

(OTDT/OPDT)

**Study on the Optimization of Controller Time Constant for OTDT/OPDT
Reactor Trip System at Nuclear Power Plant**

103-16

RTD	(setpoint=106%)	(109%)	106%	107%	OP/OTDT	OTDT	Lead/Lag	Lead/Lag	T	Lead
5	22	20								
12	8									
0	2									

ABSTRACT

The results of measurements showed that the reactor temperature fluctuation was higher after RTD modification than that of original system. So partial turbine runback signal and temperature deviation between three channel is occurred. This paper suggests that time constant of lag unit be increased to reduce the temperature fluctuation. Nevertheless we can meet the time limit of total time delay including RTD time response, and trip circuit channel electronics delay, 8 sec. The electronic delay is the trip circuit channel electronics delay plus the time for the reactor trip breakers to open and time for the CRDM stationary grippers to disengage(gripper release time). Time constants utilized in the lag compensator for T is changed from 0 sec to 2 secs. Time constant utilized in the measured Tavg lag Compensator is changed from 0 sec to 2secs In this case we could obtain lower fluctuation and could meet the response time limit.

1.

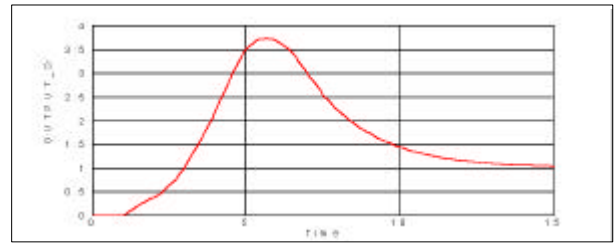
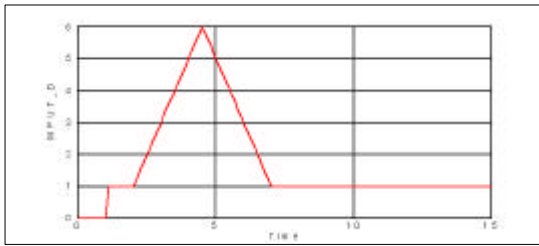
1,2 RTD

OT T 113.79% C3 110.79% OP T 109% C4 106% .(가
)
 3,4 Loop 3 106.65% T
 C-4 (2/3 Overpower T (Setpoint=106%)
)가 . C-4 (109%)
 C4 alarm 106% 107%
 Lead/Lag T
 0 2

2.

2.1.

가
 2 가 C-4 Interlock
 Simulink 1 6 3.7



(z=0)

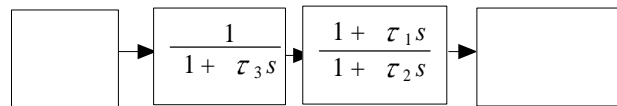
(z=2)

1

2.2. Lead/Lag

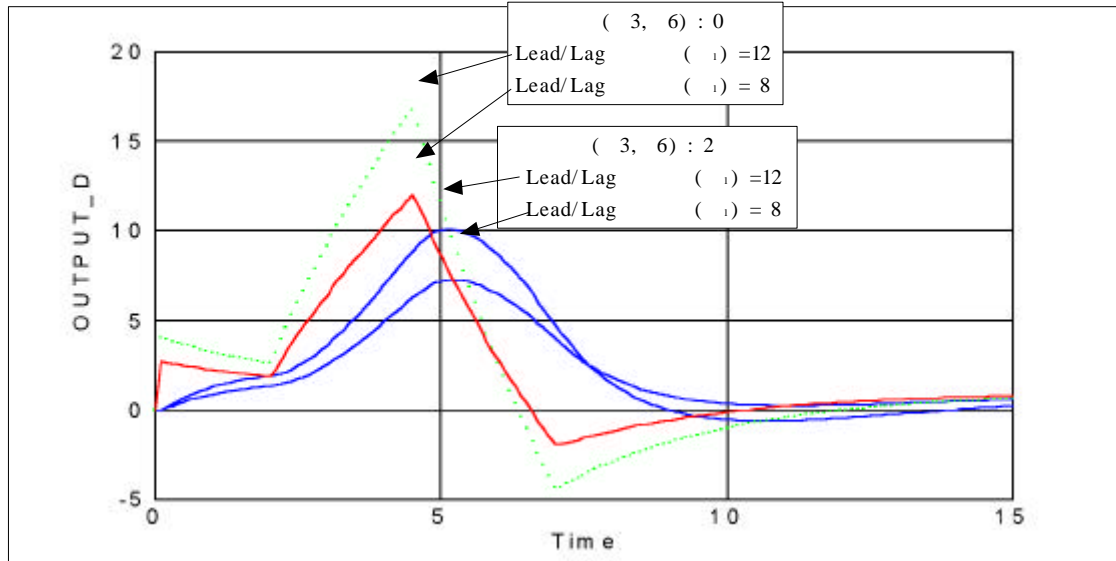
가

/



2. Temperature of reactor protection system

T Lead/Lag , , 12 8
 T



3. Lead/Lag

3.

OTDT/OPDT
 DT, OPDT, OTDT 가
 Lead/Lag
 Lead/Lag Lead 가 12
 8

$$\begin{aligned}
 & \text{OTDT} \left(\frac{1 + \tau_1 s}{1 + \tau_2 s} \right) \left(\frac{1}{1 + \tau_3 s} \right) T_0 + K_3 (P - P') - f_1(\Delta q) \\
 & \left\{ K_1 - K_2 \left(\frac{1 + \tau_4 s}{1 + \tau_5 s} \right) \left[T \left(\frac{1}{1 + \tau_6 s} \right) - T' \right] \right\} \quad (1)
 \end{aligned}$$

$$\begin{aligned}
 & \text{OPDT} \left(\frac{1 + \tau_1 s}{1 + \tau_2 s} \right) \left(\frac{1}{1 + \tau_3 s} \right) T_0 \\
 & \left\{ K_4 - K_5 \left(\frac{\tau_7 s}{1 + \tau_7 s} \right) \left(\frac{1}{1 + \tau_6 s} \right) T - K_6 \left[T \left(\frac{1}{1 + \tau_6 s} \right) - T'' \right] - f_2(\Delta q) \right\} \quad (2)
 \end{aligned}$$

4.

5

Lead Controller for T , Lag Compensator for T_{avg} , Lag Compensator for T , Lead Controller for T_{avg} 4가
 Rate-lag Controller for T_{avg}

2 5

			OPDT (C4)	OTDT (C3)	
RTD		1=12 3,6=0 4=22	3.420	6.902	
RTD	1	<u>1=8</u> <u>3,6=2</u> 4=20	4.825	9.256	RTD 3.5% 1% OTDT C3 가 1
	2	<u>1=8</u> 3,6=0 <u>4=20</u>	2.774	7.574	
	3	1=12 <u>3,6=2</u> <u>4=20</u>	4.263	9.032	
	4	<u>1=8</u> <u>3,6=2</u> 4=22	4.825	9.051	
	5 ()	1=12 <u>3,6=2</u> 4=22	4.263	8.827	

6-6 LOOP 1,2,3 Lead/Lag

OPDT, OTDT

($\tau_3=0, \tau_6=0$).

DT OTDT

Lag

(DT)

가 0

OPDT

2

C4

가 3.42%, C3

6.9%

C3, C4 가

가

Fig.7-10

T_{avg} DT

($\tau_3=2, \tau_6=2$)

1 12 8

4 22 20

(DT)

OPDT, OTDT

DT OTDT

2 1

C4

가 4.8%, C3

9.2% 가

2

T_{avg} DT

0

1 12 8

4 22

20

2

C4

가 2.7%, C3

7.5%

5.

RTD

1

		RTD	RTD	
1	Lead Controller for T	12	8	OPDT, OTDT
3	Lag Compensator for T	0	2	
6	Lag Compensator for T _{avg}	0	2	
4	Lead Controller for T _{avg}	22	20	OTDT
7	Rate-lag Controller for T _{avg}	10	10	OPDT

6.

(C3, C4)

, Lead/Lag Lead

(106% 107%),

, Lead/Lag Lead

2 (Disturbance) 45%가

. Lead Controller for T Lead Controller for T_{avg}

RTD 3.5% 1%

, OTDT C3 가 1

. 1 OTDT Lead/Lag T_{avg} Lead 22 20

OP/OTDT Lead/Lag T Lead 12 8 0

2 가 RCS

Depressurization, RWAP : Rod Withdrawal At Power accident Steam Line Break(Hot Full Power), LOL/TT(Loss of Load/Turbine Trip accident)

1. 1

2. 3,4 Process Control System Scaling Manual WCAP- 10378

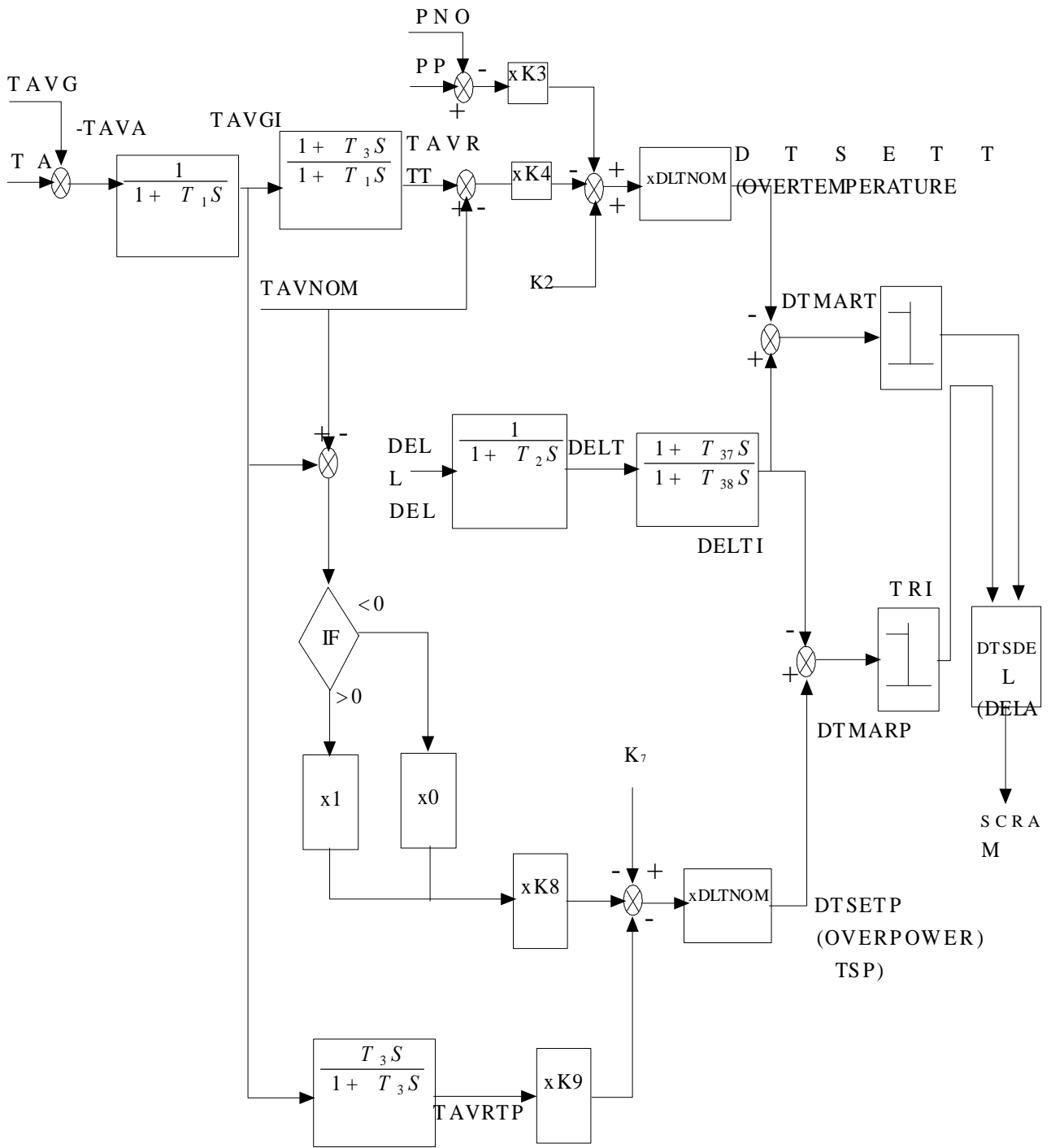
3. OPTOAX use's Manual, WCAP- 12518

4. , “ 1,2,3,4 OTDT/OPDT ” 98 - 194, 98.4

5. Westinghouse, Design Bases for the Thermal Overpower T and Thermal Overtemperature T Trip Function, WCAP- 8745-P-A

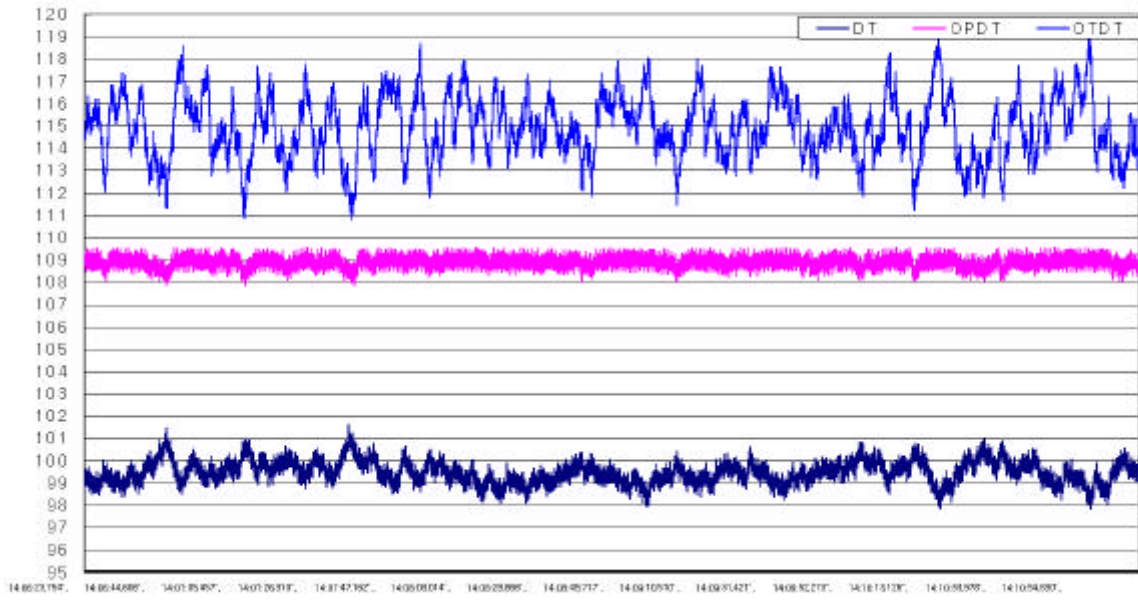
6. , ‘ 가’, 96 , P 309-312

7. , ‘ , , 97 - 232, 1997.6.19



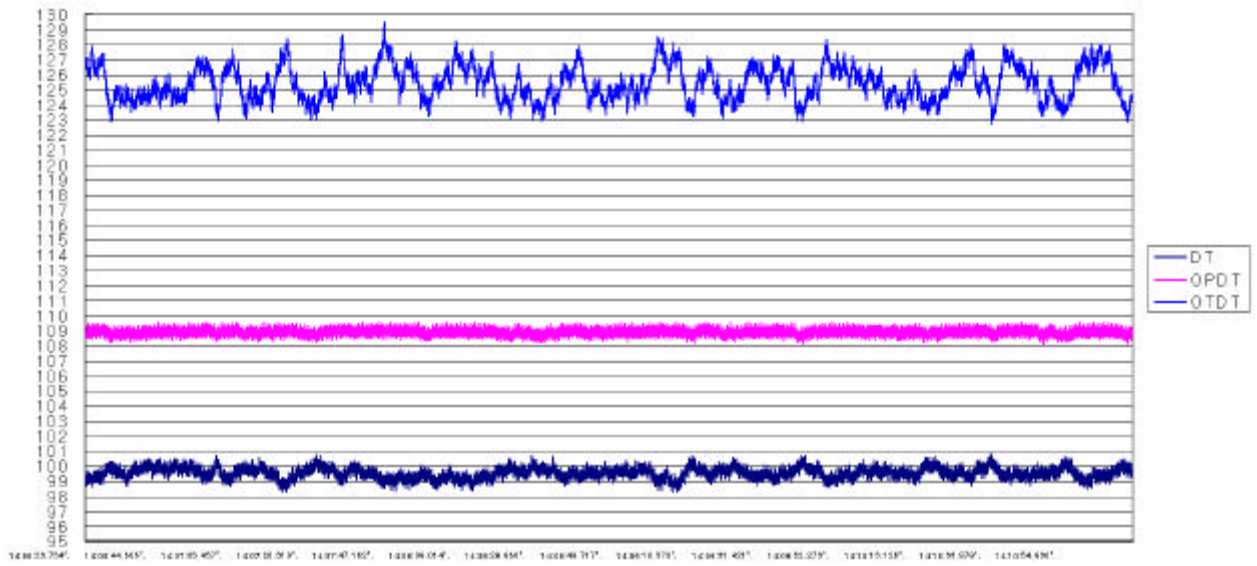
4. OTDT/OPDT

SET1 OPDT/OPDT (RTD 개조전)



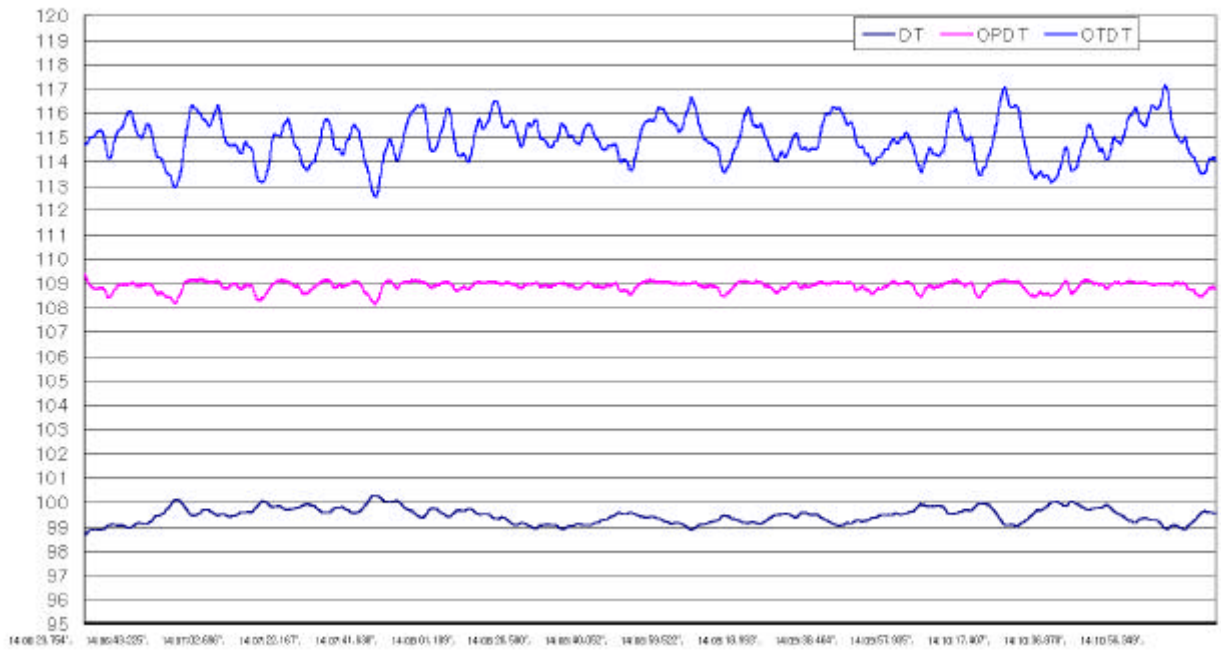
5 OPDT/OTDT (1)

SET2 OPDT/OPDT (RTD 개조전)



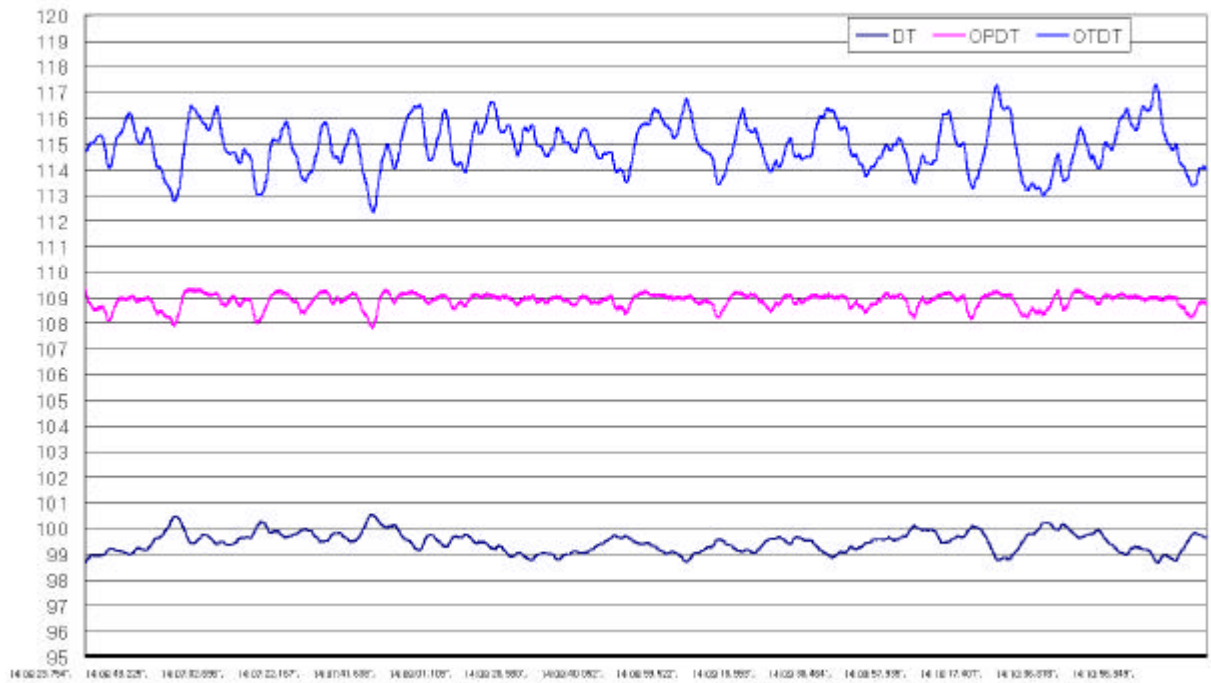
6 OPDT/OTDT (2)

SET1 OTDT/OPDT (RTD 개조후 TAU1=8,TAU3,6=2,TAU4=20 Sec)



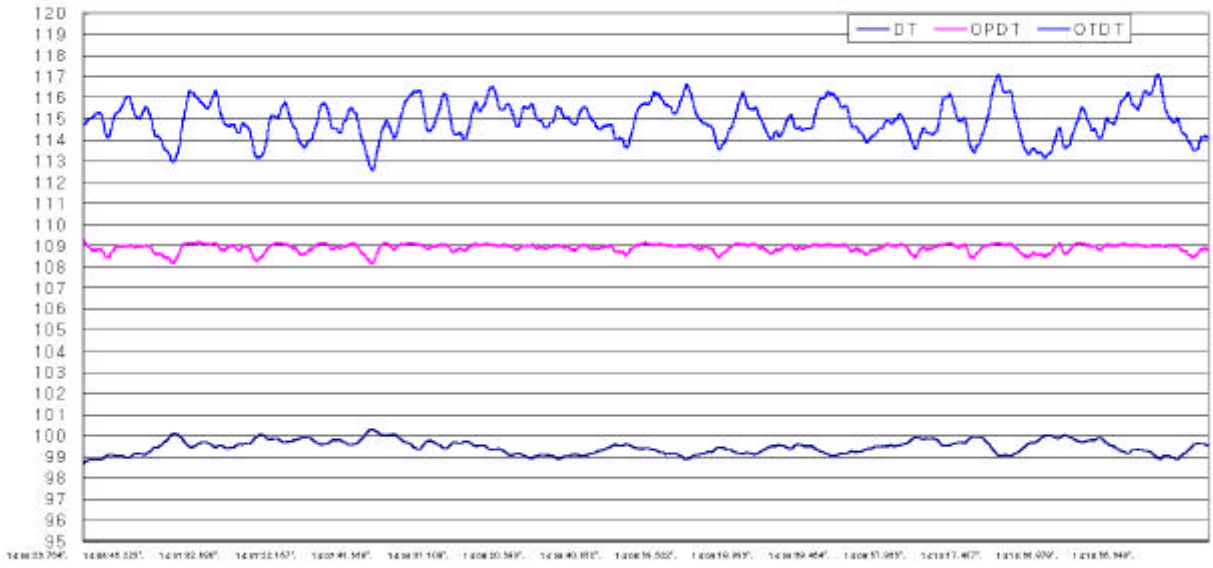
7 OPDT/OTDT (1)

SET1 OTDT/OPDT (RTD 개조후 TAU1=12,TAU3,6=2,TAU4=22 Sec)



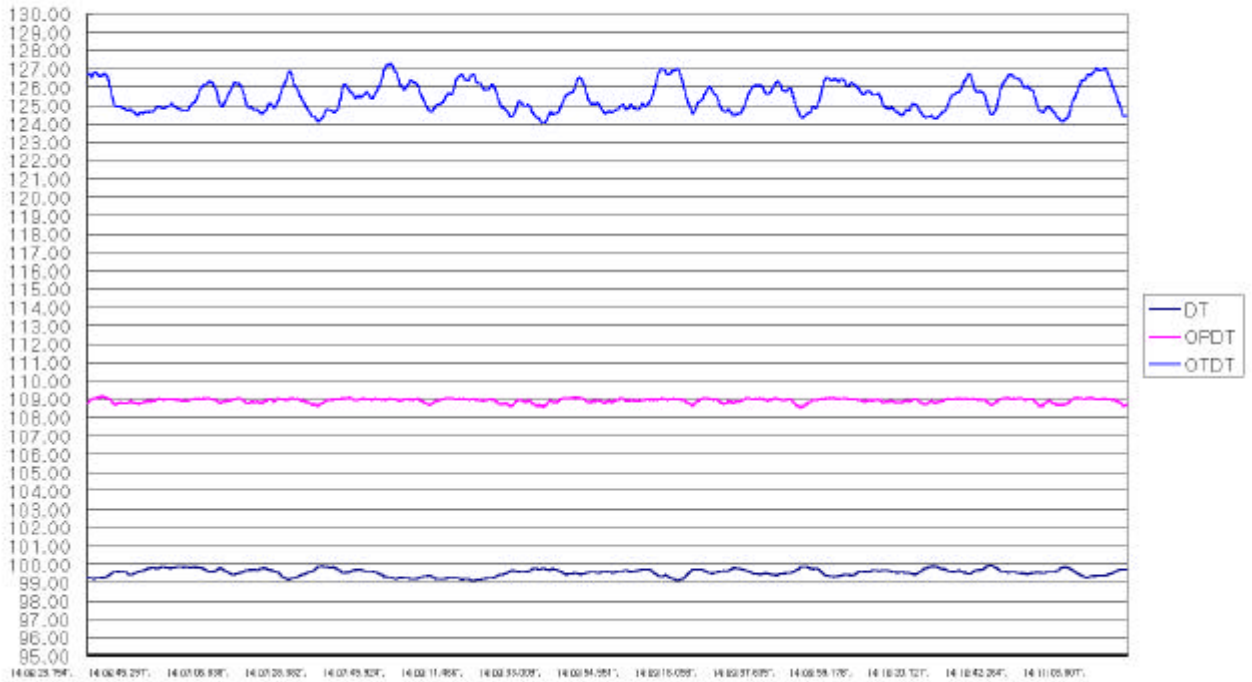
8 OPDT/OTDT (2)

SET1 OTDT/OPDT (RTD 개조후 TAU1=8,TAU3,6=0,TAU4=20 Sec)



9. OPDT/OTDT (3)

SET2 OTDT/OPDT (RTD 개조후 TAU1=8,TAU3,6=2,TAU4=20 Sec)



10. OPDT/OTDT (4)