PSEG

Public Service Electric and Gas Company 80 Park Place Newark, N.J. 07101 Phone 201/430-7000

March 3, 1980

Mr. Denwood F. Ross, Jr., Acting Director
Division of Project Management
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Ross:

MODIFICATION OF SMALL-BREAK LOSS-OF-COOLANT
ACCIDENT OPERATOR GUIDELINES
SALEM GENERATING STATION
UNIT NO. 1
DOCKET NO. 50-272

In compliance with your letter of December 27, 1979 to Cordell Reed, our response is attached.

If you have any questions, please do not hesitate to contact us.

Very truly yours,

Frank P. Librizzi
General Manager -
Electric Production

Attachment

CENTENNIAL OF LIGHT
1879 1979

8003110 573

G001 s/1
CHANGES: 4 4
ORB#1
ADD: OLSHINSKI
KERRIGAN
BURDOIN
WILLIS
FIELDS
ANDERSON

ATTACHMENT

1. A copy of the detailed error analysis and its effects on the calculation of subcooling temperature margin is attached.

2. The application of the subcooling criterion for HPI termination for non-LOCA events to existing operating procedures has been discussed in the Westinghouse Owner's Group Letter OG-29, dated January 23, 1980 from Cordell Reed to Mr. Denwood F. Ross, Jr.

3. Our calculations show that we have provided a minimum actual margin of 20°F in subcooling temperature indication after discounting the effect of possible maximum instrumentation error. Therefore, we presently do not plan to add any additional instrumentation.

4. Sufficient instrumentation is available on redundant emergency power supplies to permit the operator to perform the actions defined in the procedure for the subcooling criterion for HPI termination.

ERROR ANALYSIS OF THE SUBCOOLING MARGIN READING:

SALEM NUCLEAR GENERATING STATION

PUBLIC SERVICE ELECTRIC & GAS CO.

CONTENT: Page No.

NOTE: THE ERRORS IN THE SUBCOOLING MARGIN READINGS FOUND IN THIS ANALYSIS HAVE TO BE APPLIED TO THE MINIMUM INDICATED SUBCOOLING MARGIN SET-POINT OF 50°F.

Prepared by : Bardhan

(Sanjit K. Bardhan)

Date : Feb.22.1980

ANALYSIS OF ERROR IN SIGNAL CHANNELS:

Assumptions: (1) All the sources of error in any instrument (or measurement subsystem) are assumed to be random variables in the statistical sense. E_{ij} represents the random variable due to the j^{th} source of error in the i^{th} instrument in a particular signal channel.

(2) Each E_{ij} is statistically characterized by a Normal (Gaussian) distribution with zero mean (i.e. systematic or bias error is zero) and standard deviation d_{ij}.

(3) Some of the E_{ij}'s may be statistically dependent. The statistical correlation is assumed to be 100% for the sake of conservativeness.

(4) Individual instrument (or measurement subsystem) errors are assumed to be statistically independent (E_i). As $E_i = E_{i1} + E_{i2} + \ldots\ldots$, it will be normally distributed with zero mean and standard deviation d_i.

(5) Any E_{ij}'s contributing less than 1% accuracy to E_i may be neglected.

Derivation:

For zero bias or systematic error in any E_{ij}'s, the accuracy is equal to the precision.

Let, e_{ij} = accuracy (precision) for E_{ij}

e_i = accuracy (precision) for E_i

The random variable E with standard deviation d represents the overall signal channel error and is given by,

$$E = E_1 + E_2 + \ldots\ldots \qquad \ldots \quad \ldots \quad (1)$$

The given accuracy figures e_{ij}'s have confidence levels of better than

95% i.e. the probability is greater than 95% that the true value will be within a range of $\pm e_{ij}$ with respect to the instrument reading due to E_{ij} alone.

$$\therefore \quad e_{ij} = 2d_{ij} \qquad \ldots \qquad \ldots \qquad (2)$$

When $E_{ik}, E_{il}, \ldots$ are statistically dependent, the random variable defined by,

$$E_{ik,l,\ldots} = E_{ik} + E_{il} + \ldots\ldots\ldots \qquad \ldots \qquad \ldots \qquad (3)$$

and is also normally distributed with standard deviation $d_{ik,l,\ldots}$ which is given by,

$$d_{ik,l,\ldots} = d_{ik} + d_{il} + \ldots\ldots \qquad \ldots \qquad \ldots \qquad (4)$$

$$\therefore \quad d_i^2 = d_{i1}^2 + d_{i2}^2 + \ldots\ldots + (d_{ik} + d_{il} + \ldots\ldots)^2$$

$$= (1/2)^2 e_{i1}^2 + (1/2)^2 e_{i2}^2 + \ldots\ldots + (1/2)^2 (e_{ik} + e_{il} + \ldots\ldots)^2 \qquad \ldots \qquad \ldots \qquad (5)$$

$\therefore$ For a confidence level of at least 95% in E_i,

$$e_i^2 = (2d_i)^2 = e_{i1}^2 + e_{i2}^2 + \ldots\ldots + (e_{ik} + e_{il} + \ldots\ldots)^2 \qquad \ldots \qquad (6)$$

$\therefore$ For a confidence level of 95% in the signal channel,

$$e^2 = (2d)^2 = (2d_1)^2 + (2d_2)^2 + \ldots\ldots$$

$$e = \sqrt{e_1^2 + e_2^2 + \ldots\ldots} \qquad \ldots \qquad \ldots \qquad (7)$$

i.e. the overall signal channel accuracy is equal to the square root of the sum of the squares of the individual instrument/or measurement subsystem accuracies and is also defined as the root mean square (rms) error. It may be expressed either in units of a physical variable or in percentage of a reference span.

A. Errors in the Reactor Temperature Measurement Channel as used in the Subcooling Margin Calculations:

Reference Span = 700 °F

Regular Channel:

Incore Thermocouple ⟶ Computer Signal Conditioner ⟶ Computer

Normal Operating Condition:

Thermocouple:

Combined accuracy (e_1) ... ... = $\pm$ 5 °F

(Mr. Wassel, W, Tel. Con. 2.7.80) = $\pm$ 0.7143 %

Computer Signal Conditioner:

Dependent accuracies:

Reference accuracy (e_{21}) ... = $\pm$ 0.05 %

Drift (e_{22}) ... ... = $\pm$ 0.05 %

Independent accuracies:

Repeatability (e_{23}) ... ... = $\pm$ 0.05 %

Resolution (e_{24}) ... ... = $\pm$ 0.025 %

$$\therefore e_2 = \pm\sqrt{(e_{21} + e_{22})^2 + e_{23}^2 + e_{24}^2}$$

$$= \pm\sqrt{(0.05 + 0.05)^2 + 0.05^2 + 0.025^2} = \pm 0.115 \%$$

The channel accuracy is given by,

$$e(nl) = \pm\sqrt{e_1^2 + e_2^2} = \pm\sqrt{0.7143^2 + 0.115^2} = \pm 0.7235 \%$$

$$= \pm 5.1 \ ^{\circ}F$$

Small Break LOCA Condition:

The effects of a small break LOCA are assumed to result in a containment temperature of 165 °F and a corresponding pressure of 8 psig.

The channel accuracy is not affected by the changes in the environment as the components in this channel are unaffected by it. Hence, the channel accuracy e(al) = e(nl) = $\pm$ 5.1 °F

Back-up Channel #1:

Incore Thermocouple ⟶ Precision Chart Recorder

Normal Operating Condition:

Thermocouple:

Combined accuracy (e_1) = $\pm$ 0.7143 %

(From Reg. Ch.)

Test Instruments:

Combined accuracy (e_8) ... ... $= \pm 0.1\ \%$

Precision Chart Recorder:

Independent accuracies:

Accuracy (e_{31}) ... ... $= \pm 0.2\ \%$

Resolution (e_{32}) ... ... $= \pm 0.07\ \%$

Reading error (e_{33}) ... ... $= \pm(1/4)(1/2\ ^{o}F)$

(Mr. Andy Smith, Honeywell, $= \pm 0.125\ ^{o}F$

Tel. Con. 2.13.80) $= \pm 0.018\ \%$

$$\therefore e_3 = \pm \sqrt{e_{31}^2 + e_{32}^2 + e_{33}^2}$$

$$= \pm \sqrt{0.2^2 + 0.07^2 + 0.018^2} \qquad = \pm 0.213\ \%$$

The channel accuracy is given by,

$$e(n2) = \pm \sqrt{e_1^2+e_8^2+e_3^2} = \pm \sqrt{0.7143^2+0.1^2+0.213^2} = \pm 0.752\ \%$$

$$= \pm \underline{\underline{5.26\ ^{o}F}}$$

Small Break LOCA Condition:

The channel accuracy $e(a2) = e(n2) = \pm 0.75\ \% \qquad = \pm \underline{\underline{5.26\ ^{o}F}}$

Back-up Channel #2:

Hot Leg RTD $\longrightarrow$ Amplifier $\longrightarrow$ Isolater $\longrightarrow$ Chart Recorder

Normal Operating Condition:

RTD:

Independent accuracies:

Accuracy (e_{41}) ... ... $= \pm 3\ \%$

(includes process measurement error, reference error per Mr. Dick Miller, W, Tel. Con. 2.7.80)

Calibration Curve accuracy (e_{42}) $= \pm 0.003\ \%$

Test Inst. accuracy (e_{43}) ... $= \pm 0.1\ \%$

$$\therefore e_4 = \pm \sqrt{e_{41}^2 + e_{42}^2 + e_{43}^2}$$

$$= \pm \sqrt{3^2 + 0.003^2 + 0.1^2} \qquad = \pm 3.002\ \%$$

Amplifier:

Combined accuracy (e_5) ... ... $= \pm 0.1\ \%$

Isolater:

Combined accuracy (e_6) ... ... $= \pm 0.1\ \%$

Chart Recorder:

Independent Accuracies:

Accuracy (e_{71})	... ...	$= \pm\ 0.5\ \%$
Repeatability (e_{72})	... ...	$= \pm\ 0.2\ \%$
Deadband (e_{73})	... ...	$= \pm\ 0.1\ \%$
Reading error (e_{74})	... ...	$= \pm (1/4)(10\,^{\circ}F)$
		$= \pm\ 0.36\ \%$

$$\therefore e_7 = \pm \sqrt{e_{71}^2 + e_{72}^2 + e_{73}^2 + e_{74}^2}$$

$$= \pm \sqrt{0.5^2 + 0.2^2 + 0.1^2 + 0.36^2} \qquad = \pm\ 0.656\ \%$$

The channel accuracy is given by,

$$e(n3) = \pm \sqrt{e_4^2 + e_5^2 + e_6^2 + e_7^2}$$

$$= \pm \sqrt{3.002^2 + 0.1^2 + 0.1^2 + 0.656^2} \qquad = \pm\ 3.08\ \%$$

$$= \pm\ 21.56\ ^{\circ}F$$

Small Break LOCA Condition:

The channel accuracy e(a3) = e(n3) = $\pm$ 3.08 % $\quad = \pm\ 21.56\ ^{\circ}F$

B. Errors in the Reacter Pressure Measurement Channel as used in the Subcooling Margin Calculations:

Reference Span = 3000 psig

Regular Channel:

Transmitter ⟶ Isolator ⟶ Computer Signal Conditioner ⟶ Computer.

Normal Operating Condition:

Transmitter:

Dependent Accuracies:

Reference accuracy (e_{11}) ... = $\pm$ 0.5 %

Drift (e_{12}) ... ... = $\pm$ 0.5 %

Temperature effects (e_{13}) ... = $\pm$ 0.5 %

Independent Accuracies:

Deadband (e_{14}) ... ... = $\pm$ 0.01 %

$$\therefore e_1 = \pm\sqrt{(e_{11} + e_{12} + e_{13})^2 + e_{14}^2}$$

$$= \pm\sqrt{(0.5 + 0.5 + 0.5)^2 + 0.01^2} = \pm 1.5\ \%$$

Isolator:

Combined accuracy (e_6) ... ... = $\pm$ 0.1 %

Computer Signal Conditioner:

Combined accuracy (e_2) ... ... = $\pm$ 0.115 %
(From Temp. Ch.)

Test Instruments:

Combined accuracy (e_8) ... ... = $\pm$ 0.1 %

The channel accuracy is given by,

$$e(nl) = \pm\sqrt{e_1^2 + e_6^2 + e_2^2 + e_8^2}$$

$$= \pm\sqrt{1.5^2 + 0.1^2 + 0.115^2 + 0.1^2} = \pm 1.51\ \%$$

$$= \pm\ \underline{\underline{45.35\ \text{psig}}}$$

Small Break LOCA Condition:

Transmitter:

Dependent Accuracies:

Reference accuracy (e_{11}) ... = $\pm$ 0.5 %

Drift (e_{12}) ... ... = $\pm$ 0.5 %

*Temperature effects (e_{13}) ... = $\pm$ 3.47 %

Independent Accuracies:

Deadband (e_{14}) ... ... = $\pm$ 0.01 %

$$\therefore e_1 = \pm \sqrt{(e_{11} + e_{12} + e_{13})^2 + e_{14}^2}$$

$$= \pm \sqrt{(0.5 + 0.5 + 3.47)^2 + 0.01^2} = \pm 4.47 \%$$

*Temperature effects at 165 °F are being calculated as the square of the ratio of (165/280) multiplied by the accuracy at 280 °F because the accuracy is affected by the additional heat energy absorbed by the transmitter at an accident condition.

Isolator:
Combined accuracy (e_6) ... ... $= \pm 0.1 \%$

Computer Signal Conditioner:
Combined accuracy (e_2) ... ... $= \pm 0.115 \%$
(From Temp. Ch.)

Test Instruments:
Combined accuracy (e_8) ... ... $= \pm 0.1 \%$

Bias Error (e_b):
Due to rise in the containment pressure from 0 psig (approx) to 8 psig during accident condition, the gage pressure instruments will have bias errors of (-)8 psig. This type of bias error can be factored out with the help of the containment pressure instrumentation. Otherwise it will tend to indicate a lower value for the Subcooling Margin than the actual. For the sake of conservativeness the bias error will not be factored out.

The channel accuracy is given by,

$$e(al) = \pm \sqrt{e_1^2 + e_6^2 + e_2^2 + e_8^2}$$

$$= \pm \sqrt{4.47^2 + 0.1^2 + 0.115^2 + 0.1^2} = \pm 4.474 \%$$

$$= \pm \underline{\underline{134.2 \text{ psig}}}$$

Back-up Channel #1:

Transmitter → Isolator → Chart Recorder

Normal Operating Condition:

Transmitter:
Combined accuracy (e_1) ... ... $= \pm 1.5 \%$
(From Reg. Ch.)

Isolator:
Combined accuracy (e_6) ... ... $= \pm 0.1\ \%$

Chart Recorder:
Combined accuracy (e_7) ... ... $= \pm 0.656\ \%$
(From Temp. Ch.)

Test Instruments:
Combined accuracy (e_8) ... ... $= \pm 0.1\ \%$

The channel accuracy is given by,

$$e(n2) = \pm \sqrt{e_1^2 + e_6^2 + e_7^2 + e_8^2}$$

$$= \pm \sqrt{1.5^2 + 0.1^2 + 0.656^2 + 0.1^2} = \pm 1.643\ \%$$

$$= \pm \underline{\underline{49.3\ \text{psig}}}$$

Small Break LOCA Condition:

Transmitter:
Combined accuracy (e_1) ... ... $= \pm 4.47\ \%$
(From Reg. Ch.)

Isolator:
Combined accuracy (e_6) ... ... $= \pm 0.1\ \%$

Chart Recorder:
Combined accuracy (e_7) ... ... $= \pm 0.656\ \%$

Test Instruments:
Combined accuracy (e_8) ... ... $= \pm 0.1\ \%$

The channel accuracy is given by,

$$e(a2) = \pm \sqrt{e_1^2 + e_6^2 + e_7^2 + e_8^2}$$

$$= \pm \sqrt{4.47^2 + 0.1^2 + 0.656^2 + 0.1^2} = \pm 4.52\ \%$$

$$= \pm \underline{\underline{135.6\ \text{psig}}}$$

Back-up Channel #2:

Transmitter ⟶ Isolator ⟶ Indicator

Normal Operating Condition:

Transmitter:
Combined accuracy (e_1) ... ... $= \pm 1.5\ \%$
(From Reg. Ch.)

Isolater:
Combined accuracy (e_6) ... ... $= \pm 0.1$ %

Indicator:
Independent Accuracies:
Accuracy (e_{91}) ... ... $= \pm 1.0$ %
Linearity(e_{92}) ... ... $= \pm 1.0$ %
Repeatability (e_{93}) ... ... $= \pm 0.5$ %
Deadband (e_{94})... ... ... $= \pm 0.5$ %
Reading error (e_{95}) ... ... $= \pm(1/4)(50 \text{ psig})$
$= \pm 12.5$ psig
$= \pm 0.42$ %

$$\therefore e_9 = \pm \sqrt{e_{91}^2 + e_{92}^2 + e_{93}^2 + e_{94}^2 + e_{95}^2}$$

$$= \pm \sqrt{1^2 + 1^2 + 0.5^2 + 0.5^2 + 0.42^2} = \pm 1.64 \%$$

Test Instruments:
Combined accuracy (e_8) ... ... $= \pm 0.1$ %

The channel accuracy is given by,

$$e(n3) = \pm \sqrt{e_1^2 + e_6^2 + e_9^2 + e_8^2}$$

$$= \pm \sqrt{1.5^2 + 0.1^2 + 1.64^2 + 0.1^2} \qquad = \pm 2.23 \%$$

$$= \pm \underline{\underline{66.8 \text{ psig}}}$$

Small Break LOCA Condition:

Transmitter:
Combined accuracy (e_1) ... ... $= \pm 4.47$ %
(From Reg. Ch.)

Isolator:
Combined accuracy (e_6) ... ... $= \pm 0.1$ %

Indicator:
Combined accuracy (e_9) ... ... $= \pm 1.64$ %
(From Norm. Cond.)

Test Instruments:
Combined accuracy (e_8) ... ... $= \pm 0.1$ %

The channel accuracy is given by,

$$e(a3) = \pm \sqrt{e_1^2 + e_6^2 + e_9^2 + e_8^2}$$

$$= \pm \sqrt{4.47^2 + 0.1^2 + 1.64^2 + 0.1^2} \qquad = \pm 4.77 \%$$

$$= \pm \underline{\underline{142.9 \text{ psig}}}$$

C. Errors in the Reactor Subcooling Margin Calculations:

The Subcooling Margin is given by,

$$\Delta T = T_{sat} - T_{act}$$
$$= T(P) - T_{act} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (C\text{-}1)$$

where, $T(P)$ = A non-linear function of the coolant pressure in ^{o}F. It is found from the Steam Table (ASME) for a given pressure level.

$\therefore$ Total Error in $\Delta T = \pm$ Error in $T(P) \pm$ Error in T_{act}

$$\text{Or, } e_{\Delta T} = (\pm e_P \pm e_T)\ ^{o}F \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (C\text{-}2)$$

The worst case results from the maximum positive value of $(\Delta T_{reading} - \Delta T_{act})$. This corresponds to the situation when e_P is positive and e_T negative.

$$\therefore e_{\Delta T} = |e_P| + |e_T| \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (C\text{-}3)$$

The same e_P in psig will result in different e_P's in ^{o}F corresponding to the different coolant pressure levels.

Let, $e_P(jk)$ = The coolant pressure error (psig) in k^{th} pressure instrument channel (k=1,2,3) under j^{th} operating condition (j= normal (n), accident (a)).

$e_{Pi}(jk)$= T_{sat} error (^{o}F) due to $e_P(jk)$ corresponding to the coolant pressure level reading of P_i (i=1,2,3).

$e_T(jk)$ = T_{act} error (^{o}F) in k^{th} temperature instrument channel (k=1,2,3) under j^{th} operating condition.

$$\therefore e_{Pi}(jk) = T(P_i) - T(P=P_i - e_P(jk)) \quad \ldots \quad \ldots \quad (C\text{-}4)$$

The different values for $e_{Pi}(jk)$, $e_P(jk)$ & $e_T(jk)$ are being shown in Table-I. The different values for $e_{\Delta T}$ are being shown in Table-II.

Sample Calculations:

Assumed Pressure Reading P_1 = 1765 psig = 1780 psia
Operating Condition: Small Break LOCA Accident (a)
Pressure Instrument Channel: #2 (BU#1)
Temperature Instrument Channel: #1 (Reg.)
From the Steam Table & equn(C-4),

$$e_{P1}(a2) = T(1780) - T(1780-135.6) = 619.47 - 608.88 = \underline{10.89\ ^{o}F}$$
(shown in Table-I)

The total error in Subcooling Margin is given by,

$$e_{\Delta T}(a21)_{P1} = e_{P1}(a2) + e_T(a1) = 10.89 + 5.1 = \underline{15.99\ ^{o}F}$$
(shown in Table-II)

TABLE-I: TEMPERATURE &PRESSURE CHANNEL ERROR MATRIX AT DIFFERENT OPERATING CONDITIONS & COOLANT PRESSURES.

Operating Condition	Assumed Indicated Pressure (psia)	TEMP CH. ERRORS Reg. °F	BU#1 °F	BU#2 °F	PRESS CH. ERRORS Reg. °F	Reg. psi	BU#1 °F	BU#1 psi	BU#2 °F	BU#2 psi	NOTE
Normal	P_1 = 1780	$e_T(n1)$ = 5.10	$e_T(n2)$ = 5.26	$e_T(n3)$ = 21.56	$e_{P1}(n1)$ 3.57	$e_P(n1)$ = 45.35	$e_{P1}(n2)$ 3.88	$e_P(n2)$ = 49.3	$e_{P1}(n3)$ 5.28	$e_P(n3)$ = 66.8	
	P_2 = 1880				$e_{P2}(n1)$ 3.42		$e_{P2}(n2)$ 3.72		$e_{P2}(n3)$ 5.05		
	P_3 = 2000				2.73 $e_{P3}(n1)$		3.73 $e_{P3}(n2)$		4.27 $e_{P3}(n3)$		
Small Break LOCA Accident	P_1 = 1780	$e_T(a1)$ = 5.10	$e_T(a2)$ = 5.26	$e_T(a3)$ = 21.56	$e_{P1}(a1)$ 10.77	$e_P(a1)$ = 134.2	$e_{P1}(a2)$ 10.89	$e_P(a2)$ = 135.6	$e_{P1}(a3)$ 11.49	$e_P(a3)$ = 142.9	
	P_2 = 1880				$e_{P2}(a1)$ 10.29		$e_{P2}(a2)$ 10.41		$e_{P2}(a3)$ 10.98		
	P_3 = 2000				$e_{P3}(a1)$ 9.98		$e_{P3}(a2)$ 10.09		$e_{P3}(a3)$ 10.64		

TABLE-II: TOTAL SUBCOOLING MARGIN ERROR MATRIX AT DIFFERENT OPERATING CONDITIONS & COOLANT PRESSURES.

	MAXIMUM ERRORS IN PRESSURE & TEMPERATURE CHANNEL COMBINATIONS							
Assumed Indicated Pressure (psia)	Normal Operating Condition: e_P's (°F) ↓ / e_T's (°F) →	Reg: (5.1) $e_T(n1)$	BU#1: (5.26) $e_T(n2)$	BU#2 (21.56) $e_T(n3)$	Small Break LOCA Condition: e_P's (°F) ↓ / e_T's (°F) →	Reg: (5.1) $e_T(a1)$	BU#1 (5.26) $e_T(a2)$	BU#2 (21.56) $e_T(a3)$
P_1=1780	Reg(3.57) $e_{P1}(n1)$	8.67	8.83	25.13	Reg(10.77) $e_{P1}(a1)$	15.87	16.03	32.33
	BU#1(3.88) $e_{P1}(n2)$	8.98	9.14	25.44	BU#1(10.89) $e_{P1}(a2)$	15.99	16.15	32.45
	BU#2(5.28) $e_{P1}(n3)$	10.38	10.54	26.84	BU#2(11.49) $e_{P1}(a3)$	16.59	16.75	32.45
P_2=1880	Reg(3.42) $e_{P2}(n1)$	8.52	8.68	24.98	Reg(10.29) $e_{P2}(a1)$	15.39	15.55	31.85
	BU#1(3.72) $e_{P2}(n2)$	8.82	8.98	25.28	BU#1(10.41) $e_{P2}(a2)$	15.51	15.47	31.97
	BU#2(5.05) $e_{P2}(n3)$	10.15	10.31	26.61	BU#2(10.98) $e_{P2}(a3)$	16.08	16.24	32.54
P_3=2000	Reg(2.73) $e_{P2}(n1)$	7.83	7.99	24.29	Reg(9.98) $e_{P2}(a1)$	15.08	15.24	31.54
	BU#1(3.73) $e_{P2}(n2)$	8.83	8.99	25.29	BU#1(10.09) $e_{P2}(a2)$	15.19	15.35	31.65
	BU#2(4.27) $e_{P3}($	9.37	9.53	25.83	BU#2(10.64) $e_{P3}(a3)$	15.74	15.90	32.20