuits

i) TOT carries out a quality test for trunk telephone circuits every month by the RAMPART (Remote Automatic Measuring of Performance and Reporting on Trunks) system.

ii) Results of the test are reported in the monthly report.

iii) The installed RAMPART can measure performance of telephone trunk lines such as " Loss, Noise, Normal/ Tone, Gain/Slope". The measurement by RAMPART is carried out during the night time by the operators.

iv) Items of measurement by RAMPART are

- Quality test of long distance telephone circuits and
- Transmission system test.

The Study Team has not confirmed how results of the test are used to upgrade the quality of telecommunications network.

d) Extraordinary Fault Control Activity

When a big trouble occurs in the telecommunications network of TOT, the maintenance staff immediately informs the situation to their superior. This information will go up to the executives of TOT. The subject is the scale of faults. The extraordinary fault information system in TOT is shown in Figure 2.5.1-26. TOT has not defined the extraordinary faults.

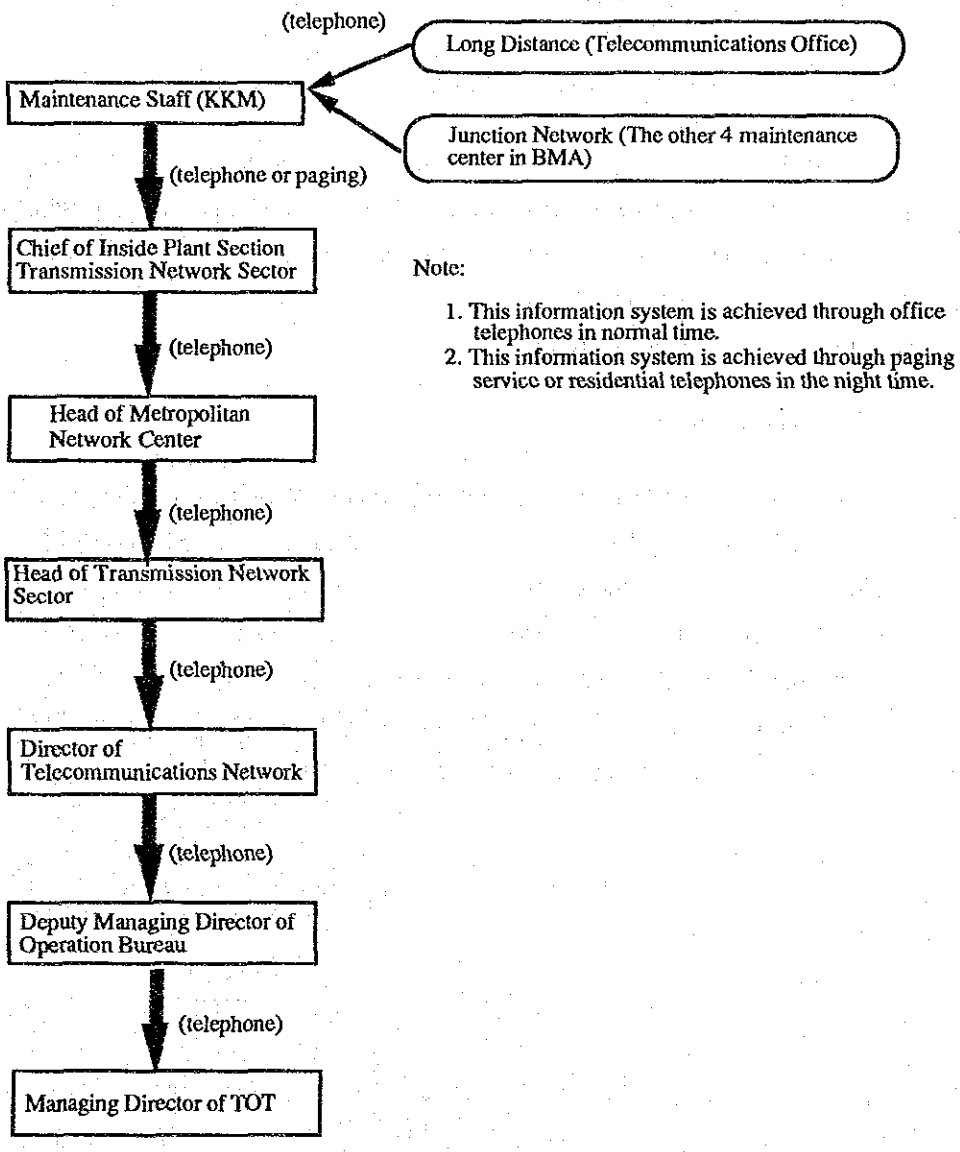


Figure 2.5.1-26 Extraordinary Fault Information System

i) Extraordinary Fault Control

Extraordinary Faults in the transmission network are directory controlled by the network transmission sector through 24 hours. When a big trouble such as a optical fiber cable cut, the transmission sector orders an inspection and a repair to the maintenance sections concerned. It seems that establishment of an emergency control system will be required in the future because troubles in a big telecommunications network will give serious problems to an information intensive society.

ii) Overall Extraordinary Failure Control

Troubles in a transmission network also causes a big congestion problem. The traffic control section must, therefore, always corporate with the transmission network section for operating the network smoothly.

e) Leased Line Maintenance Activity

i) Leased Line Maintenance Organization

TOT has recently established a leased line office to improve the service quality of leased lines. The leased line office controls fault repair works of leased lines. When a trouble occurs in leased lines, a customer complains about the fault to the office. If the office receives a complaint, the staff asks about the troubled line and then simultaneously orders the sections concerned to inspect and repair the fault. The organization of the leased line office is shown in Figure 2.5.1-27 and the work flow chart is shown in Figure 2.5.1-28.

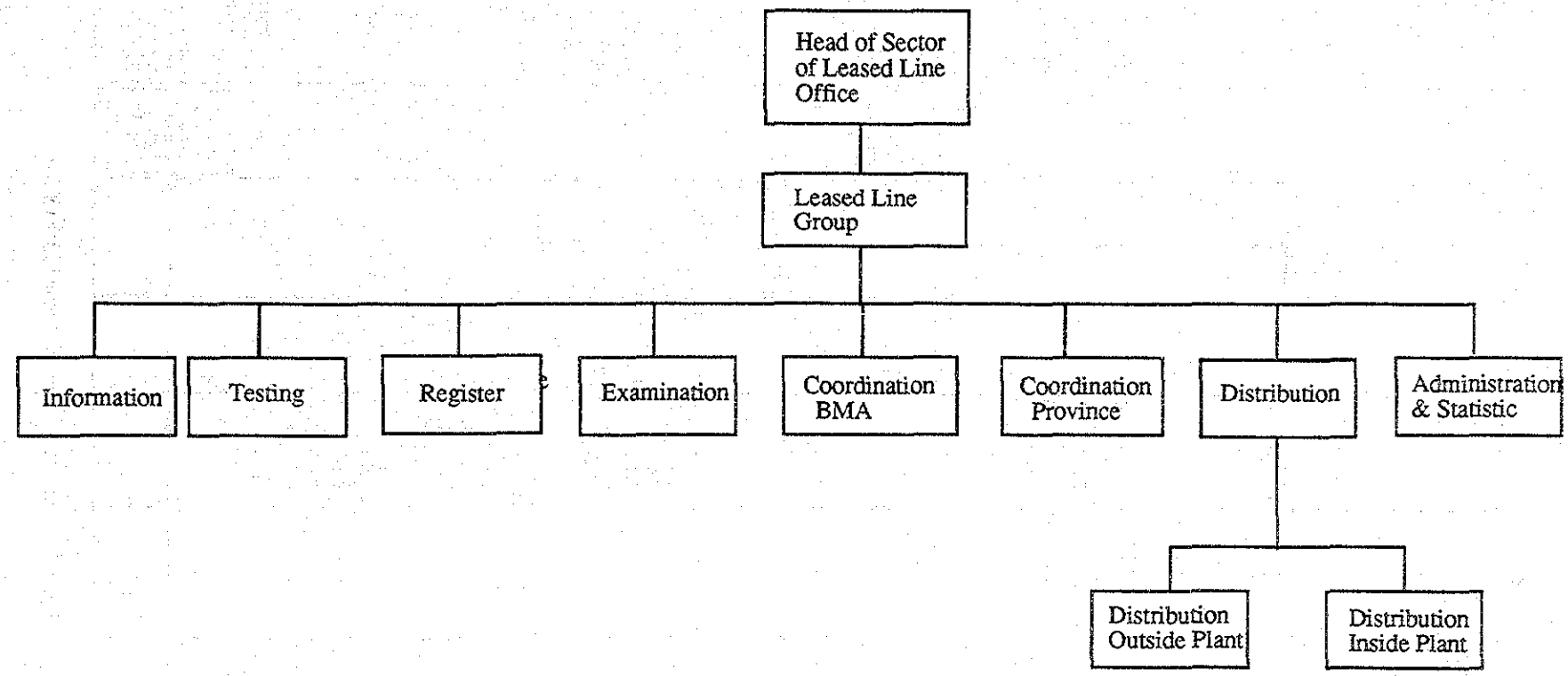


Figure 2.5.1-27 Organization of Leased Line Office

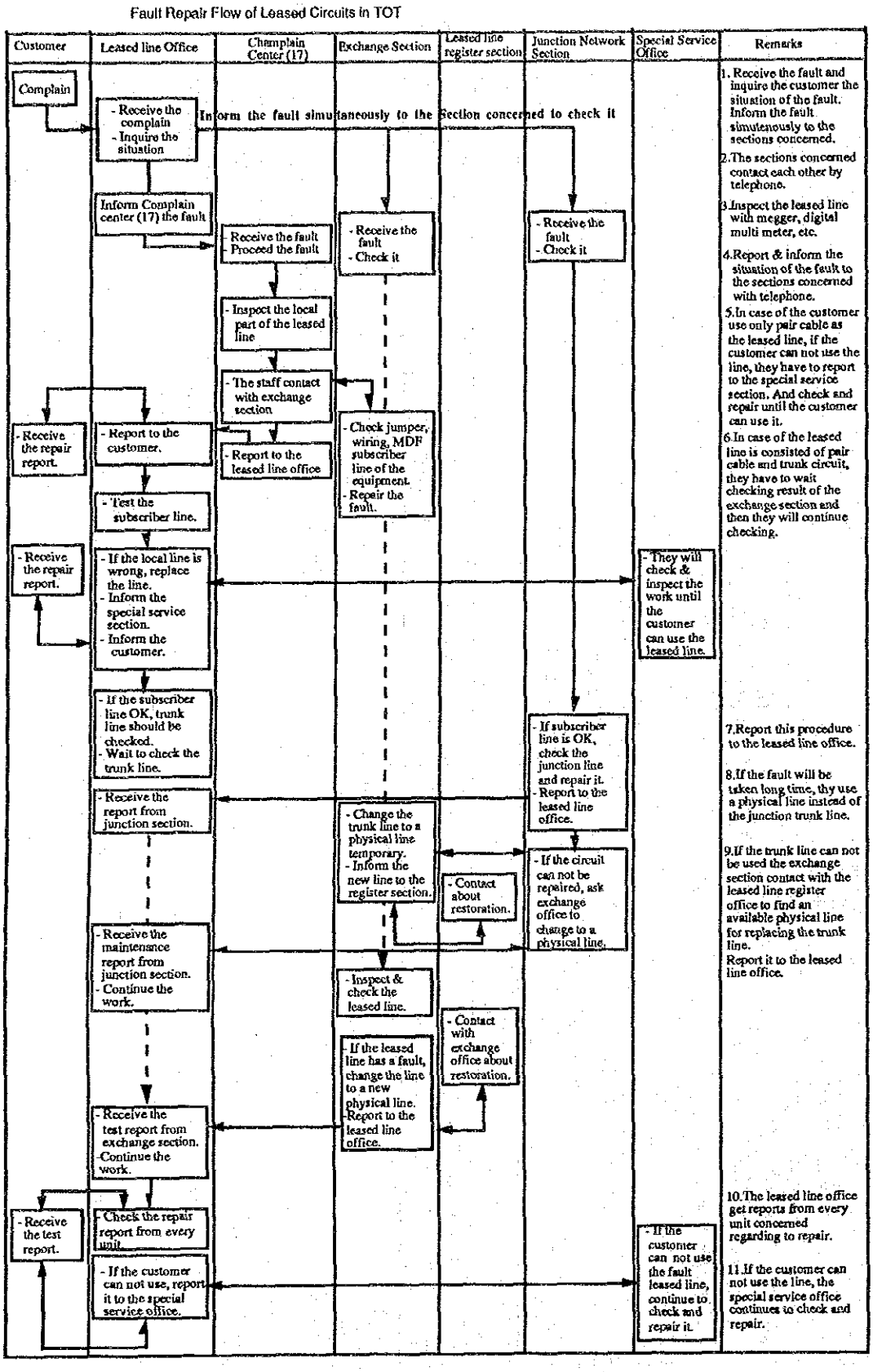


Figure 2.5.1-28 Work Flow of Leased Line Office

ii) Leased Circuit Office Activity

The leased line office has been established temporally in the Operation Bureau about one year ago to upgrade the leased line service quality. This office takes care of both installation and maintenance of leased lines.

TOT is now changing trunk circuits of leased lines in deteriorated routes such as analog and PCM routes to new transmission routes such as optical fiber and digital microwave routes; however, it has not completed yet.

This office has a plan to establish a computerized leased line control system in the near future. It is very important and convenient to use a computerized control system for upgrading the service quality of leased lines.

f) Deteriorated Facility Control Activity

Replacement of deteriorated facilities in the transmission section is basically carried out according to the flow shown in Figure 2.5.1-29.

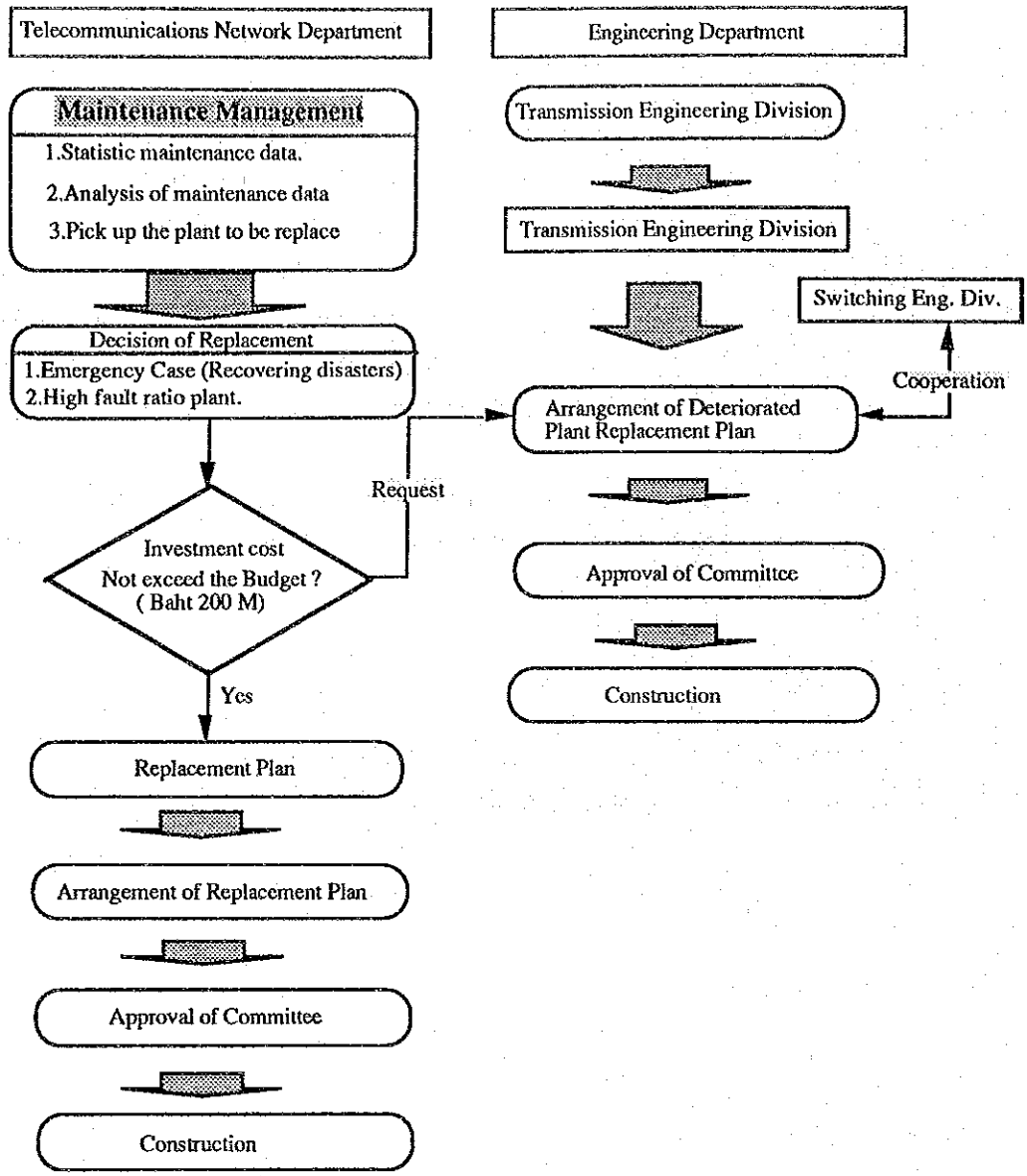


Figure 2.5.1-29 Deteriorated Facility Control Flow

Deteriorated facility control method in TOT is in the following.

i) TOT has already made a decision to replace deteriorated facilities in accordance with introduction of new services and improvement of telecommunications service quality.

ii) When the Division of Transmission Engineering in the Sector of Engineering Technique that belongs to Department of Engineering makes a replacement plan of the deteriorated facilities such as metallic PCM system, they discuss

this matter with the Division of Switching Engineering. Because, analog transmission systems are connected to analog switching facilities. Therefore replacement of analog transmission facilities must be coordinated with the replacement of analog switching facilities.

iii) When a replacement plan is formulated, a committee is established in the department for discussing the plan. After getting an approval from the committee, the plan is carried out by the division.

iv) If the Sector of Transmission in the Department of Telecommunications Network finds a bad facility with a high fault ratio, they can make a decision to replace the facilities. However, if investment cost for replacing the facilities exceeds their budget, they request the replacement to the Department of Engineering.

v) When an extraordinary fault occurs by the deteriorated transmission facilities, TOT must recover its telecommunications network services as soon as possible. In the case, the sector of transmission network can also replace the damaged facilities.

A replacement plan of the PCM systems has already been basically decided by the Division of Transmission Engineering in accordance with the replacement plan of crossbar switching facilities. This plan is now waiting to get an approval from the committee.

2.5.2 Improvement Measure

4) Improvement of Human Resource Management

a) Manpower Planning

The required (saved) number of staff for maintenance is estimated by using under the following assumptions and the microscopic estimation method in Chapter 14 of the Long-term Plan. Detailed data is shown in ANNEX. The method for estimating the saved manpower cost is described in Section 5.1 in Chapter 5.

i) Outside Plant Maintenance

- The maintenance work in this section consists of eight fields (drop wire repair, cable repair, preventive, cable construction, splicing cable, gas check and repair, sub carrier repair and leased line repair).

- The work for repairing the drop wires and cables depend on customer complaints (fault occurrence). Hence, the Study Team estimates the required number of staff by using the number of faults in each year (FY1993 to FY1997) and section.

- The required number of staff in the other work fields such as preventive and cable construction works adopts the standard number of staff in TOT. Because how many persons is assigned to preventive and construction works depends on maintenance policy of TOT. Actually, the actual number of staff tends to be less than that of the standard number. For positively carrying out preventive and small-scale-construction works, the required number of staff in these fields is applied to the standard number of staff which is more than the actual number of staff.

  However, the gas check and repair, and sub carrier team adopts the 10% - reduction in each year. Because, it can be foreseen that the works will gradually decrease from now on.

  Note: Staff of headquarters, managing office and administration in TOT is excluded from the required number of staff. Data is described in ANNEX.

ii) PABX Maintenance Section

- The work for repairing PABX depends on the customer complaint (fault occurrences). Hence, the estimation method is same as the maintenance section.

  Data is described in ANNEX.

iii) Public Telephone Maintenance Section

- The work for repairing public telephone depends on the number of fault occurrences. Hence, the estimation method is same as the maintenance section.

Data is described in ANNEX.

iv) Switching Maintenance Section

The required number of staff in this maintenance section uses the number in the Long-term Plan. The number is included the cut-number by adopting the efficient work scheme (centralization and replacing XB switches with SPC switches).

Data is described in ANNEX.

v) Transmission Section

The required number of staff in this section adopts the number in the Long-term Plan.

2.5.3 Establishment of Maintenance Control System

4) Transition of Improving Fault Ration in Japan

Figure 2.5.3-1 and Table 2.5.3 show transition of improving fault ratio in Japan.

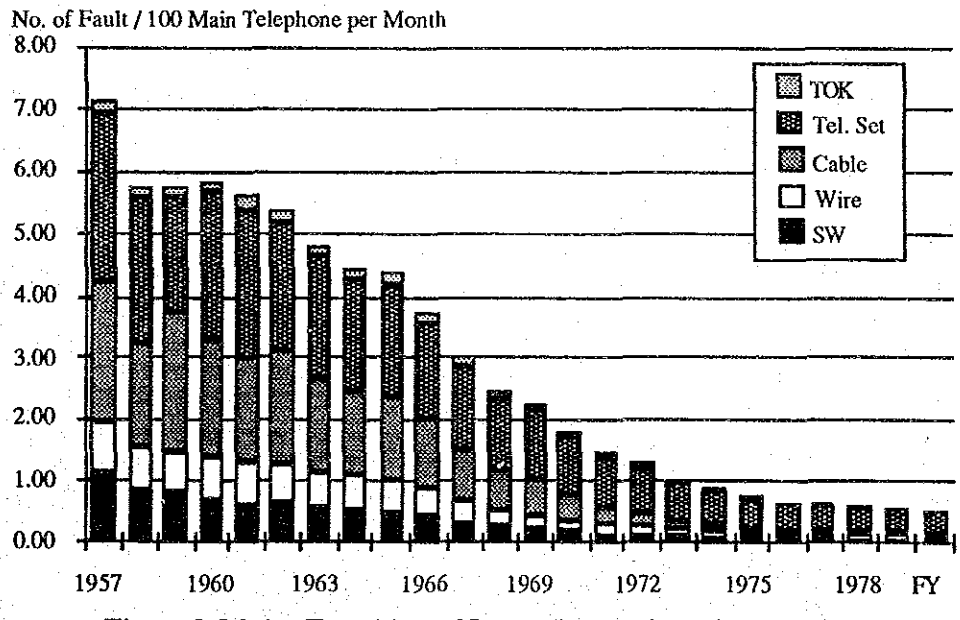


Figure 2.5.3-1 Transition of Improving Fault Ratio in Japan

Table 2.5.3 Transition of Improving Fault Ratio in Japan

Year	Switch	Wire	Cable	Tel. Set	TOK	Total
1957	1.11	0.81	2.27	2.73	0.20	7.12
1958	0.85	0.72	1.65	2.36	0.15	5.73
1959	0.78	0.70	2.23	1.85	0.16	5.72
1960	0.69	0.68	1.92	2.34	0.19	5.82
1961	0.62	0.67	1.66	2.41	0.25	5.61
1962	0.66	0.61	1.82	2.07	0.19	5.35
1963	0.56	0.55	1.55	1.96	0.19	4.81
1964	0.54	0.53	1.37	1.81	0.17	4.42
1965	0.50	0.50	1.38	1.78	0.19	4.35
1966	0.44	0.42	1.13	1.58	0.16	3.73
1967	0.34	0.35	0.82	1.38	0.13	3.02
1968	0.27	0.28	0.62	1.16	0.11	2.44
1969	0.22	0.23	0.53	1.18	0.09	2.25
1970	0.18	0.19	0.38	0.99	0.08	1.82
1971	0.12	0.20	0.25	0.83	0.06	1.46
1972	0.12	0.15	0.22	0.74	0.06	1.29
1973	0.10	0.12	0.15	0.59	0.05	1.01
1974	0.08	0.11	0.11	0.53	0.04	0.87
1975	0.07	0.10	0.07	0.48	0.04	0.76
1976	0.06	0.09	0.05	0.45	0.03	0.68
1977	0.05	0.09	0.05	0.42	0.03	0.64
1978	0.04	0.09	0.05	0.40	0.03	0.61
1979	0.04	0.09	0.05	0.39	0.02	0.59
1980	0.03	0.08	0.04	0.38	0.02	0.55

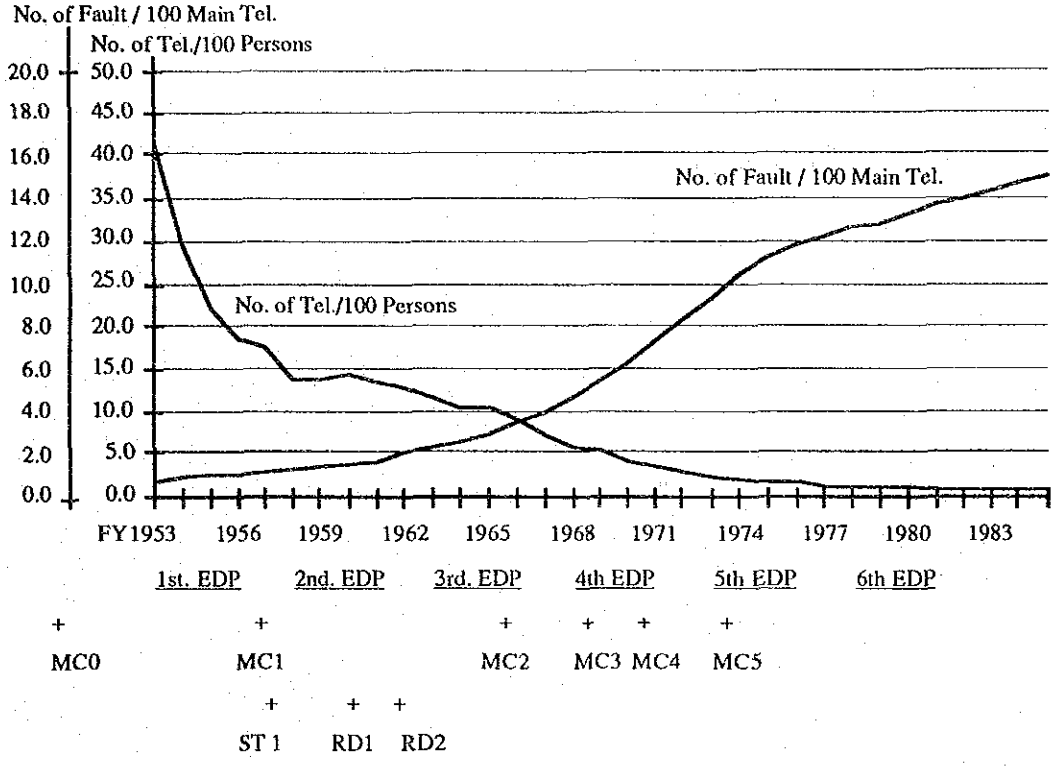


Figure 2.5.3-2 Transition of Fault Ratio and Number of Main Telephone Set per 100 Persons

Note:

Maintenance Control System

MC 0	Failure Control Manual.
MC 1	Introduction of Maintenance Control System
	- Average Value Control
MC 2	- Extraordinary Failure Control
	- Compound Failure Control
	Introduction of Electronic Data Processing System for the Failure Control.
MC 3	- Leased Line Failure Control
MC 4	- Service Figure Control
	- Facility Control value
MC 5	- New Equipment Control

Development

RD 1	Introduction of PVC wire for the Drop Wire.
RD 2	Introduction of Plastic Insulation Plastic Sheathed Cable, New Type Telephone Set.

Standard Manual, etc.

ST 1	Establishment of Standard Manuals

CHAPTER 3 IMPROVEMENT OF CALL COMPLETION RATIO

APPENDIX

APPENDIX

3.3 Present State of Network Service Performance and Traffic Characteristics

3.3.2 Traffic Characteristics

1) Traffic Fluctuations in 24 Hours

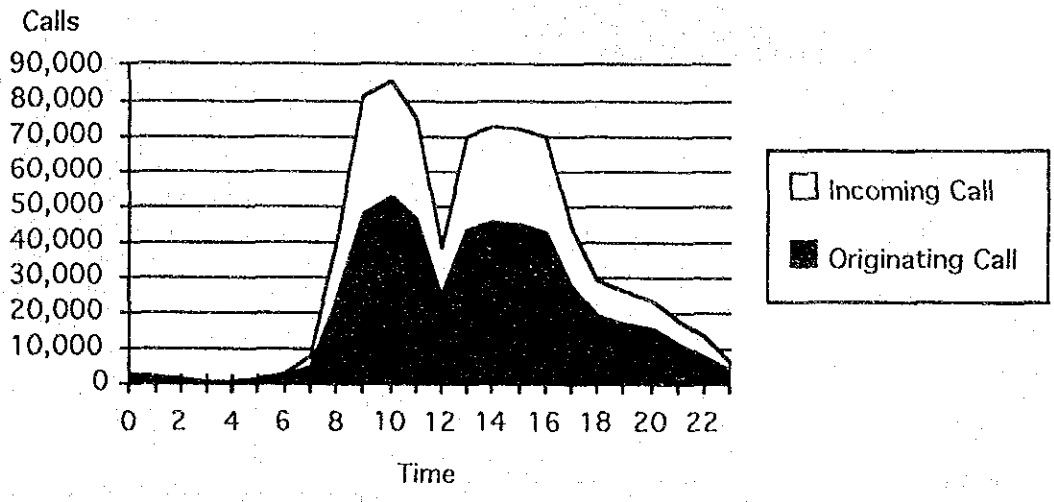


Figure 3.3.2-1 Traffic Pattern in a Day (Pathum Wan-2)
(The Average of the Measured Days)

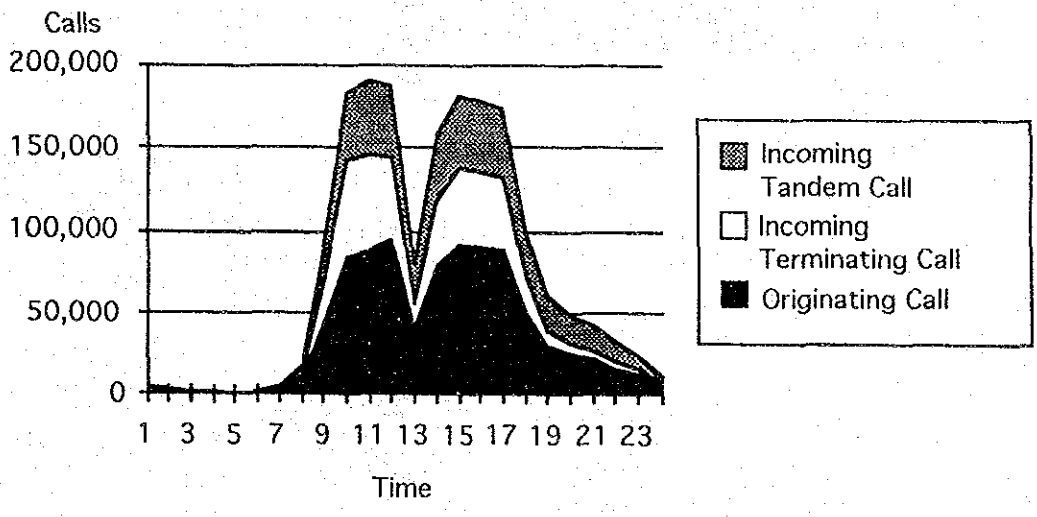


Figure 3.3.2-2 Traffic Pattern in a Day (Surawong-4)
(The Average of the Measured Days)

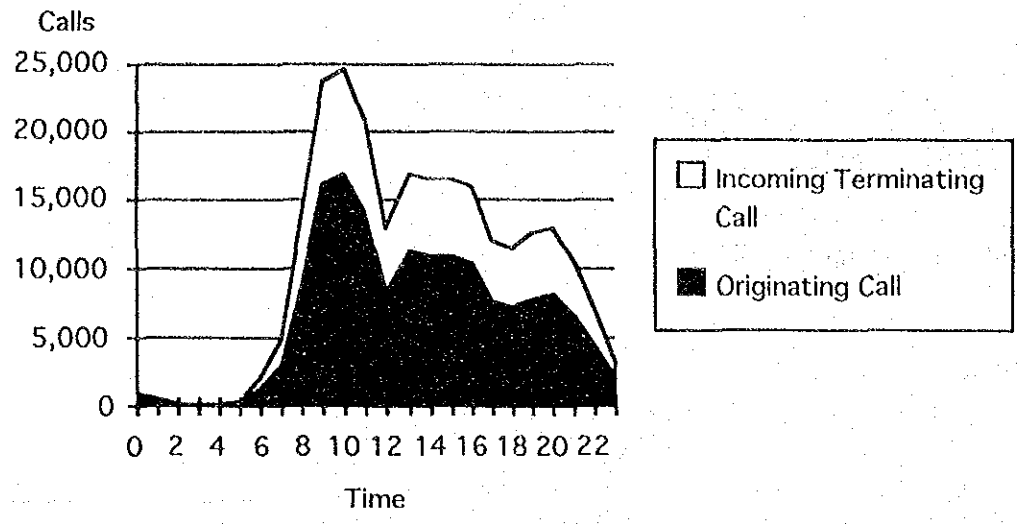


Figure 3.3.2-3 Traffic Pattern in a Day (Bang Kae)
(The Average of the Measured Days)

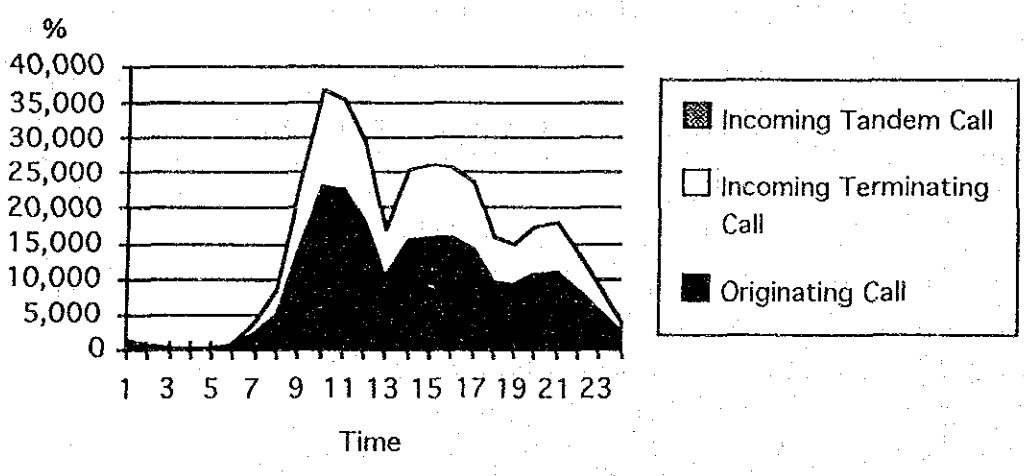


Figure 3.3.2-4 Traffic Pattern in a Day (Pak Kret)
(The Average of the Measured Days)

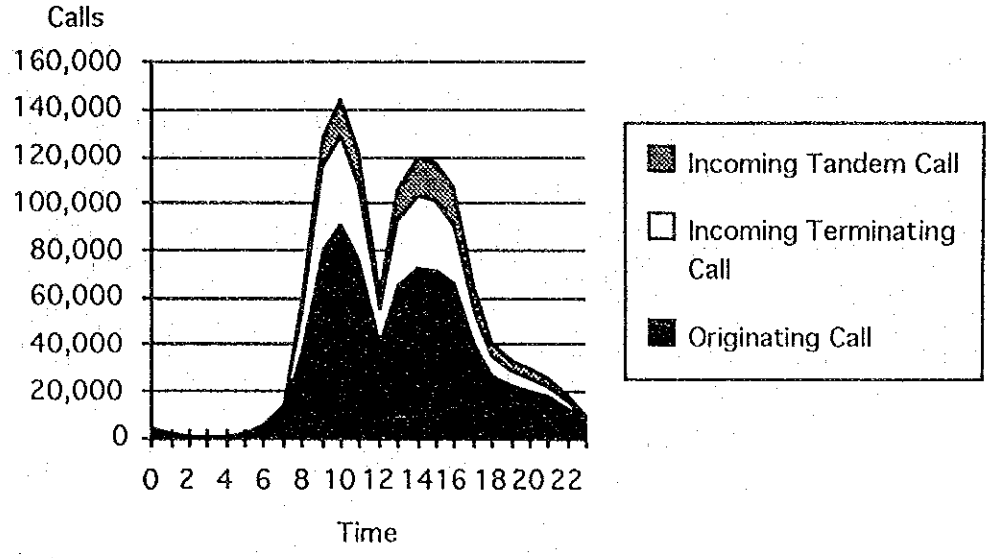


Figure 3.3.2-5 Traffic Pattern in a Day (Samran Rat-4)
(The Average of the Measured Days)

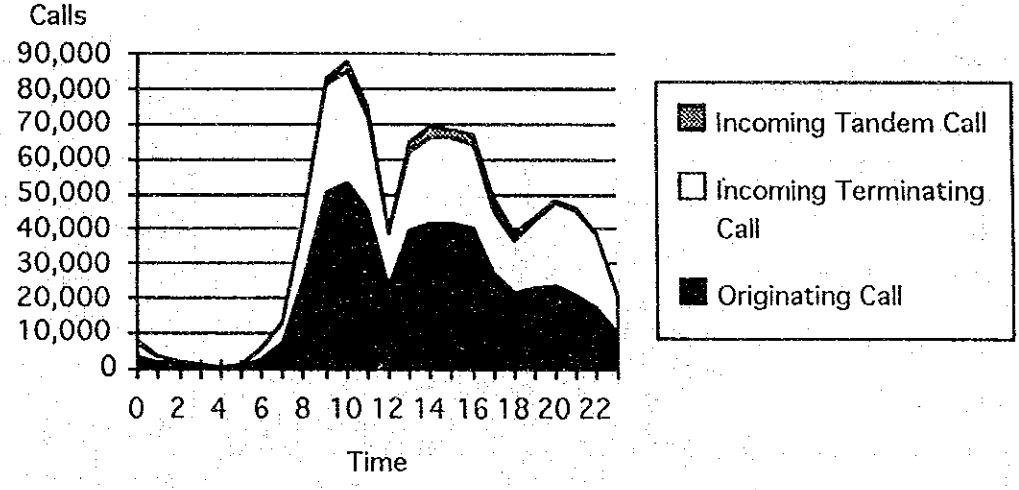


Figure 3.3.2-6 Traffic Pattern in a Day (Hua Mak-2)
(The Average of the Measured Days)

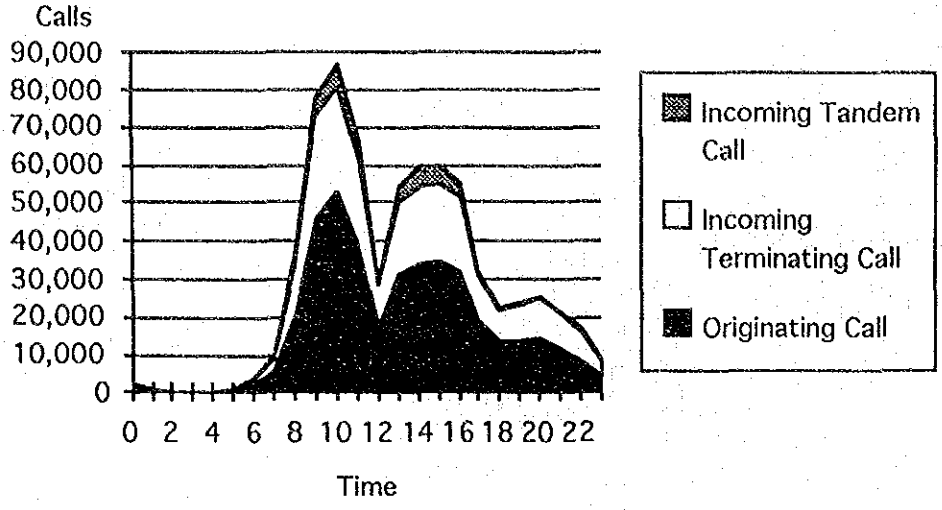


Figure 3.3.2-7 Traffic Pattern in a Day (Lat Phrao-1)
(The Average of the Measured Days)

2) Transition of Service Performance in a Day

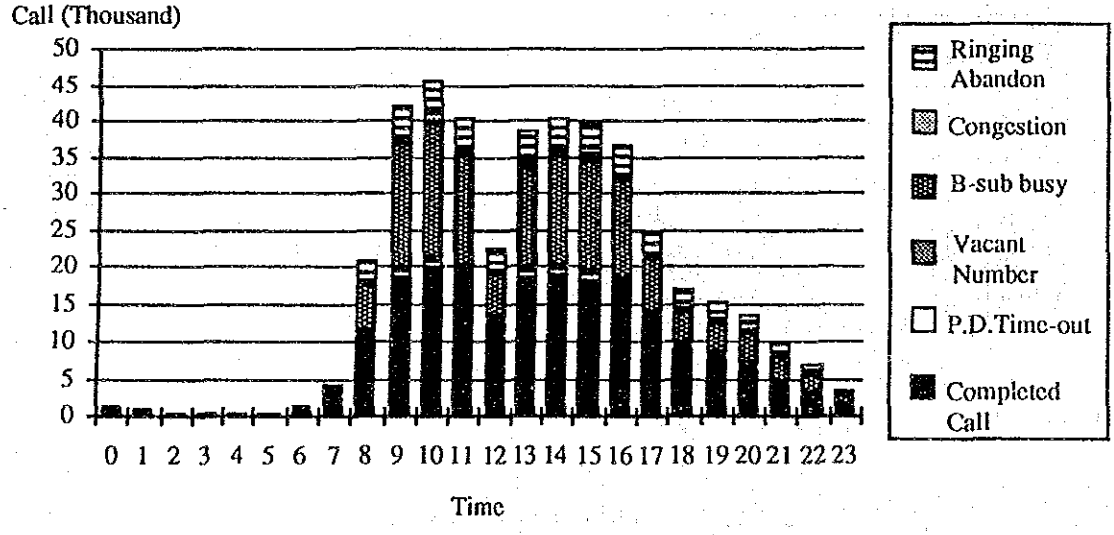


Figure 3.3.2-8 Transition of Service-Performance in Number oc Calls (Pathum Wan-2)

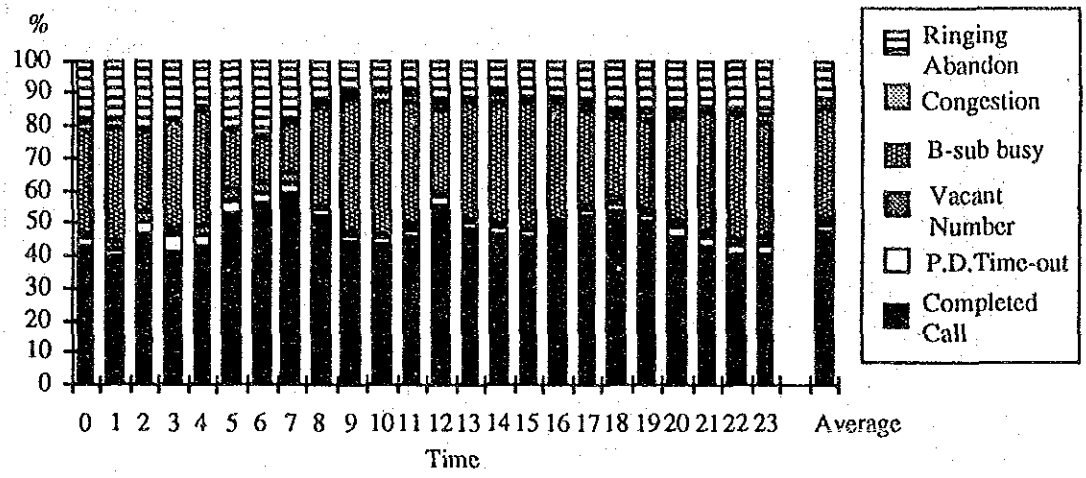


Figure 3.3.2-9 Transition of Service Performance in Percentage (Pathum Wan-2)

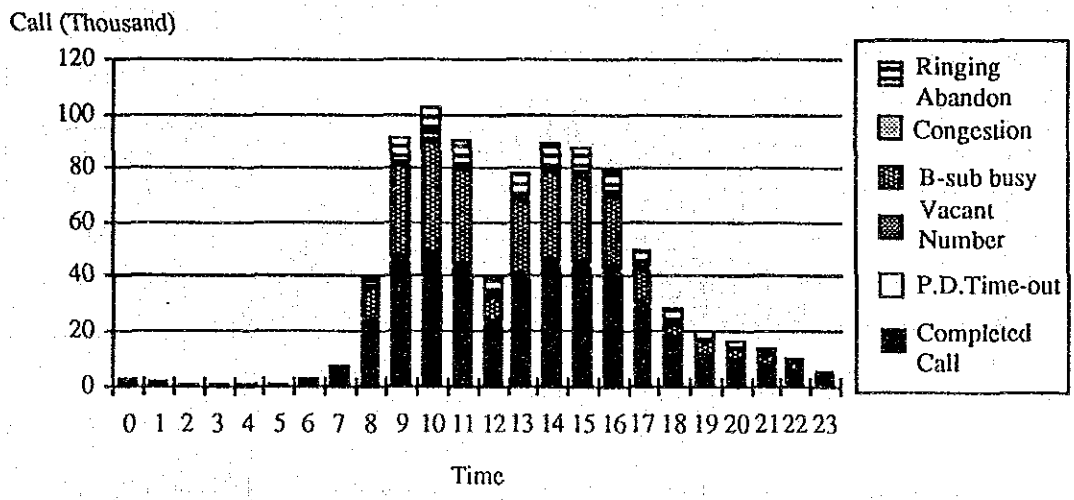


Figure 3.3.2-10 Transition of Service Performance in Number oc Calls (Surawong-4)

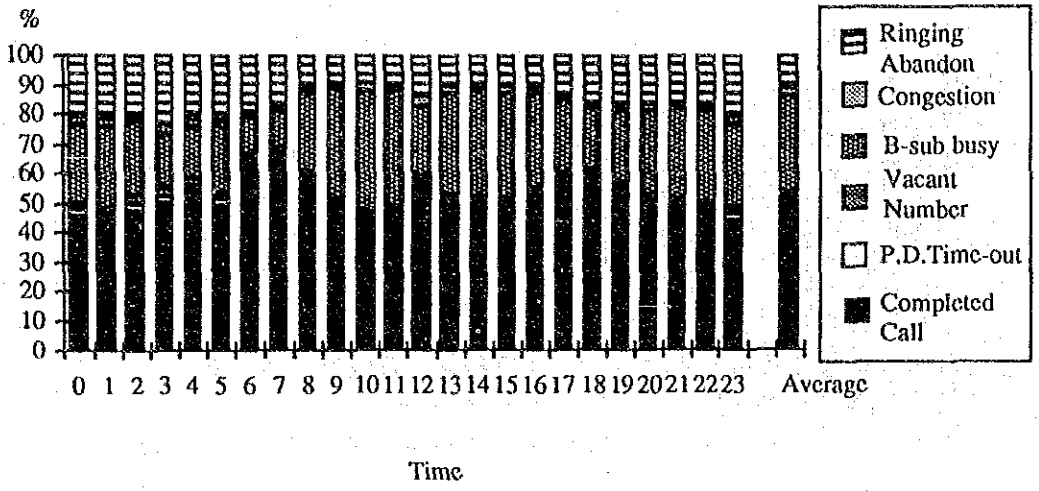


Figure 3.3.2-11 Transition of Service Performance in Percentage (Surawong-4)

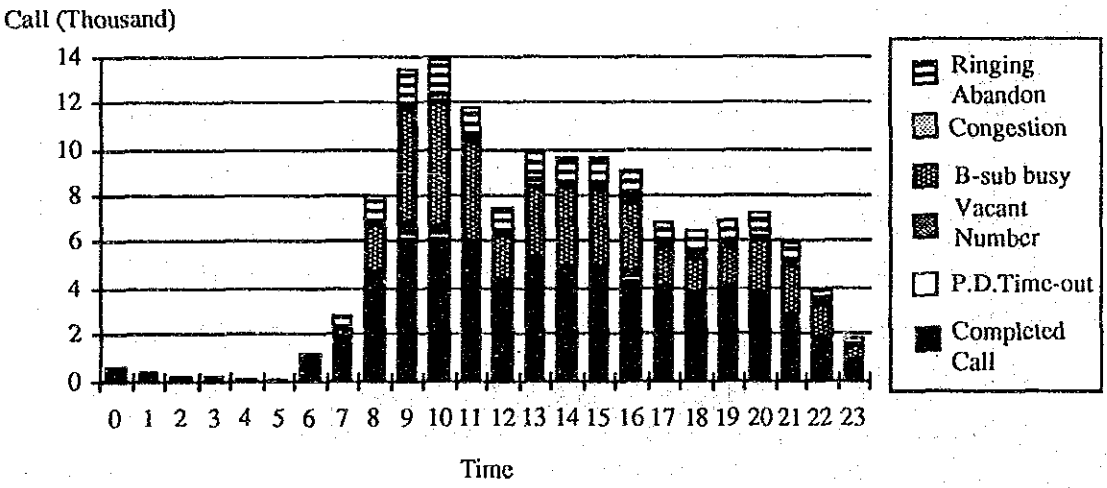


Figure 3.3.2-12 Transition of Service Performance in Number oc Calls (Bang Kae)

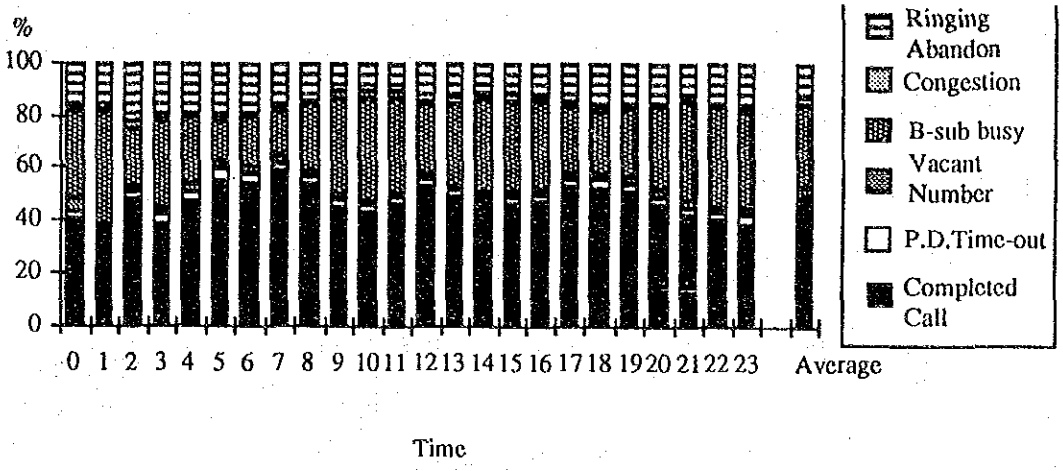


Figure 3.3.2-13 Transition of Service Performance in Percentage (Bang Kae)

APPENDIX

3.4 P.S.Abandon Calls

3.4.3 Field Trial

Table 3.4.2-1 P.S.Abandon Occurrence and Subscriber Line Faults (PKG-T6)
Measured on 22 April (2:00 ~ 2:20) 1992

Tel. NO	Occurence	%	Sub. Category	Test Results	Cause of Fault
3310451	321	64.20	public	Low ins.	Tel. set (Print board)
NO Sub	67	13.40	-	-	-
3316888	56	11.20	Normal	Open cct, Short	In house wire
3323813	13	2.60	Normal	Open cct	In house wire
3325671	13	2.60	Normal	Short cct	In house wire
3320467	6	1.20	public	Good	-
3310454	3	0.60	public	Good	-
3310461	3	0.60	public		
3313125	3	0.60	Normal		
3310015	2	0.40	Normal		
3310417	2	0.40	public		
3313841	2	0.40	Normal		
1 x 9 Sub.	9	1.80			
Total	500	100.00			

Table 3.4.2-2 P.S.Abandon Occurrence and Subscriber Line Faults (PKG-T6)
Measured on 22 April (10:00 ~ 10:30) 1992

Tel. NO	Occurence	%	Sub. Category	Test Results	Cause of Fault
NO Sub	41	5.70	-	-	-
3320474	25	3.48	Public	Open cct	Restoration
3312560	12	1.67	Normal	Good	-
3310414	11	1.53	Public	Short	Restoration
3316901	11	1.53	Normal	Good	-
3323813	8	1.11	Normal	Open cct	In house wire
3310467	7	0.97	Public	Good	-
3310717	7	0.97	Normal	AC ind.	Restoration
3315904	7	0.97	Normal	Good	-
3321595	7	0.97	Normal	AC ind.	Restoration
3322346	7	0.97	Normal	Good	-
3330570	7	0.97	Public	Good	-
6 x 10 Sub	60	8.34			
5 x 8 Sub	40	5.56			
4 x 16 Sub.	64	8.90			
3 x 22 Sub.	66	9.18			
2 x 66 Sub.	132	18.36			
1 x 207 Sub.	207	28.79			
Total	719	100			

Table 3.4.2-3 P.S.Abandon Occurrence and Subscriber Line Faults (PKG-T6)
Measured on 4 May (2:00 ~ 5:04) 1992

Tel. NO	Occurence	%	Sub. Category	Test Results	Cause of Fault
No Sub Number	169	34.1			
331-8354	121	24.4	Ordinary	Short CCT	In side house
331-3686	98	19.8	Ordinary	Short CCT	
331-4572	22	4.4	Ordinary	Short CCT	In side house
332-2143	8	1.6	Ordinary	Short CCT	In side house
331-4752	6	1.2	Ordinary	Good	
331-0015	5	1.0	PST*		
331-1014	4	0.8	Ordinary	Short CCT	Cable
333-0892	3	0.6			
332-0745	3	0.6			
333-1193	3	0.6			
331-3948	3	0.6			
2 x 5 sub	10	2.0			
1 x 41	41	8.3			
Total	496	100.0			

PST Permanent Signal Test call which is automatically originated by the system itself.

Table 3.4.2-4 P.S.Abandon Occurrence and Subscriber Line Faults (PKG-T6)
Measured on 6 May (2:00 ~ 6:09) 1992

Tel. NO	Occurence	%	Sub. Category	Test Results	Cause of Fault
331-6381	41	8.2	Ordinary	Low ins.	In side house
331-1244	38	7.6	Ordinary	Good	
331-9402	34	6.8	Ordinary	Short CCT	In side house
331-5077	26	5.2	Ordinary	Ind. volt	In side house
331-0015	23	4.6	PST*		
331-9208	21	4.2	Ordinary	Low ins.	In side house
333-0892	21	4.2	Ordinary	Open CCT	In side house
331-0402	14	2.8	Public	Low ins.	Coin slot
331-0417	13	2.6	Public	Low ins.	Coin slot
331-0455	8	1.6	Public	Good	
331-9379	7	1.4			
332-2143	7	1.4			
331-0413	6	1.2			
331-0449	5	1.0			
331-8110	5	1.0			
4 x 5 sub	20	4.0			
3 x 15 sub	45	9.0			
2 x 20 sub	40	8.0			
1 x 127 sub	127	25.3			
Total	501	100.0			

Table 3.4.2-5 P.S.Abandon Occurrence and Subscriber Line Faults (PKG-T6)
Measured on 8 May (2:00 ~ 5:30) 1992

Tel. NO	Occurence	%	Sub. Category	Test Results	Cause of Fault
332-5539	249	49.5	Ordinary	Open CCT	In side house
331-1244	64	12.7	Ordinary	Good	
331-0015	21	4.2	PST		
331-4572	11	2.2	Ordinary	Ind. volt	In side house
331-0445	11	2.2	Public	Low ins.	Coin slot
331-3948	6	1.2	Ordinary	Good	
331-7947	5	1.0	Ordinary	Open CCT	In side house
332-5594	5	1.0	Ordinary	Open CCT	In side house
4 x 2 sub	8	1.6			
3 x 7 sub	21	4.2			
2 x 13 sub	26	5.2			
1 x 76 sub	76	15.1			
Total	503	100.0			

Table 3.4.2-6 P.S.Abandon Occurrence and Subscriber Line Faults (PKG-T6)
Measured on 12 May (2:00 ~ 5:35) 1992

Tel. NO	Occurence	%	Sub. Category	Test Results	Cause of Fault
332-0424	95	19.0	Ordinary	Short CCT	In side house (fire)
331-9482	88	17.6	Ordinary	Good	
331-2814	55	11.0	Ordinary	Short CCT	In side house
331-1810	36	7.2	Ordinary	Short CCT	In side house
331-0127	35	7.0	Ordinary	Open CCT	In side house
331-3649	33	6.6	Ordinary	Short CCT	In side house
331-3424	32	6.4	Ordinary	Short CCT	In side house
332-4450	16	3.2	Ordinary	Short CCT	In side house
331-0015	12	2.4	PST		
332-5594	9	1.8	Ordinary	Low ins.	In side house
4 x 1 sub	4	0.8			
3 x 1 sub	3	0.6			
2 x 12 sub	24	4.8			
1 x 59 sub	59	11.8			
Total	501	100.0			