

Chapter 6

THE POWER LINE CARRIER.

The Power line carrier ( PLC) is the method of transmitting signals along the high voltage transmission lines. This method is good in economic point of views. Because we can use the high voltage transmission lines among the substations as the transmission paths of the control signals instead of wiring the paths for the signals as in the pilot wire method.

The control signals which are in the form of voltage and current are converted into the pulse form at the transmitter, before transmits to the receiver of other substation along the transmission lines. The range of frequency of PLC system is from 50 - 500 KHz ,

The PLC components compose of.

1. Wave trap. (WT)
2. Coupling Capacitor. (CC)
3. Symmetrical line matching unit (SLM)
4. PLC equipment.

The control signals in the form of the pulse codes and in the frequency range 50 - 500 KHz are transmitted along the High voltage Transmission lines. These signals go together with the 50 Hz transmission load. Before entering

the terminal substation, the signals are attracted by the wave traps which are the tank circuits. This operation will not disturb the load of the transmission system. Because of the difference in frequency. The high frequency signals are sent from the wave traps through the coupling capacitors to the symmetrical line matching unit.

In the simple PLC system only one wave trap, one coupling capacitor are used. But for reliability of the control system, two sets of these equipments are employed. In the 3-phases -3-lines transmission system the phases are coded as phase R, phase Y and phase B. The only phases R and B are used for PLC system. The signals from the two phases R and B are matched by the symmetrical line matching unit to be one set of control signals.

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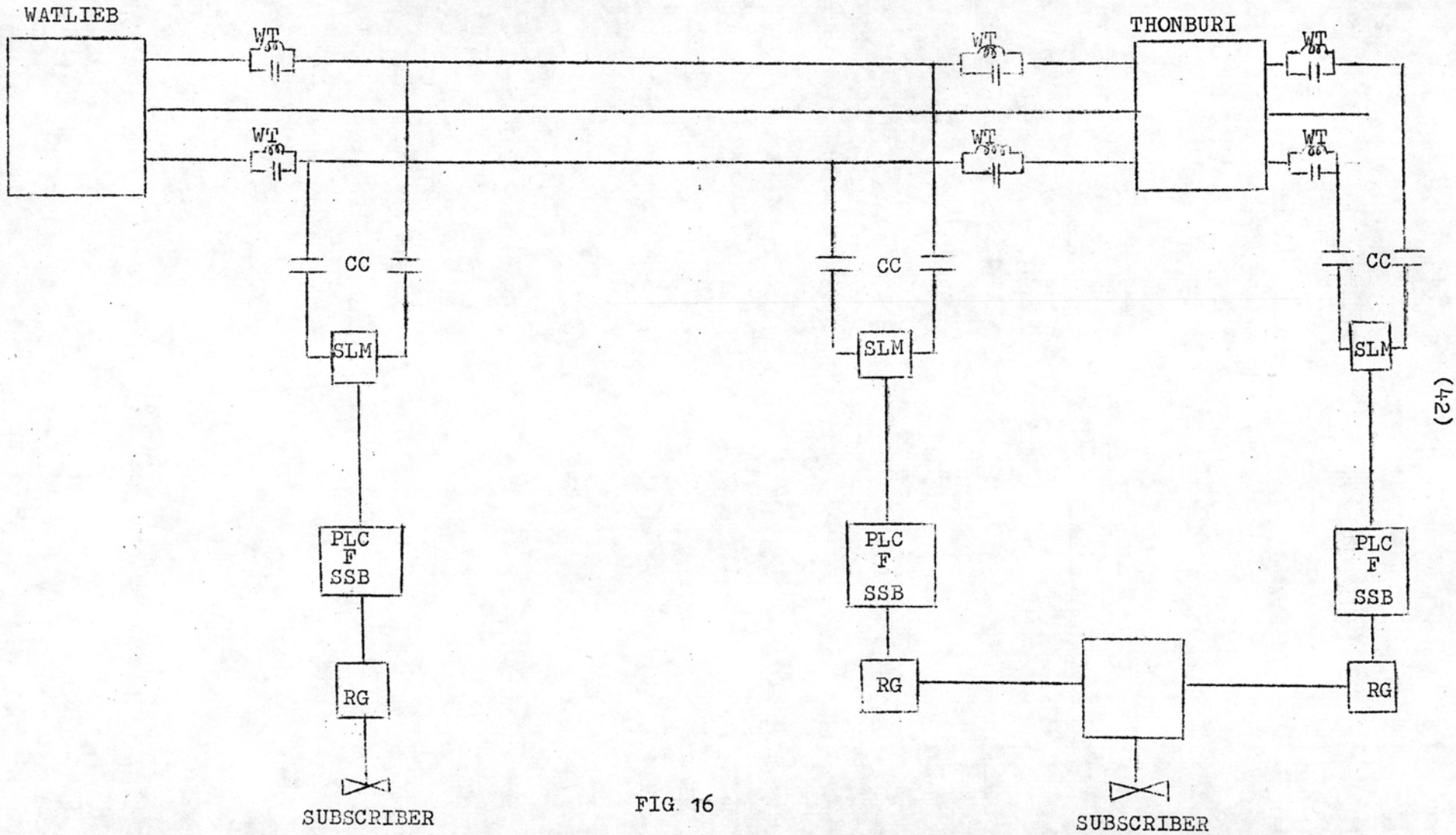


FIG. 16

The Single Circuit PLC System Links between Watlieb & Thonburi

(43)

LEGEND.

CC	=	Coupling Capacitor
WT	=	Wave Trap.
LMU	=	Line Matching Unit
SLM	=	Symmetrical Line Matching Unit.
PLC	=	Power Line Carrier equipment.
SSB	=	Single Side Band.
DSB	=	Double Side Band.
RG	=	Relay Group.
F	=	Fujisu equipment.

The signals from symmetrical line matching unit are sent to the PLC equipment and will be converted from pulse codes to the signals in the form of voltage and current. These voltage and current signals will control the operation of the telemetering and supervisory control equipments.

The reasons why the two out of three phases are used in the PLC system is that . When fault occurs in one phase the other phase will serve as the PLC transmission path. No interruption occurs in the system, so the substations are still controllable . In Fig.16. shows the PLC system which links between Watlieb and Thonburi stations.

The PLC equipments produce a lot of channels for many duty such as.

1. Speech
2. Telemetry
3. Teleprotection
4. Signalling
5. Pilot.

In ordinary communication system. The frequency band of the PLC is about 0-4 KHz which can be divided as follow:

1. Speech            0 - 2.4    KHz
  2. Telemetry       2.7-3.4    KHz
  3. Teleprotection 3.925    KHz
  4. Signaling
  5. Pilot
- According to the types.

(From Communication Division. EGAT)

In order to get more reliable PLC control system. The double circuit of the transmission line is used. But this method is too expensive because of installing the new transmission paths, unless the double circuit were already built for the benefit of transmission system. If this method is employed, the middle phases (or phase Y) of each circuit are used for PLC transmission paths. The advantage of this method is that, when all three lines of one circuit are damaged by faults or accident, the remain circuit may be

used as the PLC path. By this reason the system is still controllable.

The arrangement of the double circuit control system is shown in Fig.15. The figure shows the control paths link from center which is Watlieb to Thonburi.

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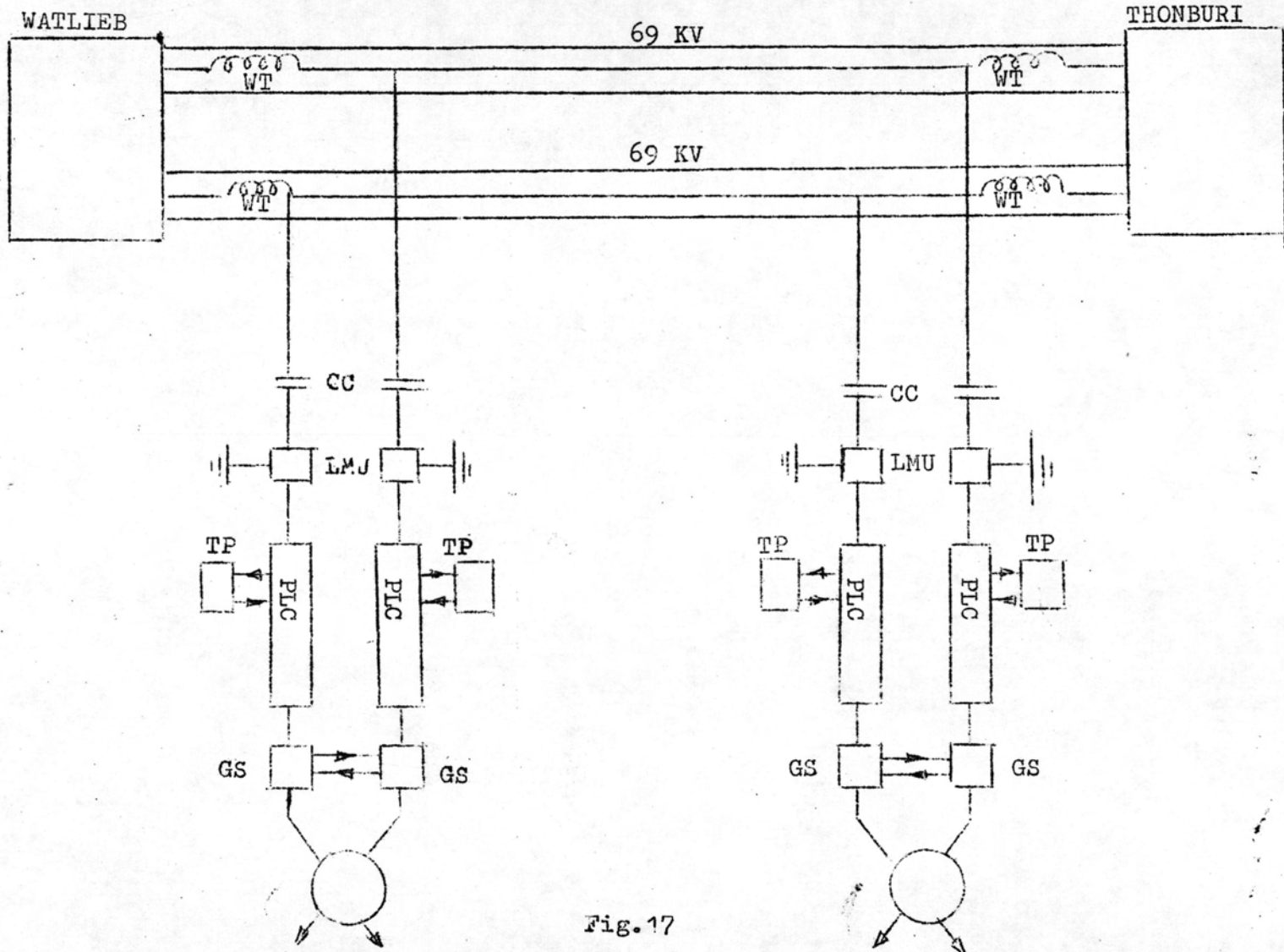


Fig. 17

The Double Circuit PLC System Links between Watlieb & Thonburi

LEGEND

WT	=	Wave Trap
CC	=	Coupling Capacitor potential device
LMU	=	Line Matching Unit
PLC	=	Power Line Carrier
TP	=	Telerelaying Channel
GS	=	Group Selector
TAX	=	Private Automatic Exchange
T	=	Telephone
CX	=	Coaxial Cable.

6.1 Disadvantages

The great disadvantages of the PLC system are.

1. The faults of the transmission system.
2. The damages of the transmission lines, according to the accidents.

These causes may be separately described as follow.

6.2 The Faults

Most of the faults that occurs on power system are unsymmetrical faults, which may consist of unsymmetrical short circuits, unsymmetrical faults through impedances, or non conductors. Unsymmetrical faults occur as:



1. Line to ground faults.
2. Line to line faults.
3. Double Line to ground faults.

For the MEA system, the transmission system is 3-phases -3-lines type. So the faults that usually occur may be classified as.

1. Single phase to ground faults.
2. Two phases to ground faults.
3. Three phases to ground faults.
4. Three phases faults.

In single circuit method Fig. 6. The PLC lines are connected with phase R and phase B of the transmission lines. So, if the single phase to ground faults occur at phase Y it will not affect the PLC system. Other types of faults affect the PLC system.

The faults of the power system occur from many reasons such as.

1. lightning which produces the temporary faults.
2. The construction of buildings, bridges near the high voltage transmission lines.
3. The breakdown of insulation of the high voltage equipments.

When the faults in transmission system occur. The oil

Circuit breakers (OCB) which are used as the system protectors at the substations trip. The tripping of OCB is operated by many types of relay according to the faults such as.

1. Over current relay.
2. Earth fault relay.
3. Neutral displacement relay.

The table 4. is the data of the OCB tripping on faults in the year 1971. This data shows the stability of each substation, which North Bangkok substation is the worst. Because, in every month there are many times of OCB tripping.

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Table 1

No. of OCB 69 KV Tripping.

2514

( trip on Fault)

Substation	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
SK	-	-	-	-	-	-	-	-	1	2	-	-
R	-	-	-	-	-	-	-	-	-	-	-	-
Q	-	-	-	1	1	1	-	-	-	-	-	1
SR	1	1	-	2	5	3	1	-	1	4	-	-
TK	-	-	-	-	-	-	-	-	-	-	-	-
RN	1*	1	-	2	-	-	-	-	-	-	-	-
BG	-	-	-	-	-	-	-	-	-	-	-	-
MM	-	-	-	-	-	-	-	-	-	-	-	-
P	-	-	-	4	-	-	1	1	-	-	-	-
L	-	2	1	4	-	-	2	1	3	1	-	3
T	1	-	-	2	-	-	-	-	1	-	-	-
K	5	2	-	-	-	-	-	-	-	-	2	2
BY	-	-	-	-	-	-	-	-	-	-	1	-
SD	-	-	-	-	-	-	-	-	2	-	-	-
PM	-	-	-	-	-	-	-	-	2	-	-	3
MS	-	-	-	-	-	-	4	-	3	-	-	2
SS	-	-	-	-	-	-	-	-	-	-	-	-
B	-	-	-	5	-	-	-	2	2	1	-	1
RT	-	-	-	-	-	-	-	-	-	-	-	1
M	-	-	-	-	-	-	-	-	-	-	-	-
S	-	-	2	-	1	-	-	-	2	-	-	1
BS	-	-	-	-	-	-	-	-	1	-	-	-
N	3	1	5	7	2	1	2	3	5	2	1	6
NR	-	-	-	1	-	-	-	-	1	-	-	-
D	1	-	-	-	-	-	-	1	1	-	-	1
BD	-	-	-	-	-	-	-	-	-	-	-	-
RSI	-	-	-	-	-	-	-	-	-	-	-	-
RS2	-	-	-	-	-	-	-	-	-	-	-	-
W	2	-	-	5	2	-	-	-	2	-	-	-

### 6.3 The damage of the transmission lines caused by the accidents

Most of the accidents are caused by the cars. The damage occurs from the severe collision of lorry? Buses and other vehicles with the concrete posts. This collision damages all the transmission lines, which causes open circuit not only for the power transmission system but also the PLC control system. The substations are no longer controllable.

In Thailand, especially, in the metropolitan area, the traffic accidents occur every day. The table 2.illustrates the damage of the transmission system from the sever calli- sion of buses or lorry with the posts. Because of the recently installing of the transmission Line Maintenance Division, the data obtained is only from January 1971 to March 1972. This fourteen-mouth events show the frequent occuring of accidents that the PLC system is less reliable for MEA. system.

Table 2

Date	Circuit breaker or Route	Tripping Causes.
August 18, 1971	Donmuang-Rungsit	Severe Collision.
September 8, 1971	N 691	
October 29, 1971	Sukumvith.	
December 6, 1971	N 692	
December 7, 1971	K 693.	
February 2, 1972	B 694	

Table 2 (Cont)

Date	Circuit Breaker or Route.	Tripping Causes.
Jan 5, 71	K 6912	Construction of building near transmission line.
Jan 10, 71	K 6922 W 6922 T 6922	The balloons are found at the mid spon of the lines.
Jan 25, 71	N 6922 N 6952	Snake - -
Jan 31, 71	K 6912	Nylon rope
Feb 3, 71	K 6912	-
Feb 19, 71	N 6932	-
Feb 20, 71	K 6932	-
March 5, 71	N 6922	Kite
April 8, 71	N 6912	Kite
April 10, 71	N 6932 L 6912 N 6932	- - -
April 14, 71	N 6922	-
April 29, 71	N 6912 N 6902	Construction of building near HV. lines.
May 22, 71	SR 6922	explosion of LV. lightning Arrester.
May 29, 71	SR 6952	The transmission lines are damaged by the factory's chimney.

Table 2 (Cont)

Date	Circuit breaker or Route	Tripping Cause
June 1, 71	N 6952	Explosion of LV.cable Under HV lines.
June 16,71	SR6922	The boom of hydra-lift touch the transmission line
July 16,71	N 6932	-
July 16,71	B 6942	Kite with nylon rope
July 16,71	B 6942	guy wire
	L 6922	
	P 6912	
August18,71	N 6952	Severe collison of lorry and transmission post.
	D 6912	
August19,71	N 6932	-
October 2,71	SK 6952	Touching of 2phases
	SR 6912	
October 23,71	SR 6972	Damage of porecelain at load side.
October29,71	B 6932	Construction near HV transmission
November5,71	K 692	Touching of 2phanses.
November18,71	N 6932	Guy wire.
December31,71	N 6932	-

Table 2 (Cont)

Date	Circuit Breaker or Route	Tripping Causes
Jan 5, 72	N 6932	-
Jan 31, 72	SK6962	Kite
Feb 2, 72	B 6942	Severe collision of bus
	L 6922	Transmission post.
	P 6912	
Feb 12, 72	K 6922 T 6922 W 6922 W 6932	Touching of 2 phases
Feb 21, 72	N 6932	-
March 2, 72	N 6932	Wire
March 4, 72	SK6962	snake
March 13, 72	K 6932	severe collision of lorry and post.
March 17, 72	N 6932	-
March 22, 72	N 6932	Kite with copper rope
March 24, 72	B 6922	Kite
March 28, 72	N 6952	-
March 30, 72	B 6942	Kite

LEGEND

N	=	North Bangkok substation
K	=	Bangkok Noi "
B	=	Bang kapi "
W	=	Wattlieb "
T	=	Thonburi "
SR	=	Samrong "
L	=	Lumpini "
P	=	Phrakanong "
D	=	Donmuang "
SK	=	South Bangkok "
691	=	69 kv. system, Route 1.
6932	=	69 kv. system, Route 3, Oil Circuit breaker
2	=	Oil Circuit breaker.

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