



Fresno County Employees' Retirement Association

ACTUARIAL EXPERIENCE STUDY

Analysis of Actuarial Experience
During the Period
July 1, 2015 through June 30, 2018



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April 9, 2019

Board of Retirement
Fresno County Employees' Retirement Association
7772 N Palm Ave
Fresno, CA 93711

Re: Review of Actuarial Assumptions for the June 30, 2019 Actuarial Valuation

Dear Members of the Board:

We are pleased to submit this report of our review of the actuarial experience for the Fresno County Employees' Retirement Association (FCERA). This study utilizes the census data for the period July 1, 2015 to June 30, 2018 and provides the proposed actuarial assumptions, both economic and demographic, to be used in the June 30, 2019 valuation.

We are members of the American Academy of Actuaries and we meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion herein.

We look forward to reviewing this report with you and answering any questions you may have.

Sincerely,

A handwritten signature in black ink, appearing to read "Paul Angelo".

Paul Angelo, FSA, MAAA, FCA, EA
Senior Vice President and Actuary

A handwritten signature in black ink, appearing to read "Andy Yeung".

Andy Yeung, ASA, MAAA, FCA, EA
Vice President and Actuary

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Actuarial Experience Study

Analysis of Actuarial Experience

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I. Introduction, Summary, and Recommendations

To project the cost and liabilities of the pension plan, assumptions are made about all future events that could affect the amount and timing of the benefits to be paid and the assets to be accumulated. Each year actual experience is compared against the projected experience, and to the extent there are differences, the future contribution requirement is adjusted.

If assumptions are modified, contribution requirements are adjusted to take into account a change in the projected experience in all future years. There is a great difference in both philosophy and cost impact between recognizing the actuarial deviations as they occur annually and changing the actuarial assumptions. Taking into account one year's gains or losses without making a change in the assumptions means that year's experience is treated as temporary and that, over the long run, experience will return to what was originally assumed. Changing assumptions reflects a basic change in thinking about the future, and it has a much greater effect on the current contribution requirements than recognizing gains or losses as they occur.

The use of realistic actuarial assumptions is important in maintaining adequate funding, while paying the promised benefit amounts to participants already retired and to those near retirement. The actuarial assumptions used do not determine the "actual cost" of the plan. The actual cost is determined solely by the benefits and administrative expenses paid out, offset by investment income received. However, it is desirable to estimate as closely as possible what the actual cost will be so as to permit an orderly method for setting aside contributions today to provide benefits in the future, and to maintain equity among generations of participants and taxpayers.

This study was undertaken in order to review the economic and demographic actuarial assumptions and to compare the actual experience with that expected under the current assumptions during the three-year experience period from July 1, 2015 through June 30, 2018. The study was performed in accordance with Actuarial Standard of Practice (ASOP) No. 27 "Selection of Economic Assumptions for Measuring Pension Obligations" and ASOP No. 35 "Selection of Demographic and Other Non-Economic Assumptions for Measuring Pension Obligations." These Standards of Practice put forth guidelines for the selection of the various actuarial assumptions utilized in a pension plan actuarial valuation. Based on the study's results and expected future experience, we are recommending various changes in the current actuarial assumptions.

We are recommending changes in the assumptions for inflation, investment return, merit and promotional salary increases, retirement from active employment, retirement age for deferred vested members, percent of members assumed to go on to work for a reciprocal system, reciprocal salary increases, percentage of members with an eligible spouse or domestic partner, pre-retirement mortality, healthy life post-retirement mortality, disabled life post-retirement mortality, termination (refund and deferred vested retirement), disability (service and non-service connected), and annual leave conversion.

Our recommendations for the major actuarial assumption categories are as follows:

Pg #	Actuarial Assumption Categories	Recommendation
7	<p>Inflation: Future increases in the Consumer Price Index (CPI) which drives investment returns and active member salary increases.</p>	<p>Reduce the inflation assumption from 3.00% to 2.75% per annum as discussed in Section (III)(A).</p>
9	<p>Investment Return: The estimated average net rate of return on current and future assets of the Association as of the valuation date. This rate is used to discount liabilities.</p>	<p>Recommend maintaining the investment return assumption at 7.00% per annum as discussed in Section (III)(B).</p> <p>An alternative of 6.75% per annum is also discussed.</p>
17	<p>Individual Salary Increases: Increases in the salary of a member between the date of the valuation to the date of separation from active service. This assumption has three components:</p> <ul style="list-style-type: none"> • Inflationary salary increases • Real “across the board” salary increases • Merit and promotional increases 	<p>Reduce the current inflationary salary increase assumption from 3.00% to 2.75% and maintain the current real “across the board” salary increase assumption at 0.50%. This means that the combined inflationary and real “across the board” salary increases will decrease from 3.50% to 3.25%.</p> <p>Change the merit and promotional increases to those developed in Section (III)(C). Future merit and promotional salary increases are slightly higher for General and Safety members at most years of service under the proposed assumption.</p> <p>The recommended salary increase assumptions anticipate slightly lower salary increases <u>overall</u> for both General and Safety members.</p>
23	<p>Retirement Rates: The probability of retirement at each age at which participants are eligible to retire.</p> <p>Other Retirement Related Assumptions including:</p> <ul style="list-style-type: none"> • Retirement age for deferred vested members • Future reciprocal members and reciprocal salary increases • Percent married and spousal age differences for members not yet retired 	<p>For active members, adjust the current retirement rates to those developed in Section (IV)(A). For General Tier 1, we are proposing different sets of age based retirement assumptions for those with less than 30 years of service and for those with 30 or more years of service. For Safety Tiers 1 and 2 members, we are proposing an immediate retirement assumption once a member accrues a benefit of 100% of final average earnings.</p> <p>For deferred vested members, increase the assumed retirement age from 58 to 59 for General members and maintain the assumed retirement age at 54 for Safety members.</p> <p>Maintain the current proportion of future deferred vested members terminated with less than five years of service expected to be covered by a reciprocal system at 20% for General members and 30% for Safety members. Reduce the proportion of future deferred vested members terminated with five or more years of service expected to be covered by a reciprocal system from 35% to 30% for General members and from 55% to 50% for Safety members. In addition, reduce the reciprocal salary increase assumption from 4.50% to 4.35% for General members and from 4.90% to 4.75% for Safety members (based on expected salary increase assumptions for active members with 10 or more years of service).</p> <p>For active and deferred vested members, reduce the percent married at retirement assumption from 75% to 70% for males and maintain the percent married at retirement assumption at 50% for females. Maintain the spouse age difference assumption that male retirees are three years older than their spouses and female retirees are two years younger than their spouses.</p>

Pg #	Actuarial Assumption Categories	Recommendation
58	Annual Leave Conversion: Additional service that is expected to be received when the member retires due to conversion of unused annual leave.	Adjust the current annual leave conversion assumptions for each annual leave plan to those developed in Section (IV)(F).

We have estimated the impact of all the recommended demographic and economic assumptions and the alternative investment return assumption as if they were applied to the June 30, 2018 actuarial valuation. The tables below show the changes in the employer and member contribution rates due to the proposed assumption changes separately for the recommended demographic assumption changes (as recommended in Section IV of this report) and the recommended and alternative economic assumption changes (as recommended in Section III of this report).

Cost Impact		
	Recommended (7.00% Return and Other Recommended Assumptions)	Alternative (6.75% Return and Other Recommended Assumptions)
<u>Impact on Employer</u>		
Change due to demographic assumptions	2.91%	2.91%
Change due to economic assumptions	<u>-3.85%</u>	<u>0.73%</u>
Total change in average employer rate	-0.94%	3.64%
Total estimated change in annual dollar amount (\$000s)	-\$4,029	\$15,745
<u>Impact on Member</u>		
Change due to demographic assumptions	0.42%	0.42%
Change due to economic assumptions	<u>-0.30%</u>	<u>0.19%</u>
Total change in average member rate	0.12%	0.61%
Total estimated change in annual dollar amount (\$000s)	\$530	\$2,659
<u>Impact on UAAL and Funded Percentage</u>		
Change in UAAL	-\$64 million	\$123 million
Change in funded percentage	From 81.5% to 82.4%	From 81.5% to 79.8%

Of the various demographic assumption changes, the most significant cost impacts are from the mortality assumption change followed by the retirement assumption change. Of the various economic assumption changes, the most significant cost impact is from the inflation assumption change under Recommended (cost decrease) and the investment return assumption change under Alternative (cost increase).

Section II provides some background on the basic principles and methodology used for the experience study and for the review of the economic and demographic actuarial assumptions. A detailed discussion of each assumption and reasons for the proposed changes are found in Section III for the economic assumptions and Section IV for the demographic assumptions. The cost impact of the proposed changes is detailed in Section V.

II. Background and Methodology

In this report, we analyzed both economic and demographic (“non-economic”) assumptions. The primary economic assumptions reviewed are inflation, investment return, and salary increases. Demographic assumptions include the probabilities of certain events occurring in the population of members, referred to as “decrements,” e.g., termination from service, disability retirement, service retirement, and death before and after retirement. In addition to decrements, other demographic assumptions reviewed in this study include the percentage of members with an eligible spouse or domestic partner, spousal age difference, percent of members assumed to go on to work for a reciprocal system, reciprocal salary increases, and annual leave conversion.

Economic Assumptions

Economic assumptions consist of:

- **Inflation:** Increases in the price of goods and services. The inflation assumption reflects the basic return that investors expect from securities markets. It also reflects the expected basic salary increase for active members and drives increases in the allowances of retired members.
- **Investment Return:** Expected long-term rate of return on the Association’s investments after investment expenses. This assumption has a significant impact on contribution rates.
- **Salary Increases:** In addition to inflationary increases, it is assumed that salaries will also grow by “across the board” real pay increases in excess of price inflation. It is also assumed that members will receive raises above these average increases as they advance in their careers. These are commonly referred to as merit and promotional increases. Payments to amortize any Unfunded Actuarial Accrued Liability (UAAL) are assumed to increase each year by the price inflation rate plus any “across the board” real pay increases that are assumed.

The setting of these economic assumptions is described in Section III.

Demographic Assumptions

In order to determine the probability of an event occurring, we examine the “decrements” and “exposures” of that event. For example, taking termination from service, we compare the number of employees who actually terminate in a certain age and/or service category (i.e., the number of “decrements”) with those “who could have terminated” (i.e., the number of “exposures”). For example, if there were 500 active employees in the 20-24 age group at the beginning of the year and 50 of them terminate during the year, we would say the probability of termination in that age group is $50 \div 500$ or 10%.

The reliability of the resulting probability is highly dependent on both the number of decrements and the number of exposures. For example, if there are only a few people in a high age category at the beginning of the year (number of exposures), we would not lend as much credibility to the probability of termination developed for that age category, especially if it is out of line with the

pattern shown for the other age groups. Similarly, if we are considering the death decrement, there may be a large number of exposures in, say, the age 20-24 category, but very few decrements (actual deaths); therefore, we would not be able to rely heavily on the probability of death developed for that category.

One reason we use several years of experience for such a study is to have more exposures and decrements, and therefore more statistical reliability. Another reason for using several years of data is to smooth out fluctuations that may occur from one year to the next. However, we also calculate the rates on a year-to-year basis to check for any trend that may be developing in the later years.

III. Economic Assumptions

A. Inflation

Unless an investment grows at least as fast as prices increase, investors will experience a reduction in the inflation-adjusted value of their investment. There may be times when “riskless” investments return more or less than inflation, but over the long term, investment market forces will generally require an issuer of fixed income securities to maintain a minimum return which protects investors from inflation.

The inflation assumption is long term in nature, so it is set using primarily historical information. Following is an analysis of 15 and 30 year moving averages of historical inflation rates:

HISTORICAL CONSUMER PRICE INDEX – 1930 TO 2018¹ (U.S. City Average - All Urban Consumers)

	25 th Percentile	Median	75 th Percentile
15-year moving averages	2.4%	3.3%	4.5%
30-year moving averages	2.9%	3.8%	4.8%

The average inflation rates have continued to decline gradually over the last several years due to the relatively low inflationary period over the past two decades. Also, the later of the 15-year averages during the period are lower as they do not include the high inflation years of the mid-1970s and early 1980s.

Based on information found in the Public Plans Data website, which is produced in partnership with the National Association of State Retirement Administrators (NASRA), the median inflation assumption used by 178 large public retirement funds² in their 2017 fiscal year valuations was 2.75%. In California, CalSTRS and eight other 1937 Act CERL systems use an inflation assumption of 2.75%, one other 1937 Act CERL system uses an inflation assumption of 2.90% and two 1937 Act CERL systems use an inflation assumption of 2.50%. CalPERS recently lowered their inflation assumption from 2.75% to 2.50% over a 3-year period. Nine other 1937 Act CERL systems (including FCERA) use an inflation assumption of 3.00%.

FCERA’s investment consultant, Verus, anticipates an annual inflation rate of 1.80% over a 30-year horizon, while the average inflation assumption provided by Verus and six other investment advisory firms retained by Segal’s California public sector clients was 2.35%. Note that, in general, investment consultants use a time horizon³ for this assumption that is shorter than the time horizon of the actuarial valuation.

¹ Source: Bureau of Labor Statistics – Based on CPI for All items in U.S. city average, all urban consumers, not seasonally adjusted (Series Id: CUUR0000SA0)

² Among 178 large public retirement funds, the inflation assumption was not available for 32 of the public retirement funds in the survey data.

³ The time horizon used by the seven investment consultants included in our review generally ranges from 10 years to 30 years and Verus uses both 10-year or 30-year horizons.

To find a forecast of inflation based on a longer time horizon, we referred to the 2018 report on the financial status of the Social Security program.⁴ The projected average increase in the Consumer Price Index (CPI) over the next 75 years under the intermediate cost assumptions used in that report was 2.60%. Besides projecting the results under the intermediate cost assumptions using an inflation assumption of 2.60%, alternative projections were also made using a lower and a higher inflation assumption of 2.00% and 3.20%, respectively.

We also compared the yields on the thirty-year inflation indexed U.S. Treasury bonds to comparable traditional U.S. Treasury bonds.⁵ As of January 2019, the difference in yields is about 1.85%, which provides a measure of market expectations of inflation.

Based on all of the above information, we recommend that the current 3.00% annual inflation assumption be reduced to 2.75% for the June 30, 2019 actuarial valuation.

The setting of the inflation assumption using the information outlined above is a somewhat subjective process, and Segal does not apply a specific weight to each of the metrics in determining our recommended inflation assumption. Based on a consideration of all these metrics, since 2018 we have been recommending the same 2.75% inflation assumption in our experience studies for our California based public retirement system clients.

Retiree Cost of Living Increases

Consistent with our recommended inflation assumption, we also recommend reducing the current assumptions to value the post-retirement COLA benefit from 3.00% to 2.75% per year for all General Tiers 1, 2 and 3 and Safety Tiers 1 and 2 members.⁶

Note that members in Tiers 4 and 5 receive no COLA increases.

In developing the COLA assumption, we also considered the results of a stochastic approach that would attempt to account for the possible impact of low inflation that could occur before COLA banks are able to be established for the member. Although the results of this type of analysis might justify the use of a lower COLA assumption, we are not recommending that at this time. The reasons for this conclusion include the following:

- The results of the stochastic modeling are significantly dependent on assuming that lower levels of inflation will persist in the early years of the projections. If this is not assumed, then the stochastic modeling will produce results similar to our proposed COLA assumptions.
- Using lower long-term COLA assumptions based on a stochastic analysis would mean that an actuarial loss would occur even when the inflation assumption of 2.75% is met in a year. We question the reasonableness of this result.

⁴ Source: Social Security Administration – The 2018 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds

⁵ Source: Board of Governors of the Federal Reserve System

⁶ For current retirees and beneficiaries, we would utilize the accumulated COLA banks to value an annual 3.00% COLA increase to General Tiers 1, 2 and 3 and Safety Tiers 1 and 2 payees until those banks become depleted.

We do not see the stochastic possibility of COLAs averaging less than those predicted by the assumed rate of inflation as a reliable source of cost savings that should be anticipated in our COLA assumptions. Therefore, we continue to recommend setting the COLA assumptions based on the lesser of the Tier specific COLA and the long-term annual inflation assumption, as we have in prior years.

B. Investment Return

The investment return assumption is comprised of two primary components, inflation and real rate of investment return, with adjustments for expenses and risk.

Real Rate of Investment Return

This component represents the portfolio's incremental investment market returns over inflation. Theory has it that as an investor takes a greater investment risk, the return on the investment is expected to also be greater, at least in the long run. This additional return is expected to vary by asset class and empirical data supports that expectation. For that reason, the real rate of return assumptions are developed by asset class. Therefore, the real rate of return assumption for a retirement association's portfolio will vary with the Board's asset allocation among asset classes.

The following is FCERA's current target asset allocation and the assumed real rate of return assumptions by asset class. The first column of real rate of return assumptions are determined by reducing Verus' total or "nominal" 2019 January return assumptions over a 30-year horizon by their assumed 1.80% inflation rate. The second column of returns (except for Value Add Real Estate, Opportunistic Real Estate, Infrastructure, Hedge Funds, Private Equity and Private Credit) represents the average of a sample of real rate of return assumptions. The sample includes the expected annual real rate of return provided to us by Verus and six other investment advisory firms retained by Segal's public sector clients. We believe these averages are a reasonable consensus forecast of long-term future market returns in excess of inflation.

FCERA'S TARGET ASSET ALLOCATION AND ASSUMED ARITHMETIC REAL RATE OF RETURN ASSUMPTIONS BY ASSET CLASS AND FOR THE PORTFOLIO

Asset Class	Percentage of Portfolio	Verus' Assumed Real Rate of Return ⁷	Average Assumed Real Rate of Return from a Sample of Consultants to Segal's California Public Sector Clients ⁸
Large Cap Equity	20.00%	5.00%	5.44%
Small Cap Equity	5.00%	6.10%	6.18%
Developed Int'l Large Cap Equity	15.00%	6.90%	6.54%
Developed Int'l Small Cap Equity	3.00%	6.60%	6.64%
Emerging Market Equity	6.00%	8.60%	8.73%
Core Bonds	4.00%	2.30%	1.42%
High Yield Bonds	3.00%	5.10%	3.64%
Global Sovereign	7.00%	0.10%	0.16%
Bank Loan	3.00%	4.10%	3.45%
TIPS	3.00%	1.40%	1.20%
Local Emerging Market Debt	3.00%	5.80%	4.72%
Real Estate	3.00%	5.90%	4.51%
Value Add Real Estate	1.00%	8.80%	8.80% ⁹
Opportunistic Real Estate	1.00%	12.00%	12.00% ⁹
Infrastructure	3.00%	7.90%	7.90% ⁹
Hedge Funds	6.00%	3.20%	3.20% ⁹
Private Equity	6.00%	9.90%	9.90% ⁹
Private Credit	8.00%	5.80%	5.80% ⁹
Total	100.00%	5.52%	5.39%

The above are representative of “indexed” returns and do not include any additional returns (“alpha”) from active management. This is consistent with the Actuarial Standard of Practice No. 27, Section 3.6.3.d, which states:

“Investment Manager Performance - Anticipating superior (or inferior) investment manager performance may be unduly optimistic (or pessimistic). The actuary should not assume that superior or inferior returns will be achieved, net of investment expenses, from an active investment management strategy compared to a passive investment management strategy unless the actuary believes, based on relevant supporting data, that such superior or inferior returns represent a reasonable expectation over the measurement period.”

The following are some observations about the returns provided above:

- ⁷ Derived by reducing Verus' nominal return assumptions by their 1.80% inflation assumption over a 30-year horizon.
- ⁸ These are based on the projected arithmetic returns provided by Verus and six other investment advisory firms serving the county retirement association of Fresno and 16 other city and county retirement systems in California. These return assumptions are gross of any applicable investment expenses.
- ⁹ For these asset classes, Verus' assumptions are applied in lieu of the average because there is a larger disparity in returns for these asset classes among the firms surveyed and using Verus' assumptions should more closely reflect the underlying investments made specifically for FCERA.

1. The investment consultants to our California public sector clients have each provided us with their expected real rates of return for each asset class, over various future periods of time. However, in general, the returns available from investment consultants are projected over time periods shorter than the durations of a retirement plan's liabilities.
2. Using a sample average of expected real rate of returns allows the FCERA's investment return assumption to reflect a broader range of capital market information and should help reduce year to year volatility in the investment return assumption.
3. Therefore, we recommend that the 5.39% portfolio real rate of return be used to determine FCERA's investment return assumption. This is 0.36% higher than the return that was used three years ago in the review of the recommended investment return assumption for the June 30, 2016 valuation. The difference is due to changes in FCERA's target asset allocation (0.48%), changes in the real rate of return assumptions provided to us by the investment advisory firms (-0.09%) and the interaction effect between these changes (-0.03%).

Investment Expenses

For funding purposes, the real rate of return assumption for the portfolio needs to be adjusted for investment expenses expected to be paid from investment income. The following table provides the investment expenses in relation to the actuarial value of assets for the five-year period ending June 30, 2018.

INVESTMENT EXPENSES AS A PERCENTAGE OF ACTUARIAL VALUE OF ASSETS (Dollars in 000's)

Year Ending June 30	Actuarial Value of Assets ¹⁰	Investment Expenses ¹¹	Investment %
2014	\$3,539,367	\$15,795	0.45
2015	3,828,862	16,374	0.43
2016	4,093,377	17,766	0.43
2017	4,278,161	24,608	0.58
2018	4,529,508	26,422	0.58
Five-Year Average			0.49
Recommendation			0.60

The average expense percentage over the most recent five-year period is 0.49%. However, the expense percentage was 0.58% for both June 30, 2017 and 2018. According to FCERA, the main driver of the increase in investment expenses from 2016 to 2017 was (based on experience from the last two years) for the implementation of hedge funds, private equity and private credit portions of the portfolio. As buildout will continue for private equity and private credit, we understand investment expenses may continue to increase in those areas for the next few years.

¹⁰ As of beginning of plan year.

¹¹ Net of securities lending expenses. Because we do not assume any additional net return for this program, we effectively assume that any securities lending expenses will be offset by related income.

Based on the experience from the last two years, we have increased the future expense assumption from 0.45% to 0.60%. This assumption will be re-examined in subsequent assumption reviews as new data becomes available.

Note related to investment expenses paid to active managers – As cited above, under Section 3.6.3.d of ASOP No. 27, the effect of an active investment management strategy should be considered “net of investment expenses...unless the actuary believes, based on relevant data, that such superior or inferior returns represent a reasonable expectation over the measurement period.”

For FCERA, of the \$26.4 million in investment expenses and fees paid in fiscal year ending June 30, 2018, FCERA identified that about \$22.4 million (or about 0.5% of plan assets) was associated with active portfolio management expenses. We have not performed a detailed analysis to measure how much of the investment expenses paid to active managers might have been offset by additional returns (“alpha”) earned by that active management.

For this study, we have continued to use the current approach that any “alpha” that may be identified would be treated as an increase in the risk adjustment and corresponding confidence level. For example, 0.25% of alpha would increase the confidence level by 3% (see discussions that follow on definitions of risk adjustment and confidence level).

Administrative Expenses

The following table provides the administrative expenses in relation to the projected payroll for each of the five-year period ending June 30, 2018.

ADMINISTRATIVE EXPENSES AS A PERCENTAGE OF PROJECTED PAYROLL (Dollars in 000’s)

Year Ending June 30	Projected Payroll	Administrative Expenses	Administrative Expenses as a Percent of Payroll%
2014	\$370,079	\$3,542	0.96
2015	373,774	4,297	1.15
2016	383,775	4,814	1.25
2017	402,535	4,762	1.18
2018	413,760	5,677	1.37
Five-Year Average			1.18
Recommendation			1.20

The average administrative expenses percentage over this five-year period is 1.18% of projected payroll with higher expenses for the most recent year as of June 30, 2018. Based on this experience, we recommend increasing the current administrative expense assumption from 1.10% to 1.20% of projected payroll. This expense will be allocated to both the employer and member based on the total average contribution rates in the upcoming June 30, 2019 actuarial valuation, as determined before including the administrative expenses.

Risk Adjustment

The real rate of return assumption for the portfolio is adjusted to reflect the potential risk of shortfalls in the return assumptions. FCERA's asset allocation determines this portfolio risk, since risk levels are driven by the variability of returns for the various asset classes and the correlation of returns among those asset classes. This portfolio risk is incorporated into the real rate of return assumption through a risk adjustment.

The purpose of the risk adjustment (as measured by the corresponding confidence level) is to increase the likelihood of achieving the actuarial investment return assumption in the long term.¹² This is consistent with our experience that retirement plan fiduciaries would generally prefer that returns exceed the assumed rate more often than not.

The 5.39% expected real rate of return developed earlier in this report was based on expected mean or average arithmetic returns. In our model, the confidence level associated with a particular risk adjustment represents the relative likelihood that future investment earnings would equal or exceed the assumed earnings over a 15-year period on an expected value basis.¹³ The 15-year time horizon represents an approximation of the "duration" of the fund's liabilities, where the duration of a liability represents the sensitivity of that liability to interest rate variations. Note that, based on the investment return assumptions recently adopted by systems that have been analyzed under this model, we observe a confidence level generally in the range of 50% to 55%.

Three years ago, the Board adopted an investment return assumption of 7.00%. That return implied a risk adjustment of 0.58%, reflecting a confidence level of 58% that the actual average return over 15 years would not fall below the assumed return, assuming that the distribution of returns over that period follows the normal statistical distribution.¹⁴

If we use the same 58% confidence level from our last study to set this year's risk adjustment, based on the current long-term portfolio standard deviation of 12.40% provided by Verus, the corresponding risk adjustment would be 0.67%. Together with the other investment return components, this would result in an investment return assumption of 6.87%, which is 0.13% lower than the current assumption of 7.00%.

Based on the general practice of using one-quarter percentage point increments for economic assumptions, we evaluated the effect on the confidence level of two investment return assumptions. In particular, we recommend maintaining the current net investment return assumption of 7.00%, which would have a risk adjustment of 0.54% and corresponds to a confidence level of 57%. Alternatively, a net investment return assumption of 6.75%, together with the other investment return components, would produce a risk adjustment of 0.79% and corresponds to a confidence level of 59%.

¹² This type of risk adjustment is sometimes referred to as a "margin for adverse deviation."

¹³ If a retirement system uses the expected arithmetic average return as the discount rate in the funding valuation, that retirement system is expected to have no surplus or asset shortfall relative to its expected obligations assuming all actuarial assumptions are met in the future.

¹⁴ Based on an annual portfolio return standard deviation of 10.70% provided by Verus. Strictly speaking, future compounded long-term investment returns will tend to follow a log-normal distribution. However, we believe the Normal distribution assumption is reasonable for purposes of setting this type of risk adjustment.

The table below shows FCERA’s recommended investment return assumption, the risk adjustment and confidence level compared to the historical values for prior studies.

HISTORICAL INVESTMENT RETURN ASSUMPTIONS, RISK ADJUSTMENTS AND CONFIDENCE LEVELS BASED ON ASSUMPTIONS ADOPTED BY THE BOARD

Years Ending June 30	Investment Return	Risk Adjustment	Corresponding Confidence Level
2010 - 2012	7.75%	1.05%	64%
2013 (Full Study)	7.25%	0.68%	59%
2014 - 2015 (Interim Study)	7.25% ¹⁵	0.80%	61%
2016 - 2018	7.00% ¹⁵	0.58%	58%
2019 Recommended	7.00% ¹⁵	0.54%	57%
2019 Alternative	6.75% ¹⁵	0.79%	59%

As we have discussed in prior experience studies, the risk adjustment model and associated confidence level is most useful as a means for comparing how FCERA has positioned itself relative to risk over periods of time.¹⁶ The use of expected returns with either a 57% or a 59% confidence level under Segal’s model should be considered in context with other factors, including:

- As noted above, the confidence level is more of a relative measure than an absolute measure, and so can be reevaluated and reset for future comparisons.
- The confidence level is based on the standard deviation of the portfolio that is determined and provided to us by Verus. The standard deviation is a statistical measure of the future volatility of the portfolio and so is itself based on assumptions about future portfolio volatility and can be considered somewhat of a “soft” number.
- A confidence level of either 57% or 59% is above the range of about 50% to 55% confidence levels that correspond to the risk adjustments currently used by most of Segal’s other California public retirement system clients.
- We have not taken into account any additional returns (“alpha”) that might be earned on active management. This means that if active management generates only enough alpha to cover its related expenses, there would be some reduction to the 0.6% investment expenses used under our model. In particular, if active management generated enough return to cover only the 0.15% increase in assumed investment expenses, the confidence level associated with the 7.00% (recommended) assumption would increase from 57% to 58%.

¹⁵ These investment return assumptions are gross of administrative expenses.

¹⁶ In particular, it would not be appropriate to use this type of risk adjustment as a measure of determining an investment return rate that is “risk-free.”

- As with any model, the results of the risk adjustment model should be evaluated for reasonableness and consistency. This is discussed in the later section on “Comparisons with Other Public Retirement Systems”.

Taking into account the factors above, we recommend the Board maintain the 7.00% assumption that implies a 0.54% risk adjustment, reflecting a confidence level of 57%. Alternatively, reducing the assumption to 6.75% would imply a 0.79% risk adjustment, reflecting a confidence level of 59%.

Recommended Investment Return Assumption

The following table summarizes the components of the investment return assumption developed in the previous discussion. For comparison purposes, we have also included similar values from the last study.

Assumption Component	June 30, 2016	June 30, 2019	
	Adopted	Recommended	Alternative
Inflation	3.00%	2.75%	2.75%
Plus Average Real Rate of Return	5.03%	5.39%	5.39%
Minus Expense Adjustment	(0.45%)	(0.60%)	(0.60%)
Minus Risk Adjustment	(0.58%)	(0.54%)	(0.79%)
Total	7.00%	7.00%	6.75%
Confidence Level	58%	57%	59%

Based on this analysis, we recommend that the investment return assumption be maintained at 7.00% per annum.

Comparison with Alternative Model used to Review Investment Return Assumption

Since our appointment as actuary for FCERA in 2006, we have consistently reviewed investment return assumptions based on our model that incorporates expected arithmetic real returns for the different asset classes and for the entire portfolio as one component of that model.¹⁷ The use of “forward looking expected arithmetic returns” is one of the approaches discussed for use in the Selection of Economic Assumptions for Measuring Pension Obligations under Actuarial Standards of Practice (ASOP) No. 27.

Besides using forward looking expected arithmetic returns, ASOP No. 27 also discussed setting investment return assumptions using an alternative “forward looking expected geometric returns” approach.¹⁸ Even though expected geometric returns are lower than expected arithmetic returns,

¹⁷ Again, as discussed in footnote 13, if a retirement system uses the expected arithmetic average return as the discount rate in the funding valuation, that retirement system is expected to have no surplus or asset shortfall relative to its expected obligations assuming all actuarial assumptions are met in the future.

¹⁸ If a retirement system uses the expected geometric average return as the discount rate in the funding valuation, that retirement system is expected to have asset value that generally converges to the median accumulated value as the time horizon lengthens assuming all actuarial assumptions are met in the future.

those California public retirement systems that have set investment return assumptions using this alternative approach have in practice adopted investment return assumptions that are comparable to those adopted by the Board for FCERA. This is because under the model used by those retirement systems, their investment return assumptions are not reduced to anticipate future investment expenses.¹⁹

For comparison, we evaluated both the 7.00% recommended and 6.75% alternative assumptions based on the expected geometric return for the entire portfolio, gross of the investment expenses under that model, over a 15-year period, there is a 55% likelihood that future average geometric returns will meet or exceed 7.00% and (coincidentally) a 59% likelihood that future average geometric returns will meet or exceed 6.75%.²⁰

Comparisons with Other Public Retirement Systems

One final test of the recommended investment return assumption is to compare it against those used by other public retirement systems, both in California and nationwide.

We note that an investment return assumption of 7.00% or lower is becoming more common among California public sector retirement systems. In particular, ten of the County employees' retirement systems (including FCERA) use either a 7.00% or 6.75% investment return assumption. Furthermore, the CalPERS Board approved a reduction in the earnings assumption to 7.00% and CalSTRS adopted a 7.00% earnings assumption for the 2017 valuation. With the exception of the retirement systems stated above, all other public sector retirement systems in California currently are using a 7.25% earnings assumption.

The following table compares FCERA's recommended net investment return assumption against those of the 178 large public retirement funds²¹ in their 2017 fiscal year valuations based on information found in the Public Plans Data website, which is produced in partnership with the NASRA:

Assumption	FCERA	Public Plans Data ²²		
		Low	Median	High
Net Investment Return	7.00% or 6.75%	5.75%	7.50%	8.50%

The detailed data shows that more than two-thirds of the systems have an investment return assumption in the range of 6.75% to 7.50%, and a little less than one-half of those systems (or about one-third overall) have used an assumption of 7.50%. Also, about one-third of the systems have reduced their investment return assumption during the last year. State systems outside of

¹⁹ This means that if that model were to be applied to FCERA, the expected geometric return would not be adjusted for the approximately 0.6% investment expenses paid by FCERA.

²⁰ We performed this stochastic simulation using the capital market assumptions included in the 2018 survey prepared by Horizon Actuarial Services. That simulation was performed using 10,000 trial outcomes of future market returns, using assumptions from 20-year arithmetic returns, standard deviations and correlation matrix that were found in the 2018 survey that included responses from 34 investment advisors.

²¹ Among 178 large public retirement funds, the investment return assumption was not available for 25 of the public retirement funds in the survey data.

²² Public Plans Data website – Produced in partnership with the National Association of State Retirement Administrators (NASRA)

California tend to change their economic assumptions less frequently and so may lag behind emerging practices in this area.

In summary, we believe that the recommended assumption of 7.00% provides for a risk margin within the risk adjustment model and is consistent with FCERA's current practice relative to other public systems.

C. Salary Increase

Salary increases impact plan costs in two ways: (i) by increasing members' benefits (since benefits are a function of the members' highest average pay) and future normal cost collections; and (ii) by increasing total active member payroll which in turn generates lower UAAL contribution rates. These two impacts are discussed separately below.

As an employee progresses through his or her career, increases in pay are expected to come from three sources:

1. **Inflation:** Unless pay grows at least as fast as consumer prices grow, employees will experience a reduction in their standard of living. There may be times when pay increases lag or exceed inflation, but over the long term, labor market forces may require an employer to maintain its employees' standards of living.

As discussed earlier in this report, we are recommending that the assumed rate of inflation be reduced from 3.00% to 2.75% per annum. This inflation component is used as part of the salary increase assumption.

2. **Real "Across the Board" Pay Increases:** These increases are typically termed productivity increases since they are considered to be derived from the ability of an organization or an economy to produce goods and services in a more efficient manner. As that occurs, at least some portion of the value of these improvements can provide a source for pay increases. These increases are typically assumed to extend to all employees "across the board". The State and Local Government Workers Employment Cost Index produced by the Department of Labor provides evidence that real "across the board" pay increases have averaged about 0.3% - 0.7% annually during the last ten to twenty years.

We also referred to the annual report on the financial status of the Social Security program published in June 2018. In that report, real "across the board" pay increases are forecast to be 1.2% per year under the intermediate assumptions.

The real pay increase assumption is generally considered a more "macroeconomic" assumption, which is not necessarily based on individual plan experience. However, recent salary experience with public systems in California as well as anecdotal discussions with plans and plan sponsors indicate lower future real wage growth expectations for public sector employees. We also note that for FCERA's active members, the actual average inflation plus "across the board" increase (i.e., wage inflation) over the three-year period ending June 30, 2018 was 1.83% for General and Safety members combined, which is lower than the change in CPI of 2.64% during that same period:

Valuation Date	Actual Average Increase ²³	Actual Change in CPI ²⁴
June 30, 2016	0.63%	1.85%
June 30, 2017	2.01%	2.79%
June 30, 2018	2.86%	3.29%
Three-Year Average	1.83%	2.64%

Considering these factors, we recommend maintaining the real “across the board” salary increase assumption at 0.50%. This means that the combined inflation and “across the board” salary increase assumption will decrease from 3.50% to 3.25%.

3. **Merit and Promotional Increases:** As the name implies, these increases come from an employee’s career advances. This form of pay increase differs from the previous two, since it is specific to the individual. For FCERA, there are service-specific merit and promotional increases.

The annual merit and promotional increases are determined by measuring the actual increases received by members over the experience period, net of the inflationary and real “across the board” pay increases. Increases are measured separately for General and Safety members. This is accomplished by:

- a. Measuring each continuing member’s actual salary increase over each year of the experience period on a salary-weighted basis, with higher weights assigned to experience from members with larger salaries;
- b. Excluding any members with increases of more than 50% or decrease of more than 20% during any particular year;
- c. Categorizing these increases according to member demographics;
- d. Removing the wage inflation component from these increases (assumed to be equal to the increase in the members’ average salary during the year);
- e. Averaging these annual increases over the experience period; and
- f. Modifying current assumptions to reflect some portion of these measured increases reflective of their “credibility.”

To be consistent with the other economic assumptions, these merit and promotional assumptions should be used in combination with the recommended 3.25% assumed inflation and real “across the board” increases.

²³ Reflects the increase in average salary for members at the beginning of the year versus those at the end of the year. It does not reflect the average salary increases received by members who worked the full year.

²⁴ Based on the change in 1st Semiannual CPI for the Western Region compared to the prior year.

Due to the high variability of the actual salary increases, we have analyzed this assumption using the data for the past nine years. The following table shows the General members' actual average merit and promotional increases by years of service over the three-year period from July 1, 2015 through June 30, 2018 along with the actual average increases based on combining the current three-year period with the six-year period from the prior two experience studies (recalculated on a salary-weighted basis). The current and proposed assumptions are also shown. The actual increases for the most recent three-year period were reduced by the actual average inflation plus “across the board” increase (i.e., wage inflation, estimated as the increase in average salaries) for each year during the current three-year experience period.

**GENERAL MEMBERS
MERIT AND PROMOTIONAL INCREASES**

Years of Service	Rate (%)				
	Current Assumptions	2015-2018 Actual Average Increase (Last 3 Years)	2009-2015 Actual Average Increase (Prior Two Studies) ²⁵	2009-2018 Actual Average Increase (Last 9 Years)	Proposed Assumption
Less than 1	8.00	11.32	8.80	10.08	8.50
1	7.00	11.44	7.10	9.08	7.50
2	6.00	9.23	5.80	7.15	6.50
3	5.00	6.89	4.94	5.62	5.25
4	4.00	6.95	4.06	4.82	4.75
5	2.75	5.73	3.43	3.85	3.75
6	2.25	4.84	2.61	2.95	3.00
7	1.25	5.35	1.36	2.12	2.00
8	1.00	4.12	1.36	2.09	1.50
9	1.00	2.58	1.05	1.51	1.25
10 & Over	1.00	2.27	0.88	1.36	1.10

The following table provides the same information for Safety members. The actual average merit and promotional increases for the most recent three-year period were determined by reducing the actual average total salary increases by the actual average inflation plus real “across the board” increase (i.e., wage inflation, estimated as the increase in average salaries) for each year during the current three-year experience period.

²⁵ The average rates have been recalculated on a salary-weighted basis.

SAFETY MEMBERS MERIT AND PROMOTIONAL INCREASES

Years of Service	Rate (%)				
	Current Assumptions	2015-2018 Actual Average Increase (Last 3 Years)	2009-2015 Actual Average Increase (Prior Two Studies) ²⁶	2009-2018 Actual Average Increase (Last 9 Years)	Proposed Assumption
Less than 1	8.00	8.51	10.72	9.44	8.50
1	7.00	10.81	5.35	8.38	7.75
2	5.50	9.93	0.65	6.62	6.50
3	5.50	5.12	5.65	5.34	5.50
4	5.00	3.47	4.28	3.98	4.75
5	3.75	3.66	4.17	4.10	3.75
6	3.25	3.74	2.75	2.78	3.50
7	2.75	4.11	1.63	1.87	2.50
8	1.40	4.34	1.78	2.11	1.70
9	1.40	4.02	0.63	1.33	1.60
10 & Over	1.40	2.54	1.09	1.59	1.50

Charts 1 and 2 provide a graphical comparison of the actual merit and promotional increases, compared to the proposed and current assumptions. The charts also show the actual merit and promotional increases based on averages over the current three-year period as well as over a nine-year period, including the previous two three-year experience periods. This is discussed below. Chart 1 shows this information for General members and Chart 2 for Safety members.

The Association has had salary gains during the past nine valuations meaning salaries increased less than assumed. That was the case even though we have been reducing the inflation component of the salary increase assumption. With that experience in mind, we examined the merit and promotional increases from the most recent three-year experience period together with the experience from the prior two experience studies for a combined total of nine-year experience. We believe that the combined experience provides a more reasonable representation of potential future merit and promotional salary increases over the long term. In light of the favorable salary experience (i.e., increases less than assumed) from the last nine valuations, we made relatively modest adjustments to the assumptions recommended for both General and Safety member even though the data from the most three-year period might appear to support higher assumptions.

Based on this experience, we are proposing increases in the merit and promotional salary increases for both General and Safety members. Overall, salary increases are assumed to be slightly lower for both General and Safety members when the above somewhat higher merit and promotional increases are taken into consideration with our other recommendation to lower the price inflation assumption by 0.25%.

²⁶ The average rates have been recalculated on a salary-weighted basis.

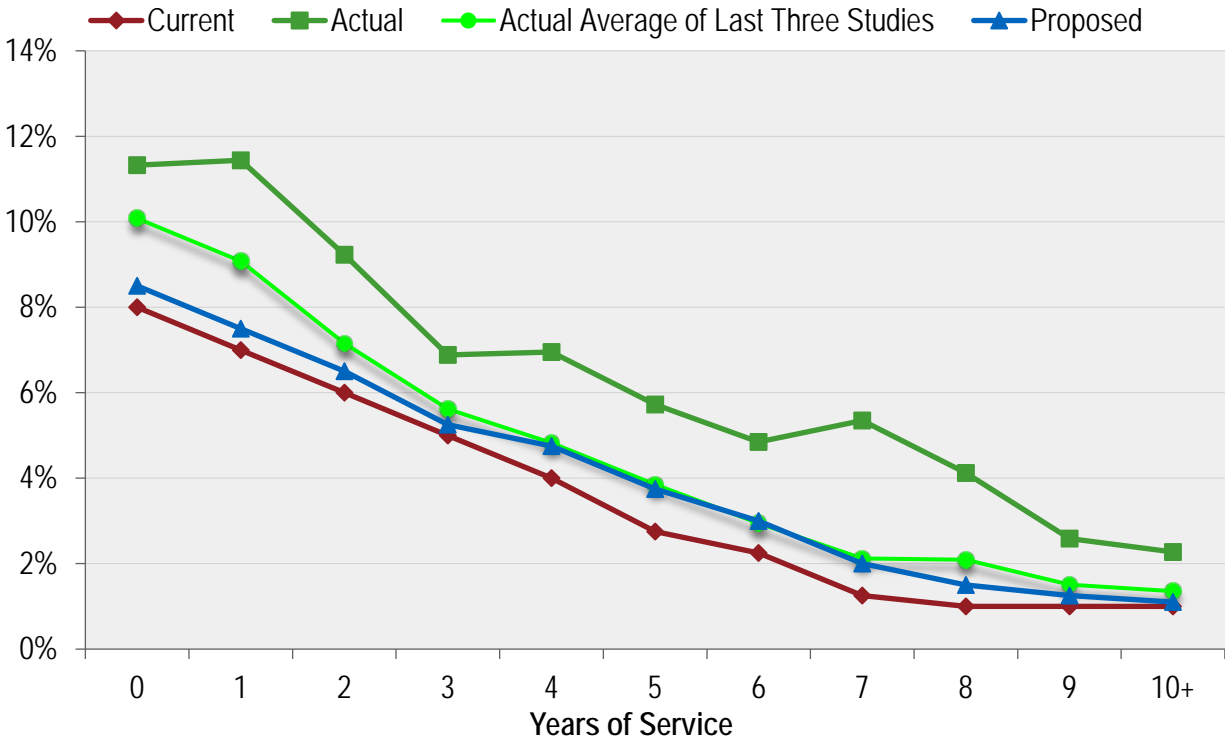
Active Member Payroll

Projected active member payrolls are used to develop the UAAL contribution rate. Future values are determined as a product of the number of employees in the workforce and the average pay for all employees. The average pay for all employees increases only by inflation and real “across the board” pay increases. The merit and promotional increases are not an influence, because this average pay is not specific to an individual.

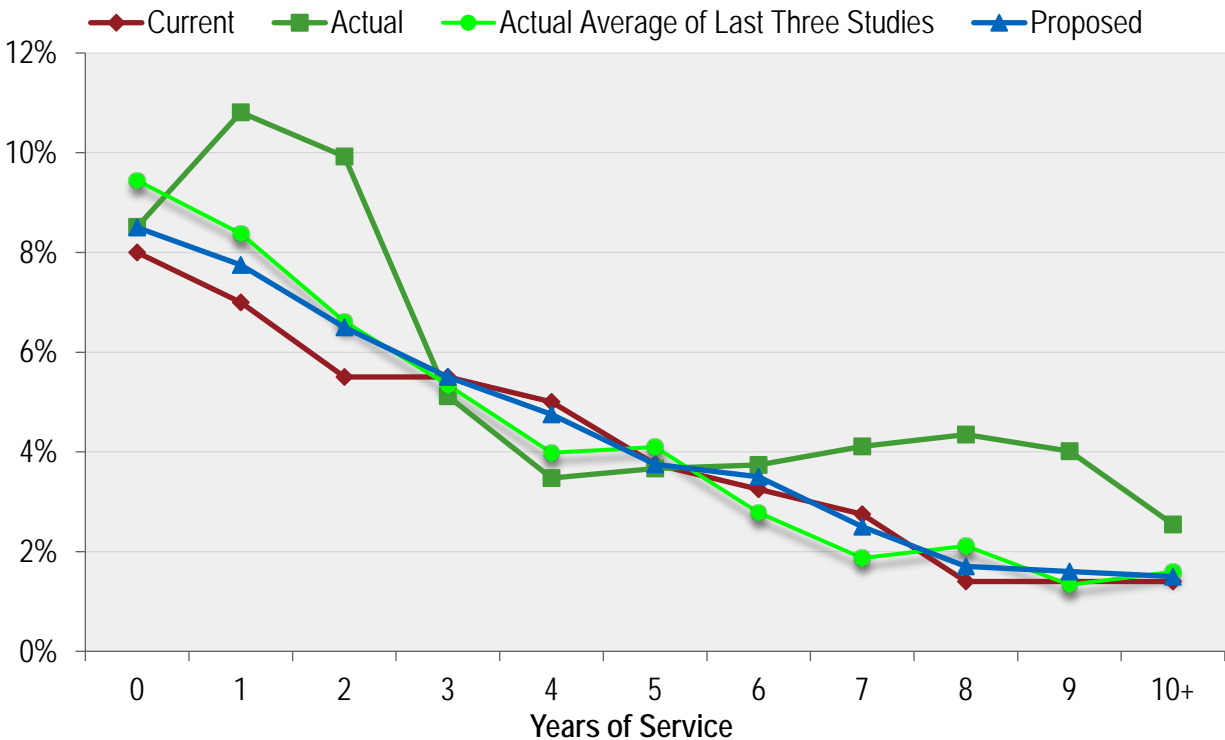
Under the Board’s current practice, the UAAL contribution rate is developed by assuming that the total payroll for all active members will increase annually over the amortization periods at the same assumed rates of inflation plus real “across the board” salary increase assumptions as are used to project the member’s future benefits.

We recommend that the active member payroll increase assumption be decreased from 3.50% to 3.25% annually, consistent with the combined inflation plus real “across the board” salary increase assumptions.

**CHART 1: MERIT AND PROMOTIONAL SALARY INCREASE RATES
GENERAL MEMBERS**



**CHART 2: MERIT AND PROMOTIONAL SALARY INCREASE RATES
SAFETY MEMBERS**



IV. Demographic Assumptions

A. Retirement Rates

The age at which a member retires from service (i.e., does not retire on a disability pension) will affect both the amount of the benefits that will be paid to that member as well as the period over which funding must take place.

Currently, the assumed retirement rates are a function of only member's age. Our experience review analyzed recent years' retirement experience both as a function of age and years of service in relation to the probability of retirement. Our review concludes that the retirement rates correlate both with age and with years of service (especially for those with high years of service) for General Tier 1 and Safety Tiers 1 and 2.²⁷

As a result of this observation, we recommend that retirement rates be structured as a function of both age and years of service for General Tier 1. The new structure of retirement assumptions will apply different sets of age based retirement assumptions for those with less than 30 years of service and to those with more than 30 years of service. For Safety Tiers 1 and 2, we continue to recommend that retirement rates be structured as a function of member's age until a member accrues a benefit of 100% of final average earnings at which point we recommend 100% retirement.²⁸ For the remaining General Tiers 2, 3, 4 and 5 and Safety Tiers 4 and 5, we will continue to recommend that retirement rates be structured as a function of only age. This is because there were no member with more than 30 years of service in the past three years from these remaining tiers.

In addition, we are recommending combining and using only a single set of retirement assumptions for both General Tier 1 male and General Tier 1 female starting with the assumptions recommended in this experience study.

The table on the following page shows the observed service retirement rates for members of General Tiers 1, 2 and 3 and Safety Tiers 1 and 2 based on the actual experience over the past three years. The observed service retirement rates were determined by comparing those members who actually retired from service to those eligible to retire from service. This same methodology is followed throughout this report and was described in Section II. Also shown are the current rates assumed and the rates we propose.

Even though there were no actual retirements from General Tiers 4 and 5 and Safety Tiers 4 and 5, we are nonetheless recommending some changes in the Safety Tiers 4 and 5 retirement rates at the older ages to commensurate with the changes we are recommending for Safety Tiers 1 and 2. This is because the retirement rates for General and Safety Tiers 4 and 5 were partially developed based on the then current Tier 1 retirement rates when those tiers were first established.

²⁷ The retirement rates for Safety Tier 2 have always been set equal to those for Safety Tier 1 since the inception of Safety Tier 2.

²⁸ For instance, this means that a Safety Tier 1 member at age 55 with 30.6 years of service or above (with an accrual rate of 3.27% per year of service) and a Safety Tier 2 member at age 55 with 33.3 years of service or above (with an accrual rate of 3.00% per year of service) will be assumed to retire immediately.

General Tier 1

Rate of Retirement (%)						
	Less than 30 Years of Service			30 or More Years of Service		
Age	Current Rate*	Actual Rate	Proposed Rate	Current Rate*	Actual Rate	Proposed Rate
50	4.35	3.21	5.00	4.50	0.00	15.00
51	3.83	0.93	3.75	4.00	50.00	11.25
52	3.65	3.55	3.50	3.86	14.29	10.50
53	4.00	2.95	3.50	4.00	16.67	10.50
54	5.29	6.16	5.00	5.30	15.00	15.00
55	8.65	7.76	8.00	8.63	12.50	16.00
56	10.29	6.46	10.00	10.41	22.22	20.00
57	14.00	13.62	13.00	14.00	25.00	26.00
58	15.00	8.94	14.00	15.00	37.50	28.00
59	16.00	9.47	15.00	16.00	35.48	30.00
60	21.93	15.13	16.00	21.92	26.92	24.00
61	21.17	16.75	18.00	20.88	43.75	27.00
62	26.91	26.42	26.50	26.00	33.33	31.50
63	22.99	20.66	21.00	23.80	40.00	31.50
64	25.00	29.67	25.00	25.00	50.00	37.50
65	38.95	38.16	40.00	35.00	33.33	60.00
66	37.23	42.55	40.00	35.00	50.00	60.00
67	37.22	41.67	40.00	36.67	0.00	60.00
68	43.10	19.05	35.00	42.50	0.00	52.50
69	46.84	15.79	35.00	46.25	25.00	52.50
70	50.00	21.05	35.00	50.00	0.00	52.50
71	50.00	27.27	50.00	50.00	0.00	75.00
72	50.00	0.00	50.00	50.00	0.00	75.00
73	50.00	66.67	50.00	50.00	0.00	75.00
74	50.00	100.00	50.00	50.00	0.00	75.00
75 & Over	100.00	0.00	100.00	100.00	0.00	100.00

*The current rate is developed as a weighted average of the current General Tier 1 male and General Tier 1 female assumptions.

As shown above, we are recommending decreases in most of the retirement rates for General Tier 1 members with less than 30 years of service and recommending increases in most of the retirement rates for General Tier 1 members with 30 or more years of service.

Chart 3 that follows later in this section compares actual experience with the current and proposed rates of retirement for General Tier 1 members with less than 30 years of service.

Chart 4 compares actual experience with the current and proposed rates of retirement for General Tier 1 members with 30 or more years of service.

General Tiers 2 and 3

Age	Rate of Retirement (%)					
	General Tier 2			General Tier 3		
	Current Rate	Actual Rate	Proposed Rate	Current Rate	Actual Rate	Proposed Rate
50	3.00	0.00	3.00	2.40	0.00	3.60
51	3.00	0.00	3.00	2.40	0.00	3.60
52	3.60	0.00	3.60	2.80	25.00	4.20
53	3.60	0.00	3.60	2.80	12.50	4.20
54	4.20	0.00	4.20	3.40	0.00	5.00
55	8.40	100.00	8.40	6.70	0.00	10.00
56	10.00	0.00	10.00	8.00	0.00	12.00
57	10.00	0.00	10.00	8.00	16.67	12.00
58	10.00	0.00	10.00	8.00	22.22	12.00
59	10.00	0.00	10.00	12.00	0.00	14.00
60	15.00	0.00	15.00	15.40	0.00	16.00
61	15.00	0.00	15.00	15.40	0.00	16.00
62	25.00	100.00	25.00	27.40	50.00	30.00
63	24.00	0.00	24.00	19.00	0.00	22.00
64	24.00	100.00	24.00	19.00	100.00	22.00
65	35.00	0.00	35.00	34.60	66.67	35.00
66	34.00	0.00	34.00	26.60	100.00	30.00
67	34.00	100.00	34.00	26.60	0.00	30.00
68	35.00	33.33	35.00	32.00	50.00	35.00
69	35.00	50.00	35.00	37.00	60.00	40.00
70	70.00	50.00	70.00	60.00	100.00	60.00
71	70.00	0.00	70.00	60.00	0.00	60.00
72	70.00	0.00	70.00	60.00	0.00	60.00
73	70.00	50.00	70.00	60.00	0.00	60.00
74	70.00	0.00	70.00	60.00	0.00	60.00
75 & Over	100.00	0.00	100.00	100.00	0.00	100.00

As shown above, we are recommending maintaining the retirement rates for General Tier 2 and recommending increases in most of the retirement rates for General Tier 3 members.

Chart 5 that follows later in this section compares actual experience with the current and proposed rates of retirement for General Tier 2 members.

Chart 6 compares actual experience with the current and proposed rates of retirement for General Tier 3 members.

Safety Tiers 1 and 2

Age	Rate of Retirement (%)		
	Current Rate	Actual Rate	Proposed Rate
45	1.00	12.50	10.00
46	1.00	3.70	2.00
47	1.00	0.00	2.00
48	1.00	5.00	2.00
49	3.00	2.00	3.00
50	5.00	5.00	5.00
51	7.00	2.86	6.00
52	8.00	12.70	10.00
53	14.00	8.93	12.00
54	27.00	34.04	30.00
55	40.00	38.24	40.00
56	25.00	14.29	25.00
57	25.00	50.00	25.00
58	20.00	18.18	20.00
59	20.00	0.00	20.00
60	40.00	14.29	30.00
61	40.00	25.00	30.00
62	50.00	20.00	35.00
63	50.00	0.00	35.00
64	50.00	0.00	35.00
65 & Over	100.00	20.00	100.00

As shown above, we are recommending increases in retirement rates at lower ages and decreases in retirement rates at higher ages for Safety Tiers 1 and 2 members. In addition, we are recommending 100% retirement once a Safety Tiers 1 and 2 member accrues a benefit of 100% of final average earnings. This is based on 10 members actually accruing a benefit of 100% of final average earnings with 7 retiring in the same year and 1 member retiring in the following two years.

Chart 7 compares actual experience with the current and proposed rates of retirement for Safety Tiers 1 and 2 members with less than 30 years of service.

General Tiers 4 and 5

Age	Rate of Retirement (%)			
	General Tier 4		General Tier 5	
	Current Rate	Proposed Rate	Current Rate	Proposed Rate
50	2.00	2.00	0.00	0.00
51	2.00	2.00	0.00	0.00
52	2.50	2.50	4.50	4.50
53	2.50	2.50	2.00	2.00
54	3.00	3.00	2.50	2.50
55	4.00	4.00	3.50	3.50
56	5.00	5.00	4.50	4.50
57	6.00	6.00	5.50	5.50
58	7.00	7.00	6.50	6.50
59	8.00	8.00	7.50	7.50
60	9.00	9.00	8.50	8.50
61	10.00	10.00	9.50	9.50
62	16.00	16.00	15.00	15.00
63	16.00	16.00	15.00	15.00
64	19.00	19.00	18.00	18.00
65	23.00	23.00	22.00	22.00
66	20.00	20.00	20.00	20.00
67	20.00	20.00	20.00	20.00
68	25.00	25.00	25.00	25.00
69	30.00	30.00	30.00	30.00
70	60.00	60.00	60.00	60.00
71	60.00	60.00	60.00	60.00
72	60.00	60.00	60.00	60.00
73	60.00	60.00	60.00	60.00
74	60.00	60.00	60.00	60.00
75 & Over	100.00	100.00	100.00	100.00

As shown above, we are recommending maintaining the retirement rates for General Tiers 4 and 5 members.

Chart 8 compares the current and proposed rates of retirement for General Tier 4 members. There were no actual retirement from General Tier 4.

Chart 9 compares the current and proposed rates of retirement for General Tier 5 members. There were no actual retirement from General Tier 5.

Safety Tiers 4 and 5

Age	Rate of Retirement (%)			
	Safety Tier 4		Safety Tier 5	
	Current Rate	Proposed Rate	Current Rate	Proposed Rate
45	1.00	1.00	0.00	0.00
46	1.00	1.00	0.00	0.00
47	1.00	1.00	0.00	0.00
48	1.00	1.00	0.00	0.00
49	2.00	2.00	0.00	0.00
50	4.00	4.00	4.00	4.00
51	4.00	4.00	4.00	4.00
52	5.00	5.00	5.00	5.00
53	6.00	6.00	6.00	6.00
54	11.00	11.00	11.00	11.00
55	20.00	18.00	20.00	18.00
56	20.00	18.00	20.00	18.00
57	20.00	20.00	25.00	22.00
58	20.00	20.00	20.00	20.00
59	23.00	23.00	23.00	23.00
60	45.00	40.00	45.00	40.00
61	45.00	40.00	45.00	40.00
62	45.00	40.00	45.00	40.00
63	45.00	40.00	45.00	40.00
64	45.00	40.00	45.00	40.00
65 & Over	100.00	100.00	100.00	100.00

As shown above, we are recommending decreases in retirement rates at the older ages for Safety Tiers 4 and 5 members to commensurate with the changes we are recommending for Safety Tiers 1 and 2.

Chart 10 compares the current and proposed rates of retirement for Safety Tier 4 members. There were no actual retirement from Safety Tier 4.

Chart 11 compares with the current and proposed rates of retirement for Safety Tier 5 members. There were no actual retirement from Safety Tier 5.

Deferred Vested Members

In prior valuations, deferred vested General and Safety members were assumed to retire at ages 58 and 54, respectively. The average age at retirement over the prior three years was 59.0 for General and 54.1 for Safety.

We recommend increasing the General deferred vested retirement assumption from assume age 58 to assume age 59 and maintaining the Safety deferred vested retirement assumption at assume age 54.

Reciprocity

Under the current assumptions, it was assumed that 20% of General deferred vested participants with less than five years of service and 35% of General deferred vested participants with five or more years of service would be covered under a reciprocal retirement system and receive 4.50% annual salary increases from termination until their date of retirement. It was also assumed that 30% of Safety deferred vested participants with less than five years of service and 55% of Safety deferred vested participants with five or more years of service would be covered under a reciprocal retirement system and receive 4.90% annual salary increases from termination until their date of retirement.

As of June 30, 2018, about 16% of the General deferred vested participants with less than five years of service and 25% of the General deferred vested participants with five or more years of service went on to be covered by a reciprocal retirement system. Additionally, about 26% of the Safety deferred vested participants with less than five years of service and 45% of the Safety deferred vested participants with five or more years of service went on to be covered by a reciprocal retirement system.

We recommend maintaining the reciprocity assumption for General members with less than five years of service and decreasing the reciprocity assumption from 35% to 30% for General members with five or more years of service. Additionally, we recommend maintaining the reciprocity assumption for Safety members with less than five years of service and decreasing the reciprocity assumption from 55% to 50% for Safety members with five or more years of service.

The annual reciprocal salary increase assumption is based on the ultimate merit and promotional salary increase assumptions (for members with 10 or more years of service) for General and Safety members together with the 2.75% inflation and 0.50% real “across the board” salary increase assumptions that are recommended earlier in Section III of this report. This assumption is utilized to anticipate salary increases (under the reciprocal system) from termination from FCERA to the expected date of retirement.

We recommend decreasing the annual reciprocal salary increase assumption from 4.50% to 4.35% (i.e., 2.75% inflation plus 0.50% “across the board” plus 1.10% merit and promotional) for General deferred vested participants, and from 4.90% to 4.75% (i.e., 2.75% inflation plus 0.50% “across the board” plus 1.50% merit and promotional) for Safety deferred vested participants.

Survivor Continuance under Unmodified Option

In prior valuations, it was assumed that 75% of all active and inactive male members and 50% of all active and inactive female members would be married or have an eligible domestic partner and selected unmodified option when they retired. We reviewed experience for new retirees during the three-year period and determined the actual percentage of these new retirees that had an eligible spouse or eligible domestic partner at the time of retirement. The results of that analysis are shown below.

New Retirees – Actual Percent with Eligible Spouse or Domestic Partner and Selected Unmodified Option		
Year Ending June 30	Male	Female
2016	68%	46%
2017	66%	52%
2018	64%	52%
Total	66%	50%

We recommend decreasing the percent married assumption for male members from 75% to 70% and maintaining the percent married assumption female members at 50%.

Since the value of the survivor’s benefit is dependent on the survivor’s age and sex, we must also have assumptions for the age and sex of the survivor. Based on the experience for members who retired during the current three-year period and studies done for other retirement systems, we recommend the following:

1. Since more than 95% of the survivors are actually the opposite sex, even with the inclusion of domestic partners, we will continue to assume that for all active and inactive members, the survivor’s sex is the opposite of the member.
2. The current and proposed assumption for the age of the survivor for all active and inactive members are shown below. These assumptions will continue to be monitored in future experience studies.

Survivor’s Age as Compared to Member’s Age			
Beneficiary Sex	Current Assumption	Actual FCERA Experience	Proposed Assumption
Male	3 years older	2.8 years older	3 years older
Female	2 years younger	2.4 years younger	2 years younger

CHART 3: RETIREMENT RATES – GENERAL TIER 1 MEMBERS LESS THAN 30 YEARS OF SERVICE

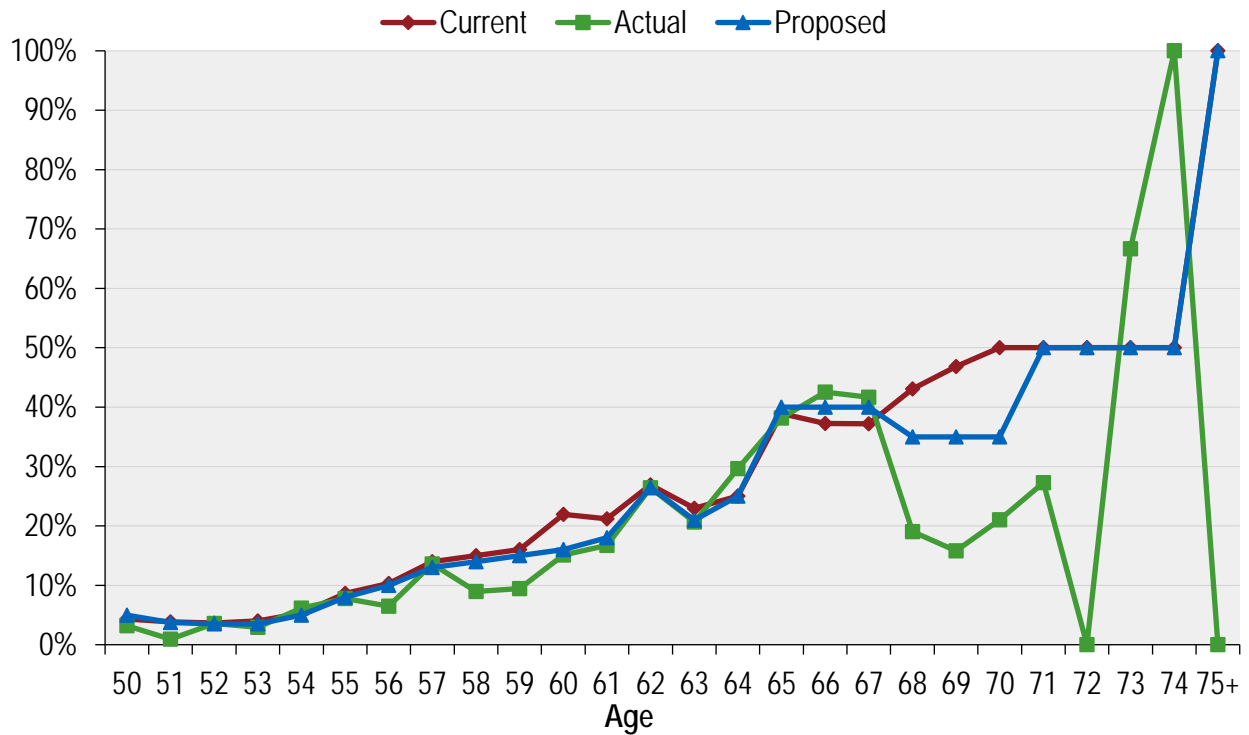


CHART 4: RETIREMENT RATES – GENERAL TIER 1 MEMBERS 30 OR MORE YEARS OF SERVICE

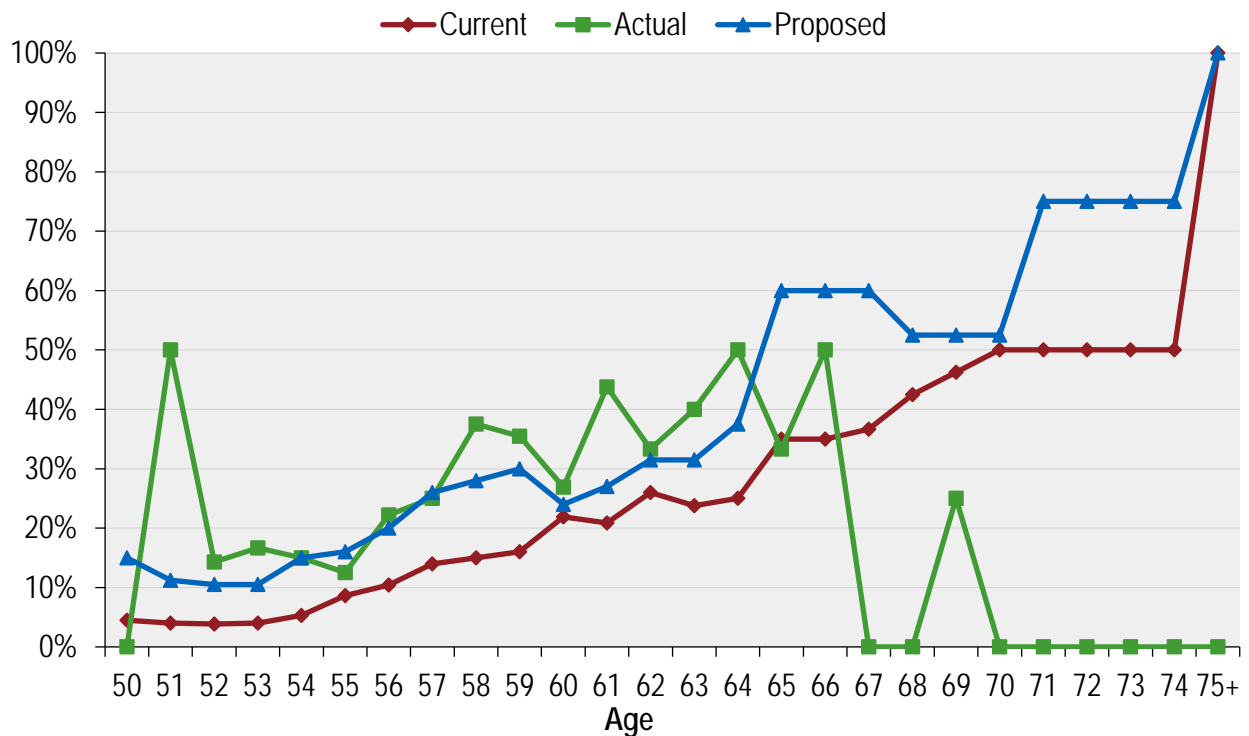


CHART 5: RETIREMENT RATES – GENERAL TIER 2 MEMBERS

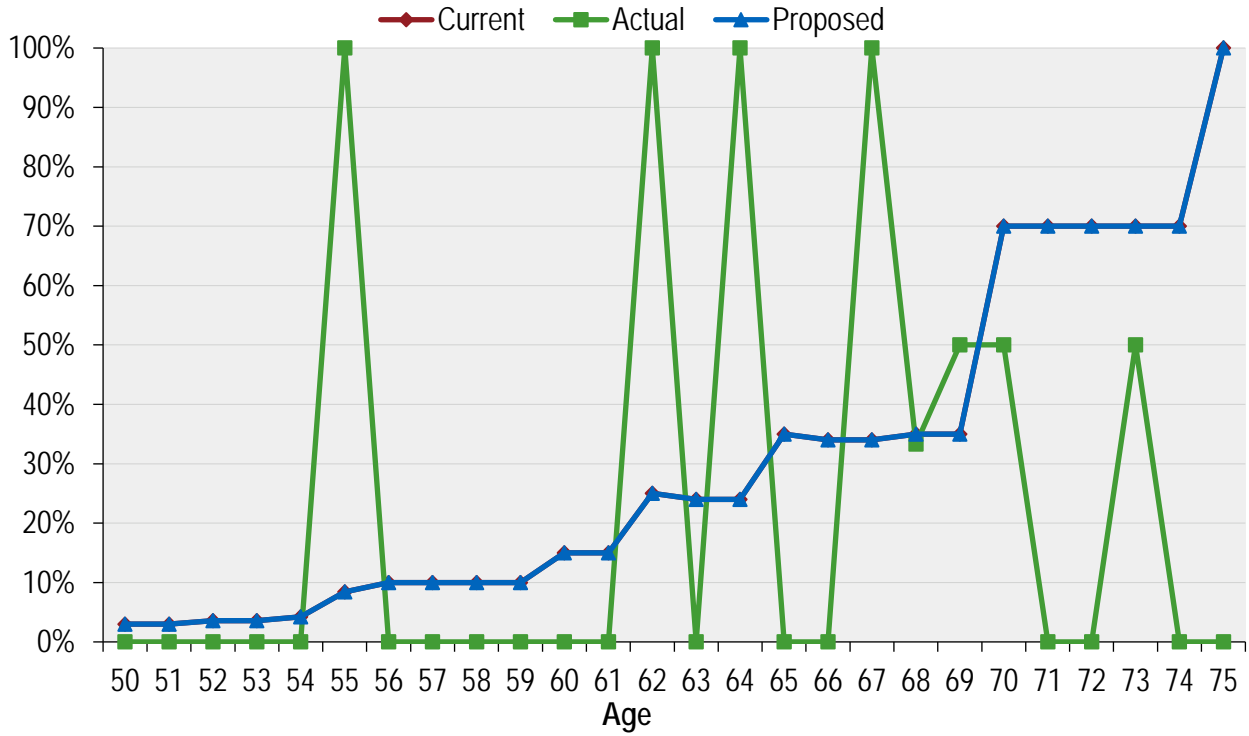


CHART 6: RETIREMENT RATES – GENERAL TIER 3 MEMBERS

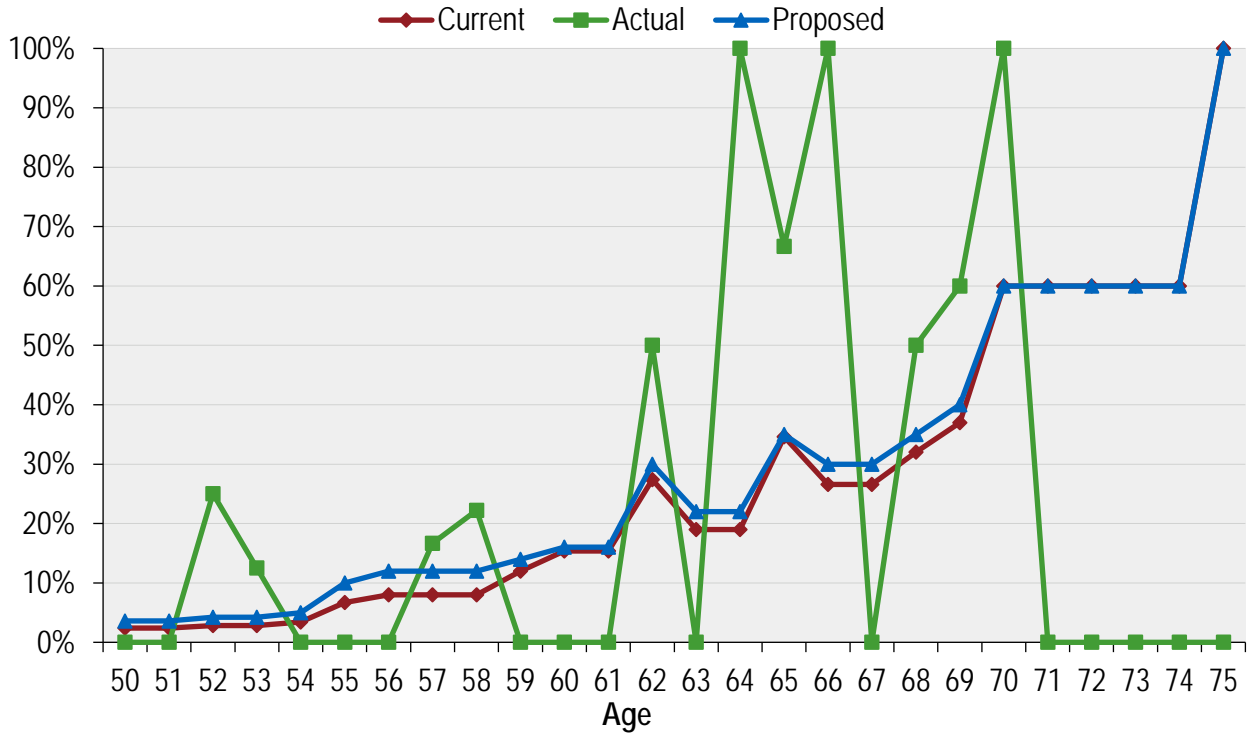


CHART 7: RETIREMENT RATES – SAFETY TIERS 1 AND 2

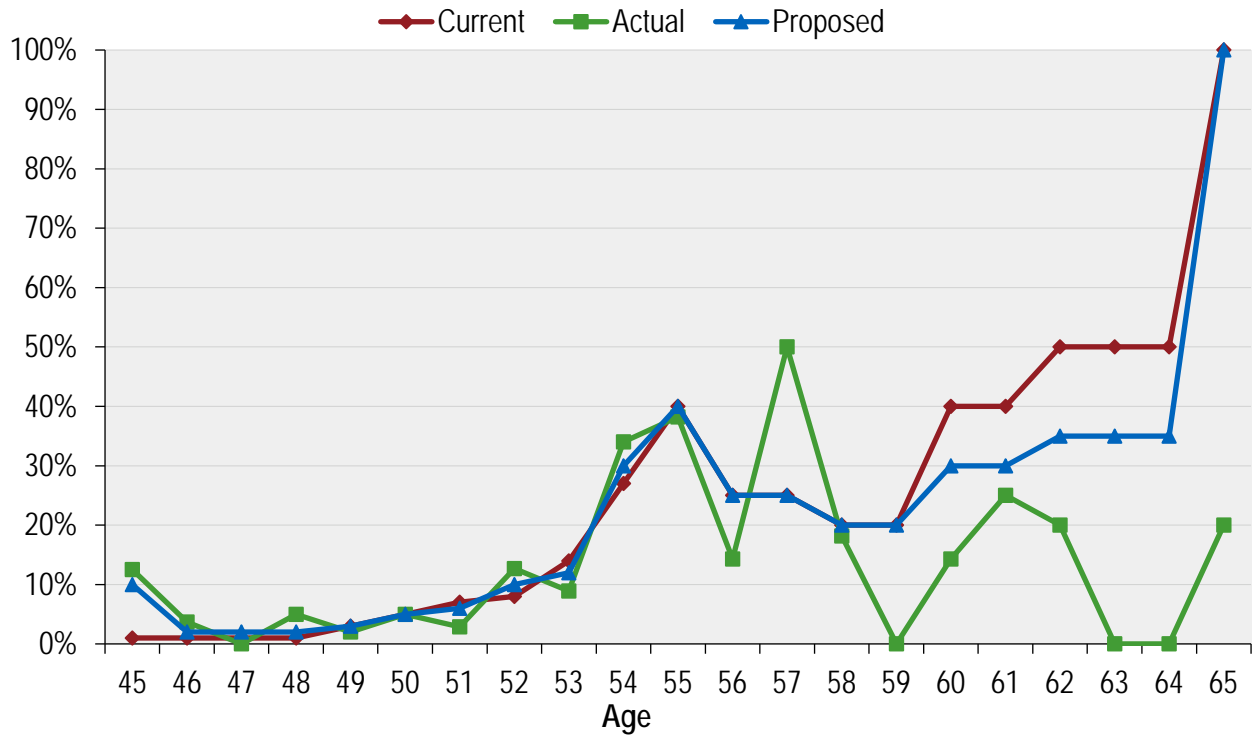


CHART 8: RETIREMENT RATES – GENERAL TIER 4

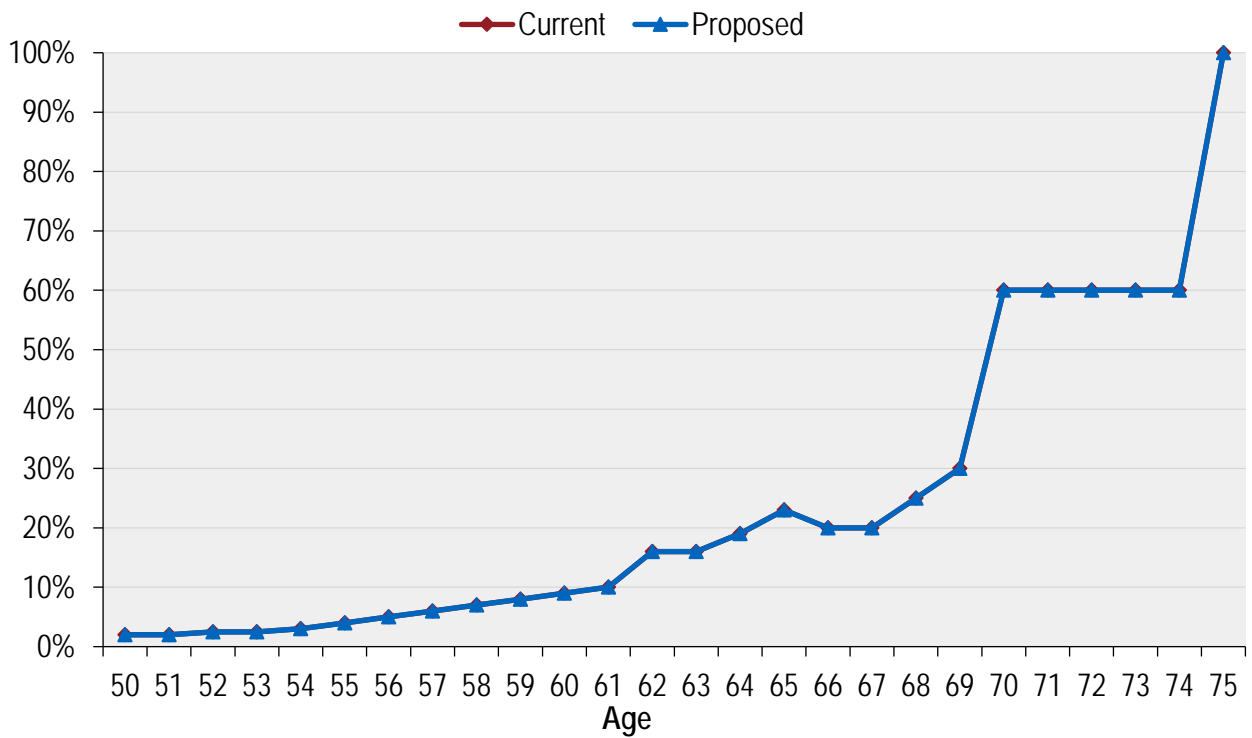


CHART 9: RETIREMENT RATES – GENERAL TIER 5

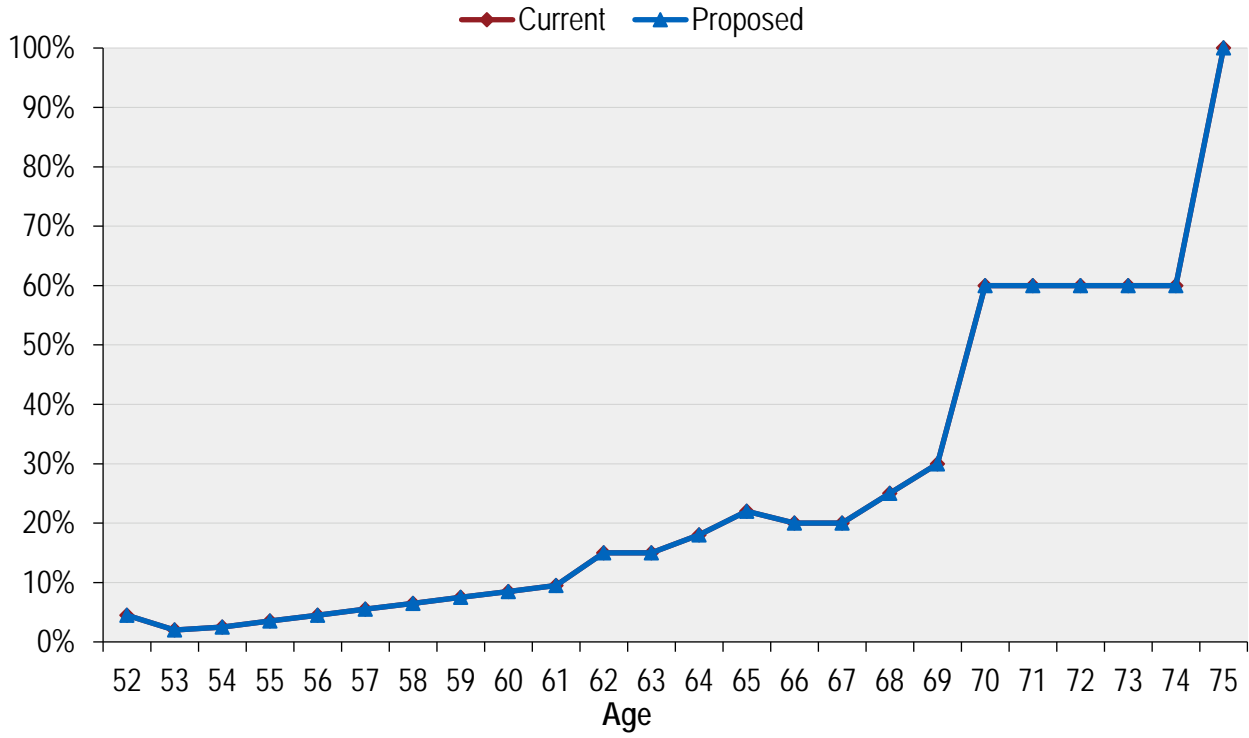


CHART 10: RETIREMENT RATES – SAFETY TIER 4

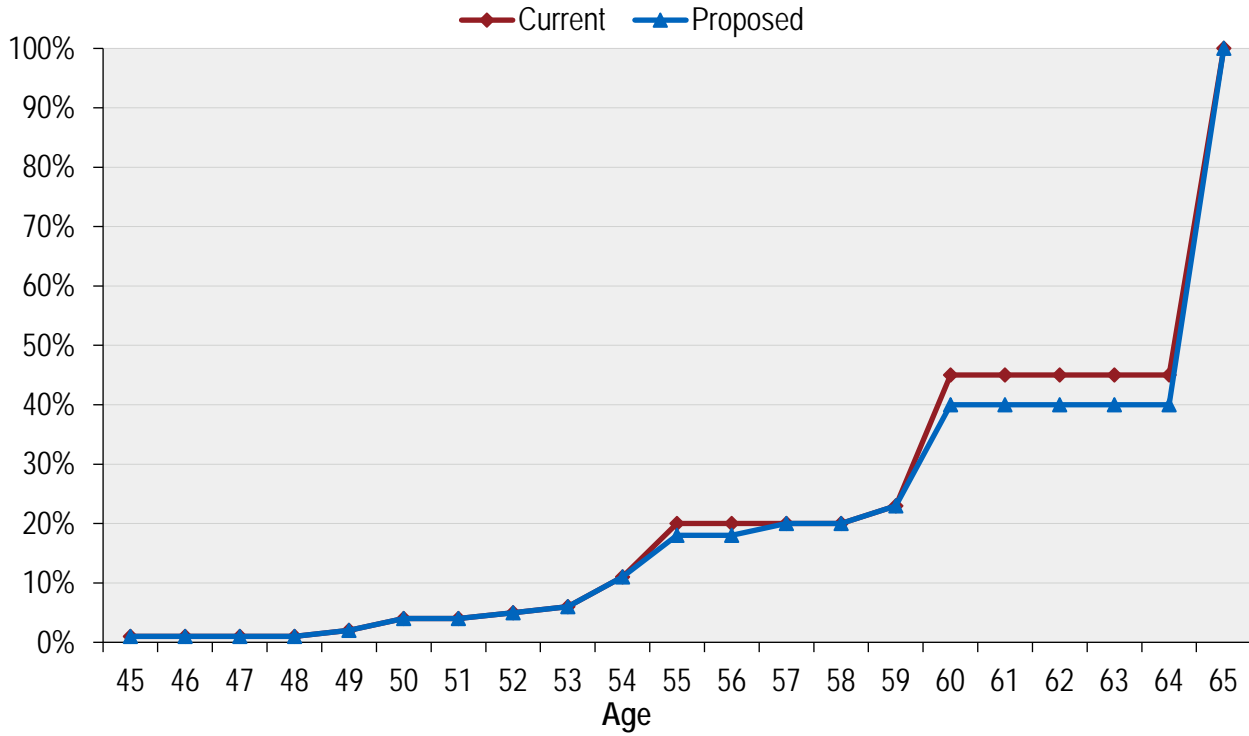
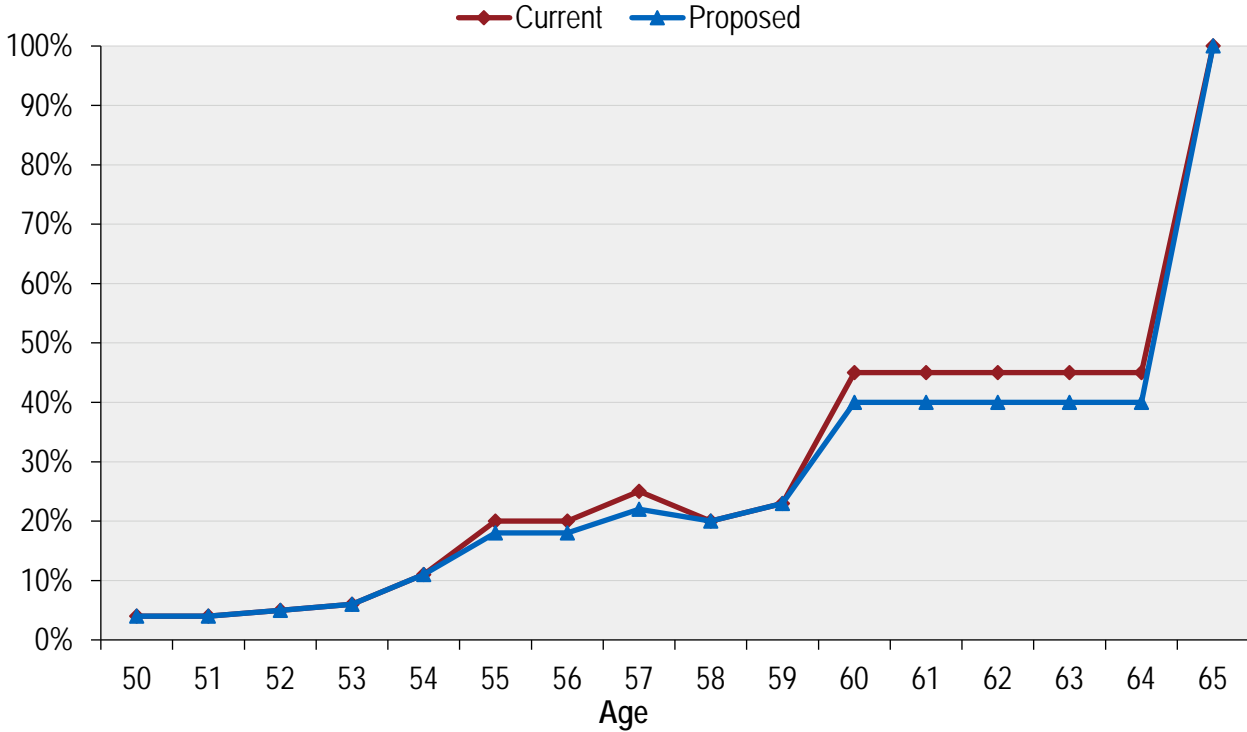


CHART 11: RETIREMENT RATES – SAFETY TIER 5



B. Mortality Rates - Healthy

The “healthy” mortality rates project the life expectancy of a member who retires from service (i.e., who did not retire on a disability pension). Also, the “healthy” pre-retirement mortality rates project what proportion of members will die before retirement. For General members, the table currently being used for post-service retirement mortality rates is the Headcount-Weighted RP-2014 Healthy Annuitant Table projected 20 years using a “static” approach with the two-dimensional scale MP-2015 set forward one year for females. For Safety members, the table currently being used for post-service retirement mortality rates is the Headcount-Weighted RP-2014 Healthy Annuitant Table projected 20 years using a “static” approach with the two-dimensional scale MP-2015 set back two years. Beneficiaries are assumed to have the same mortality as General members who have taken a service (non-disability) retirement.

When we conducted the last experience study, we alerted the Board that we would recommend a switch from a Headcount-Weighted to a Benefit-Weighted table and from a “static” to “generational” approach to anticipate mortality improvement, but only after the Society of Actuaries (SOA) provides mortality tables based on public sector experience comparable to the RP-2014 mortality tables developed using data collected from private and multi-employer pension plans.

The Retirement Plans Experience Committee (RPEC) of the SOA has recently published the Pub-2010 Public Retirement Plans Mortality tables (Pub-2010). For the first time, the Pub-2010 mortality tables are based exclusively on public sector pension plan experience in the United States. Within the Pub-2010 family of mortality tables, there are separate tables by job categories of General, Safety and Teachers. Included with the mortality tables is the analysis prepared by RPEC that continues to observe that benefit amount for healthy retirees and salary for employees are the most significant predictors of mortality differences within the job categories. Therefore, Pub-2010 includes mortality rates developed for annuitants on a “benefit” weighted basis, with higher credibility assigned to experience from annuitants receiving larger benefits.

As the Pub-2010 study shows that benefit (or salary for employees) is a significant predictor of mortality difference, the Pub-2010 family of mortality tables also include mortality rates based on population with above-median benefit amount (or salary for employees), below-median benefit amount (or salary for employees) and total population within each job category. The median benefit amounts used to determine the above-median and below-median mortality rates as shown in the Pub-2010 report for General and Safety are as follows:

Median Amounts (\$) by Gender, Job Category, and Status				
	Males		Females	
Job Category	Employees	Retirees	Employees	Retirees
General	45,800	21,200	34,700	11,900
Safety	72,200	36,900	61,800	29,200

Note: Values shown as of 2010.

Even after we adjust the above amounts by a reasonable measure of U.S. price inflation from 2010 to 2018 for a total increase of less than 20%, the benefit amounts (or salaries) paid to FCERA’s members were generally greater than the adjusted median amounts shown above.

Therefore, we recommend that the above-median version of the mortality tables for each job category be used.

As for the mortality improvement scales, they can be applied in one of two ways. Historically, the more common application is to use a “static” approach to anticipate a fixed level of mortality improvement for all annuitants receiving benefits from a retirement plan. This is in contrast to a “generational” approach where each future year has its own mortality table that reflects the forecasted improvements, using the published improvement scales. While the static approach is still used by some of Segal’s California public system clients, as well as CalPERS, the “generational” approach is clearly the emerging practice within the actuarial profession.

A generational mortality table provides dynamic projections of mortality experience for each cohort of retirees. For example, the mortality rate for someone who is 65 next year will be slightly less than for someone who is 65 this year. In general, using generational mortality anticipates increases in the cost of the Plan over time as participants’ life expectancies are projected to increase. This is in contrast to updating a static mortality assumption with each experience study as we have proposed in prior experience studies.

We understand that RPEC intends to publish annual updates to their mortality improvement scales. Improvement scale MP-2018 is the latest improvement scale available. We recommend that given the trend in the retirement industry to move towards generational mortality, it would be reasonable for the Board to adopt the Benefit-Weighted Above-Median Pub-2010 mortality table (adjusted for FCERA experience), and project the mortality improvement generationally using the MP-2018 mortality improvement scale.

In order to use more actual FCERA experience in our analysis, we have used experience for a nine-year period by using data from the current (from July 1, 2015 to June 30, 2018) and the last two (from July 1, 2012 to June 30, 2015 and from July 1, 2009 to June 30, 2012) experience study periods to analyze this assumption.

Even with the use of nine years of experience, based on standard statistical theory the data is only partially credible especially under the recommended benefit-weighted basis when dispersion of retirees’ benefit amounts is taken into account. In 2008 the SOA published an article recommending that mortality assumptions include an adjustment for credibility. Under this approach, the number of deaths needed for full credibility for a headcount-weighted mortality table is just over 1,000, where full credibility means a 90% confidence that the actual experience will be within 5% of the expected value. Therefore, in our recommended assumptions, we have only partially adjusted the Pub-2010 mortality tables to fit FCERA’s experience. In future experience studies, more data will be available which may further increase the credibility of the FCERA experience.

Pre-Retirement Mortality

For General and Safety members, the table currently being used for pre-retirement mortality rates is the Headcount-Weighted RP-2014 Employee Mortality Table (separate tables for males and females) projected 20 years with the two-dimensional scale MP2015 times 75%.

For General members, we recommend changing the pre-retirement mortality to follow the Pub-2010 General Employee Amount-Weighted Above-Median Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018.

For Safety members, we recommend changing the pre-retirement mortality to follow the Pub-2010 Safety Employee Amount-Weighted Above-Median Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018.

We also recommend maintaining the current assumption that all pre-retirement deaths are assumed to be non-service connected for both General and Safety members.

Post-Retirement Mortality (Service Retirements)

Among all retired members, the actual deaths compared to the expected deaths weighted by benefit amounts under the current assumptions for the last nine years are shown in the table below. We also show the deaths weighted by benefit amount under the proposed assumptions. In the prior study we set the mortality assumption using a static mortality projection so that actual deaths would be about 20% greater than those assumed. As noted above, we are recommending the use of a generational mortality table rather than a static mortality table. A generational mortality table incorporates a more explicit assumption for future mortality improvement. Accordingly, the goal is to start with a mortality table that closely matches the current experience (without a margin for future mortality improvement), and then reflect mortality improvement by projecting lower mortality rates in future years.

Also, the proposed mortality table reflects current experience to the extent that the experience is credible based on standard statistical theory. For FCERA, the volume of General member data makes it relatively credible. In contrast, there is much less Safety data, so it is given substantially less credibility. That is why the proposed tables (as shown in the table below) after adjustments for partial credibility have actual to expected ratios of 103% and 110% for General and Safety, respectively. In future years the ratio should remain around 103% and 110% for General and Safety, respectively, as long as actual mortality improves at the same rates as anticipated by the generational mortality tables. The number of actual deaths compared to the number expected under the current and proposed assumptions weighted by benefit amounts for the last nine years are as follows:

Gender	General Members – Healthy (\$ in millions)			Safety Members – Healthy (\$ in millions)		
	Current Expected Weighted Deaths	Actual Weighted Deaths	Proposed Expected Weighted Deaths	Current Expected Weighted Deaths	Actual Weighted Deaths	Proposed Expected Weighted Deaths
Male	\$12.8	\$14.2	\$14.0	\$2.9	\$3.5	\$3.1
Female	\$12.2	\$13.2	\$12.7	\$0.2	\$0.1	\$0.2
Total	\$25.0	\$27.4	\$26.7	\$3.1	\$3.6	\$3.3
Actual / Expected	110%		103% ²⁹	116%		110%

Notes: (1) Experience shown above is weighted by annual benefit amounts for deceased members instead of by headcounts.

(2) Expected amounts under the proposed generational mortality table are based on mortality rates from the base year projected with mortality improvements to the experience study period.

For General members, the combined ratio of actual to expected deaths in terms of benefit amounts was 110%. We recommend updating the current table to the Pub-2010 General Healthy Retiree Amount-Weighted Above-Median Mortality Table (separate tables for males and females) times 110%, projected generationally with the two-dimensional mortality improvement scale MP-2018. The recommended mortality tables will have an actual to expected ratio of 103%.

For Safety members, the combined ratio of actual to expected deaths was 116%. We recommend updating the current table to the Pub-2010 Safety Healthy Retiree Amount-Weighted Above-Median Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018. This will bring the actual to expected ratio to 110%.

For this transitional year for informational purposes only, we have also provided in the table below the actual and expected deaths computed without weighting these by benefit amounts. This is similar to how actual and expected deaths ratios were developed based on the prior headcount approach.

Gender	General Members – Healthy			Safety Members – Healthy		
	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths
Male	355	401	392	57	73	62
Female	498	577	531	6	5	7
Total	853	978	923	63	78	69
Actual / Expected	115%		106%	124%		114%

Notes: (1) Experience shown above is weighted by headcounts for deceased members instead of by annual benefit amounts.
(2) The proposed expected deaths are based on the Pub-2010 Amount-Weighted Above-Median Mortality Tables.

²⁹ If we use the benchmark Pub-2010 General table without any adjustment, the proposed actual to expected ratio would be 113%.

Chart 12 compares actual to expected deaths on a benefit-weighted basis for General members under the current and proposed assumptions over the past nine years.

Chart 13 compares actual to expected deaths on a benefit-weighted basis for Safety members under the current and proposed assumptions over the past nine years.

Chart 14 compares actual to expected deaths on a headcount-weighted basis for General members under the current and proposed assumptions over the past nine years provided for informational purposes only.

Chart 15 compares actual to expected deaths on a headcount-weighted basis for Safety members under the current and proposed assumptions over the past nine years provided for informational purposes only.

Chart 16 shows the life expectancies (i.e., expected future lifetime) under the current and the proposed tables for General members on a benefit-weighted basis. Life expectancies under the proposed generational mortality rates are based on age as of 2019. In practice, life expectancies will be assumed to increase based on applying the mortality improvement scale.

Chart 17 shows the life expectancies under the current and the proposed tables for Safety members on a benefit-weighted basis.

Beneficiaries Mortality

In studying the mortality for all General and Safety beneficiaries in our prior experience study, we reviewed the actual deaths compared to the expected deaths and recommended the same mortality tables for healthy General retirees and all beneficiaries. Pub-2010 has separate mortality tables for healthy retirees and contingent annuitants. However, the Pub-2010 Contingent Survivors Table is developed only based on contingent survivor data after the death of the retirees. Considering the size of FCERA's beneficiary population and those contingent survivor mortality rates are somewhat comparable (about 4% higher) to those of the General healthy retiree mortality rates, we recommend using the General healthy retiree mortality table for both General and Safety beneficiaries based on the gender of the beneficiary.

Mortality Table for Member Contributions and Optional Forms of Payment

There are administrative reasons why a generational mortality table is more difficult to implement for determining member contributions for legacy tiers (i.e., non-CalPEPRA), optional forms of payment and reserves. For determining member contributions, one emerging practice is to approximate the use of a generational mortality table by the use of a static table with projection of the mortality improvement from the measurement year over a period that is close to the duration of the benefit payments for active members. We would recommend the use of this approximation for determining member contributions for employees in the legacy tiers.

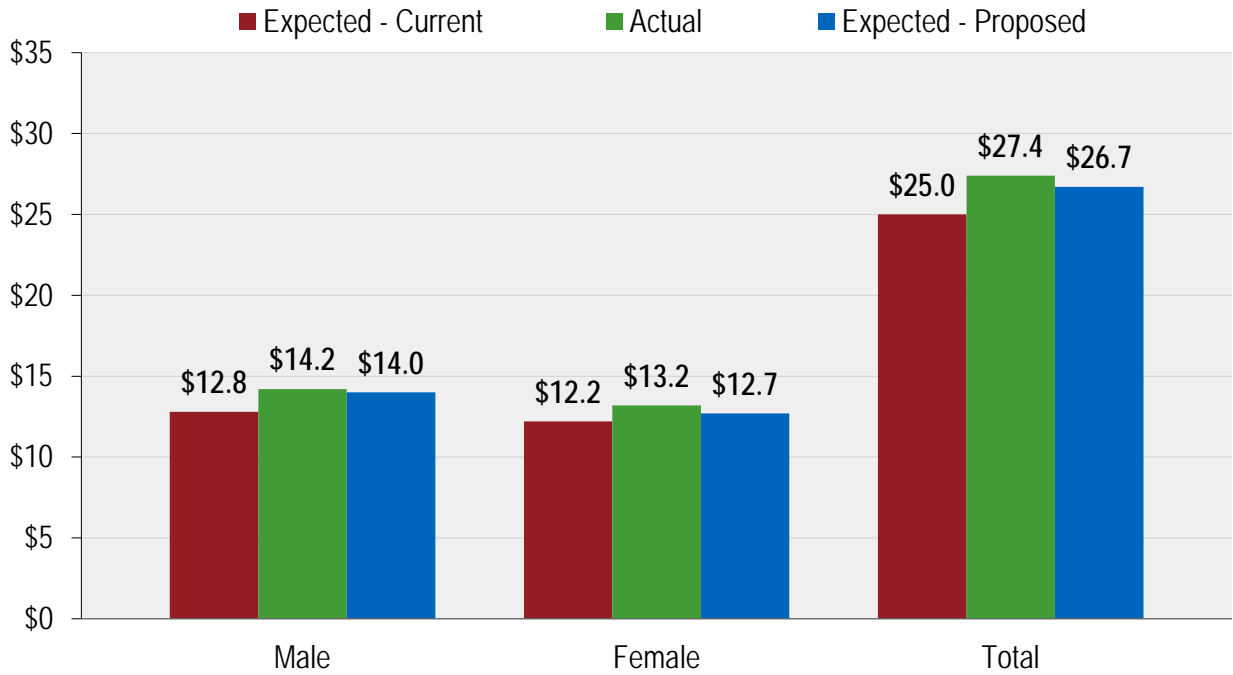
For General members, we recommend that the mortality table used for determining contributions for General members be updated to a blended table based on the Pub-2010 General Healthy Retiree Amount-Weighted Above-Median Mortality Table (separate tables for males and females) times 110%, projected 30 years (from 2010) with the two-dimensional mortality improvement scale MP-2018, weighted 35% male and 65% female. This is based on the

proposed valuation mortality table for General members and the actual gender distribution of General members.

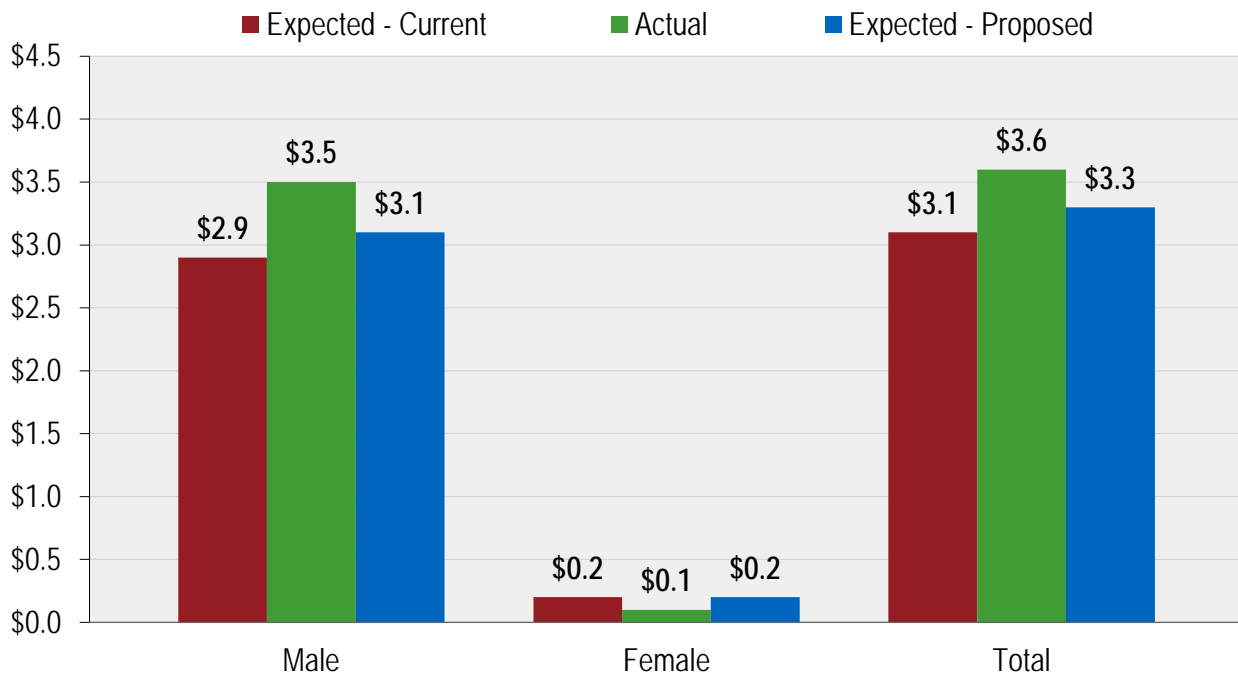
For Safety members, we also recommend an update to the mortality table for Safety members to be the Pub-2010 Safety Healthy Retiree Amount-Weighted Above-Median Mortality Table (separate tables for males and females), projected 30 years (from 2010) with the two-dimensional mortality improvement scale MP-2018, weighted 80% male and 20% female. This is based on the proposed mortality table for Safety members and the actual gender distribution for the current Safety members.

In prior experience studies, for determining optional forms of payment, our recommendation for mortality tables was based on the post-retirement mortality we recommended for service retirement and disability retirement projected with a static scale to anticipate future mortality improvement. However, given that our current recommendation for post-retirement mortality now includes a generational mortality improvement scale, there are some administrative issues that we may need to resolve with FCERA and its vendor maintaining the pension administration software before we would recommend a comparable generational scale to anticipate future mortality improvement. We will provide a recommendation to FCERA for use in reflecting mortality improvement for determining optional forms of payment after we have those discussions with FCERA and its vendor.

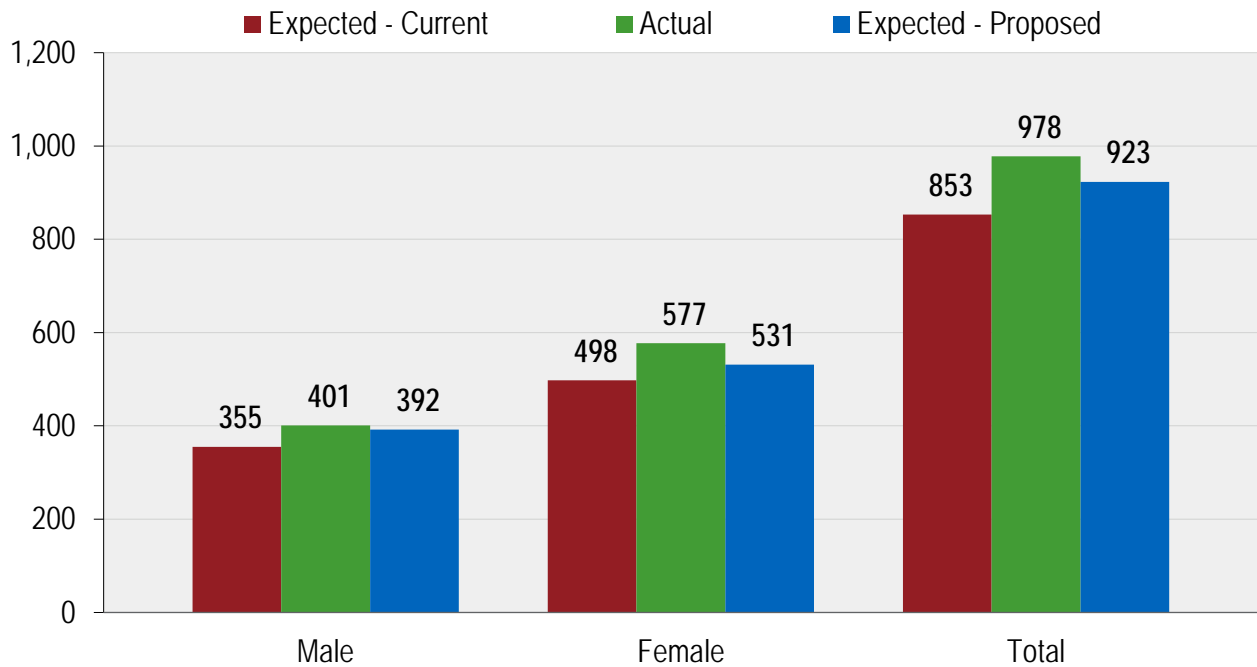
**CHART 12: POST-RETIREMENT BENEFIT-WEIGHTED DEATHS
NON-DISABLED GENERAL MEMBERS (IN MILLIONS)
(JULY 1, 2009 THROUGH JUNE 30, 2018)**



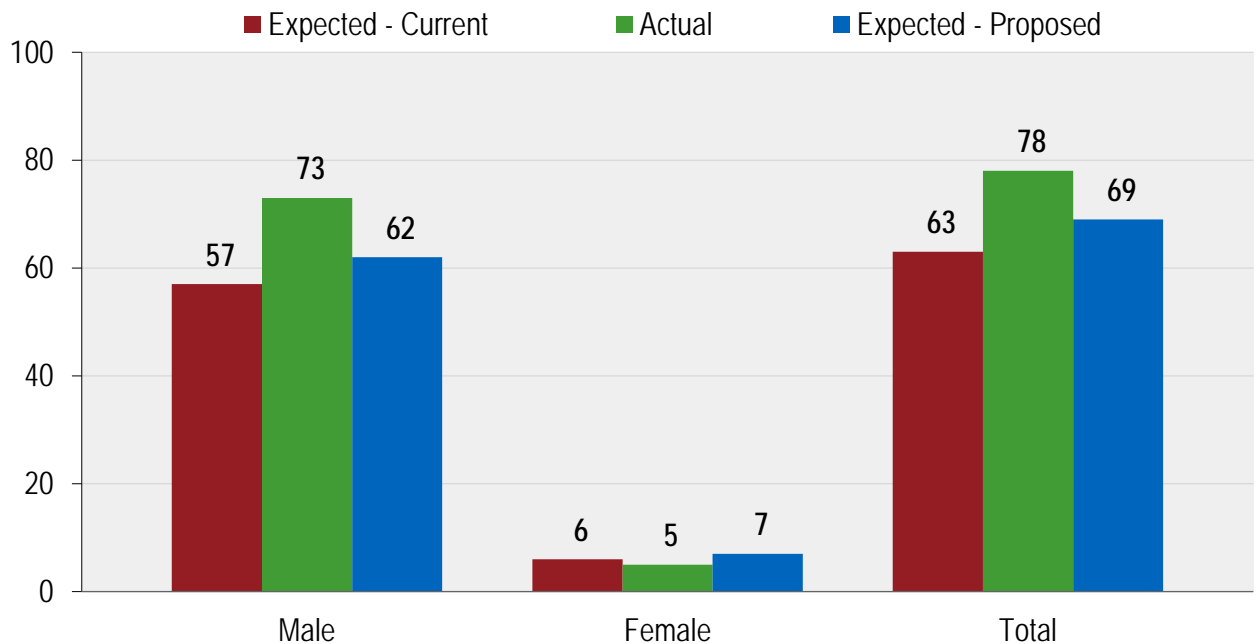
**CHART 13: POST-RETIREMENT BENEFIT-WEIGHTED DEATHS
NON-DISABLED SAFETY MEMBERS (IN MILLIONS)
(JULY 1, 2009 THROUGH JUNE 30, 2018)**



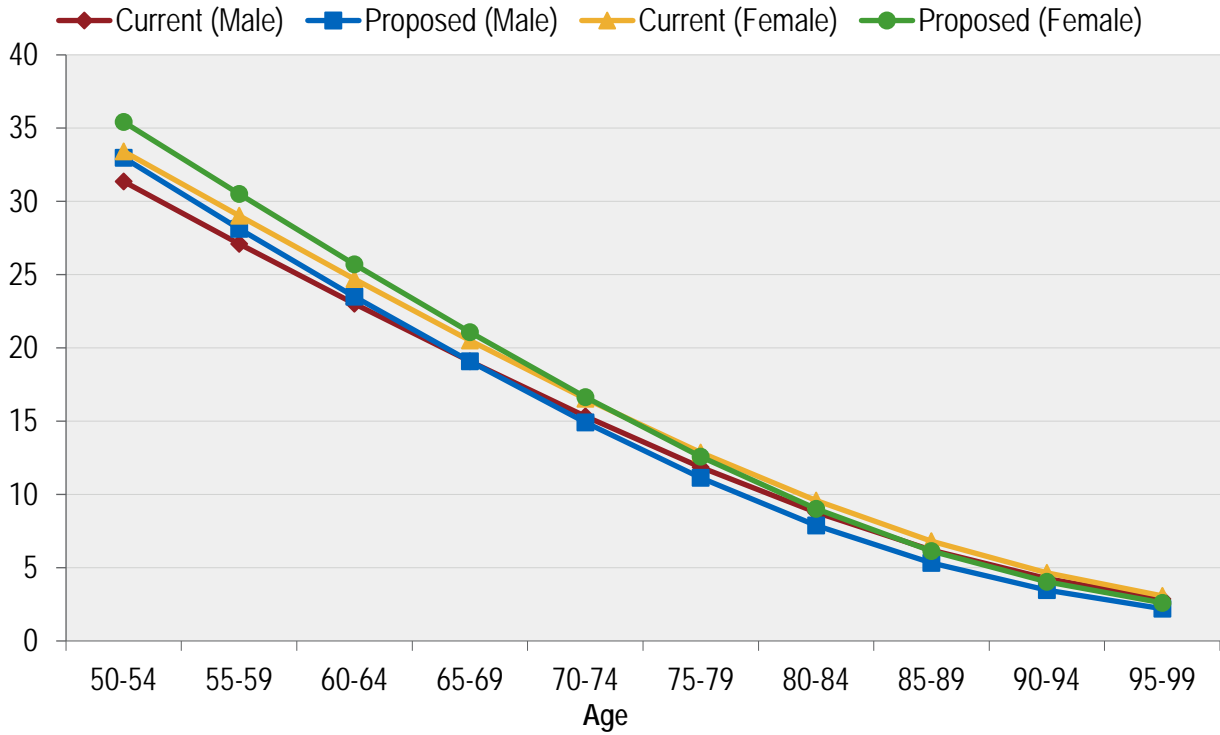
**CHART 14: POST-RETIREMENT HEADCOUNT-WEIGHTED DEATHS
NON-DISABLED GENERAL MEMBERS
PROVIDED FOR INFORMATIONAL PURPOSES ONLY
(JULY 1, 2009 THROUGH JUNE 30, 2018)**



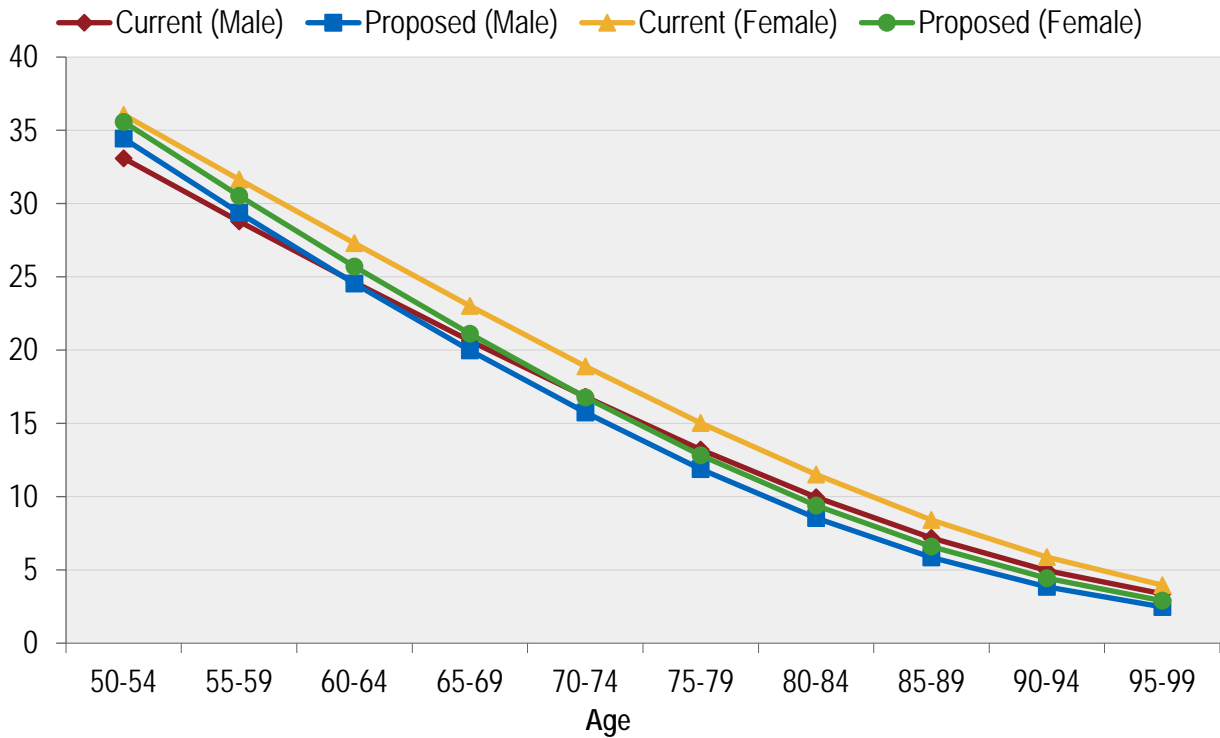
**CHART 15: POST-RETIREMENT HEADCOUNT-WEIGHTED DEATHS
NON-DISABLED SAFETY MEMBERS
PROVIDED FOR INFORMATIONAL PURPOSES ONLY
(JULY 1, 2009 THROUGH JUNE 30, 2018)**



**CHART 16: BENEFIT-WEIGHTED LIFE EXPECTANCIES
NON-DISABLED GENERAL MEMBERS**



**CHART 17: BENEFIT-WEIGHTED LIFE EXPECTANCIES
NON-DISABLED SAFETY MEMBERS**



C. Mortality Rates - Disabled

Since mortality rates for disabled members can vary from those of healthy members, a different mortality assumption is often used. For General members, the table currently being used is the Headcount-Weighted RP-2014 Healthy Annuitant Table projected 20 years using a “static” approach with the two-dimensional scale MP-2015 set forward eight years. For Safety members, the table currently being used is the Headcount-Weighted RP-2014 Healthy Annuitant Table projected 20 years using a “static” approach with the two-dimensional scale MP-2015 set forward seven years.

Post-Retirement Mortality (Disability Retirements)

The number of actual deaths compared to the number expected under the current and proposed assumptions weighted by benefit amounts for the last nine years are as follows:

Gender	General Members- Disabled (\$ in millions)			Safety Members- Disabled (\$ in millions)		
	Current Expected Weighted Deaths	Actual Weighted Deaths	Proposed Expected Weighted Deaths	Current Expected Weighted Deaths	Actual Weighted Deaths	Proposed Expected Weighted Deaths
Male	\$0.70	\$0.93	\$0.71	\$0.68	\$0.45	\$0.44
Female	\$0.60	\$0.49	\$0.66	\$0.10	\$0.22	\$0.07
Total	\$1.30	\$1.42	\$1.37	\$0.78	\$0.67	\$0.51
Actual / Expected	109%		103%	86%		133%

Notes: (1) Experience shown above is weighted by annual benefit amounts for deceased members instead of by headcounts.

(2) Expected amounts under the proposed generational mortality table are based on mortality rates from the base year projected with mortality improvements to the experience study period.

The Pub-2010 family of mortality tables provide separate disabled retiree mortality tables for Non-Safety disabled retirees and Safety disabled retirees. Based on the actual experience, we recommend updating the current table for General disabled members to the Pub-2010 Non-Safety Disabled Retiree Amount-Weighted Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018. The recommended mortality tables will have an actual to expected ratio of 103%.

Furthermore, based on the actual experience, we recommend updating the current table for Safety disabled members to the Pub-2010 Safety Disabled Retiree Amount-Weighted Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018. The recommended mortality tables will have an actual to expected ratio of 133%.

For this transitional year for informational purposes only, we have also provided in the table below the actual and expected deaths computed without weighting these by benefit amounts. This is similar to how actual and expected deaths ratios were developed based on the prior headcount approach.

Gender	General Members – Disabled			Safety Members – Disabled		
	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths
Male	34	41	33	17	17	11
Female	33	30	34	3	8	2
Total	67	71	67	20	25	13
Actual / Expected	106%		106%	127%		195%
<i>Notes: (1) Experience shown above is weighted by headcounts for deceased members instead of by annual benefit amounts.</i> (2) The proposed expected deaths are based on the Pub-2010 Amount-Weighted Above-Median Mortality Tables.						

Chart 18 compares actual to expected deaths on a benefit-weighted basis for disabled General members under the current and proposed assumptions over the past nine years.

Chart 19 compares actual to expected deaths on a benefit-weighted basis for disabled Safety members under the current and proposed assumptions over the past nine years.

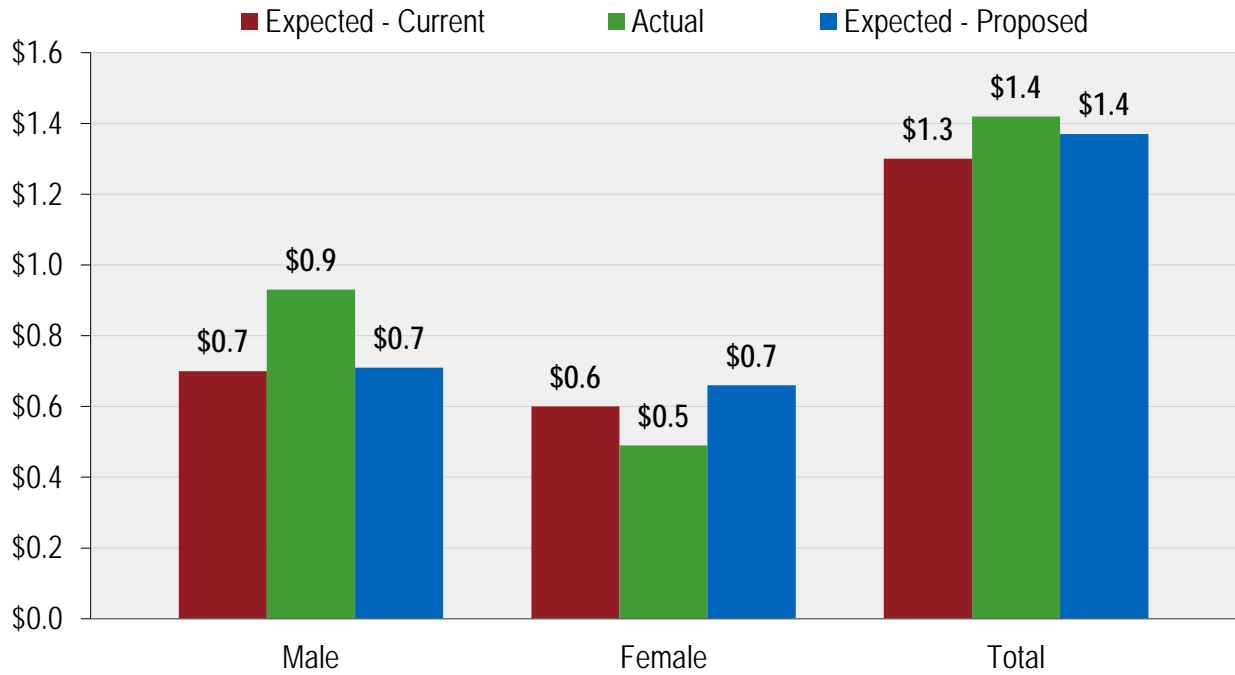
Chart 20 compares actual to expected deaths on a headcount-weighted basis for disabled General members under the current and proposed assumptions over the past nine years provided for informational purposes only.

Chart 21 compares actual to expected deaths on a headcount-weighted basis for disabled Safety members under the current and proposed assumptions over the past nine years provided for informational purposes only.

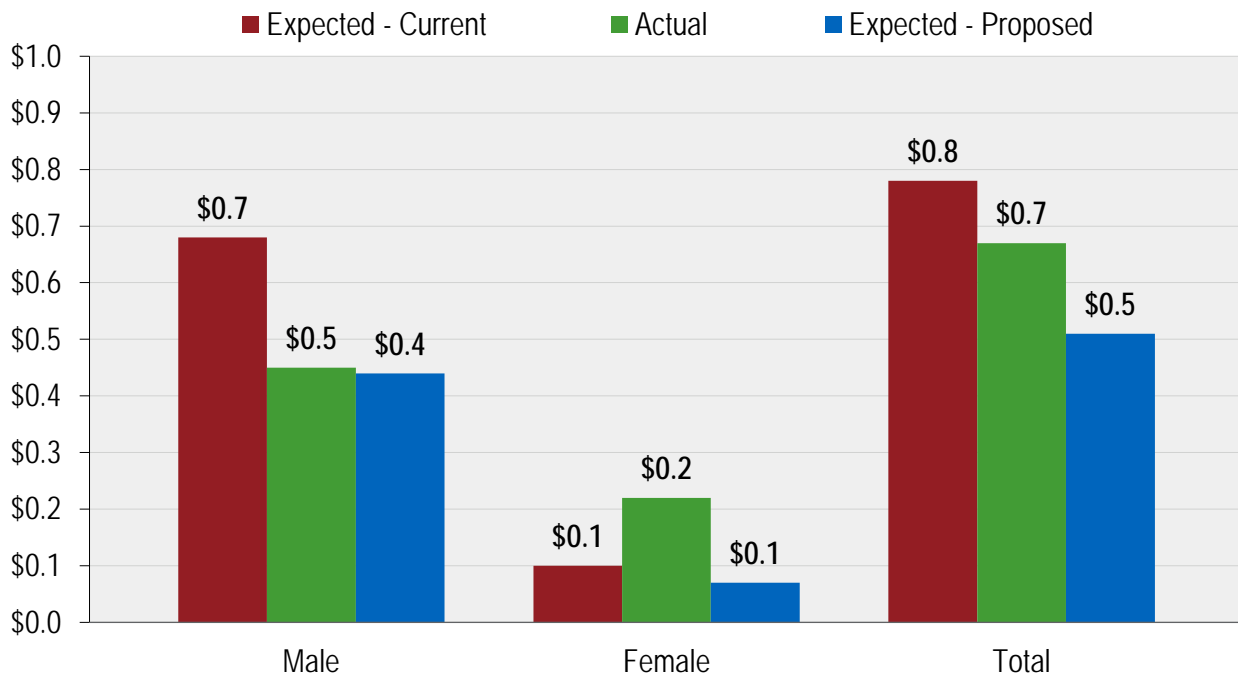
Chart 22 shows the life expectancies (i.e., expected future lifetime) under the current and the proposed tables for disabled General members on a benefit-weighted basis. Life expectancies under the proposed generational mortality rates are based on age as of 2019. In practice, life expectancies will be assumed to increase based on applying the mortality improvement scale.

Chart 23 shows the life expectancies under the current and the proposed tables for disabled Safety members on a benefit-weighted basis.

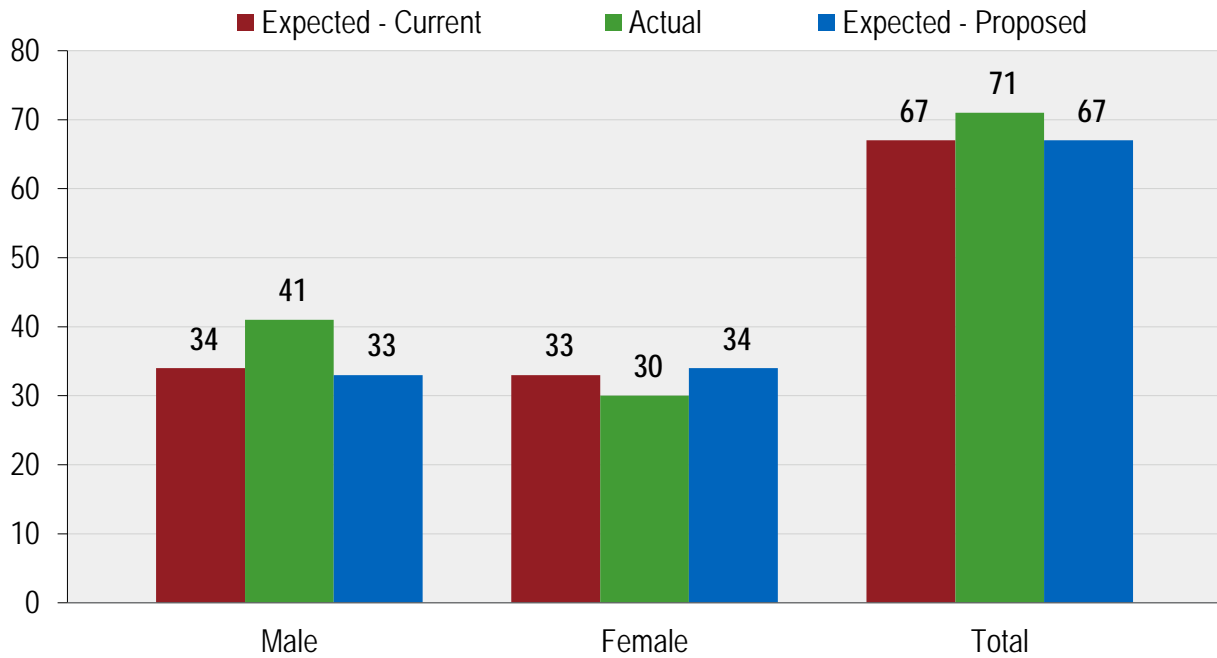
**CHART 18: POST-RETIREMENT BENEFIT-WEIGHTED DEATHS
DISABLED GENERAL MEMBERS (IN MILLIONS)
(JULY 1, 2009 THROUGH JUNE 30, 2018)**



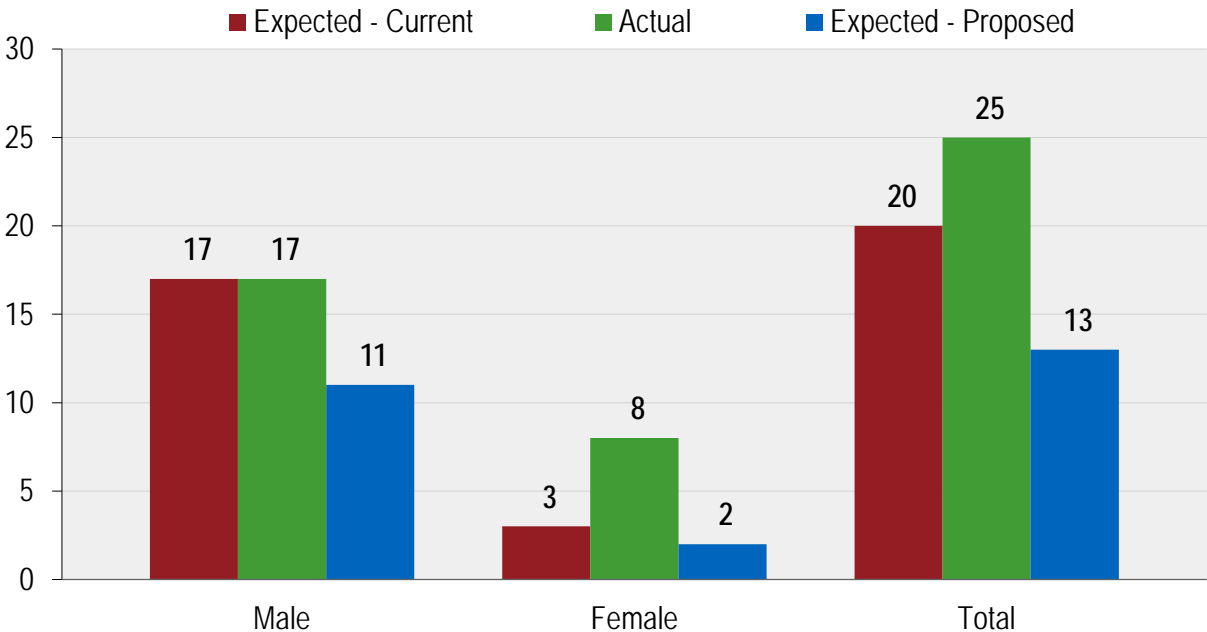
**CHART 19: POST-RETIREMENT BENEFIT-WEIGHTED DEATHS
DISABLED SAFETY MEMBERS (IN MILLIONS)
(JULY 1, 2009 THROUGH JUNE 30, 2018)**



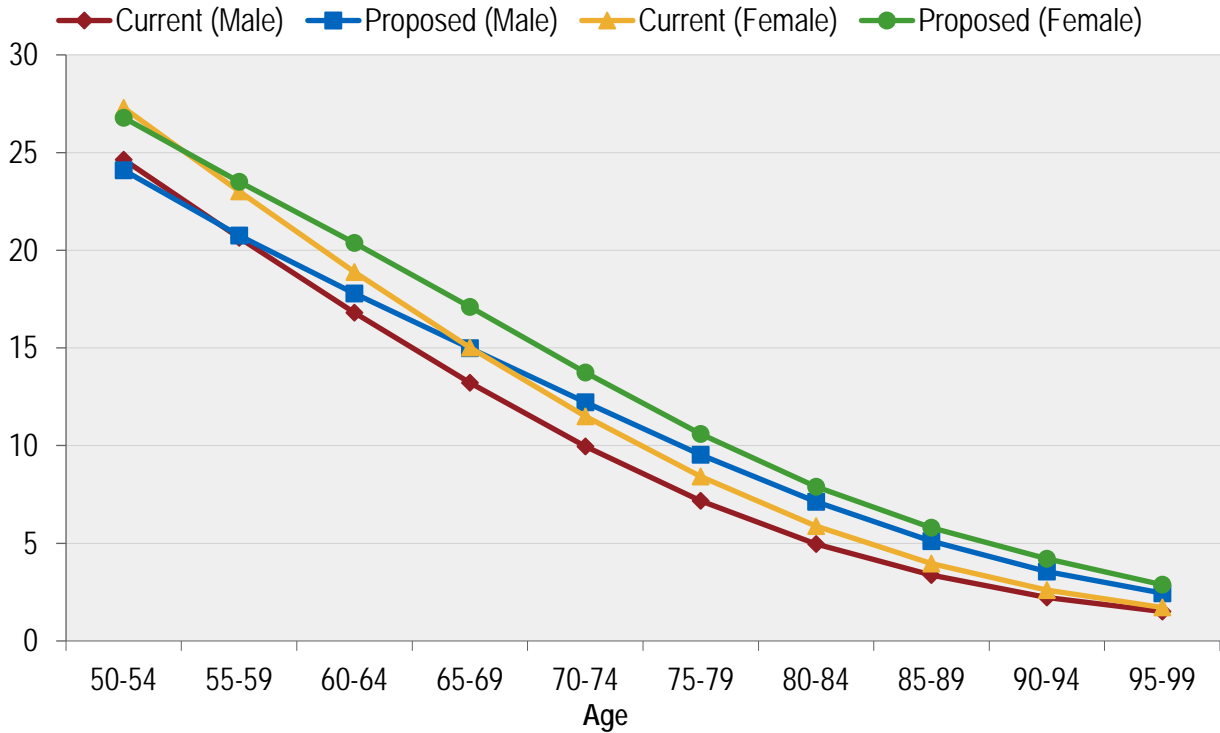
**CHART 20: POST-RETIREMENT HEADCOUNT-WEIGHTED DEATHS
DISABLED GENERAL MEMBERS
PROVIDED FOR INFORMATIONAL PURPOSES ONLY
(JULY 1, 2009 THROUGH JUNE 30, 2018)**



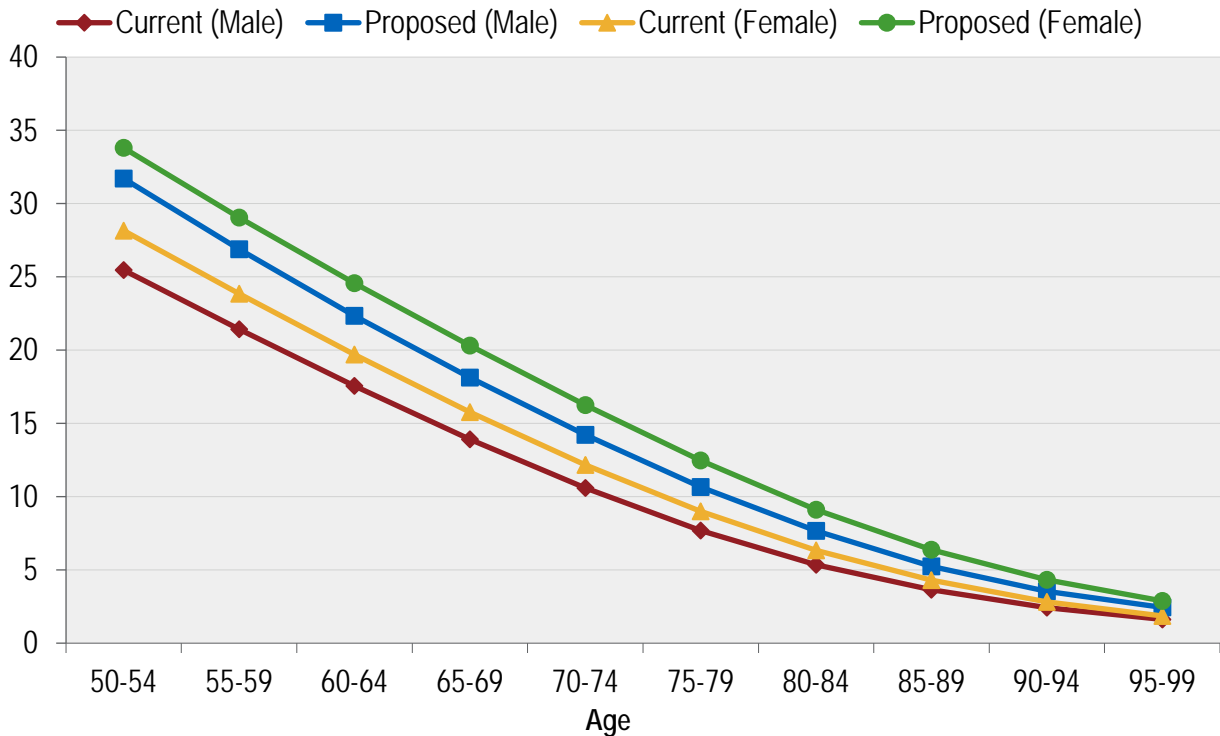
**CHART 21: POST-RETIREMENT HEADCOUNT-WEIGHTED DEATHS
DISABLED SAFETY MEMBERS
PROVIDED FOR INFORMATIONAL PURPOSES ONLY
(JULY 1, 2009 THROUGH JUNE 30, 2018)**



**CHART 22: BENEFIT-WEIGHTED LIFE EXPECTANCIES
DISABLED GENERAL MEMBERS**



**CHART 23: BENEFIT-WEIGHTED LIFE EXPECTANCIES
DISABLED SAFETY MEMBERS**



D. Termination Rates

Termination rates include all terminations for reasons other than death, disability, or retirement. Under the current assumptions, the assumed termination rates are a function of a member's age for members with five or more years of service. Starting with this year's experience review, we analyzed terminations based on age and years of service. Our review concludes that termination rates correlate better with years of service.

As a result of this review, we recommend that the termination rate assumption be structured solely as a function of years of service.

The termination experience over the last three years for General and Safety members is shown by years of service in the following tables. Please note that we have excluded any members that were eligible for retirement.

Rates of Termination

Years of Service	Rates of Termination (%)					
	General			Safety		
	Current Rate	Actual Rate	Proposed Rate	Current Rate	Actual Rate	Proposed Rate
Less than 1	17.00	19.18	18.00	14.00	11.65	13.00
1	9.50	12.76	11.00	7.50	7.28	8.00
2	8.00	9.89	9.00	6.00	8.67	7.00
3	7.00	8.78	8.00	5.00	3.36	4.00
4	6.75	8.47	7.50	4.75	3.67	3.50
5	4.19	7.30	6.00	2.22	0.00	3.25
6	4.11	7.63	5.50	2.17	0.00	3.00
7	4.10	6.54	5.00	1.98	3.70	2.75
8	4.03	5.85	4.75	2.01	2.38	2.50
9	3.99	4.28	4.00	1.98	3.95	2.25
10	4.10	4.41	4.00	2.03	1.05	2.00
11	4.02	4.55	4.00	1.94	2.13	1.90
12	3.94	3.02	3.75	1.89	0.00	1.80
13	3.89	3.50	3.75	1.82	1.96	1.70
14	3.81	4.83	3.75	1.77	1.53	1.60
15	3.75	3.24	3.50	1.72	0.88	1.50
16	3.71	2.46	2.75	1.72	0.96	1.40
17	3.65	2.82	2.75	1.68	2.15	1.30
18	3.62	1.89	2.75	1.64	1.47	1.20
19	3.57	1.14	2.50	1.63	0.00	1.10
20 or more	3.53	2.16	2.25	0.00	0.00	1.00

Note: The rate shown for five or more years of service is an average rate developed from the current age based assumption for members in that service category.

It is important to note that not every service category has enough exposures and/or decrements such that the results in that category are statistically credible. This is mainly the case at the highest service categories since most members in those categories are eligible to retire and so have been excluded from our review of this experience.

We will also continue to assume that termination rates are zero at any age where members are assumed to retire. In other words, at those ages, members will either retire in accordance with the retirement rate assumptions or continue working, rather than terminate and defer their benefit.

Chart 24 compares actual to expected terminations over the past three years for both the current and proposed assumptions for General members

Chart 25 graphs the same information as Chart 24, but for Safety members.

Chart 26 shows the actual termination rates over the past three years compared to the current and proposed assumptions for General members.

Chart 27 shows the same information as Chart 26, but for Safety members.

Based upon the recent experience, we have adjusted the termination rates accordingly.

In addition, we recommend the following assumptions for the percent of members who would elect a refund of contributions versus those who would leave their contributions on deposit and receive a deferred vested benefit.

Proportion of Total Termination Assumed to Receive Refunds and Deferred Vested Benefit (%)			
Years of Service	Current Rate	Actual Rate	Proposed Rate
0 – 4	60.00	36.64	50.00
5 – 9	30.00	23.43	30.00
10 – 14	25.00	28.97	25.00
15 – 19	15.00	14.00	15.00
20 or more	10.00	22.22	10.00

CHART 24: ACTUAL NUMBER OF TERMINATIONS COMPARED TO EXPECTED – GENERAL MEMBERS

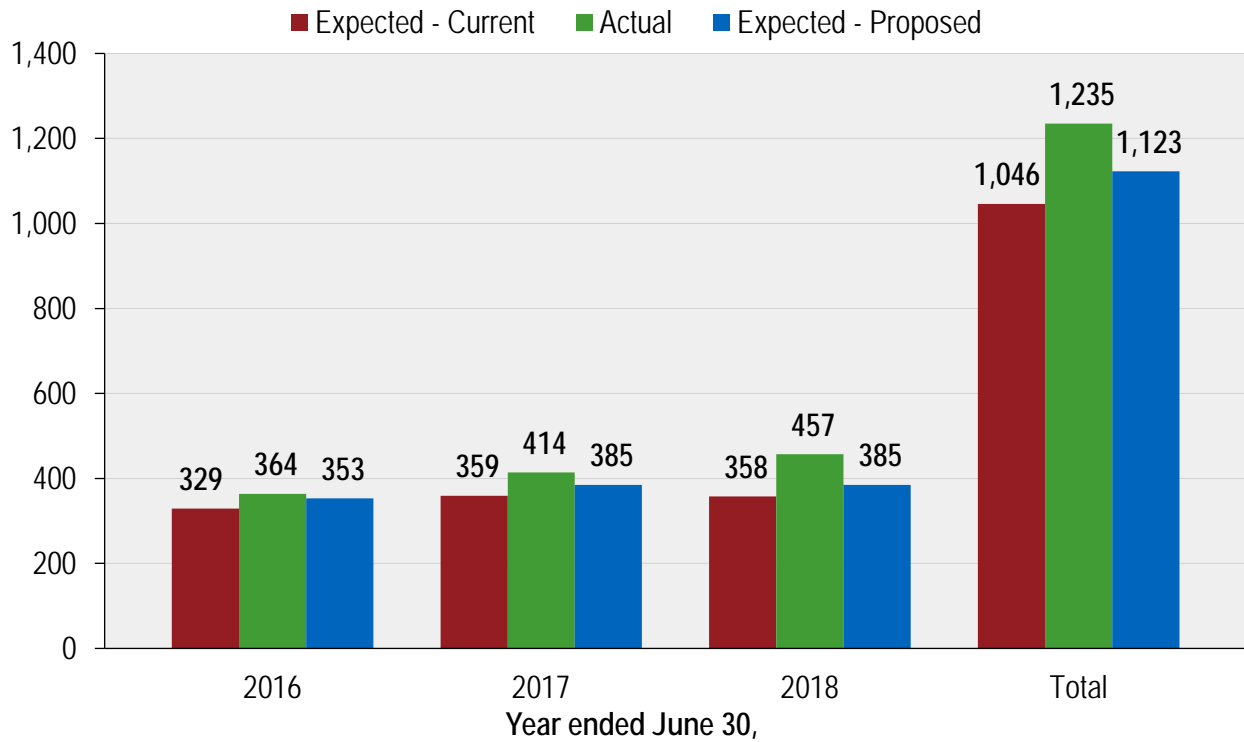


CHART 25: ACTUAL NUMBER OF TERMINATIONS COMPARED TO EXPECTED – SAFETY MEMBERS

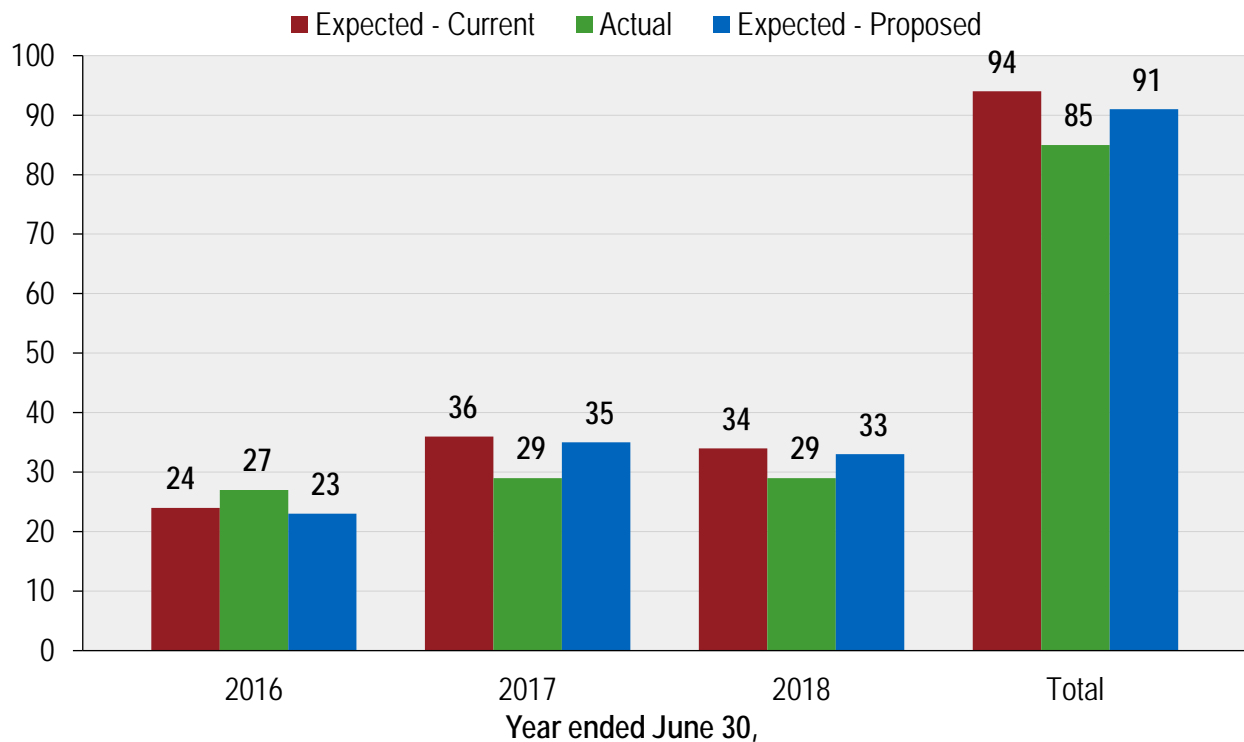


CHART 26: TERMINATION RATES – GENERAL MEMBERS

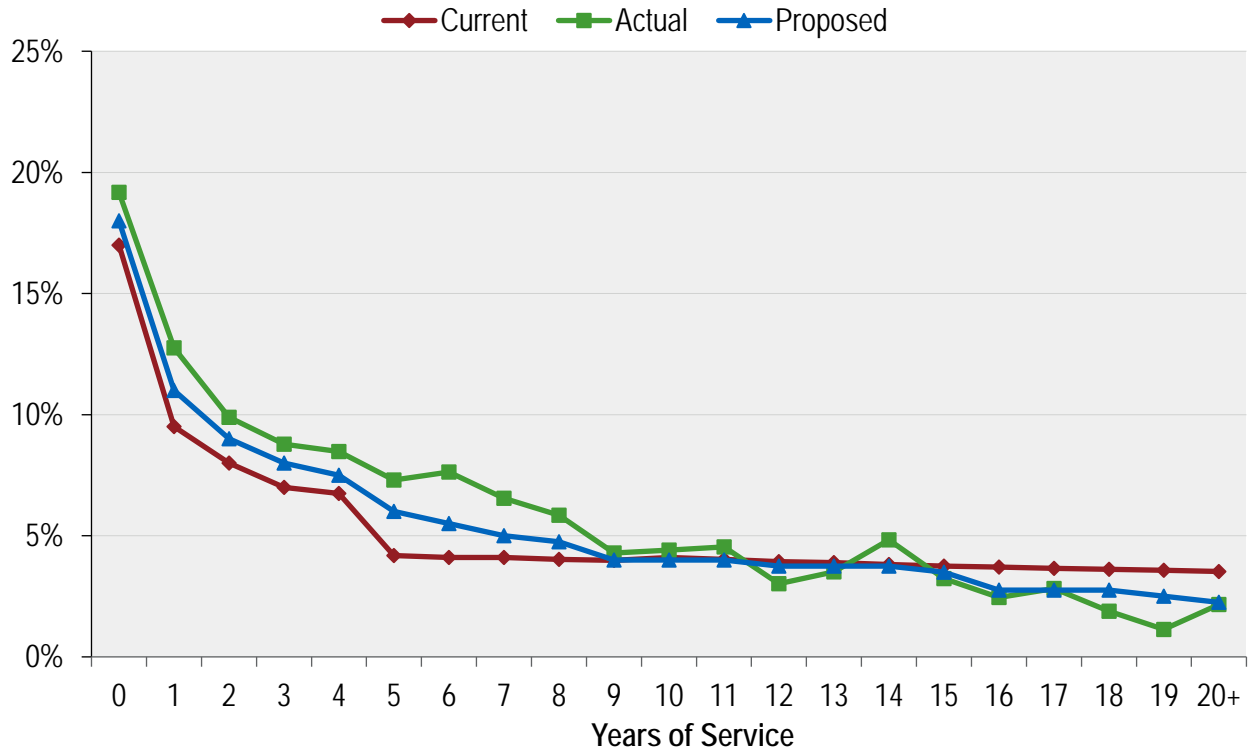
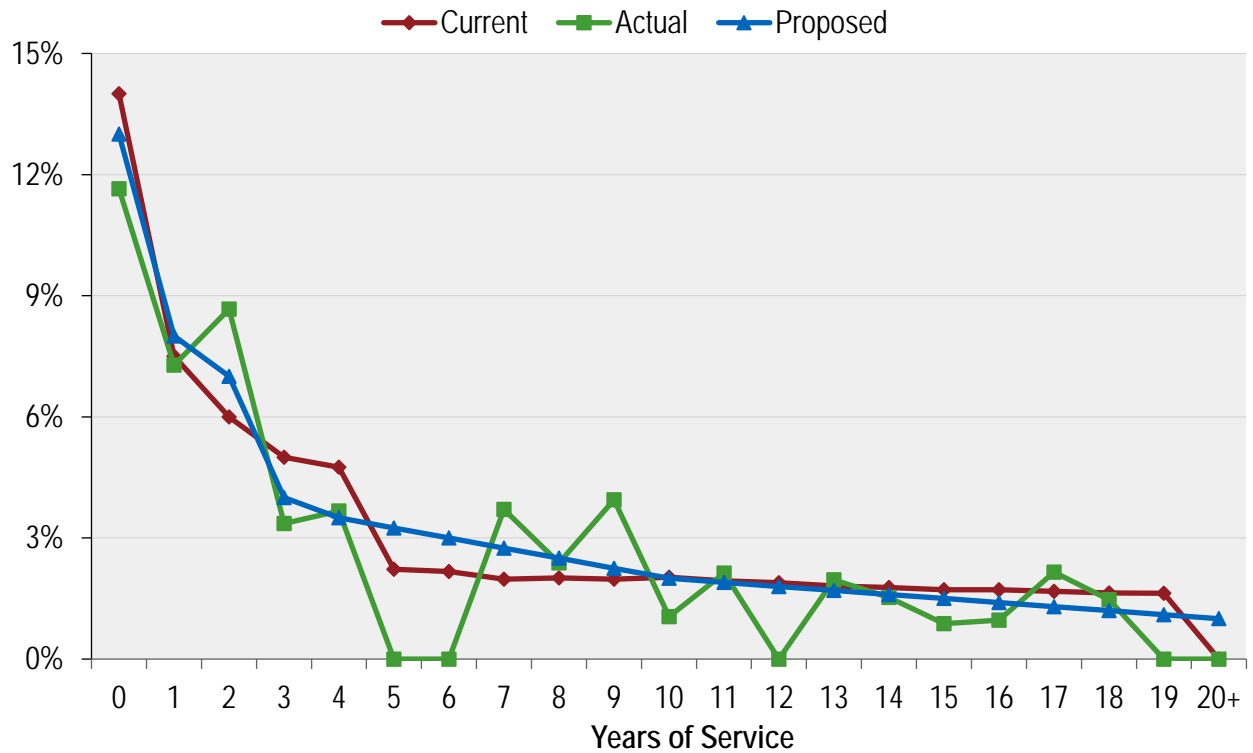


CHART 27: TERMINATION RATES – SAFETY MEMBERS



E. Disability Incidence Rates

When a member becomes disabled, he or she may be entitled to at least a 50% of pay pension (service connected disability), or a pension that depends upon the member’s years of service (non-service connected disability). In the past, we have used two separate sets of disability assumptions for General male and General female. With this experience study, we are recommending combining the experiences for male and female General disability into one single set of disability rates.

The following summarizes the actual incidence of combined service and non-service connected disabilities over the past three years compared to the current and proposed assumptions for both service connected and non-service connected disability incidence:

Rates of Disability Incidence

Age	Disability Incidence Rate (%)					
	General			Safety		
	Current Rate*	Actual Rate	Proposed Rate	Current Rate	Actual Rate	Proposed Rate
20 – 24	0.01	0.00	0.01	0.05	0.00	0.05
25 – 29	0.02	0.00	0.01	0.15	0.00	0.15
30 – 34	0.02	0.04	0.03	0.30	0.00	0.30
35 – 39	0.07	0.03	0.05	0.50	0.51	0.50
40 – 44	0.13	0.18	0.15	0.60	1.41	0.75
45 – 49	0.19	0.27	0.25	0.70	1.22	1.00
50 – 54	0.20	0.61	0.30	0.80	2.32	1.50
55 – 59	0.30	0.38	0.35	2.00	0.91	2.00
60 – 64	0.57	0.24	0.50	4.00	0.00	3.00
65 – 69	0.85	0.63	0.75	4.00	0.00	3.00
70 – 74	1.00	0.00	0.75	4.00	0.00	3.00

**The rate shown for General is an average rate developed from the current sex based assumption for male and female members.*

The proposed disability rates were adjusted to reflect the past three years’ experience. We are recommending increases in most of the disability incidence rates for General members and Safety members.

We understand from our discussions with FCERA that the Association has accelerated the process of reviewing the applications for disabilities which, everything else being equal could have resulted in higher incidence of disability being reported for the current period. The significant changes to the review process include:

- No longer allowing applications to go into abeyance which resulted in a number of languishing applications to be moved forward to a hearing and final Board decision.

- Appointing new disability service providers that resulted in much faster collection of medical records. As a result, the average processing time from receipt of application to initial Board decision is approximately 9 months (down from 18 months) and hearings are occurring on a more timely basis.

In preparing our prior experience studies, we included in the actual rates those members who changed status from vested terminated or service retirement to disability retirement regardless of whether their actual dates of disabilities would have fallen during the three-year period within those prior experience studies. That was done in order to capture the lag in processing the disability application.

We believe with the new process implemented by FCERA, we should consider excluding some of the disabilities reported from vested terminated or service retirement to disability retirement if the disability was granted before a certain date. Below is a table which summarizes the number of such disabilities that we consider excluding based on one-year, two-year and a three-year lag:

Membership	Number of Members to be Excluded		
	One-Year Lag (With Date of Retirement prior to July 1, 2014)	Two-Year Lag (With Date of Retirement prior to July 1, 2013)	Three-Year Lag (With Date of Retirement prior to July 1, 2012)
General	20	13	10
Safety	7	4	4

As the new disability application process was only implemented during the current experience study period, we believe it would be prudent to assume that there would still be a two-year lag in the disability application process until more data is available at the next experience study. As a result, we have only reduced the actual incidence of disability reported to us by 13 for General members and 4 for Safety members.

After analyzing the data, 48.9% of disabled General members over the past three-year period received a service connected disability. We recommend maintaining the current 50% assumption that General disabled members will be assumed to receive a service connected disability. The remaining 50% of General disabled members will be assumed to receive a non-service connected disability.

Similarly, 95.8% of disabled Safety members over the past three-year period received a service connected disability. We recommend maintaining the current 100% assumption that Safety disabled members will be assumed to receive a service connected disability. No disabled Safety members will be assumed to receive a non-service connected disability.

Chart 28 compares actual to expected disabilities for General members over the past three years for the current and proposed assumptions.

Chart 29 shows the actual disability incidence rates over the past three years compared to the current and proposed assumptions for General members.

Chart 30 shows the actual disability incidence rates over the past three years compared to the current and proposed assumptions for Safety members.

CHART 28: ACTUAL NUMBER OF DISABILITIES COMPARED TO EXPECTED

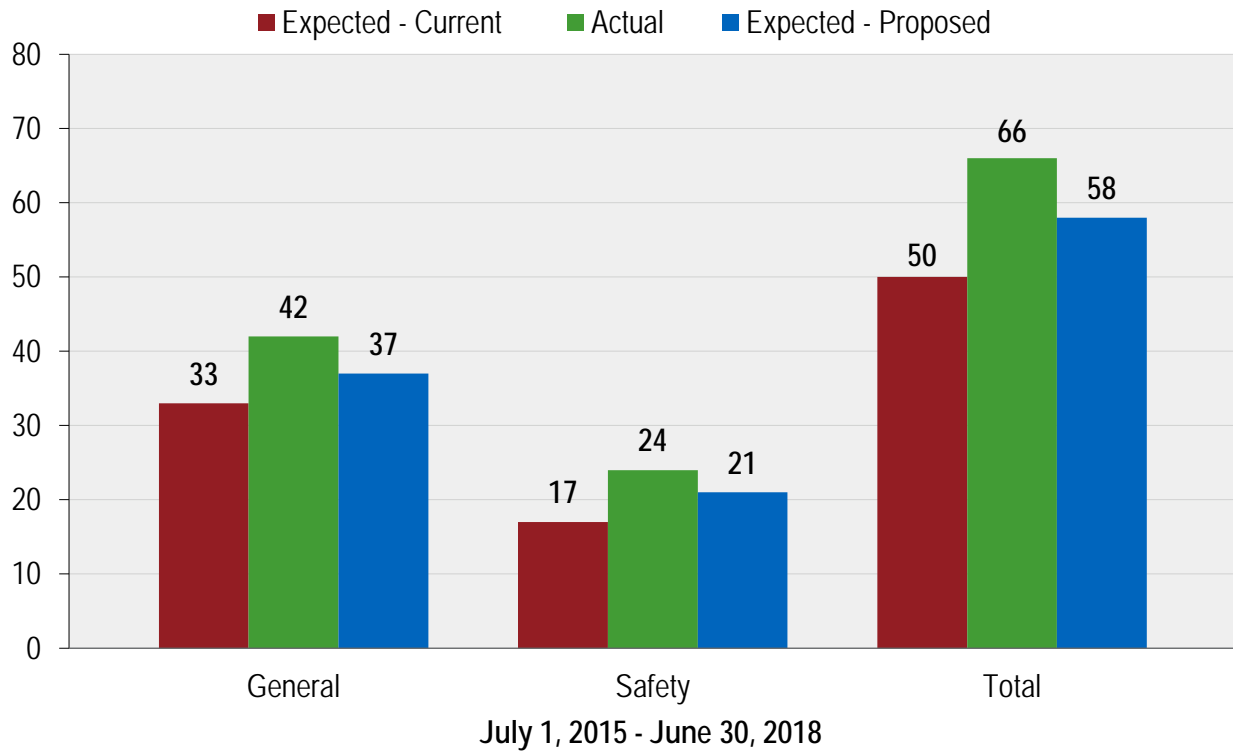


CHART 29: DISABILITY INCIDENCE RATES – GENERAL MEMBERS

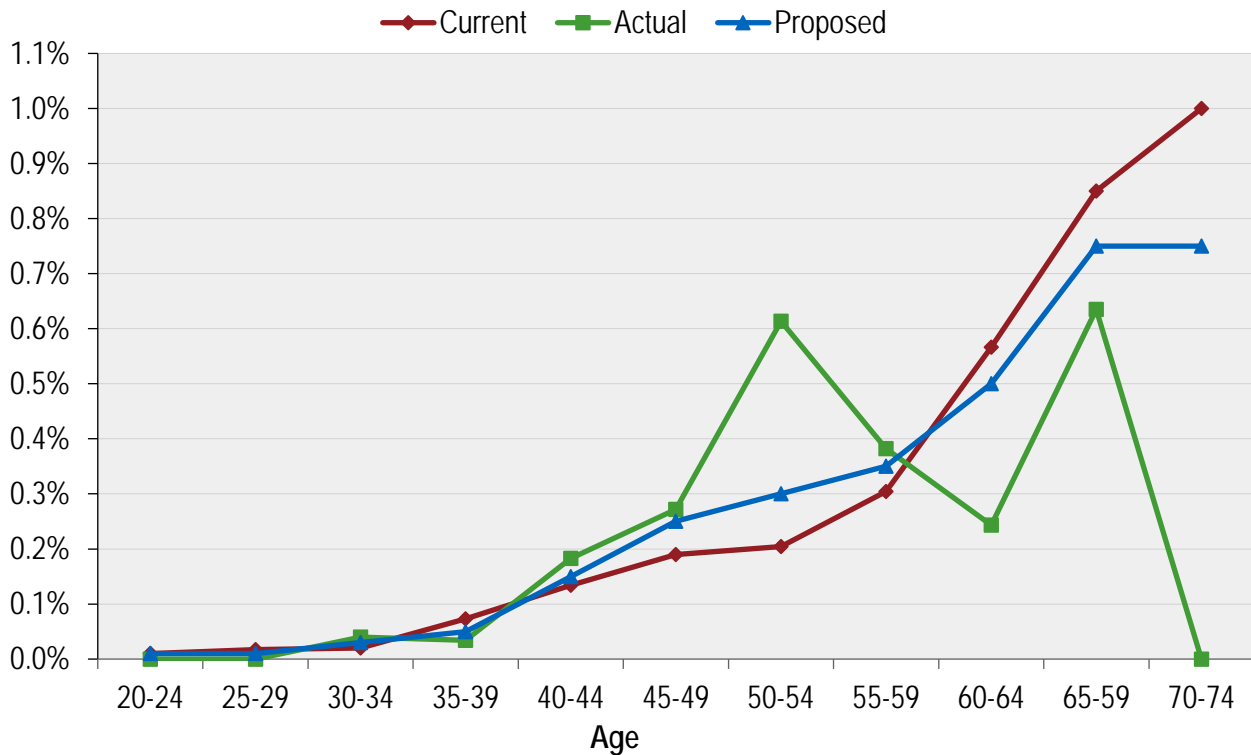
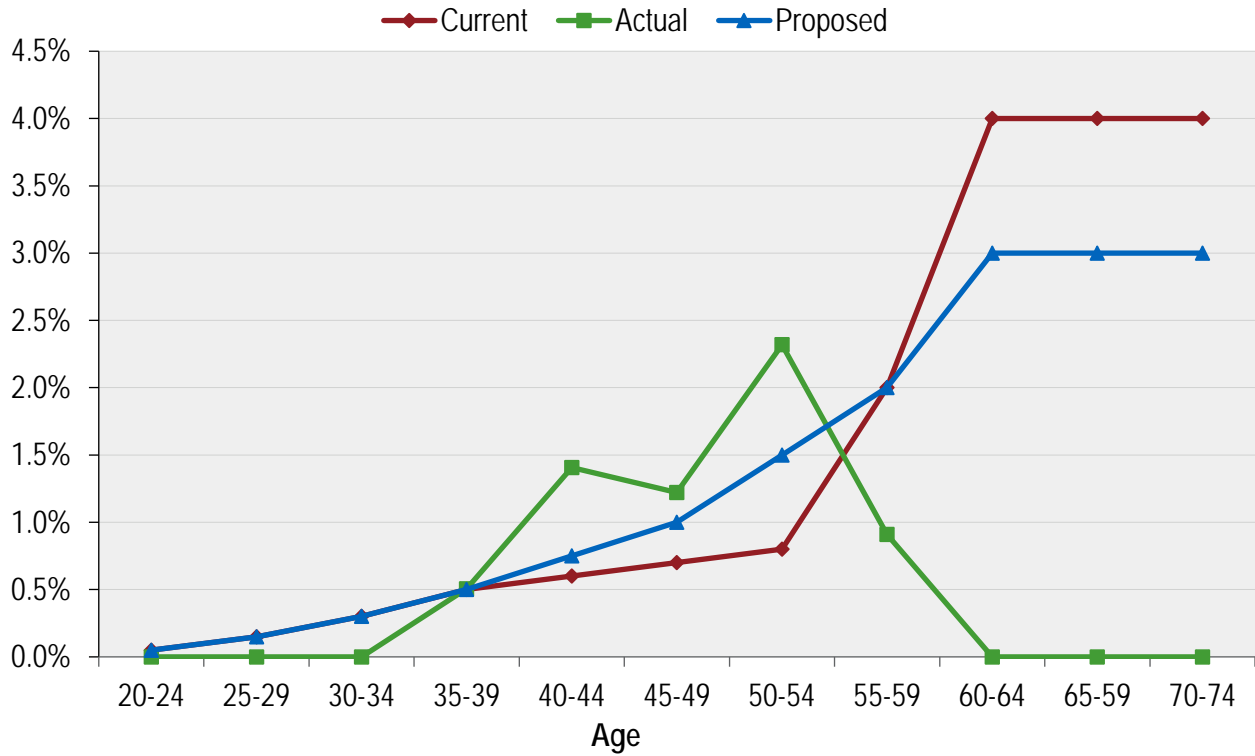


CHART 30: DISABILITY INCIDENCE RATES – SAFETY MEMBERS



F. Annual Leave Conversion

At retirement, members can convert their unused annual leave to increase the service credit used in the calculation of their retirement benefit. In the actuarial valuation, we anticipate this additional benefit by using an assumption to estimate the number of hours of annual leave that will be converted at retirement.

We collected information on the actual amount of annual leave balance for actives as of June 30, 2018. Consistent with the structure of the current assumption, the actual annual leave balance was expressed as a number of hours per year of service.

The tables below show the actual hours of accumulated annual leave available at retirement and the number of active members currently eligible for each plan.

	Annual Leave Conversion			
	Number of Members Reported	Current	Actual	Proposed
New Annual Leave Plan (5Y)	16	35.00	42.38	40.00
Annual Leave Plan II (5Y)	195	25.00	22.35	25.00
Vacation/Sick Leave Plan (General: 5Q, 5S and 5W)	79	35.00	32.23	35.00
Vacation/Sick Leave Plan (Safety: 5Q, 5S and 5W)	311	40.00	47.33	45.00

Ordinary Annual Leave Programs

We understand that members in the Annual Leave Plan IV (5P) and Annual Leave Plan V (5N) are allowed to transfer hours to their Time Off Bank (5O). Since the hours in the Time Off Bank are frozen, with the exception of some one-time adjustments, we will continue to assume no future addition to the Time Off Bank hours and a member will only convert his/her frozen Time Off hours to service credit.

V. Cost Impact

We have estimated the impact of all the recommended demographic and economic assumptions and the alternative investment return assumption as if they were applied to the June 30, 2018 actuarial valuation. The table below shows the changes in the employer and member contribution rates due to the proposed assumption changes separately for the recommended demographic assumption changes (as recommended in Section IV of this report) and the recommended and alternative economic assumption changes (as recommended in Section III of this report).

The results include the change in the administrative expense load from 1.10% to 1.20% of payroll. The cost associated with the administrative expense load has continued to be allocated to both the employer and the member based on the components of the total contribution rate (before expenses) for the employer and the member.

Cost Impact		
	Recommended (7.00% Return and Other Recommended Assumptions)	Alternative (6.75% Return and Other Recommended Assumptions)
<u>Impact on Employer</u>		
Change due to demographic assumptions	2.91%	2.91%
Change due to economic assumptions	<u>-3.85%</u>	<u>0.73%</u>
Total change in average employer rate	-0.94%	3.64%
Total estimated change in annual dollar amount (\$000s)	-\$4,029	\$15,745
<u>Impact on Member</u>		
Change due to demographic assumptions	0.42%	0.42%
Change due to economic assumptions	<u>-0.30%</u>	<u>0.19%</u>
Total change in average member rate	0.12%	0.61%
Total estimated change in annual dollar amount (\$000s)	\$530	\$2,659
<u>Impact on UAAL and Funded Percentage</u>		
Change in UAAL	-\$64 million	\$123 million
Change in funded percentage	From 81.5% to 82.4%	From 81.5% to 79.8%

Of the various demographic assumption changes, the most significant cost impacts are from the mortality assumption change followed by the retirement assumption change. Of the various economic assumption changes, the most significant cost impact is from the inflation assumption change under Recommended (cost decrease) and the investment return assumption change under Alternative (cost increase).

We have also analyzed in the tables below the average employer and member contribution rate impacts by each Tier due to the recommended and alternative assumption changes as if they were applied to the June 30, 2018 actuarial valuation.

Recommended (7.00% Return and Other Recommended Assumptions)

Employer Contribution Rate Impact (% of Payroll)				
Plan	Normal Cost	UAAL	Total	Estimated Dollar Amounts (in Thousands)³⁰
General Tier 1	0.01%	-0.79%	-0.78%	-\$1,602
General Tier 2	-0.21%	-0.79%	-1.00%	-\$83
General Tier 3	-0.16%	-0.79%	-0.95%	-\$284
General Tier 4	0.00%	-0.79%	-0.79%	-\$96
General Tier 5	0.22%	-0.79%	-0.57%	-\$556
Safety Tier 1	-0.40%	-1.76%	-2.16%	-\$961
Safety Tier 2	0.01%	-1.76%	-1.75%	-\$85
Safety Tier 4	0.14%	-1.76%	-1.62%	-\$75
Safety Tier 5	0.20%	-1.76%	-1.56%	-\$287
Total Increase	0.01%	-0.95%	-0.94%	-\$4,029

Member Contribution Rate Impact (% of Payroll)		
Plan	Total	Estimated Dollar Amounts (in Thousands)³⁰
General Tier 1	0.16%	\$277
General Tier 2	0.00%	\$1
General Tier 3	0.13%	\$46
General Tier 4	0.32%	\$48
General Tier 5	0.22%	\$275
Safety Tier 1	-0.39%	-\$172
Safety Tier 2	-0.14%	-\$7
Safety Tier 4	0.37%	\$15
Safety Tier 5	0.20%	\$47
Total Increase	0.12%	\$530

³⁰ Based on June 30, 2018 projected annual payrolls as determined under each set of assumptions.

Alternative (6.75% Return and Other Recommended Assumptions)

Employer Contribution Rate Impact (% of Payroll)				
Plan	Normal Cost	UAAL	Total	Estimated Dollar Amounts (in Thousands) ³¹
General Tier 1	1.54%	2.43%	3.97%	\$7,324
General Tier 2	0.98%	2.43%	3.41%	\$309
General Tier 3	1.11%	2.43%	3.54%	\$1,166
General Tier 4	0.69%	2.43%	3.12%	\$459
General Tier 5	0.65%	2.43%	3.08%	\$3,712
Safety Tier 1	1.10%	2.81%	3.91%	\$1,598
Safety Tier 2	1.98%	2.81%	4.79%	\$219
Safety Tier 4	1.22%	2.81%	4.03%	\$167
Safety Tier 5	0.90%	2.81%	3.71%	\$791
Total Increase	1.15%	2.49%	3.64%	\$15,745

Member Contribution Rate Impact (% of Payroll)		
Plan	Total	Estimated Dollar Amounts (in Thousands) ³¹
General Tier 1	0.67%	\$1,236
General Tier 2	0.36%	\$33
General Tier 3	0.51%	\$169
General Tier 4	0.51%	\$75
General Tier 5	0.65%	\$778
Safety Tier 1	0.33%	\$131
Safety Tier 2	0.47%	\$21
Safety Tier 4	0.64%	\$26
Safety Tier 5	0.90%	\$190
Total Increase	0.61%	\$2,659

³¹ Based on June 30, 2018 projected annual payrolls as determined under each set of assumptions.

Appendix A: Current Actuarial Assumptions

Economic Assumptions

Net Investment Return:	7.00%, net of investment expenses.
Administrative Expenses:	1.10% of payroll allocated to both the employer and member based on the components of the total contribution rate (before expenses) for the employer and member.
Employee Contribution Crediting Rate:	3.00%, compounded semi-annually. (The difference between the 7.00% net investment return assumption and 3.00% is credited to the other valuation reserves.)
Consumer Price Index:	Increase of 3.00% per year, retiree COLA increases due to CPI subject to a 3.00% maximum change per year for General Tiers 1, 2 and 3, and Safety Tiers 1 and 2. General and Safety Tiers 4 and 5 receive no COLA increases.
Payroll Growth:	Inflation of 3.00% per year plus “across the board” real salary increases of 0.50% per year.
Increase in Section 7522.10 Compensation Limit:	Increase of 3.00% per year from the valuation date.

Individual Salary Increases

Annual Rate of Compensation Increase (%)		
Inflation: 3.00% per year; plus “across the board” real salary increases of 0.50% per year; plus the following merit and promotional increases:		
Years of Service	General	Safety
Less than 1	8.00	8.00
1	7.00	7.00
2	6.00	5.50
3	5.00	5.50
4	4.00	5.00
5	2.75	3.75
6	2.25	3.25
7	1.25	2.75
8 and Over	1.00	1.40

Demographic Assumptions

Post-Retirement Mortality Rates – Healthy

- **General Members and all Beneficiaries:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table projected 20 years with the two-dimensional scale MP2015, set forward one year for females
- **Safety Members:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table projected 20 years with the two-dimensional scale MP2015, set back two years

Post-Retirement Mortality Rates – Disabled

- **General Members:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table projected 20 years with the two-dimensional scale MP2015, set forward eight years
- **Safety Members:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table projected 20 years with the two-dimensional scale MP2015, set forward seven years

Member Contribution Rates

- **General Members:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table projected 20 years with the two-dimensional scale MP2015, set forward one year for females, weighted 35% male and 65% female
- **Safety Members:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table projected 20 years with the two-dimensional scale MP2015, set back two years weighted, 80% male and 20% female

Pre-Retirement Mortality Rates

- **General and Safety Members:** Headcount-Weighted RP-2014 Employee Mortality Table projected 20 years with the two-dimensional scale MP2015 times 75%

Age	Rate (%)			
	General		Safety	
	Male	Female	Male	Female
25	0.03	0.01	0.03	0.01
30	0.03	0.02	0.03	0.02
35	0.04	0.02	0.04	0.02
40	0.04	0.03	0.04	0.03
45	0.07	0.05	0.07	0.05
50	0.11	0.08	0.11	0.08
55	0.20	0.13	0.20	0.13
60	0.35	0.19	0.35	0.19
65	0.60	0.27	0.60	0.27

All pre-retirement deaths are assumed to be non-service connected.

Disability Incidence Rates

Age	Rate (%)		
	General ⁽¹⁾		Safety ⁽²⁾
	Male	Female	Male and Female
20	0.01	0.01	0.05
25	0.01	0.02	0.11
30	0.02	0.02	0.24
35	0.04	0.06	0.42
40	0.12	0.10	0.56
45	0.21	0.14	0.66
50	0.25	0.17	0.76
55	0.31	0.24	1.52
60	0.68	0.33	3.20
65	0.96	0.59	4.00
70	1.00	0.90	4.00

⁽¹⁾ 50% of General disabilities are assumed to be service connected disabilities. The other 50% are assumed to be non-service connected disabilities.

⁽²⁾ 100% of Safety disabilities are assumed to be service connected disabilities.

Termination Rates

Less than Five Years of Service (%)		
Years of Service	General	Safety
Less than 1	17.00	14.00
1	9.50	7.50
2	8.00	6.00
3	7.00	5.00
4	6.75	4.75

Five or More Years of Service (%)		
Age	General	Safety
20	5.75	3.50
25	5.75	3.50
30	5.30	2.90
35	4.55	2.20
40	3.92	1.85
45	3.58	1.60
50	3.44	1.50
55	3.31	1.50
60	3.10	0.60
65	3.00	0.00
70	1.20	0.00

Proportion of Total Termination Assumed to Receive Refunds and Deferred Vested Benefits (%)		
Years of Service	Refunds	Deferred Vested Benefits
0 – 4	60.00	40.00
5 – 9	30.00	70.00
10 – 14	25.00	75.00
15 – 19	15.00	85.00
20 and Over	10.00	90.00

Retirement Rates

Age	Rate (%)					
	General					
	Tier 1 Male	Tier 1 Female	Tier 2	Tier 3	Tier 4	Tier 5
50	5.00	4.00	3.00	2.40	2.00	0.00
51	3.50	4.00	3.00	2.40	2.00	0.00
52	3.00	4.00	3.60	2.80	2.50	4.50
53	4.00	4.00	3.60	2.80	2.50	2.00
54	4.00	6.00	4.20	3.40	3.00	2.50
55	8.00	9.00	8.40	6.70	4.00	3.50
56	9.00	11.00	10.00	8.00	5.00	4.50
57	14.00	14.00	10.00	8.00	6.00	5.50
58	15.00	15.00	10.00	8.00	7.00	6.50
59	16.00	16.00	10.00	12.00	8.00	7.50
60	25.00	20.00	15.00	15.40	9.00	8.50
61	20.00	22.00	15.00	15.40	10.00	9.50
62	25.00	28.00	25.00	27.40	16.00	15.00
63	25.00	22.00	24.00	19.00	16.00	15.00
64	25.00	25.00	24.00	19.00	19.00	18.00
65	45.00	35.00	35.00	34.60	23.00	22.00
66	40.00	35.00	34.00	26.60	20.00	20.00
67	40.00	35.00	34.00	26.60	20.00	20.00
68	40.00	45.00	35.00	32.00	25.00	25.00
69	50.00	45.00	35.00	37.00	30.00	30.00
70	50.00	50.00	70.00	60.00	60.00	60.00
71	50.00	50.00	70.00	60.00	60.00	60.00
72	50.00	50.00	70.00	60.00	60.00	60.00
73	50.00	50.00	70.00	60.00	60.00	60.00
74	50.00	50.00	70.00	60.00	60.00	60.00
75 and Over	100.00	100.00	100.00	100.00	100.00	100.00

Retirement Rates (continued)

Age	Rate (%)		
	Safety		
	Tier 1 & Tier 2	Tier 4	Tier 5
45	1.00	1.00	0.00
46	1.00	1.00	0.00
47	1.00	1.00	0.00
48	1.00	1.00	0.00
49	3.00	2.00	0.00
50	5.00	4.00	4.00
51	7.00	4.00	4.00
52	8.00	5.00	5.00
53	14.00	6.00	6.00
54	27.00	11.00	11.00
55	40.00	20.00	20.00
56	25.00	20.00	20.00
57	25.00	20.00	25.00
58	20.00	20.00	20.00
59	20.00	23.00	23.00
60	40.00	45.00	45.00
61	40.00	45.00	45.00
62	50.00	45.00	45.00
63	50.00	45.00	45.00
64	50.00	45.00	45.00
65 and Over	100.00	100.00	100.00

Retirement Age and Benefit for Deferred Vested Members:	<p>For current and future deferred vested members, retirement assumptions are as follows:</p> <p style="padding-left: 40px;">General Age: 58 Safety Age: 54</p> <p>We assume that 20% of future General and 30% of future Safety deferred vested members terminated with less than five years of service will continue to work for a reciprocal employer. For those future deferred vested members terminated with five or more years of service, we assume that 35% of General and 55% of Safety will continue to work for a reciprocal employer. In addition, we assume 4.50% and 4.90% compensation increases per annum for General and Safety members, respectively.</p>
Future Benefit Accruals:	<p>1.0 year of service per year.</p>
Unknown Data for Members:	<p>Same as those exhibited by members with similar known characteristics. If not specified, members are assumed to be male.</p>
Percent Married:	<p>75% of male members and 50% of female members are assumed to be married at retirement or pre-retirement death and to select Unmodified option.</p>
Age of Spouse:	<p>Male retirees are 3 years older than their spouses, and Female retirees are 2 years younger than their spouses.</p>
Annual Leave Conversion:	<p>Eligibility for annual leave plans is determined based on hire date along with other factors. The following assumptions for the amount of service converted from unused annual leave at retirement are used:</p> <p><u>New Annual Leave Plan:</u> 35 hours per year of service.</p> <p><u>Annual Leave Plan II:</u> 25 hours per year of service.</p> <p><u>Vacation/Sick Leave Plans:</u> 35 hours per year of service for General and 40 hours per year of service for Safety.</p> <p><u>Annual Leave IV Plan or the Old Annual Leave Plan:</u> Based on actual hours in a member's frozen time off bank.</p>

Appendix B: Proposed Actuarial Assumptions

Economic Assumptions

Net Investment Return:	7.00% (Recommended) or 6.75% (Alternative), net of investment expenses.
Administrative Expenses:	1.20% of payroll allocated to both the employer and member based on the components of the total contribution rate (before expenses) for the employer and member.
Employee Contribution Crediting Rate:	2.75%, compounded semi-annually. (The difference between the 7.00% or 6.75% net investment return assumption and 2.75% is credited to the other valuation reserves.)
Consumer Price Index:	Increase of 2.75% per year, retiree COLA increases due to CPI subject to a 3.00% maximum change per year for General Tiers 1, 2 and 3, and Safety Tiers 1 and 2. General and Safety Tiers 4 and 5 receive no COLA increases.
Payroll Growth:	Inflation of 2.75% per year plus “across the board” real salary increases of 0.50% per year.
Increases in Internal Revenue Code Section 401(a)(17) Compensation Limit:	Increase of 2.75% per year from the valuation date.
Increase in Section 7522.10 Compensation Limit:	Increase of 2.75% per year from the valuation date.

Individual Salary Increases

Annual Rate of Compensation Increase (%)		
Inflation: 2.75% per year; plus “across the board” real salary increases of 0.50% per year; plus the following merit and promotional increases:		
Years of Service	General	Safety
Less than 1	8.50	8.50
1	7.50	7.75
2	6.50	6.50
3	5.25	5.50
4	4.75	4.75
5	3.75	3.75
6	3.00	3.50
7	2.00	2.50
8	1.50	1.70
9	1.25	1.60
10 and Over	1.10	1.50

Demographic Assumptions

Post-Retirement Mortality Rates – Healthy

- **General Members and all Beneficiaries:** Pub-2010 General Healthy Retiree Amount-Weighted Above-Median Mortality Table (separate tables for males and females) times 110%, projected generationally with the two-dimensional mortality improvement scale MP-2018
- **Safety Members:** Pub-2010 Safety Healthy Retiree Amount-Weighted Above-Median Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018

Post-Retirement Mortality Rates – Disabled

- **General Members:** Pub-2010 Non-Safety Disabled Retiree Amount-Weighted Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018
- **Safety Members:** Pub-2010 Safety Disabled Retiree Amount-Weighted Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018

Pre-Retirement Mortality Rates

- **General Members:** Pub-2010 General Employee Amount-Weighted Above-Median Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018
- **Safety Members:** Pub-2010 Safety Employee Amount-Weighted Above-Median Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018

The Pub-2010 mortality tables and adjustments as shown above reflect the mortality experience as of the measurement date. The generational projection is a provision for future mortality improvement.

Member Contribution Rates

- **General Members:** Pub-2010 General Healthy Retiree Amount-Weighted Above-Median Mortality Table (separate tables for males and females) times 110%, projected 30 years with the two-dimensional mortality improvement scale MP-2018, weighted 35% male and 65% female
- **Safety Members:** Pub-2010 Safety Healthy Retiree Amount-Weighted Above-Median Mortality Table (separate tables for males and females), projected 30 years with the two-dimensional mortality improvement scale MP-2018, weighted 80% male and 20% female

Age	Pre-Retirement Mortality Rate (%)			
	General		Safety	
	Male	Female	Male	Female
25	0.02	0.01	0.03	0.02
30	0.03	0.01	0.04	0.02
35	0.04	0.02	0.04	0.03
40	0.06	0.03	0.05	0.04
45	0.09	0.05	0.07	0.06
50	0.13	0.08	0.10	0.08
55	0.19	0.11	0.15	0.11
60	0.28	0.17	0.23	0.14
65	0.41	0.27	0.35	0.20
70	0.61	0.44	0.66	0.39

Note that generational projections beyond the base year (2010) are not reflected in the above mortality rates. All pre-retirement deaths are assumed to be non-service connected.

Disability Incidence Rates

Age	Rate (%)	
	General	Safety
20	0.01	0.05
25	0.01	0.11
30	0.02	0.24
35	0.04	0.42
40	0.11	0.65
45	0.21	0.90
50	0.28	1.30
55	0.33	1.80
60	0.44	2.60
65	0.65	3.00
70	0.75	3.00

⁽¹⁾ 50% of General disabilities are assumed to be service connected disabilities. The other 50% are assumed to be non-service connected disabilities.

⁽²⁾ 100% of Safety disabilities are assumed to be service connected disabilities.

Termination Rates

Years of Service	Less than Five Years of Service (%)	
	General	Safety
Less than 1	18.00	13.00
1	11.00	8.00
2	9.00	7.00
3	8.00	4.00
4	7.50	3.50
5	6.00	3.25
6	5.50	3.00
7	5.00	2.75
8	4.75	2.50
9	4.00	2.25
10	4.00	2.00
11	4.00	1.90
12	3.75	1.80
13	3.75	1.70
14	3.75	1.60
15	3.50	1.50
16	2.75	1.40
17	2.75	1.30
18	2.75	1.20
19	2.50	1.10
20 and Over	2.25	1.00

Years of Service	Proportion of Total Termination Assumed to Receive Refunds and Deferred Vested Benefits (%)	
	Refunds	Deferred Vested Benefits
0 – 4	50.00	50.00
5 – 9	30.00	70.00
10 – 14	25.00	75.00
15 – 19	15.00	85.00
20 and Over	10.00	90.00

Retirement Rates

		Rate (%)				
		General				
Age	Tier 1 With Less Than 30 Years of Service	Tier 1 With 30+ Years of Service	Tier 2	Tier 3	Tier 4	Tier 5
50	5.00	15.00	3.00	3.60	2.00	0.00
51	3.75	11.25	3.00	3.60	2.00	0.00
52	3.50	10.50	3.60	4.20	2.50	4.50
53	3.50	10.50	3.60	4.20	2.50	2.00
54	5.00	15.00	4.20	5.00	3.00	2.50
55	8.00	16.00	8.40	10.00	4.00	3.50
56	10.00	20.00	10.00	12.00	5.00	4.50
57	13.00	26.00	10.00	12.00	6.00	5.50
58	14.00	28.00	10.00	12.00	7.00	6.50
59	15.00	30.00	10.00	14.00	8.00	7.50
60	16.00	24.00	15.00	16.00	9.00	8.50
61	18.00	27.00	15.00	16.00	10.00	9.50
62	26.50	31.50	25.00	30.00	16.00	15.00
63	21.00	31.50	24.00	22.00	16.00	15.00
64	25.00	37.50	24.00	22.00	19.00	18.00
65	40.00	60.00	35.00	35.00	23.00	22.00
66	40.00	60.00	34.00	30.00	20.00	20.00
67	40.00	60.00	34.00	30.00	20.00	20.00
68	35.00	52.50	35.00	35.00	25.00	25.00
69	35.00	52.50	35.00	40.00	30.00	30.00
70	35.00	52.50	70.00	60.00	60.00	60.00
71	50.00	75.00	70.00	60.00	60.00	60.00
72	50.00	75.00	70.00	60.00	60.00	60.00
73	50.00	75.00	70.00	60.00	60.00	60.00
74	50.00	75.00	70.00	60.00	60.00	60.00
75 and Over	100.00	100.00	100.00	100.00	100.00	100.00

Retirement Rates (continued)

Age	Rate (%)		
	Safety		
	Tier 1 & Tier 2 ⁽¹⁾	Tier 4	Tier 5
45	10.00	1.00	0.00
46	2.00	1.00	0.00
47	2.00	1.00	0.00
48	2.00	1.00	0.00
49	3.00	2.00	0.00
50	5.00	4.00	4.00
51	6.00	4.00	4.00
52	10.00	5.00	5.00
53	12.00	6.00	6.00
54	30.00	11.00	11.00
55	40.00	18.00	18.00
56	25.00	18.00	18.00
57	25.00	20.00	22.00
58	20.00	20.00	20.00
59	20.00	23.00	23.00
60	30.00	40.00	40.00
61	30.00	40.00	40.00
62	35.00	40.00	40.00
63	35.00	40.00	40.00
64	35.00	40.00	40.00
65 and Over	100.00	100.00	100.00

⁽¹⁾ Retirement rate is 100% after a member accrues a benefit of 100% of final average earnings.

Retirement Age and Benefit for Deferred Vested Members:	<p>For current and future deferred vested members, retirement assumptions are as follows:</p> <p style="text-align: center;"> General Age: 59 Safety Age: 54 </p> <p>We assume that 20% of future General and 30% of future Safety deferred vested members terminated with less than five years of service will continue to work for a reciprocal employer. For those future deferred vested members terminated with five or more years of service, we assume that 30% of General and 50% of Safety will continue to work for a reciprocal employer. In addition, we assume 4.35% and 4.75% compensation increases per annum for General and Safety members, respectively.</p>
Future Benefit Accruals:	<p>1.0 year of service per year.</p>
Unknown Data for Members:	<p>Same as those exhibited by members with similar known characteristics. If not specified, members are assumed to be male.</p>
Percent Married:	<p>70% of male members and 50% of female members are assumed to be married at retirement or pre-retirement death and to select Unmodified option.</p>
Age of Spouse:	<p>Male retirees are 3 years older than their spouses, and Female retirees are 2 years younger than their spouses.</p>
Annual Leave Conversion:	<p>Eligibility for annual leave plans is determined based on hire date along with other factors. The following assumptions for the amount of service converted from unused annual leave at retirement are used:</p> <p><u>New Annual Leave Plan:</u> 40 hours per year of service.</p> <p><u>Annual Leave Plan II:</u> 25 hours per year of service.</p> <p><u>Vacation/Sick Leave Plans:</u> 35 hours per year of service for General and 45 hours per year of service for Safety.</p> <p><u>Annual Leave IV Plan or the Old Annual Leave Plan:</u> Based on actual hours in a member's frozen time off bank.</p>

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