

Wisconsin Retirement System

36th Annual Actuarial Valuation of Retired Lives

December 31, 2018



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February 28, 2019

Employee Trust Funds Board
Madison, Wisconsin

Ladies and Gentlemen:

The results of the **36th annual actuarial valuation of core and variable annuities** being paid from the Wisconsin Retirement System are presented in this report. The purpose of this report is to establish the ratio of assets to liabilities in the Core and Variable Funds and to make recommendations for related benefit adjustments in accordance with statutory provisions and administrative code. This report should not be relied on for any other purpose.

The date of this valuation was December 31, 2018. Actuarial assumptions used in the valuation are summarized in the Appendix.

The results of the valuation may be briefly summarized as follows (\$ millions):

	Core	Variable
Number of Annuitants	211,126	41,187
Annual Amount of Annuities Paid	\$ 5,040.9	\$ 425.8
Fund Balance	56,493.8	3,749.1
Actuarial Reserve	56,629.3	4,207.6
Ratio	0.998	0.891

Based upon these results, there is no change in core annuities and variable annuities will be decreased by 10.0%.

This report was prepared at the request of the Wisconsin Retirement System and those designated or approved by the Wisconsin Retirement System. This report may be provided to parties other than the Wisconsin Retirement System only in its entirety and only with the permission of the Wisconsin Retirement System. GRS is not responsible for unauthorized use of this report. The valuation was based upon data furnished by the WRS staff, concerning Fund assets and individual annuitants and beneficiaries. Data was checked for internal consistency, but was not audited. We are not responsible for the accuracy or completeness of the information provided by the Wisconsin Retirement System.

Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of the natural operation of the methodology used for these measurements; and changes in plan provisions or applicable law.

This report includes some risk graphics on page 13, but does not include a more robust assessment of the risks of future experience not meeting the actuarial assumptions. Additional assessment of risks was outside the scope of this assignment. A discussion of various risk factors will be included in the active lives valuation report.

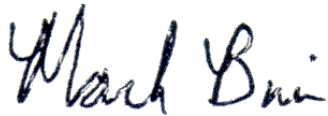
To the best of our knowledge this report is complete and accurate. All calculations have been made in conformity with generally accepted actuarial principles and practices and with the Actuarial Standards of Practice issued by the Actuarial Standards Board. Brian B. Murphy, Mark Buis and James D. Anderson are all Members of the American Academy of Actuaries (MAAA) and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein. The signing actuaries are independent of the plan sponsor.

The cooperation of the Secretary and his staff in gathering materials for this valuation is acknowledged with appreciation.

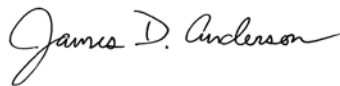
Respectfully submitted,



Brian B. Murphy, FSA, EA, FCA, MAAA



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BBM/MB/JDA:ah



SECTION A

EXECUTIVE SUMMARY

Executive Summary

1. Retiree Dividend in Core Annuities

The Net of fee investment return of -3.66% in the Core annuity fund was lower than the assumed investment return of 7.0% on a market value basis. However, under the asset valuation method, investment gains and losses are spread over a 5-year period. Partial recognition of this year's loss was combined with the continued phase-in of investment gains and losses from prior years resulting in a published effective earnings rate of 5.0%. The 5.0% published effective earnings rate does not exceed the 5.0% assumed investment return threshold that triggers an annuity adjustment. This valuation determined the amount of available surplus/deficit. The deficit in the core fund is \$135.5 million as of December 31, 2018. After adjusting for expected improvements in longevity and various other items (described in detail on page 6), **the result is no change in the core annuity benefit.**

2. Change in Variable Annuities

The variable fund effective earnings rate was -7.0% resulting in a deficit of \$458.5 million. The deficit of \$458.5 million will **result in a 10.0% decrease in all variable annuities in force.**

3. General Comments

Due to the asset smoothing method used in the core annuity fund, there are approximately \$4.9 billion in unrecognized asset losses as of December 31, 2018 which will be recognized over the next four years. Although approximately half of this applies to the annuitant reserve, this will put downward pressure on dividends being granted over the next few years.

The value of previously granted dividends is approximately \$6.9 billion. It is important that the value of dividend payments continue to build up in order to avoid the possibility of leveraged negative adjustments in the future. This buildup will happen naturally as long as investments in the core fund attain the long term investment assumption of 7.0% adopted with the most recent experience study.

Long Term Disability Insurance (LTDI) assets and liabilities were folded into the Core valuation at the beginning of the year. This was a one-time change affecting both assets and liabilities that does not affect the dividend process in a material way.

4. Conclusion

In accordance with the Administrative Code, ETF 20.25, Section 40.27(2) and Section 40.28(2) of the Wisconsin Statutes:

Core annuities will not be changed, and
Variable annuities will be decreased by 10.0%.

SECTION B

OPERATION OF THE SYSTEM

Operation of the Retirement System

Each year, as of December 31, an actuarial valuation of the liability for retired persons receiving benefits from the Wisconsin Retirement System is conducted. The purpose of the valuation is to determine the actuarial present value of future benefit payments on behalf of current retired lives. This present value is the “actuarial reserve.” Theoretically, if an amount of money equal to the actuarial present value were invested at a yield equal to the valuation interest rate, the initial amount plus the continuing investment income would provide exactly the right amount of money to pay the annuities of all current retired persons and their beneficiaries for the rest of their lives. The fund would decrease each year, and would become zero many decades in the future when the last annuitant dies.

The above is a “closed group” description of the operation of the annuity reserve fund. But the fund is really an “open group.” The size of the fund does not actually decrease because each year more benefits are added to the rolls than are removed and fresh money is transferred into the annuity reserve fund to finance the benefits of the new annuitants. (The actuary calculates the reserve transfers for new annuitants each year as a by-product of the actuarial valuation.)

According to theory, the fund will eventually reach a state when the number of people entering (retiring) each year is approximately equal to the number of people exiting (dying) each year. When this mature state is reached, the amount of money in the fund will remain approximately level in constant dollars from year to year. Each year, the reserve transfers for the new annuitants plus real investment earnings on the whole fund (total money in) will be approximately equal to the benefit payments (total money out). The only source of growth in assets would be the result of the effects of inflation. The dollars in the fund would increase, but the “real” value of the fund would not change.

There are at least two factors that cause the actual operation to be different from the theoretical operation described above. The first is that annuitants may have longer or shorter lifetimes than expected. In recognition of this, the actuary monitors mortality experience of the retirement system and recommends a new mortality table when appropriate. The second factor is that actual investment earnings are rarely equal to the assumed rate. When either mortality or investment earnings differ from expectations, the difference, positive or negative, is recorded in a supplemental reserve. The operation of the supplemental reserve is described on the next page.

Operation of the Retirement System

The Wisconsin Retirement System (WRS) maintains separate reserves for core and variable annuities. Each year, the actuary determines the actuarial reserve for core and variable annuities separately. WRS' practice with respect to the use of supplemental reserves is described below.

Core Annuity Division: If the supplemental reserve is positive and is at least 0.5% of core annuity liabilities, core annuity increases (dividends) may be granted. If the supplemental reserve is negative and is equal to or greater than 0.5% of core annuity liabilities in absolute value, prior core annuity dividends are reduced by an aggregate amount equal to the shortfall. Increases or decreases become effective in April following the December 31 valuation.

Variable Annuity Division: If the supplemental reserve is at least 2% of variable annuity liabilities, substantially all of the reserve (dropping fractions of a percent) is used to increase or decrease variable annuities for the ensuing year. Increases or decreases become effective in April following the December 31 valuation.

In calculating both the dividend for the Core annuities and the adjustment for Variable annuities, a 5.0% assumed investment return is used to fund the original benefit. Returns in excess of 5.0% can produce an increase in a member's annuity. Returns below 5% result in a decrease. Please see page 29 for a full description of the statutory provisions.

SECTION C

CORE ANNUITIES

Core Annuity Division Development of Assets and Liabilities

	\$ Millions		Ratio
	Assets	Liabilities	
Ending Balance December 31, 2017	\$54,899.9	\$53,590.0	1.024
Closing Adjustments ¹	308.9	311.2	
Variable Terminations	84.3	84.3	
2018 Core Annuity Average Adjustment: 2.4%	0.0	1,224.7	
Beginning Balance January 1, 2018	55,293.1	55,210.2	1.002
Increases			
Reserve Transfers	3,583.8	3,583.8	
Regular Interest	2,710.1	2,710.1	
Additional Earnings	(102.4)	0.0	
Addition for Experience Study/Mortality Reserve	0.0	115.0	
Other	0.0	1.0	
Total Increases	6,191.5	6,409.9	
Decreases			
Annuities & Lump Sums	4,990.8	4,990.8	
Credit Re-establishments	0.0	0.0	
Subtraction for Experience Study/Mortality Reserve	0.0	0.0	
Other	0.0	0.0	
Total Decreases	4,990.8	4,990.8	
Ending Balance December 31, 2018	\$56,493.8	\$56,629.3	0.998

The ending liability balance includes a data reserve of \$56.6 million and a liability for previously granted dividends of \$6,903 million (prior to any 2019 adjustments).

¹ Includes one-time adjustment for LTDI members.

Reserve Transfer Recommendation

Amounts to be transferred from the Employer Reserve and the Employee Reserve to the Annuity Reserve to cover liabilities for new annuities are computed as the first step in the annual actuarial valuation. The actuarial present value at time of retirement of core annuities reported as new since the last actuarial valuation is \$3,561,202,042. Adjustments to prior transfers, related to estimated annuities for which final computations have now been made, totaled \$22,592,516. Reserve transfers are distributed as follows:

Group	Regular Transfer	Adjustment to Prior Transfer	Total Transfer
General	\$3,065,074,428	\$19,072,995	\$3,084,147,423
Protective with Social Security	375,641,117	2,805,345	378,446,462
Protective without Social Security	87,840,204	193,676	88,033,880
Executive & Elected	32,646,293	520,500	33,166,793
Totals	\$3,561,202,042	\$22,592,516	\$3,583,794,558

Accordingly, we recommend that \$3,583,794,558 be transferred to the Core Annuity Reserve. The results in this report assume that this transfer has been made.

Discussion of Dividend

The Core Annuity Fund balance, \$56,493.8 million, was lower than the actuarial present value of core annuities and reserves, \$56,629.3 million, by \$135.5 million, which resulted in an annuity adjustment of 0.0%. The primary sources of the 0.0% adjustment are:

	% of APV
1. SWIB net of fee investment return	(3.66)%
2. MRA adjustment	8.66%
3. Published effective earnings rate	5.00%
4. Adjustment to relate earnings to average core annuity fund balance	(0.22)%
5. Earnings rate based on average balance	4.78%
6. Expected dividend before adjustments: 1.0478/1.05-1	(0.21)%
7. Adjustment to relate average asset to ending liability	0.03%
8. Carryover from last year due to timing of dividend accounting adjustments and rounding	0.15%
9. Experience study/mortality reserve adjustment	(0.20)%
10. Experience and other effects	(0.01)%
11. Statutory adjustment to round to nearest one-tenth percent	0.04%
12. Computed average dividend rate: (6)+(7)+(8)+(9)+(10)+(11)	(0.2)%
13. Adjustment for members at or near the statutory floor	0.0%
14. Final computed dividend rate: (12)+(13), if greater than 0.5% (or less than -0.5%) of core annuities, otherwise 0%	0.0%

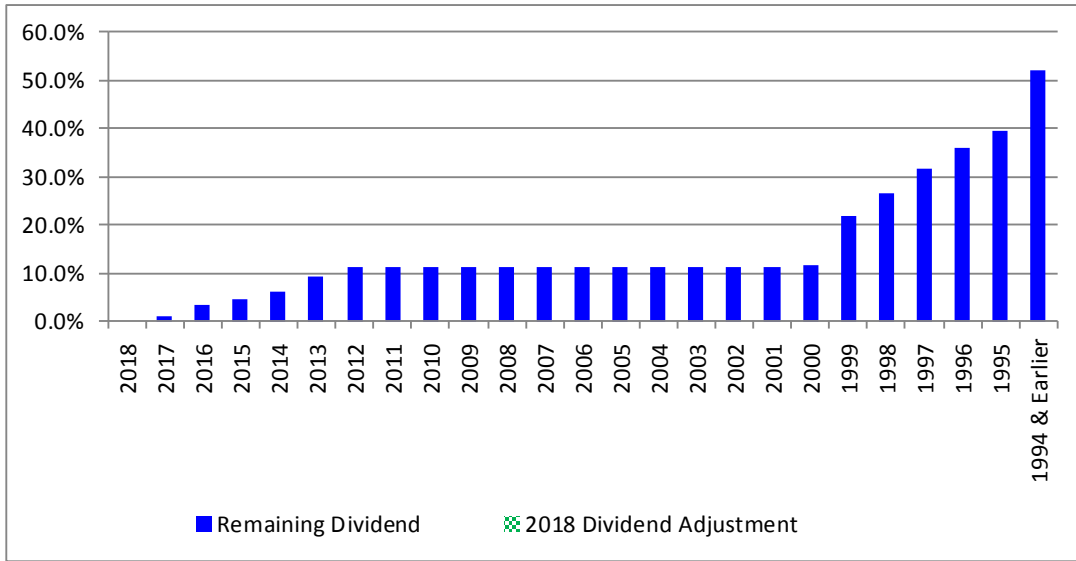
See pages 30 and 31 for a description of items on this page.

In accordance with the Administrative Code, ETF 20.25 and Section 40.27(2) Wisconsin Statutes (shown on page 29 of this report), the dividend adjustment is 0.0% effective April 1, 2019.

Discussion of Dividend

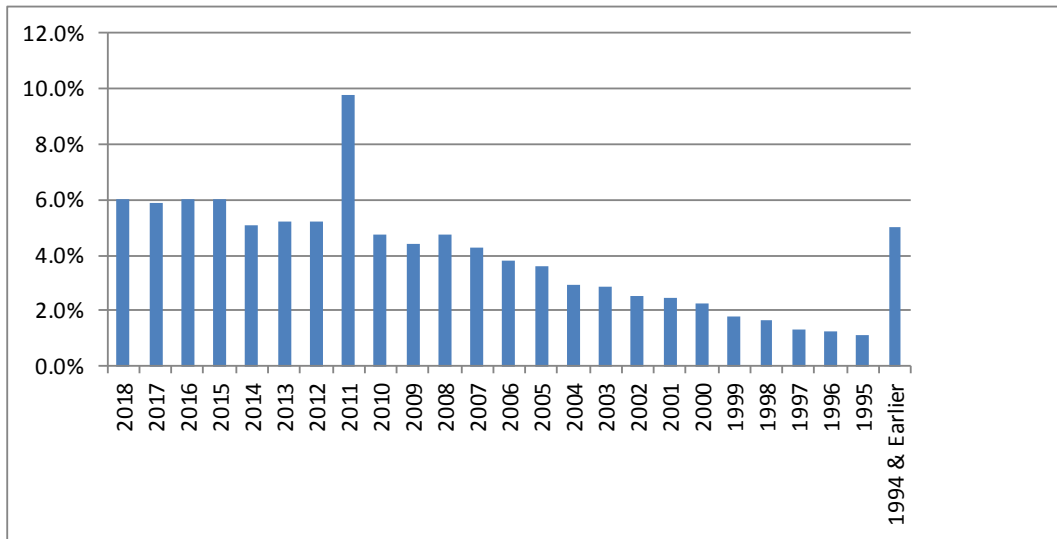
As shown on the prior page, the adjustment for all core fund members is 0.0%.

Dividend Remaining (as a Percentage of Total Benefit) by Year of Retirement



After the 2019 dividend adjustment, members retired prior to 2000 continue to have the highest dividend remaining as a percentage of total benefit and also represent a shrinking portion of the liabilities. The chart below shows liabilities by year of retirement.

Liabilities (as a Percentage of Total) by Year of Retirement



Looking ahead, a few years of spreading positive dividends over all annuitants is needed to decrease the probability of leveraged negative dividends that occurred between 2008 and 2012. Over this period, the liability for dividends decreased from about \$9.2 billion to \$3.0 billion. The value of previously granted dividends is approximately \$6.9 billion as of December 31, 2018. However, there are currently about \$4.9 billion in unrecognized asset losses that will be recognized over the next four years, about half of which will be applied to the annuitant reserve.

Transfers to Annuity Reserve to Finance Core Annuities Approved in 2018 Tabulated by Type of Annuity and Option

Alpha Code	Type of Benefit	Number	Annual Amount	Present Value
REGULAR RETIREMENT				
SL	Straight Life	1,595	\$ 31,969,172	\$ 418,214,333
SL	Straight Life (accelerated)	0	3,876,501	14,721,287
A60	Life Annuity with 60 payments guaranteed	846	17,991,982	249,737,907
A60	Life Annuity with 60 payments guaranteed (accelerated)	0	2,962,275	10,796,555
A180	Life Annuity with 180 payments guaranteed	1,923	38,576,632	558,955,066
A180	Life Annuity with 180 payments guaranteed (accelerated)	0	6,987,983	26,331,763
A180F	Life Annuity with 180 payments guaranteed (forced)	61	490,196	6,046,802
JOINT	Joint and 75% Survivor	853	22,451,617	343,425,133
JOINT	Joint and 75% Survivor (accelerated)	0	3,096,109	11,961,081
R25	Reduced 25% on First Death	421	12,465,067	181,781,743
R25	Reduced 25% on First Death (accelerated)	0	1,455,053	5,690,090
C100	100% Continued to Named Survivor	1,014	22,959,720	352,529,448
C100	100% Continued to Named Survivor (accelerated)	0	3,203,108	12,954,648
C180	100% Continued to Named Survivor with 180 payments guaranteed	3,015	75,163,097	1,195,065,750
C180	100% Continued to Named Survivor with 180 payments guaranteed (accelerated)	0	13,336,928	54,259,175
LOL	Life with Optional Length Guaranteed	2	156,477	1,665,507
AC24	Annuity Certain with 24 Payments	0	35,064	92,118
AC60	Annuity Certain with 60 Payments	2	110,589	533,633
AC120	Annuity Certain with 120 Payments	1	202,267	1,618,563
AC180	Annuity Certain between 24 and 180 Payments	0	151,094	906,168
SLNSD	Straight Life - Named Survivor Deceased	2	29,496	340,181
	Total Regular	9,735	\$ 257,670,427	\$ 3,447,626,951
	Average Age at Retirement	61.3 Years		
DISABILITY RETIREMENT				
SL	Straight Life	40	\$ 1,171,524	\$ 17,374,115
A60	Life Annuity with 60 payments guaranteed	15	313,939	4,513,103
A180	Life Annuity with 180 payments guaranteed	41	1,194,069	17,565,886
JOINT	Joint and 75% Survivor	16	422,447	6,296,816
R25	Reduced 25% on First Death	4	135,614	2,190,158
C100	100% Continued to Named Survivor	26	606,384	10,337,533
C180	100% Continued to Named Survivor with 180 payments guaranteed	88	2,066,339	34,040,062
AC180	Annuity Certain between 24 and 180 Payments	0	2,458	8,705
	Total Disability	230	\$ 5,912,774	\$ 92,326,378
	Average Age at Retirement	53.7 Years		
DEATH-IN-SERVICE BENEFITS				
SL	Straight Life	5	\$ 84,617	\$ 1,149,271
SL	Straight Life (accelerated)	0	23,796	96,590
A60	Life Annuity with 60 payments guaranteed	3	41,878	644,756
A180	Life Annuity with 180 payments guaranteed	62	1,342,664	18,995,832
A180	Life Annuity with 180 payments guaranteed (accelerated)	0	109,083	362,264
	Total Death-in-Service	70	\$ 1,602,038	\$ 21,248,713
	Average Age at Retirement	58.4 Years		
GRAND TOTAL		10,035	\$ 265,185,239	\$ 3,561,202,042

In cases where an individual is receiving more than one annuity, the person only appears once in the above number counts, but the corresponding annual amounts can show up in several different places, depending on the option elected for the different annuities. This can result in, for example, a number count of zero (or a very low number count) combined with a significant annual dollar amount in the above table.

Core Annuities Being Paid Tabulated by Type of Annuity and Option

Alpha Code	Type of Benefit	Number	Annual Amount	Present Value
REGULAR RETIREMENT				
SL	Straight Life	27,833	\$ 580,139,157	\$ 6,247,336,587
SL	Straight Life (accelerated)	0	17,394,935	42,343,604
A60	Life Annuity with 60 payments guaranteed	20,780	436,707,580	4,477,601,633
A60	Life Annuity with 60 payments guaranteed (accelerated)	0	13,014,331	29,767,069
A120	Life Annuity with 120 payments guaranteed	39	406,979	1,128,968
A180	Life Annuity with 180 payments guaranteed	40,637	815,197,086	8,826,018,427
A180	Life Annuity with 180 payments guaranteed (accelerated)	0	34,642,431	88,602,400
A180F	Life Annuity with 180 payments guaranteed (forced)	372	3,088,925	27,611,592
JOINT	Joint and 75% Survivor	23,069	610,386,958	7,086,315,550
JOINT	Joint and 75% Survivor (accelerated)	0	16,128,925	39,015,029
R25	Reduced 25% on First Death	14,028	403,839,452	4,070,759,086
R25	Reduced 25% on First Death (accelerated)	0	6,659,980	16,222,209
C100	100% Continued to Named Survivor	19,510	437,925,012	5,359,233,481
C100	100% Continued to Named Survivor (accelerated)	0	15,078,539	37,476,450
C180	100% Continued to Named Survivor with 180 payments guaranteed	54,206	1,355,531,004	17,834,081,408
C180	100% Continued to Named Survivor with 180 payments guaranteed (accelerated)	0	67,207,275	176,969,032
LOL	Life with Optional Length Guaranteed	36	850,477	5,718,293
LOLF	Life with Optional Length Guaranteed (Forced)	2	38,205	118,956
AC24	Annuity Certain with 24 Payments	2	187,192	190,557
AC60	Annuity Certain with 60 Payments	6	477,190	1,198,942
AC120	Annuity Certain with 120 Payments	14	1,232,953	5,309,003
AC180	Annuity Certain between 24 and 180 Payments	8	1,713,147	7,769,733
C50	50% Continued to One Beneficiary	29	319,012	1,093,465
C50W180	50% Continued to One Beneficiary with 180 Months guaranteed	2	17,172	45,444
C75WSS	75% Continued to One Beneficiary and Social Security Integrated	41	952,521	3,859,327
R25W120	Reduced 25% on Death of Annuitant or Named Survivor with 120 Months guaranteed	1	4,300	12,094
A60WSS	Life with 60 Months Guaranteed and Social Security Integrated	32	160,566	495,971
A180WSS	Life with 180 Months Guaranteed and Social Security Integrated	37	850,096	2,472,812
PF6213	Police and Firemen s.62.13 *	32	1,122,356	3,830,427
SLNSD	Straight Life - Named Survivor Deceased	750	20,638,014	201,834,869
Total Regular		201,466	\$4,841,911,770	\$54,594,432,418

(concluded on next page)

In cases where an individual is receiving more than one annuity, the person only appears once in the above number counts, but the corresponding annual amounts can show up in several different places, depending on the option elected for the different annuities. This can result in, for example, a number count of zero (or a very low number count) combined with a significant annual dollar amount in the above table.

Core Annuities Being Paid Tabulated by Type of Annuity and Option

Alpha Code	Type of Benefit	Number	Annual Amount	Present Value
DISABILITY RETIREMENT				
SL	Straight Life ⁽¹⁾	2,888	\$ 59,638,709	\$ 459,842,752
A60	Life Annuity with 60 payments guaranteed	386	10,097,791	94,122,457
A180	Life Annuity with 180 payments guaranteed	1,045	26,021,364	268,633,745
JOINT	Joint and 75% Survivor	502	11,559,441	125,694,765
R25	Reduced 25% on First Death	206	4,638,799	48,719,478
C100	100% Continued to Named Survivor	1,165	21,169,666	231,097,761
C180	100% Continued to Named Survivor with 180 payments guaranteed	2,067	44,405,496	566,939,400
AC180	Annuity Certain between 24 and 180 Payments	0	2,458	6,462
DWSMC	Disability with Spouse or Minor/Dependent Child	7	160,691	1,294,974
DWOSMC	Disability without Spouse or Minor/Dependent Child	1	12,375	62,414
PF6213	Police and Firemen s.62.13 *	8	125,431	575,992
SLNSD	Straight Life - Named Survivor Deceased	6	188,462	1,970,289
Total Disability		8,281	\$ 178,020,683	\$ 1,798,960,489
DEATH-IN-SERVICE BENEFITS				
SL	Straight Life	241	\$ 3,394,045	\$ 36,347,033
SL	Straight Life (accelerated)	0	89,390	368,136
A60	Life Annuity with 60 payments guaranteed	130	2,311,775	25,335,544
A60	Life Annuity with 60 payments guaranteed (accelerated)	0	46,887	221,837
A180	Life Annuity with 180 payments guaranteed	980	14,227,982	170,028,934
A180	Life Annuity with 180 payments guaranteed (accelerated)	0	617,260	2,049,780
C180	100% Continued to Named Survivor with 180 payments guaranteed	2	11,046	159,390
LOL	Life with Optional Length Guaranteed	6	178,215	1,098,311
A60WSS	Life with 60 Months Guaranteed and Social Security Integrated	18	19,751	78,539
PF6213	Police and Firemen s.62.13 *	2	62,071	219,644
Total Death-in-Service		1,379	\$ 20,958,422	\$ 235,907,148
GRAND TOTAL		211,126	\$ 5,040,890,875	\$ 56,629,300,055

⁽¹⁾Includes 2,152 LTDI members.

In cases where an individual is receiving more than one annuity, the person only appears once in the above number counts, but the corresponding annual amounts can show up in several different places, depending on the option elected for the different annuities. This can result in, for example, a number count of zero (or a very low number count) combined with a significant annual dollar amount in the above table.

*Additional Information for Police and Firemen 62.13 Annuities

	Regular Retirement			Disability Retirement			Death-in-Service Retirement		
	Original	Dividends	Total	Original	Dividends	Total	Original	Dividends	Total
Benefit Amount	\$ 295,534	\$826,822	\$1,122,356	\$ 27,713	\$97,718	\$125,431	\$ 14,477	\$ 47,594	\$ 62,071
Present Value	1,010,293	2,820,134	3,830,427	127,261	448,731	575,992	51,217	168,427	219,644

Core Annuities Being Paid Tabulated by Attained Ages

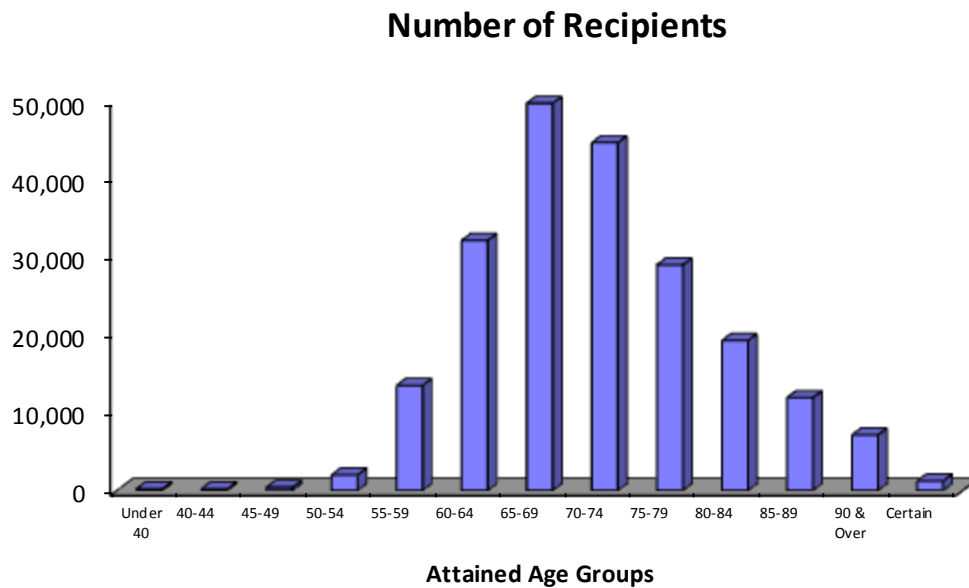
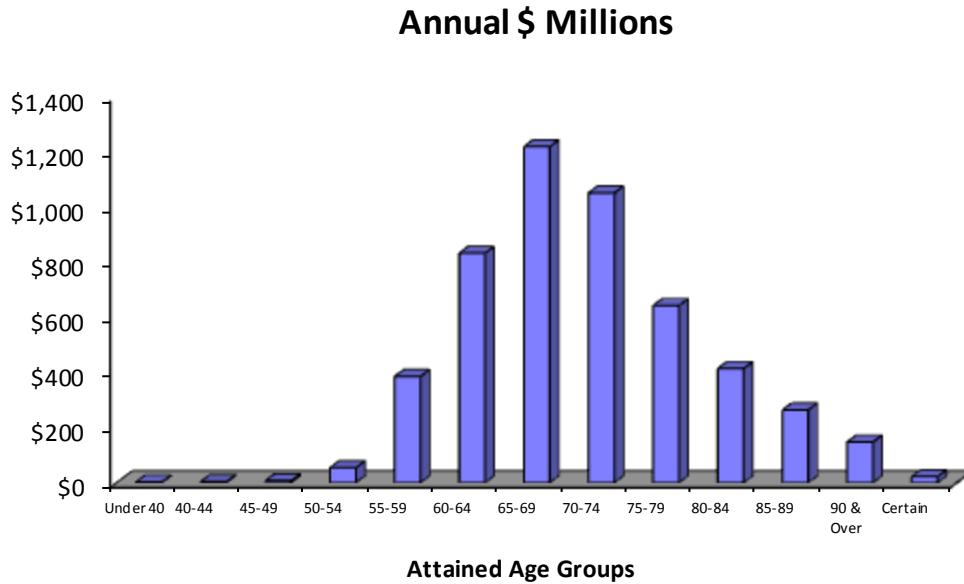
Attained Ages	Regular		Disability		Death-in-Service		Totals	
	No.	Annual Amount	No.	Annual Amount	No.	Annual Amount	No.	Annual Amount
Under 20	0	\$ 0	0	\$ 0	2	\$ 28,514	2	\$ 28,514
20-24	0	0	5	42,731	10	74,679	15	117,410
25-29	0	0	11	196,790	19	115,357	30	312,147
30-34	1	4,527	30	408,385	20	125,815	51	538,727
35-39	0	0	72	1,248,044	36	275,665	108	1,523,709
40-44	10	124,028	169	3,243,639	28	216,642	207	3,584,309
45-49	55	550,918	310	6,151,487	48	457,037	413	7,159,442
50-54	1,296	38,572,158	649	14,991,502	66	773,016	2,011	54,336,676
55-59	12,093	354,322,224	1,255	28,841,188	136	1,969,032	13,484	385,132,444
60-64	30,185	790,329,264	1,687	38,140,654	204	3,397,300	32,076	831,867,218
65-69	48,152	1,183,641,781	1,289	29,371,690	228	4,658,822	49,669	1,217,672,293
70-74	43,417	1,025,014,965	1,014	21,900,913	186	3,400,769	44,617	1,050,316,647
75-79	28,024	624,266,234	778	15,629,875	133	2,106,957	28,935	642,003,066
80-84	18,609	402,377,671	539	10,154,548	90	1,278,949	19,238	413,811,168
85-89	11,519	257,743,844	315	5,216,939	74	733,294	11,908	263,694,077
90-94	5,328	113,024,390	122	2,056,819	39	759,204	5,489	115,840,413
95& Up	1,591	30,779,554	36	425,479	23	128,118	1,650	31,333,151
Certain Only*	1,186	21,160,212	0	0	37	459,252	1,223	21,619,464
Totals	201,466	\$4,841,911,770	8,281	\$178,020,683	1,379	\$20,958,422	211,126	\$5,040,890,875

Averages in Years

Age at retirement	59.8	51.0	52.0	59.5
Attained age	70.9	64.0	67.4	70.6

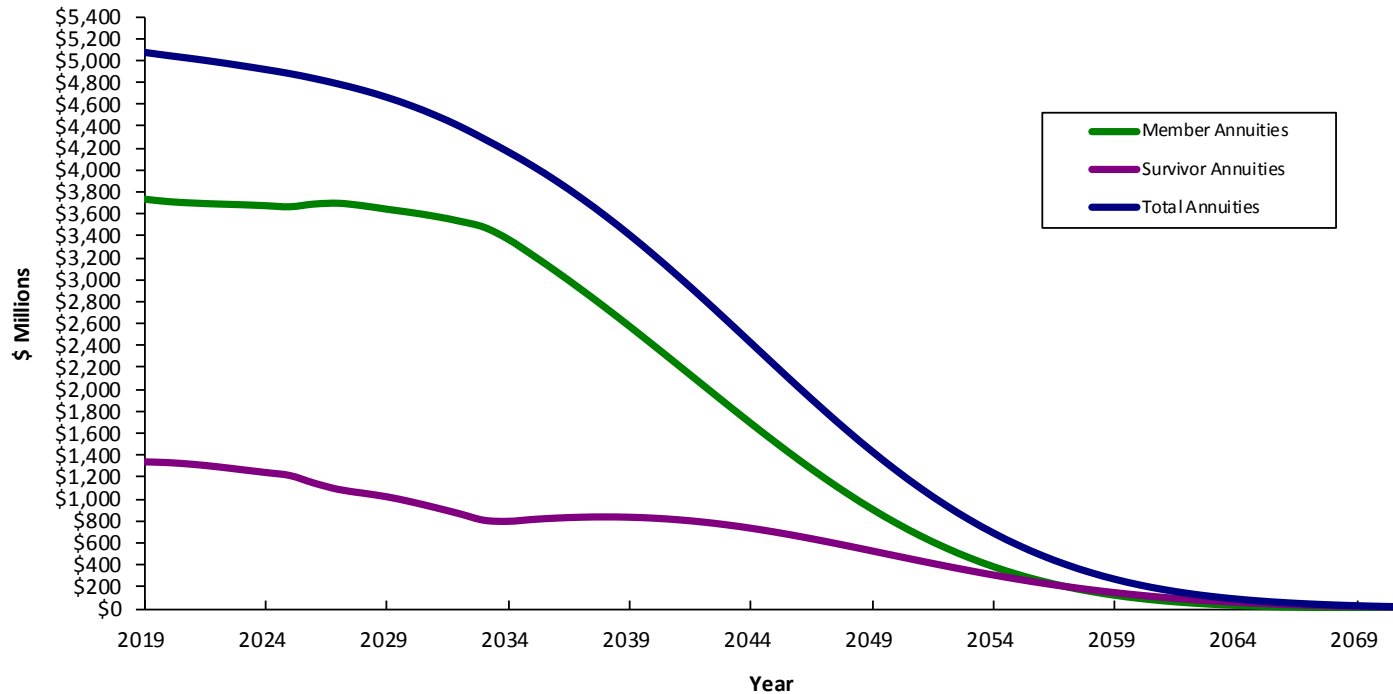
* Certain Only category consists of continuations of 5, 10 and 15-year certain and life annuities to beneficiaries of deceased annuitants.

Core Annuities Being Paid by Attained Age*



* Includes regular and disability retirees and survivor beneficiaries. The “certain” category includes annuities paid for a fixed period which is not dependent upon the age of the recipient.

Projected Future Core Annuity Payments on Behalf of Present Retired Lives Including Present and Future Expected Dividends



	\$ Billions	
	<u>With Expected Dividends</u>	<u>Without Expected Dividends</u>
Total Future Benefit Payments	\$125.6	\$96.5
Present Assets	56.5	56.5
Future Investment Return Needed	69.1	40.0

Based upon the assumptions used in the valuation, future dividends are expected to be a approximately 1.9% per year. Of course actual dividends will be based upon actual future investment return and the operation of the Market Recognition Account.

SECTION D

VARIABLE ANNUITIES

Variable Annuity Division Development of Assets and Liabilities

	\$ Millions		Ratio
	Assets	Liabilities	
Ending Balance December 31, 2017	\$4,324.9	\$3,682.1	1.175
Closing Adjustments	(1.3)	0.0	
Variable Terminations	(84.3)	(84.3)	
2018 Adjustment: 17%	0.0	611.4	
Beginning Balance January 1, 2018	4,239.3	4,209.2	1.007
Increases			
Reserve Transfers	203.2	203.2	
Regular Interest	205.3	205.3	
Additional Earnings	(487.5)	0.0	
Addition for Experience Study/Mortality Reserve	0.0	8.4	
Other	0.0	0.0	
Total Increases	(79.0)	416.9	
Decreases			
Annuities & Lump Sums	411.2	411.2	
Credit Re-establishments	0.0	0.0	
Subtraction for Experience Study/Mortality Reserve	0.0	0.0	
Other	0.0	7.3	
Total Decreases	411.2	418.5	
Ending Balance December 31, 2018	\$3,749.1	\$4,207.6	0.891

Reserve Transfer Recommendation

Amounts to be transferred from the Employer Reserve and the Employee Reserve to the Annuity Reserve to cover liabilities for new annuities are computed as the first step in the annual actuarial valuation. The actuarial present value at time of retirement of variable annuities reported as new since the last actuarial valuation is \$194,174,811. Adjustments to prior transfers, relating to estimated annuities for which final computations have now been made, totaled \$9,016,471. Reserve transfers were distributed as follows:

Group	Regular Transfer	Adjustment to Prior Transfer	Total Transfer
General	\$175,555,435	\$6,873,457	\$182,428,892
Protective with Social Security	13,844,462	1,469,441	15,313,903
Protective without Social Security	2,261,456	28,633	2,290,089
Executive & Elected	2,513,458	644,940	3,158,398
Totals	\$194,174,811	\$9,016,471	\$203,191,282

Accordingly, we recommend that \$203,191,282 be transferred to the Variable Annuity Reserve. The results in this report assume that this transfer has been made.

Discussion of Variable Annuity Change

Variable Annuity Reserves, \$3,749.1 million, were less than the actuarial present value of variable annuities, \$4,207.6 million, by \$458.5 million as of December 31, 2018 or 10.9% of the Actuarial Present Value (APV) of variable annuity payments. In accordance with Section 40.28(2) of the Wisconsin statutes (see page 29 of this report), variable annuities will be decreased by 10.0% effective April 1, 2019. The primary sources of the 10.0% are as follows:

	% of APV
1. SWIB net of fee investment return	(8.0)%
2. Adjustment to published effective rate	1.0%
3. Published effective earnings rate	(7.0)%
4. Adjustment to relate earnings to average variable annuity fund balance	0.2%
5. Earnings rate based on average balance	(6.8)%
6. Expected change before adjustments: $(1-0.068)/1.05-1$	(11.2)%
7. Adjustment to relate average asset to ending liability	(0.4)%
8. Carryover from last year due to timing of distribution, accounting adjustments and truncation	0.7%
9. Experience study/mortality reserve adjustment	(0.2)%
10. Experience and other effects	0.2%
11. Statutory adjustment: (truncate to whole percent)	0.9%
12. Variable annuity change: (6)+(7)+(8)+(9)+(10)+(11)	(10.0)%

Please see pages 30 and 31 for a description of the items on this page.

In accordance with the Administrative Code, ETF 20.25 and Section 40.28(2) Wisconsin Statutes (shown on page 29 of this report), variable annuities will be decreased by 10.0% effective April 1, 2019.

Transfers to Annuity Reserve to Finance Variable Annuities Approved in 2018 Tabulated by Type of Annuity and Option

Alpha Code	Type of Benefit	Number	Annual Amount	Present Value
REGULAR RETIREMENT				
SL	Straight Life	242	\$ 1,999,289	\$ 25,975,513
SL	Straight Life (accelerated)	0	202,504	798,255
A60	Life Annuity with 60 payments guaranteed	120	858,363	11,779,566
A60	Life Annuity with 60 payments guaranteed (accelerated)	0	141,871	549,461
A180	Life Annuity with 180 payments guaranteed	403	2,488,566	35,514,893
A180	Life Annuity with 180 payments guaranteed (accelerated)	0	495,807	1,976,648
A180F	Life Annuity with 180 payments guaranteed (forced)	1	641	7,852
JOINT	Joint and 75% Survivor	160	1,221,615	18,789,658
JOINT	Joint and 75% Survivor (accelerated)	0	219,866	913,972
R25	Reduced 25% on First Death	82	873,369	11,399,013
R25	Reduced 25% on First Death (accelerated)	0	103,263	372,177
C100	100% Continued to Named Survivor	164	1,430,565	19,561,126
C100	100% Continued to Named Survivor (accelerated)	0	163,831	737,618
C180	100% Continued to Named Survivor with 180 payments guaranteed	527	3,513,154	55,747,467
C180	100% Continued to Named Survivor with 180 payments guaranteed (accelerated)	0	855,442	3,598,176
AC24	Annuity Certain with 24 Payments	0	30,039	75,655
AC60	Annuity Certain with 60 Payments	0	7,412	37,989
AC120	Annuity Certain with 120 Payments	0	15,207	119,210
AC180	Annuity Certain between 24 and 180 Payments	0	8,614	90,993
	Total Regular	1,699	\$ 14,629,418	\$ 188,045,242
	Average Age at Retirement	60.4 Years		
DISABILITY RETIREMENT				
SL	Straight Life	11	\$ 71,802	\$ 995,468
A60	Life Annuity with 60 payments guaranteed	6	24,912	356,322
A180	Life Annuity with 180 payments guaranteed	7	41,340	606,490
JOINT	Joint and 75% Survivor	4	29,340	429,549
R25	Reduced 25% on First Death	2	12,978	204,619
C100	100% Continued to Named Survivor	7	31,344	515,962
C180	100% Continued to Named Survivor with 180 payments guaranteed	17	89,062	1,453,696
	Total Disability	54	\$ 300,778	\$ 4,562,106
	Average Age at Retirement	53.5 Years		
DEATH-IN-SERVICE BENEFITS				
SL	Straight Life	1	\$ 7,759	\$ 103,644
A180	Life Annuity with 180 payments guaranteed	18	93,496	1,397,533
A180	Life Annuity with 180 payments guaranteed (accelerated)	0	13,405	66,286
	Total Death-in-Service	19	\$ 114,660	\$ 1,567,463
	Average Age at Retirement	58.8 Years		
GRAND TOTAL		1,772	\$ 15,044,856	\$ 194,174,811

In cases where an individual is receiving more than one annuity, the person only appears once in the above number counts, but the corresponding annual amounts can show up in several different places, depending on the option elected for the different annuities. This can result in, for example, a number count of zero (or a very low number count) combined with a significant annual dollar amount in the above table.

Variable Annuities Being Paid Tabulated by Type of Annuity and Option

Alpha Code	Type of Benefit	Number	Annual Amount	Present Value
REGULAR RETIREMENT				
SL	Straight Life	5,010	\$ 46,757,098	\$ 436,498,555
SL	Straight Life (accelerated)	0	750,972	1,826,028
A60	Life Annuity with 60 payments guaranteed	3,623	34,272,862	308,511,514
A60	Life Annuity with 60 payments guaranteed (accelerated)	0	546,884	1,305,871
A120	Life Annuity with 120 payments guaranteed	11	78,809	228,425
A180	Life Annuity with 180 payments guaranteed	7,886	69,178,078	663,715,651
A180	Life Annuity with 180 payments guaranteed (accelerated)	0	1,761,337	4,779,353
A180F	Life Annuity with 180 payments guaranteed (forced)	35	255,647	1,920,781
JOINT	Joint and 75% Survivor	4,901	58,029,110	593,691,877
JOINT	Joint and 75% Survivor (accelerated)	0	785,500	2,084,936
R25	Reduced 25% on First Death	3,423	53,779,530	453,796,580
R25	Reduced 25% on First Death (accelerated)	0	366,414	840,667
C100	100% Continued to Named Survivor	3,786	39,988,048	413,040,529
C100	100% Continued to Named Survivor (accelerated)	0	613,462	1,557,222
C180	100% Continued to Named Survivor with 180 payments guaranteed	10,698	103,355,270	1,202,186,584
C180	100% Continued to Named Survivor with 180 payments guaranteed (accelerated)	0	2,714,282	7,434,651
LOL	Life with Optional Length Guaranteed	3	58,432	190,863
AC24	Annuity Certain with 24 Payments	0	30,039	61,828
AC60	Annuity Certain with 60 Payments	0	67,986	107,887
AC120	Annuity Certain with 120 Payments	1	120,071	455,540
AC180	Annuity Certain between 24 and 180 Payments	0	437,739	1,960,878
C50	50% Continued to One Beneficiary	17	195,610	599,300
C50W180	50% Continued to One Beneficiary with 180 Months guaranteed	2	22,673	62,983
C75WSS	75% Continued to One Beneficiary and Social Security Integrated	17	154,564	665,157
R25W120	Reduced 25% on Death of Annuitant or Named Survivor with 120 Months guaranteed	1	7,063	19,842
A60WSS	Life with 60 Months Guaranteed and Social Security Integrated	12	54,795	171,311
A180WSS	Life with 180 Months Guaranteed and Social Security Integrated	5	41,799	127,797
SLNSD	Straight Life - Named Survivor Deceased	143	1,711,742	15,422,146
Total Regular		39,574	\$416,135,816	\$4,113,264,756

(concluded on next page)

In cases where an individual is receiving more than one annuity, the person only appears once in the above number counts, but the corresponding annual amounts can show up in several different places, depending on the option elected for the different annuities. This can result in, for example, a number count of zero (or a very low number count) combined with a significant annual dollar amount in the above table.

Variable Annuities Being Paid Tabulated by Type of Annuity and Option

Numeric Code	Alpha Code	Type of Benefit	Number	Annual Amount	Present Value
DISABILITY RETIREMENT					
1	SL	Straight Life	126	\$ 664,635	\$ 6,040,805
3	A60	Life Annuity with 60 payments guaranteed	76	573,452	4,697,684
7	A180	Life Annuity with 180 payments guaranteed	245	1,197,961	11,511,882
10	JOINT	Joint and 75% Survivor	106	881,001	8,305,308
12	R25	Reduced 25% on First Death	43	287,035	2,545,576
14	C100	100% Continued to Named Survivor	231	1,382,482	12,799,006
16	C180	100% Continued to Named Survivor with 180 payments guaranteed	428	2,427,155	26,834,382
30	DWSMC	Disability with Spouse or Minor/Dependent Child	1	615	6,824
Total Disability			1,256	\$ 7,414,336	\$ 72,741,467
DEATH-IN-SERVICE BENEFITS					
1	SL	Straight Life	67	\$ 509,510	\$ 4,872,924
2	SL	Straight Life (accelerated)	0	6,560	4,517
3	A60	Life Annuity with 60 payments guaranteed	28	248,475	1,902,327
4	A60	Life Annuity with 60 payments guaranteed (accelerated)	0	3,579	10,678
7	A180	Life Annuity with 180 payments guaranteed	254	1,420,587	14,442,541
8	A180	Life Annuity with 180 payments guaranteed (accelerated)	0	69,645	337,228
28	A60WSS	Life with 60 Months Guaranteed and Social Security Integrated	8	8,112	30,719
Total Death-in-Service			357	\$ 2,266,468	\$ 21,600,934
GRAND TOTAL			41,187	\$ 425,816,620	\$ 4,207,607,157

In cases where an individual is receiving more than one annuity, the person only appears once in the above number counts, but the corresponding annual amounts can show up in several different places, depending on the option elected for the different annuities. This can result in, for example, a number count of zero (or a very low number count) combined with a significant annual dollar amount in the above table.

Variable Annuities Being Paid Tabulated by Attained Ages

Attained Ages	Regular		Disability		Death-in-Service		Totals	
	No.	Annual Amount	No.	Annual Amount	No.	Annual Amount	No.	Annual Amount
20-24	0	\$ 0	2	\$ 2,028	3	\$ 6,047	5	\$ 8,075
25-29	0	0	3	5,433	3	2,734	6	8,167
30-34	0	0	7	6,319	5	1,341	12	7,660
35-39	0	300	13	39,344	8	12,661	21	52,305
40-44	5	60,666	10	19,526	5	15,993	20	96,185
45-49	15	135,334	22	112,532	20	75,549	57	323,415
50-54	299	3,167,098	81	354,097	15	49,260	395	3,570,455
55-59	2,499	19,388,968	150	544,725	41	193,315	2,690	20,127,008
60-64	5,841	36,183,163	207	833,495	46	266,378	6,094	37,283,036
65-69	8,942	68,313,490	240	1,091,879	55	247,644	9,237	69,653,013
70-74	8,842	95,013,141	183	1,576,941	44	403,761	9,069	96,993,843
75-79	5,100	73,983,503	134	1,420,169	37	349,145	5,271	75,752,817
80-84	3,507	57,890,237	106	854,206	23	159,547	3,636	58,903,990
85-89	2,511	38,994,231	63	387,057	20	199,439	2,594	39,580,727
90-94	1,322	17,089,720	25	134,511	22	178,291	1,369	17,402,522
95 & Up	437	4,186,718	10	32,074	8	72,088	455	4,290,880
Certain Only*	254	1,729,247	0	0	2	33,275	256	1,762,522
Totals	39,574	\$416,135,816	1,256	\$7,414,336	357	\$2,266,468	41,187	\$425,816,620

Averages in Years

Age at retirement	59.2	52.5	52.0	59.0
Attained age	70.8	66.6	68.1	70.7

* Certain only category consists of continuations of 5, 10 and 15-year certain and life annuities to beneficiaries of deceased annuitants.

SECTION E

COMPARATIVE STATEMENTS

Core Annuities Comparative Statement 1984 Through 2018

Valuation Date	Number	\$ Millions				Change in		
		Annual Annuities	Fund Balance	Actuarial Reserve	Ratio	Annuities		CPI*
						Average	Maximum	
1984	60,302	\$ 214.3	\$ 2,255.5	\$ 2,121.3	1.064	6.0 %		4.0 %
1985	62,953	257.6	2,758.2	2,561.0	1.077	7.2 %		3.8 %
1986	65,425	303.5	3,256.9	3,021.2	1.078	7.6 %		1.1 %
1987	67,688	366.9	3,833.7	3,594.6	1.067	6.7 %		4.4 %
1988	70,017	420.6	4,319.6	4,150.9	1.041	4.1 %		4.4 %
1989	73,232	488.7	5,487.4	4,928.1	1.113	11.3 %		4.6 %
1990	77,666	611.3	6,443.8	6,219.1	1.036	3.6 %		6.2 %
1991	79,465	660.4	7,137.8	6,711.3	1.063	6.3 %		3.0 %
1992	81,508	732.3	7,782.4	7,456.6	1.044	4.4 %		3.0 %
1993	83,836	801.7	8,608.2	8,205.3	1.049	4.9 %		2.7 %
1994	86,214	882.2	9,286.2	9,029.6	1.028	2.8 %		2.7 %
1995	88,998	955.8	10,351.7	9,804.1	1.056	5.6 %		2.6 %
1996	92,198	1,065.8	11,699.8	10,977.1	1.066	6.6 %		3.3 %
1997	95,128	1,188.4	13,185.1	12,240.4	1.077	7.7 %		1.7 %
1998	99,112	1,349.5	14,951.8	13,943.0	1.072	7.2 %		1.6 %
1999	102,817	1,513.8	16,857.8	15,687.2	1.075	17.1 % **		2.7 %
2000	107,425	1,867.0	20,517.8	19,405.3	1.057	5.7 %		3.4 %
2001	112,142	2,048.6	21,979.7	21,283.6	1.033	3.3 %		1.6 %
2002	116,289	2,226.6	23,142.4	23,202.9	0.997	0.0 %		2.4 %
2003	121,582	2,364.7	25,071.9	24,724.0	1.014	1.4 %		1.9 %
2004	126,211	2,500.3	26,920.0	26,232.2	1.026	2.6 %		3.3 %
2005	131,674	2,691.4	28,575.3	28,359.7	1.008	0.8 %		3.4 %
2006	137,117	2,843.6	31,180.5	30,273.9	1.030	3.0 %		2.6 %
2007	142,906	3,075.3	35,050.1	32,877.5	1.066	6.6 %		4.1 %
2008	144,033	3,399.3	35,798.1	36,551.5	0.979	(2.1)%	(2.1)%	0.1 %
2009	150,671	3,449.3	36,655.8	37,072.7	0.989	(1.1)%	(1.3)%	2.7 %
2010	155,775	3,532.4	37,798.4	38,148.5	0.991	(0.9)%	(1.2)%	1.5 %
2011	167,453	3,842.0	40,411.5	42,078.3	0.960	(4.0)%	(7.0)%	3.0 %
2012	173,655	3,806.3	40,591.6	41,852.4	0.970	(3.0)%	(9.6)%	1.7 %
2013	180,056	3,800.7	44,273.2	42,300.5	1.047	4.7 %	4.7 %	1.5 %
2014	185,605	4,102.3	47,135.7	45,790.7	1.029	2.9 %	2.9 %	0.8 %
2015	191,795	4,364.9	49,147.0	48,897.5	1.005	0.5 %	0.5 %	0.7 %
2016	197,647	4,523.1	51,972.0	50,941.4	1.020	2.0 %	2.0 %	2.1 %
2017	203,202	4,747.0	54,900.0	53,590.0	1.024	2.4 %	2.4 %	2.1 %
2018	211,126	5,040.9	56,493.8	56,629.3	0.998	0.0 %	0.0 %	1.9 %
35-Year Average						3.7 %		2.6 %
20-Year Average						2.0 %		2.2 %
10-Year Average						0.3 %		1.8 %
5-Year Average						1.6 %		1.5 %

* CPI percentage increase determined by ratio of current year CPI-U67 December index over prior year December index.

** Including 10.6% Act 11 transfer.

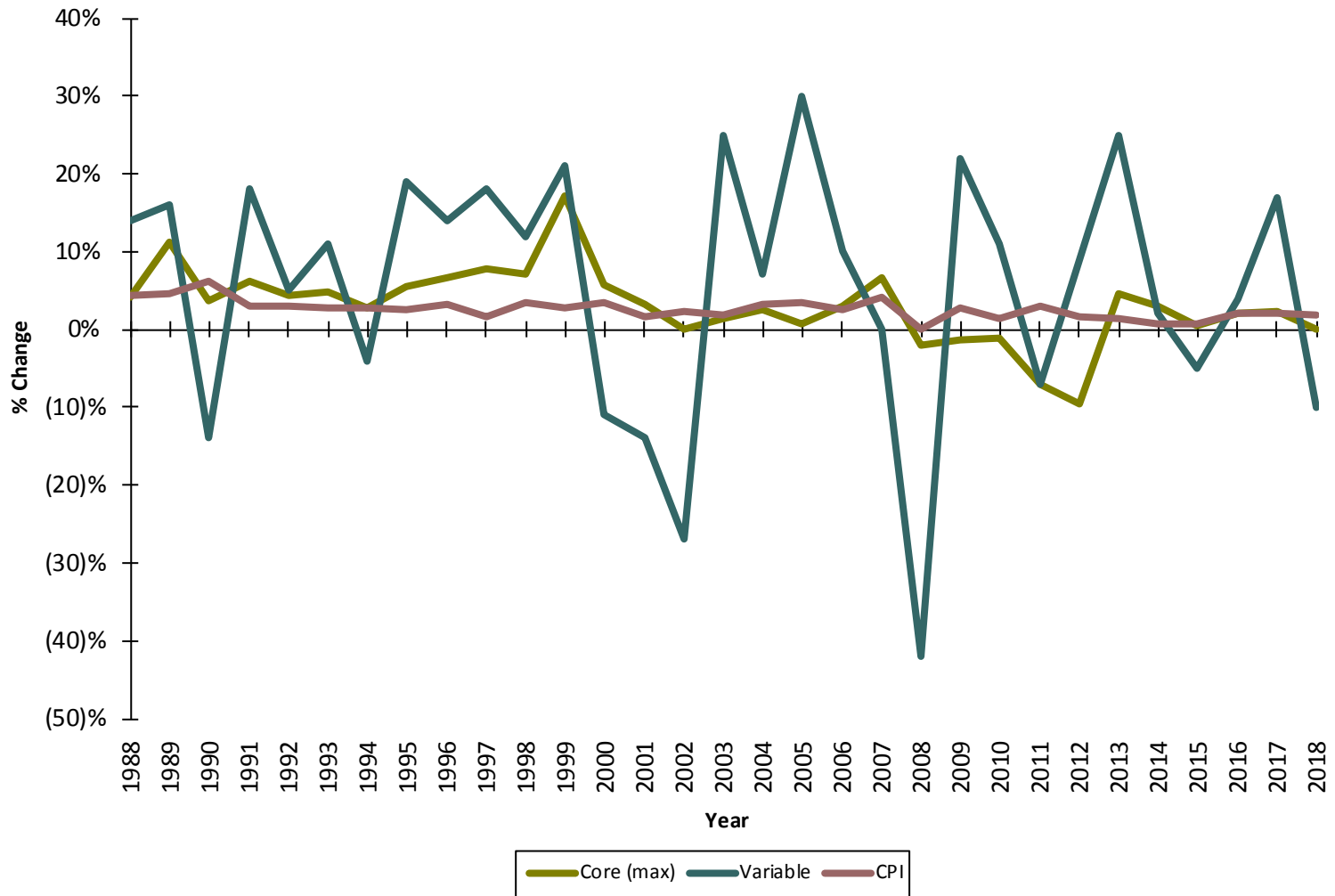
In cases where there is a negative dividend, a maximum decrease is calculated to account for annuitants that are already at the floor and whose dividend cannot be reduced.

Variable Annuities Comparative Statement 1984 Through 2018

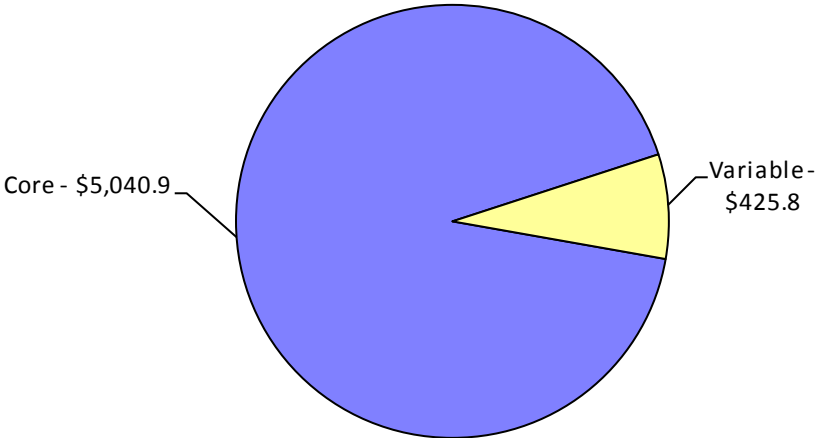
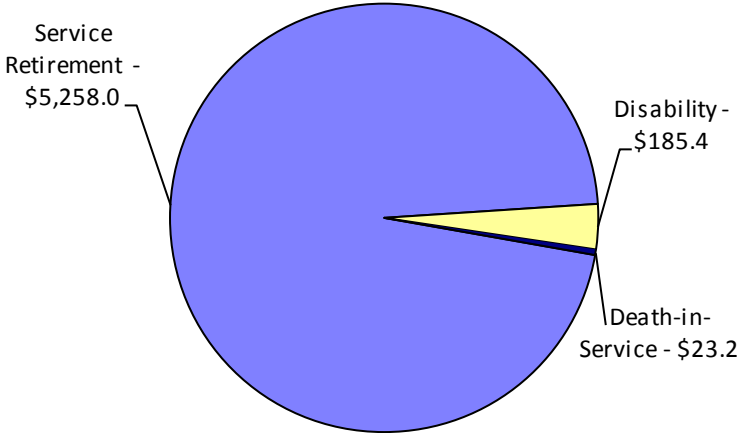
Valuation Date	Number	\$ Millions				Change in	
		Annual Annuities	Fund Balance	Actuarial Reserve	Ratio	Annuities	CPI*
1984	14,520	\$ 34.2	\$ 329.2	\$ 327.5	1.005	0.0 %	4.0 %
1985	15,529	38.0	463.1	366.6	1.263	26.0 %	3.8 %
1986	16,276	51.8	538.7	498.6	1.080	8.0 %	1.1 %
1987	17,084	60.4	548.8	584.2	0.939	(6.0)%	4.4 %
1988	17,779	61.4	682.6	594.0	1.149	14.0 %	4.4 %
1989	18,502	75.9	878.1	756.5	1.161	16.0 %	4.6 %
1990	19,922	101.0	868.6	1,013.4	0.857	(14.0)%	6.2 %
1991	20,538	91.5	1,101.3	929.7	1.184	18.0 %	3.0 %
1992	20,968	112.6	1,208.6	1,147.4	1.053	5.0 %	3.0 %
1993	21,623	123.7	1,407.9	1,268.6	1.110	11.0 %	2.7 %
1994	22,248	144.6	1,418.0	1,487.0	0.954	(4.0)%	2.7 %
1995	22,978	150.2	1,854.2	1,556.0	1.192	19.0 %	2.6 %
1996	23,725	189.8	2,264.9	1,976.7	1.146	14.0 %	3.3 %
1997	24,462	228.2	2,800.0	2,371.5	1.181	18.0 %	1.7 %
1998	25,424	289.5	3,400.5	3,035.5	1.120	12.0 %	1.6 %
1999	26,257	345.8	4,432.9	3,659.1	1.212	21.0 %	2.7 %
2000	27,321	445.3	4,211.4	4,749.3	0.887	(11.0)%	3.4 %
2001	28,314	424.4	3,901.8	4,547.4	0.858	(14.0)%	1.6 %
2002	28,662	374.0	2,899.3	3,999.1	0.726	(27.0)%	2.4 %
2003	29,496	273.3	3,635.9	2,892.2	1.257	25.0 %	1.9 %
2004	30,270	346.0	3,909.9	3,654.5	1.070	7.0 %	3.3 %
2005	31,499	376.5	4,092.7	3,970.7	1.031	3.0 %	3.4 %
2006	32,683	391.8	4,594.2	4,145.2	1.108	10.0 %	2.6 %
2007	33,880	432.6	4,625.0	4,563.7	1.013	0.0 %	4.1 %
2008	34,927	427.0	2,574.5	4,491.0	0.573	(42.0)%	0.1 %
2009	34,836	240.3	3,078.4	2,512.7	1.225	22.0 %	2.7 %
2010	35,866	288.4	3,340.6	3,005.4	1.111	11.0 %	1.5 %
2011	38,949	330.3	3,197.9	3,462.9	0.924	(7.0)%	3.0 %
2012	39,873	304.6	3,463.9	3,169.6	1.093	9.0 %	1.7 %
2013	40,317	324.5	4,187.3	3,347.0	1.251	25.0 %	1.5 %
2014	39,420	386.5	3,995.4	3,917.1	1.020	2.0 %	0.8 %
2015	40,152	387.8	3,704.8	3,910.1	0.947	(5.0)%	0.7 %
2016	40,647	363.6	3,792.0	3,645.1	1.040	4.0 %	2.1 %
2017	40,877	369.9	4,324.9	3,682.1	1.175	17.0 %	2.1 %
2018	41,187	425.8	3,749.1	4,207.6	0.891	(10.0)%	1.9 %
35-Year Average						3.8 %	2.6 %
20-Year Average						0.4 %	2.2 %
10-Year Average						6.2 %	1.8 %
5-Year Average						1.2 %	1.5 %

* CPI percentage increase determined by ratio of current year CPI-U67 December index over prior year December index.

History of % Changes in Annuities and CPI



Annual Annuities Being Paid by Type \$ Millions



Annuities Being Paid Tabulated by Year of Retirement⁽¹⁾ (\$1,000s annually)

Year Ret'd	Core Annuities				Variable Annuities				Avg. Total Annuity
	No.	Initial	Increases	Total	No.	Initial	Increases	Total	
2018	9,620	\$ 254,697	\$ 0	\$ 254,697	1,712	\$ 14,297	\$ 0	\$ 14,297	\$31,205
2017	9,895	250,476	3,311	253,787	1,547	9,431	1,603	11,034	29,779
2016	10,182	254,660	8,808	263,468	1,572	9,301	2,015	11,316	29,477
2015	10,314	253,233	11,822	265,055	1,683	9,837	1,534	11,371	29,704
2014	9,339	212,602	13,776	226,378	1,695	9,425	1,690	11,115	28,246
2013	9,655	210,744	21,979	232,723	1,678	7,341	3,479	10,820	28,178
2012	9,590	207,925	26,561	234,486	1,724	6,320	3,832	10,152	28,613
2011	15,251	380,494	48,994	429,488	3,131	14,528	7,177	21,705	33,671
2010	8,364	189,898	24,340	214,238	1,602	5,673	3,734	9,407	29,493
2009	7,870	179,299	23,116	202,415	1,424	4,143	4,240	8,383	29,474
2008	8,493	197,076	25,330	222,406	1,669	10,211	1,780	11,991	28,203
2007	8,324	180,338	23,205	203,543	1,840	11,638	2,025	13,663	26,252
2006	8,034	163,830	21,131	184,961	1,701	11,388	3,312	14,700	24,926
2005	7,995	159,960	20,682	180,642	1,724	12,068	3,979	16,047	24,766
2004	7,118	134,236	17,393	151,629	1,601	11,335	4,791	16,126	23,748
2003	6,977	133,640	17,315	150,955	1,434	9,305	7,242	16,547	24,084
2002	6,509	120,946	15,652	136,598	1,273	12,507	3,738	16,245	23,558
2001	6,557	121,089	15,684	136,773	1,349	19,740	2,298	22,038	24,324
2000	6,452	117,575	15,328	132,903	1,133	22,501	(143)	22,358	24,210
1999	5,387	85,011	23,851	108,862	956	15,079	3,049	18,128	23,608
1998	5,162	76,943	28,060	105,003	961	13,432	4,654	18,086	23,943
1997	4,273	61,760	28,626	90,386	809	9,585	5,640	15,225	24,867
1996	4,081	58,022	32,858	90,880	828	8,609	6,965	15,574	26,239
1995	3,604	49,296	32,236	81,532	717	6,084	7,029	13,113	26,459
1994	3,181	41,498	29,739	71,237	713	5,823	6,229	12,052	26,483
1993	2,790	34,259	26,734	60,993	620	4,318	5,589	9,907	25,614
1992	2,289	26,411	22,931	49,342	517	3,348	4,726	8,074	25,305
1991	1,959	22,051	21,390	43,441	466	2,650	4,897	7,547	26,474
1990	3,133	36,941	38,812	75,753	788	4,757	6,888	11,645	28,358
1989	2,192	25,420	30,612	56,032	506	2,694	4,952	7,646	29,399
1988	1,432	12,923	17,851	30,774	350	1,415	3,165	4,580	25,003
1987	1,162	9,553	14,493	24,046	317	1,191	2,437	3,628	24,382
1986	971	7,945	13,730	21,675	283	986	2,254	3,240	26,143
1985	855	6,783	13,342	20,125	224	585	1,832	2,417	27,094
1984	569	4,001	8,628	12,629	174	462	1,451	1,913	26,154
1983	432	2,386	5,473	7,859	147	329	1,267	1,596	22,249
1982	274	1,130	2,868	3,998	78	121	570	691	17,176
1981	244	825	2,304	3,129	72	85	385	470	14,935
1980	146	524	1,495	2,019	41	48	278	326	16,066
1979	89	231	735	966	27	24	155	179	12,870
Prior	362	704	2,361	3,065	101	57	408	465	6,185
Total	211,126	\$4,287,335	\$753,556	\$5,040,891	41,187	\$292,671	\$133,146	\$425,817	\$25,893

⁽¹⁾ Includes 2,152 LTDI members based on year of termination.

Liabilities as of December 31, 2018 Tabulated by Year of Retirement⁽¹⁾ (\$1,000s annually)

Year Ret'd	Core Liabilities				Variable Liabilities				Total Liabilities
	No.	Initial	Increases	Total	No.	Initial	Increases	Total	
2018	9,620	\$ 3,395,765	\$ 0	\$ 3,395,765	1,712	\$ 184,599	\$ 0	\$ 184,599	\$3,580,364
2017	9,895	3,284,653	43,623	3,328,276	1,547	122,418	20,812	143,230	3,471,506
2016	10,182	3,291,647	114,622	3,406,269	1,572	116,575	25,251	141,826	3,548,095
2015	10,314	3,244,597	152,588	3,397,185	1,683	124,412	19,405	143,818	3,541,003
2014	9,339	2,688,001	175,821	2,863,822	1,695	118,183	21,186	139,369	3,003,190
2013	9,655	2,658,006	280,051	2,938,057	1,678	92,371	43,777	136,147	3,074,204
2012	9,590	2,620,602	338,153	2,958,755	1,724	79,479	48,192	127,671	3,086,427
2011	15,251	4,901,318	633,789	5,535,107	3,131	181,989	89,901	271,891	5,806,998
2010	8,364	2,370,305	305,816	2,676,121	1,602	69,629	45,833	115,462	2,791,583
2009	7,870	2,214,092	287,064	2,501,156	1,424	49,184	50,334	99,518	2,600,674
2008	8,493	2,375,591	306,810	2,682,401	1,669	119,938	20,863	140,801	2,823,202
2007	8,324	2,150,454	277,689	2,428,142	1,840	135,279	23,533	158,812	2,586,955
2006	8,034	1,913,391	247,583	2,160,974	1,701	129,830	37,758	167,588	2,328,562
2005	7,995	1,811,904	234,870	2,046,774	1,724	133,597	44,051	177,648	2,224,422
2004	7,118	1,480,271	192,075	1,672,346	1,601	124,555	52,643	177,198	1,849,544
2003	6,977	1,449,978	188,030	1,638,008	1,434	100,301	78,061	178,362	1,816,371
2002	6,509	1,272,006	164,863	1,436,869	1,273	133,168	39,805	172,973	1,609,842
2001	6,557	1,222,721	158,497	1,381,218	1,349	197,591	23,000	220,591	1,601,809
2000	6,452	1,143,964	149,150	1,293,114	1,133	217,910	(1,382)	216,528	1,509,643
1999	5,387	791,878	221,157	1,013,035	956	137,196	27,736	164,932	1,177,967
1998	5,162	683,835	249,249	933,084	961	116,464	40,357	156,821	1,089,905
1997	4,273	519,968	240,556	760,524	809	78,932	46,438	125,370	885,894
1996	4,081	466,209	263,233	729,442	828	66,144	53,509	119,652	849,094
1995	3,604	374,294	244,118	618,413	717	44,118	50,982	95,100	713,512
1994	3,181	297,498	213,063	510,561	713	40,768	43,613	84,382	594,943
1993	2,790	234,241	182,726	416,967	620	28,084	36,331	64,415	481,382
1992	2,289	168,628	146,694	315,321	517	20,491	28,923	49,414	364,735
1991	1,959	133,022	129,287	262,309	466	15,074	27,840	42,914	305,222
1990	3,133	220,015	231,116	451,132	788	27,501	39,826	67,327	518,459
1989	2,192	137,949	166,228	304,177	506	14,142	25,993	40,135	344,312
1988	1,432	65,196	90,285	155,481	350	7,006	15,663	22,669	178,150
1987	1,162	44,304	67,058	111,363	317	5,238	10,711	15,948	127,311
1986	971	34,498	60,135	94,634	283	4,295	9,813	14,108	108,742
1985	855	28,549	56,156	84,705	224	2,434	7,617	10,051	94,757
1984	569	15,565	33,800	49,365	174	1,779	5,588	7,367	56,733
1983	432	8,712	20,018	28,730	147	1,174	4,502	5,675	34,405
1982	274	4,423	11,193	15,616	78	417	1,962	2,379	17,995
1981	244	3,159	8,887	12,047	72	315	1,427	1,742	13,789
1980	146	1,893	5,380	7,273	41	155	902	1,056	8,329
1979	89	827	2,603	3,430	27	72	469	541	3,971
Prior	362	2,592	8,740	11,332	101	196	1,380	1,576	12,908
Total	211,126	\$49,726,522	\$6,902,778	\$56,629,300	41,187	\$3,043,001	\$1,164,606	\$4,207,607	\$60,836,908

⁽¹⁾ Includes 2,152 LTDI members based on year of termination.

Comparison of Actual to Expected Deaths Among Retired Lives (Normal Retirement Only) During 2018

Age	Male Deaths			Female Deaths			Total Deaths		
	Actual	Expected	Exposure	Actual	Expected	Exposure	Actual	Expected	Exposure
30-34						1			1
35-39									
40-44			1			10			11
45-49			12			59			71
50-54	3	2	893			526	3	2	1,419
55-59	18	24	5,264	25	21	6,889	43	45	12,153
60-64	73	75	11,731	65	77	18,352	138	152	30,083
65-69	173	196	18,948	156	191	29,664	329	387	48,612
70-74	304	292	17,827	260	267	24,261	564	559	42,088
75-79	333	339	11,932	299	318	15,625	632	657	27,557
80-84	411	416	7,742	424	421	10,806	835	837	18,548
85-89	500	463	4,738	599	567	7,283	1,099	1,030	12,021
90-94	330	306	1,885	557	500	3,801	887	806	5,686
95-99	112	110	411	299	283	1,233	411	393	1,644
100 & Up	15	12	35	76	57	194	91	69	229
Totals	2,272	2,235	81,419	2,760	2,702	118,704	5,032	4,937	200,123
Average Ages	81.3	80.9	71.3	84.2	83.4	71.6	82.9	82.3	71.5

SECTION F

APPENDIX

Actuarial Assumptions Used in the Retired Life Actuarial Valuation

The interest rate used in the valuation was 5.0% a year, compounded yearly, as provided in Section 40.02 of the Wisconsin Statutes. To the extent that unfavorable investment performance reduces current dividends, liabilities would be lower than reported in this valuation. The mortality table used in the valuation was the Wisconsin 2018 Mortality Table, as adopted by the Board in connection with the 2015-2017 Experience Study. This table includes margin for future improvements in mortality by incorporating 60% of the MP-2018 fully generational scale. The impact of the new mortality tables is recognized equally over a three year period.

Single Life Retirement Values Wisconsin Projected Experience Table - 2018 with 5% Interest

Sample Attained Ages in 2018	Present Value of \$1 Monthly for Life		Future Life Expectancy (years)		Probability of Death Next Year	
	Males	Females	Males	Females	Males	Females
40	\$212.90	\$217.54	45.2	48.2	0.098%	0.061%
45	204.56	210.17	40.2	43.1	0.123%	0.092%
50	194.06	201.03	35.2	38.1	0.162%	0.134%
55	181.39	189.92	30.3	33.1	0.378%	0.242%
60	167.14	176.70	25.7	28.3	0.544%	0.351%
65	150.16	160.71	21.3	23.7	0.832%	0.526%
70	130.92	141.69	17.1	19.2	1.352%	0.878%
75	109.41	120.10	13.2	14.9	2.276%	1.590%
80	86.66	96.87	9.7	11.1	4.182%	2.990%
85	65.27	73.75	6.8	7.8	7.818%	6.005%

The values shown above are for non-disabled participants. Sample values for disabled participants are as follows:

Sample Attained Ages in 2018	Present Value of \$1 Monthly for Life		Future Life Expectancy (years)		Probability of Death Next Year	
	Males	Females	Males	Females	Males	Females
40	\$199.47	\$207.80	37.7	41.7	0.141%	0.101%
45	187.81	198.07	32.7	36.7	0.234%	0.153%
50	174.32	186.31	28.0	31.8	0.467%	0.272%
55	158.54	172.30	23.4	27.0	0.632%	0.398%
60	140.06	155.51	19.0	22.4	1.096%	0.612%
65	119.73	135.79	15.0	17.9	1.777%	1.051%
70	97.72	113.71	11.3	13.8	3.073%	1.908%
75	75.52	90.25	8.1	10.1	5.841%	3.608%
80	55.90	67.76	5.7	7.1	10.766%	7.371%
85	39.92	49.64	3.8	4.9	17.368%	12.711%

Statutory Provisions - Post-Retirement Adjustments

Core Annuities - 40.27(2)

“CORE ANNUITY RESERVE SURPLUS DISTRIBUTIONS. Surpluses in the core annuity reserve established under s. 40.04 (6) and (7) shall be distributed by the board if the distribution will result in at least a 0.5% increase in the amount of annuities in force, except as otherwise provided by the department by rule, on recommendation of the actuary, as follows:

(a) The distributions shall be expressed as percentage increases in the amount of the monthly annuity in force, including prior distributions of surpluses but not including any amount paid from funds other than the core annuity reserve fund, preceding the effective date of the distribution. For purposes of this subsection, annuities in force include any disability annuity suspended because the earnings limitation had been exceeded by that annuitant in that year.

(b) Prorated percentages based on the annuity effective date may be applied to annuities with effective dates during the calendar year preceding the effective date of the distribution, as provided by rule, but no other distinction may be made among the various types of annuities payable from the core annuity reserve.

(c) The distributions shall not be offset against any other benefit being received but shall be paid in full, nor shall any other benefit being received be reduced by the distributions. The annuity reserve surplus distributions authorized under this subsection may be revoked by the board in part or in total as to future payments upon recommendation of the actuary if a deficit occurs in the core annuity reserves and such deficit would result in a 0.5 percent or greater decrease in the amount of annuities in force, except as otherwise provided by the department by rule.

(d) Notwithstanding s 40.03 (2) (i), (7) (d), and (8) (d), the department may promulgate rules under this subsection without the approval of the teachers retirement board and the Wisconsin retirement board.”

Variable Annuities - 40.28(2)

“Whenever the balance in the variable annuity reserve, as of December 31 of any year, exceeds or is less than the then present value of all variable annuities in force, determined in accordance with the rate of interest and approved actuarial tables then in effect, by at least 2% of the present value of all variable annuities in force, the amount of each variable annuity payment shall be proportionately increased or decreased, disregarding fractional percentages, and effective on a date determined by rule, so as to reduce the variance between the balance of the variable annuity reserve and the present value of variable annuities to less than one percent.”

Narrative Regarding the Development of Dividend and Variable Annuity Changes Shown on Pages 6 and 16

- 1. SWIB Net of Fee Investment Return**
State of Wisconsin Investment Board net earnings rate on the Core/Variable Fund.
- 2. MRA Adjustment (Core)/Adjustment to Published Effective Rate (Variable)**
Item 3 below minus Item 1 above. For core annuities, this is the MRA adjustment which takes into account five-year smoothing of gains and losses.
- 3. Published Effective Earnings Rate**
The earnings rate published by DETF is funds' earnings credits expressed as a percentage of the beginning year balance adjusted for benefit payments and reserve transfers.
- 4. Adjustment to Relate Earnings to Average Core/Variable Annuity Balance**
Item 5 below minus Item 3 above.
- 5. Earnings Rate Based on Average Balance**
This is similar to the published earnings rate except that the rate is determined as a percentage of the average balance during the year instead of the adjusted beginning of year balance.
- 6. Expected Dividend (Variable Change) before Adjustments**
The relative difference in fund growth based on actual versus the 5% assumed earnings rates.
- 7. Adjustment to Relate Average Asset to Ending Liability**
The final dividend/variable change is calculated based on the end of year assets divided by the end of year liabilities. Since the calculations in Items 5 and 6 are based on average (approximately mid-year) balances, this adjustment is needed so that the final rate will be based on the end of year liabilities.
- 8. Carryover from Last Year Due to Timing of Distribution and Accounting Adjustments (and Truncation for Variable Annuity)**
The dividend or variable rate changes are made effective April 1 of each year. This adjustment takes into account the fact that the prior year dividend/variable increase was in effect for less than a full year as well as any accounting adjustments made to the asset value at the beginning of the year. This adjustment also carries over any truncated or rounded amounts from the prior year.

Narrative Regarding the Development of Dividend and Variable Annuity Changes Shown on Pages 6 and 16

9. Experience Study/Mortality Reserve Adjustment

A study is conducted for WRS every three years to analyze the assumptions that are made in the valuation versus the experience that actually occurred. If the results of the study show material changes in experience, WRS generally adopts a new set of assumptions. When assumptions are changed, this item displays the effect of the change on the dividend/variable rate. Although the mortality table now includes a projection for expected future improvements in mortality, each valuation phases into the full table incrementally over the three year experience study cycle. By increasing reserves gradually each year, instead of all at once every three years, the effect on dividends and variable increases will also be more gradual.

10. Experience and Other Effects

After making all other known adjustments, this is the remainder of all other experience. Changes here are primarily attributable to mortality experience and, generally to a lesser extent, on any data adjustments.

11. Statutory Adjustment to Round/Truncate

By statute, the dividend rate is calculated to the nearest one-tenth of a percent. For the variable annuity change, the rate is truncated to a whole percent. This is the adjustment made from the calculated dividend/variable annuity rate change without rounding/truncation to the statutory rate.

12. Computed Average Dividend Rate/Variable Annuity Change

This is the end of year asset value divided by the end of year liability. It is reconciled to the published earnings rate (Item 3) by making the adjustments in Items 6 through 11.

13. Adjustment for Members Not Eligible for Negative Dividend

This is an adjustment that is sometimes made for Core Fund recipients to reflect that some members may not have any remaining dividends and hence are not subject to a further negative dividend.

14. Final Maximum Computed Dividend Rate

When there is a negative dividend for the Core Fund, this will affect people differently based upon year of retirement. In years when there is a negative dividend, this will be the largest negative dividend that will occur in the Core Fund. If greater in absolute value than 0.5% of core annuities, Item 12 plus Item 13, otherwise 0%.