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Implementation Of Entry Age Normal and Projected Unit Credit Methods in Pension Fund Calculation at Pt. Pasifik Arta Indonesia

[1] **Tua Halomoan Harahap**
Department of Mathematics, Universitas Muhammadiyah Sumatera Utara, Medan, Indonesia
[2] **Ismail Husein**
Department of Mathematics, Universitas Islam Negeri Sumatera Utara, Medan, Indonesia
[3] **Maysarah**
Department of Mathematics, Universitas Islam Negeri Sumatera Utara, Medan, Indonesia
[4] **Wisam Ch. Alisawi**
College of science , University of al Qadisiyah, Iraq
[5] **Abeer H.Jabbar**
Institute of Information Technologies, Russian Technological University RTU MIREA, Moscow, Russia
[6] **Faisal Muhammad**
Department of Applied Mathematics, IPB University, Bogor, Indonesia

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ABSTRACT

Pension funds are financial assets provided to individuals who have retired due to reaching retirement age. PT. Pasifik Arta Indonesia, a company established in Medan for approximately five years, lacks a comprehensive understanding of pension funding, specifically concerning normal contributions and actuarial obligations for employees and agencies using the EAN and PUC methods. This study aims to provide an overview of pension fund calculations at PT. Pasifik Arta Indonesia by comparing the two methods. The results show that normal contributions under the PUC method increase with the length of service, whereas the EAN method maintains constant contributions regardless of service length. Both methods share a common trait: the younger the employee at the time of hiring, the lower the normal contribution. Regarding actuarial obligations, both methods exhibit increasing values with longer service, with the EAN method resulting in higher obligations compared to the PUC method.

Corresponding Author:

Tua Halomoan Harahap,
Department of Mathematics,
Universitas Muhammadiyah Sumatera Utara, Medan, Indonesia
Email: tuahalomoanharahap@gmail.com

1. INTRODUCTION

Funds are a collection of money in cash or non-cash, while retirement is when someone stops working because they have reached the maximum working age at their job (Abdullah & Wahjusaputri, 2018) . Pension funds are the best choice that every employee must have to support independence and welfare in the future. Many do not realize that life after not working will continue, especially if they still have family responsibilities. Many people whose productive period can meet their living needs well but after retirement depend on others because they do not have income, savings, investments or pension guarantees. In addition to meeting living needs, a person

also needs to prepare savings for the period after being inactive or retiring until death (Andani, 2023) . To overcome this risk, prevention efforts are made, one of which is by participating in a pension fund program. This program aims to improve the welfare of workers so that they and their families do not experience economic difficulties if the worker has entered old age, retired, or died. A pension program is a program that promises to pay a certain amount of money periodically after its participants stop working because they reach retirement age (Mohamad Nasir, 2016) . In addition, the pension fund program is a form of future planning that aims to guarantee employee retirement (Daulay et al., 2022) . or the method of pension fund payments must be systematic, namely explaining from the initial stage to the end of the completion of the work. This phase is continuous between departments according to their areas of responsibility (Arisca et al., 2023) .

PT. Pasifik Arta Indonesia is one of the companies in Medan. This company is a new branch company that was established for about ±5 years in Medan, therefore the company does not yet have a general picture of pension fund calculations , so in this study the researcher wants to provide a general picture of pension cost calculation planning for this company. Therefore, regarding the amount of normal contributions and actuarial obligations for participants and institutions between EAN and PUC, this study tries to provide a general description of the calculation of pension funds at PT. Pasifik Arta Indonesia using the EAN and PUC methods, so that from these two methods, which method is better for the amount of normal contributions and actuarial obligations for participants and institutions between EAN and PUC.

2. RESEARCH METHOD

Actuarial assumptions are calculations of future changes applied to actuarial valuations. These changes, including changes in assumptions, can occur at any valuation period due to differences in assumptions and reality (Riaman et al., 2018) .

2.1 Mortality Table s

Mortality table is a discrete probability distribution presented in the form of a probability table of age of death. The formulation related to the mortality table is formulated by (Novi et al., 2024) (Izzati & Kartikasari, 2022) :

$$d_x = E_x - E_{x+1} \tag{1}$$

2.2 Commutation Symbol

The commutation symbol is a symbol used to simplify the calculation of the mortality table for an annuity or series of payments (Miranda & Arnellis, 2022) :

- SymbolD_x (Mahrani & Pangestu, 2023)

$$D_x = v^x E_x \tag{2}$$

- SymbolN_x (April, 2020)

$$N_x = \sum_{t=0}^{w-x} D_{x+i} \tag{3}$$

2.3 Annuity

A life annuity is a series of monthly and annual payments made continuously as long as the beneficiary is alive (Miranda & Arnellis, 2022) . The following are the calculations used in calculating pension funds:

- Initial Life Annuity (Rembet et al., 2023)

$$\ddot{a}_x = \frac{N_x}{D_x} \tag{4}$$

- Early Term Annuity (Sulma et al., 2023)

$$a_x = \frac{N_x - N_{x+n}}{D_x} \tag{5}$$

2.4 Basic Actuarial Functions

- Interest Rate Function

The interest function is used to discount future payments to the present (Julianty et al., 2023) .

$$v^x = \frac{1}{(1+i)^x} \tag{6}$$

- Salary Function

If the participant receives a salary increase of Pper year, then the amount of the employee's salary at age $x + n$, based on the salary at age $x$is (Sumiani et al., 2022) (Aprijon, 2020) .

$$S_{x+n} = S_x(1+P)^n \tag{7}$$

- Benefits (Final Salary)

The benefit function is used to determine the amount of benefits paid at retirement age (Muchlian et al., 2024) (Maysarah & Husein, 2024) (Tobing & Manullang, 2021) .

$$B_r = k(r-e)S_{r-1} \tag{8}$$

- From the pension benefits, the present value of the pension benefits can be calculated. The amount is (Sukono et al., 2021) (Novi et al., 2024) :

$$^{r}(PVFB)_x = B_r \ddot{a}_r v^{r-x}{}_{r-x}p_x \tag{9}$$

2.5 Normal Contribution

Normal contribution (normal cost) is a payment made by participants to the pension fund according to the actuarial valuation method used. Here are some methods that can be used to calculate normal contributions (Syahrini et al., 2020) :

- Age Entry Normal Method
  Formula (Syahrini et al., 2020) :

$$^{EAN\,r}(NC)_x = \frac{v^{x-e}{}_{x-e}p_e}{\frac{N_e - N_r}{D_e}}\ {}^{r}(PVFB)_x \tag{10}$$

- Project Unit Credit Method
  Formula (Hutabalian et al., 2021) :

$$^{PUC\,r}(NC)_x = \frac{^{r}(PVFB)_x}{r-e} \tag{11}$$

2.6 Actuarial Liabilities

Actuarial Liability (AL) is the value that a pension fund must have to fulfill the pension fund's obligations to participants (Dian et al., 2024) .

- Entry Age Normal Method (Dian et al., 2024)

$$^{EAN\,r}(AL)_x = \frac{\frac{N_e - N_x}{D_e}}{\frac{N_e - N_r}{D_e}}\ {}^{r}(PVFB)_x \tag{12}$$

- Project Unit Credit Method (R & Susanti, 2024)

$$^{PUC\,r}(AL)_x = \frac{x-e}{r-e}\ {}^{r}(PVFB)_x \tag{13}$$

This researcher uses employee data at PT. Pasifik Arta Indonesia Medan branch with various ages and salary amounts. In addition, this study uses the Indonesian Population Mortality Table (TMPI) 2023 for men and women (Morbidity, 2023) .

3. RESULT AND ANALYSIS

A PPPK employee with grade IX, male, started to become a participant when the employee was (e= 33 years old),

3.1 Employee 1 is male

A male employee who started work at the age of (e= 42 years), with a retirement age of (r= 60 years), so that the length of service is (n= 18 years) and the final basic salary is IDR 5.000.000/month, with an annual salary increase ($c = 1{,}5\%$). of (i= 6%) and the proportion of the pension benefit value is (k= 2.5 %).

a. Calculating the amount of salary each year

$$S_{x+n} = S_x(1+c)^n$$
$$= Rp\ 60.000.000(1+1{,}5\%)^0$$
$$= Rp\ 60.000.000$$
$$S_{x+n} = S_x(1+c)^n$$
$$= Rp\ 60.000.000(1+1{,}5\%)^{18}$$
$$= Rp\ 78.440.438$$

The following are the results of the large salaries each year which will be shown in the table below:

Table 1. Male

x	n	Sx (gaji/tahun)
42	0	IDR 60,000,000
43	1	IDR60,900,000
44	2	IDR61,813,500
45	3	IDR62,740,703
⋮	⋮	⋮
60	18	IDR78,440,438

b. Calculating the Final Salary Benefit Function (B_r)

$B_r = k(r-e)S_{r-1}$

$B_{60} = 2{,}5\%(60-42)S_{60-1}$

$B_{60} = 2{,}5\%(18)\text{IDR } 77.281.220$

$= \text{IDR } 34.776.549$

c. Calculating actuarial valuation

Calculating the value v^x

$$v^x = \frac{1}{(1+i)^x}$$

$$v^0 = \frac{1}{(1+0{,}06)^0}$$

$= 1$

- Calculating the value D_x

  $D_x = v^x \times E_x$

  $D_0 = v^0 \times E_0$

  $= 1 \times 7.044.346{,}36$

  $= 7.044.346{,}36$

- Calculating the value N_x

  $N_x = D_x + D_{x+1} + \ldots + D_n$

  $N_0 = D_0 + D_{0+1} + \ldots + D_{60}$

  $= 167.649.720{,}5$

- Calculating the value $\ddot{a}_r$

$$\ddot{a}_x = \frac{N_x}{D_x} \Leftrightarrow \ddot{a}_0 = \frac{N_0}{D_0} = \frac{167.649.720{,}5}{7.044.346{,}36} = 23{,}79918759$$

The following table shows the results of the actuarial valuation calculations:

Table 2. Male Calculations

x	v^x	D_x	N_x	$\ddot{a}_x$
0	1	7.044.346,36	167.649.720,5	23,79918759
1	0,943396226	6.893.278,481	160.605.374,1	23,29883735
2	0,88999644	7.005.289,64	153.712.095,6	21,94228983
3	0,839619283	7.069.533,071	146.706.806	20,75197959
4	0,792093663	7.058.886,841	139.637.272,9	19,78176957
⋮	⋮	⋮	⋮	⋮
60	0,030314338	156.971,0357	156.971,0357	1

d. Calculating the present value of pension benefits ($PVFB$)

${}^r(PVFB)_x = B_r \ddot{a}_r v^{r-x}{}_{r-x}p_x$

${}^{60}(PVFB)_{42} = B_{60}\ddot{a}_{60}v^{60-42}{}_{60-42}p_{42}$

${}^{60}(PVFB)_{42} = (\text{IDR } 34.776.549) \times (1) \times (0{,}350343791) \times \left(\frac{5.178.112}{9.278.367}\right)$

$= \text{IDR } 6.799.560$

The following table shows the present value of pension benefits ($PVFB$):

Table 3. The Amount of Present Value of Pension Benefits ($PVFB$) for Male Employee 1

x	${}_{r-x}p_x$	v^{r-x}	${}^r(PVFB)_x$
42	0,558084413	0,350343791	Rp 6.799.560
43	0,576660243	0,371364419	Rp 7.447.436
44	0,592186848	0,393646284	Rp 8.106.836
45	0,597738455	0,417265061	Rp 8.673.806
⋮	⋮	⋮	⋮
59	0,950857976	0,943396226	Rp 31.195.810

e. Calculating the amount of normal contributions(NC)

- Calculating Normal Contributions PUC

$${}^{PUC\,r}(NC)_x = \frac{{}^r(PVFB)_x}{r-e}$$

$$^{PUC\ 60}(NC)_{42} = \frac{^{60}(PVFB)_{42}}{60-42}$$
$$= \frac{\text{IDR } 6.799.560}{18}$$
$$= \text{IDR } 377.753$$

- Calculating Normal Contributions EAN

$$^{EAN\ r}(NC)_x = \frac{v^{x-e}\ {}_{x-e}p_e}{\frac{N_e - N_r}{D_e}}\ {}^{r}(PVFB)_x$$

$$^{EAN\ 60}(NC)_{43} = \frac{v^{43-42}\ {}_{43-42}p_{42}}{\frac{N_{42} - N_{60}}{D_{42}}}\ {}^{60}(PVFB)_{43}$$
$$= \frac{(0{,}943396226)(0{,}967787219)}{\frac{7.911.331{,}049 - 156.971{,}0357}{802.832{,}9816}} \times \text{IDR } 7.447.436$$
$$\frac{0{,}913006811}{9{,}658746204} \times \text{IDR } 7.447.436$$
$$= \text{IDR } 703.980$$

The following table shows the results of a comparison of the normal contribution values between PUC with EAN:

Table 4. The Amount of Normal Contribution Values Between PUC With EAN Employee Participant 1 Male

x	$^{PUC\ r}(NC)_x$	$^{EAN\ r}(NC)_x$
42	IDR 377.753	IDR 703.980
43	IDR 438.084	IDR 703.980
44	IDR 506.677	IDR 703.980
45	IDR 578.254	IDR 703.980
⋮	⋮	⋮
59	IDR 31.195.810	IDR 703.980

f. Calculating the amount of actuarial liabilities(AL)

- Calculating Actuarial Liabilities PUC

$$^{PUC\ r}(AL)_x = \frac{x-e}{r-e}\ {}^{r}(PVFB)_x$$
$$^{PUC\ 60}(AL)_{42} = \frac{42-42}{60-42}\ {}^{60}(PVFB)_{42}$$
$$= \frac{0}{18} \times \text{IDR } 6.799.560$$
$$= 0$$

- Calculating Actuarial Liabilities EAN

$$^{EAN\ r}(AL)_x = \frac{\frac{N_e - N_x}{D_e}}{\frac{N_e - N_r}{D_e}}\ {}^{r}(PVFB)_x$$
$$^{EAN\ 60}(AL)_{42} = \frac{\frac{N_{42} - N_{42}}{D_{42}}}{\frac{N_{42} - N_{60}}{D_{42}}}\ {}^{60}(PVFB)_{42}$$
$$= \frac{\frac{7.911.331{,}049 - 7.911.331{,}049}{802.832{,}9816}}{\frac{7.911.331{,}049 - 156.971{,}0357}{802.832{,}9816}} \times \text{IDR } 6.799.560$$
$$= \frac{0}{9{,}658746204} \times \text{IDR } 6.799.560$$
$$= 0$$

The following table shows the results of a comparison of the value of actuarial liabilities between PUC with EAN:

Table 5. Results of Comparison of the Value of Actuarial Liabilities Between PUC With EAN Employee 1 is Male

x	${}^{PUC\,r}(AL)_x$	${}^{EAN\,r}(AL)_x$
42	0	0
43	IDR 413.746	IDR 771.056
44	IDR 900.760	IDR 1.605.636
45	IDR 1.445.634	IDR 2.471.144
⋮	⋮	⋮
59	IDR 29.462.710	IDR 30.491.831

3.2 Employee 2 is female

A female employee who starts work at the age of (e= 40 years), with a retirement age of (r= 60 years), so that the length of service is (n= 20 years) and the final basic salary is IDR 4.500.000/month, with an annual salary increase ($c = 1{,}5\%$). of (i= 6%) and the proportion of the pension benefit value is (k= 2.5 %).

a. Calculating the amount of salary each year

$S_{x+n} = S_x(1+c)^n$
$= \text{IDR } 54.000.000(1+1{,}5\%)^0$
$= \text{IDR } 54.000.000$

The following are the results of the large salaries each year which will be shown in the table below:

Table 6. Annual Salary of Employee 2, Female

x	n	Sx (gaji/tahun)
40	0	IDR 54.000.000
41	1	IDR 54.810.000
42	2	IDR 55.632.150
43	3	IDR 56.466.632
⋮	⋮	⋮
60	20	IDR 72.730.170

b. Calculating the Final Salary Benefit Function (B_r)

$B_r = k(r-e)S_{r-1}$
$B_{60} = 2{,}5\%(60-40)S_{60-1}$
$B_{60} = 2{,}5\%(20)\text{IDR } 71.655.340$
$= \text{IDR } 35.827.670$

∴ So the final salary that the participant will receive upon retirement in one year isIDR 35.827.670

c. Calculating actuarial valuation

- Calculating the value v^x

$v^x = \frac{1}{(1+i)^x}$
$v^0 = \frac{1}{(1+0{,}06)^0}$
$= 1$

- Calculating the value D_x

$D_x = v^x \times E_x$
$D_0 = v^0 \times E_0$
$= 1 \times 6.335.621$
$= 6.335.621$

- Calculating the value N_x

$N_x = D_x + D_{x+1} + \ldots + D_n$
$N_0 = D_0 + D_{0+1} + \ldots + D_{60}$
$= 153.732.647$

- Calculating the value $\ddot{a}_r$

$\ddot{a}_x = \frac{N_x}{D_x} \Leftrightarrow \ddot{a}_0 = \frac{N_0}{D_0} = \frac{153.732.647}{6.335.621} = 24{,}26481114$

The following table shows the results of the actuarial valuation calculations:

Table 7. Calculation of Actuarial Valuation of Female Employee 2

x	v^x	D_x	N_x	$\ddot{a}_x$
0	1	6.335.621	153.732.647	24,26481114
1	0,943396226	6.135.799,057	147.397.026	24,02246629
2	0,88999644	6.179.756,141	141.261.227	22,85870571
3	0,839619283	6.190.218,267	135.081.470,8	21,82176217
⋮	⋮	⋮	⋮	⋮
60	0,03406119	159.540,9337	159.540,9337	1

d. Calculating the present value of pension benefits $(PVFB)$

$${}^{r}(PVFB)_x = B_r \ddot{a}_r v^{r-x}{}_{r-x}p_x$$

$${}^{60}(PVFB)_{40} = B_{60}\ddot{a}_{60}v^{60-40}{}_{60-40}p_{40}$$

$${}^{60}(PVFB)_{40} = (\text{IDR } 35.827.670) \times (1) \times (0{,}311804727) \times \left(\frac{5.262.887}{9.686.907}\right)$$

$$= \text{IDR } 6.069.322$$

The following table shows the present value of pension benefits $(PVFB)$:

Table 8. Present Value of Pension $(PVFB)$Benefits Employee 2 is Female

x	${}_{r-x}p_x$	v^{r-x}	${}^{r}(PVFB)_x$
40	0,543299012	0,311804727	IDR 6.069.322
41	0,558546314	0,33051301	IDR 6.614.032
42	0,566780337	0,350343791	IDR 7.114.228
43	0,582375606	0,371364419	IDR 7.748.578
⋮	⋮	⋮	⋮
59	0,946999631	0,943396226	IDR 32.008.293

e. Calculating the amount of normal contributions(NC)

- Calculating Normal Contributions PUC

$${}^{PUC\ r}(NC)_x = \frac{{}^{r}(PVFB)_x}{r-e}$$

$${}^{PUC\ 60}(NC)_{40} = \frac{{}^{60}(PVFB)_{40}}{60-40}$$

$$= \frac{\text{IDR } 6.069.322}{20}$$

$$= \text{IDR } 303.466$$

- Calculating Normal Contributions EAN

$${}^{EAN\ r}(NC)_x = \frac{v^{x-e}\ {}_{x-e}p_e}{\frac{N_e - N_r}{D_e}}\ {}^{r}(PVFB)_x$$

$${}^{EAN\ 60}(NC)_{41} = \frac{v^{41-40}\ {}_{41-40}p_{40}}{\frac{N_{40} - N_{60}}{D_{40}}}\ {}^{60}(PVFB)_{41}$$

$$= \frac{(0{,}943396226)(0{,}972701813)}{\frac{9.776.714{,}331 - 159.540{,}9337}{941.782{,}2907}} \times \text{IDR } 6.614.032$$

$$= \frac{0{,}91764322}{10{,}21167365} \times \text{IDR } 6.614.032$$

$$= \text{IDR } 594.351$$

The following table shows the results of a comparison of the normal contribution values between PUC with EAN:

Table 9. The Amount of Normal Contribution Values PUC Between EAN Employee 2 Is Female

x	${}^{PUC\ r}(NC)_x$	${}^{EAN\ r}(NC)_x$
40	IDR 303.466	IDR 594.351
41	IDR 348.107	IDR 594.351
42	IDR 395.235	IDR 594.351

43	IDR 455.799	IDR 594.351
⋮	⋮	⋮
59	IDR 32.008.293	IDR 594.351

f. Calculating the amount of actuarial liabilities(AL)

- Calculating Actuarial Liabilities PUC

$$^{PUC\ r}(AL)_x = \frac{x-e}{r-e}\ {}^{r}(PVFB)_x$$

$$^{PUC\ 60}(AL)_{40} = \frac{40-40}{60-40}\ {}^{60}(PVFB)_{40}$$

$$= \frac{0}{25} \times \text{IDR } 6.069.322$$

$$= 0$$

- Calculating Actuarial Liabilities EAN

$$^{EAN\ r}(AL)_x = \frac{\frac{N_e - N_x}{D_e}}{\frac{N_e - N_r}{D_e}}\ {}^{r}(PVFB)_x$$

$$^{EAN\ 60}(AL)_{40} = \frac{\frac{N_{40} - N_{40}}{D_{40}}}{\frac{N_{40} - N_{60}}{D_{40}}}\ {}^{60}(PVFB)_{40}$$

$$= \frac{\frac{9.776.714{,}331 - 9.776.714{,}331}{941.782{,}2907}}{\frac{9.776.714{,}331 - 159.540{,}9337}{941.782{,}2907}} \times \text{IDR } 6.069.322$$

$$= \frac{0}{10{,}21167365} \times \text{IDR } 6.069.322$$

$$= 0$$

The following table shows the results of a comparison of the value of actuarial liabilities betweenPUC with EAN:

Table 10. Comparison Results of the Value of Actuarial Liabilities Between PUC 2 EAN Female Employees

x	$^{PUC\ r}(AL)_x$	$^{EAN\ r}(AL)_x$
40	0	0
41	IDR 330.702	IDR 647.693
42	IDR 711.423	IDR 1.335.976
43	IDR 1.162.287	IDR 2.102.448
⋮	⋮	⋮
59	IDR 30.407.878	IDR 31.413.941

So that the comparison between normal contributions and actuarial obligations is obtained as follows:

Table 11. Normal Contributions with Actuarial Obligations Between ***PUC*** and ***EAN*** Employee 1 is Male

x	n	Normal Contribution		Actuarial Liabilities	
		$^{PUC\ r}(NC)_x$	$^{EAN\ r}(NC)_x$	$^{PUC\ r}(AL)_x$	$^{EAN\ r}(AL)_x$
42	0	IDR 377,753	IDR 703,980	IDR -	IDR -
43	1	IDR 438,084	IDR 703,980	IDR 413,746	IDR 771,056
44	2	IDR 506,677	IDR 703,980	IDR 900,760	IDR 1,605,636
45	3	IDR 578,254	IDR 703,980	IDR 1,445,634	IDR 2,471,144
⋮	⋮	⋮	⋮	⋮	⋮
59	17	IDR 31,195,810	IDR 703,980	IDR 29,462,710	IDR 30,491,831

Table 12. Comparison Results of Normal Contributions with Actuarial Obligations Between PUC with EAN Employee 2 is Female

x	n	Normal Contribution	Actuarial Liabilities

		${}^{PUC\,r}(NC)_x$	${}^{EAN\,r}(NC)_x$	${}^{PUC\,r}(AL)_x$	${}^{EAN\,r}(AL)_x$
40	0	IDR 303,466	IDR 594,351	IDR -	IDR -
41	1	IDR 348,107	IDR 594,351	IDR 330,702	IDR 647,693
42	2	IDR 395,235	IDR 594,351	IDR 711,423	IDR 1,335,976
43	3	IDR 455,799	IDR 594,351	IDR 1,162,287	IDR 2,102,448
⋮	⋮	⋮	⋮	⋮	⋮
59	19	IDR 32,008,293	IDR 594,351	IDR 30,407,878	IDR 31,413,941

In the tables above, there are the results of calculating normal contributions and actuarial obligations from the two methods, namely the EAN (*Entry Age Normal*) method and the PUC (*Project Unit Credit*) method, where from these results, checks or comparisons can be made between the two methods regarding pension funding.

4. CONCLUSION

Based on the discussion above, it can be concluded that the normal contribution from the method PUCwill continue to increase as the length of service goes by while for the EANnominal method it will always be constant or the same even though the length of service increases. However, both of these methods have one thing in common regarding the normal contribution, namely that the younger the age of the employee when he/she enters work, the smaller the normal contribution that will be paid. For the actuarial obligations, the nominal of both methods will increase as the length of service increases, but the method EANis larger in nominal value when compared to the method PUC.

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