Kentucky Retirement Systems

Independent Actuarial Audit of the June 30, 2019 Actuarial Valuations and the 2014-2018 Experience Study

Segal

101 North Wacker Drive
Suite 500
Chicago, IL 60606-1724
segalco.com

December 3, 2020

Board of Trustees
Kentucky Retirement Systems
Perimeter Park West
1260 Louisville Road
Frankfort, KY 40601

Re: **Independent Actuarial Audit of the June 30, 2019 Actuarial Valuations and the 2004 -2018 Experience Study**

Ladies and Gentlemen:

We are pleased to present the results of Segal's actuarial audit of the June 30, 2019, actuarial valuations and review of the 2014-2018 experience study. The purpose of this audit is to conduct a review of the actuarial methods, assumptions, and procedures employed by the Kentucky Retirement Systems (KRS) and the Systems' actuary Gabriel, Roeder, Smith & Company (GRS). This audit includes the following:

1. ***Report review*** – a review of the valuation results and reports for the Kentucky Employees Retirement System (KERS), the County Employees Retirement System (CERS), and the State Police Retirement System (SPRS). The results were reviewed to determine if they comply with actuarial standards and whether such valuation reports reflect appropriate disclosure information under any required reporting.

2. ***Validation of benefits valued through test lives and data review*** – discussion of the procedures used to validate the participant data and the test lives selected, with a detailed review of the findings.

3. ***Methods and assumptions review*** – an analysis and benchmarking of the actuarial assumptions and a review of the actuarial methods utilized in determining the funded status and accrued liability as of June 30, 2019, for compliance with generally accepted actuarial principles, as well as a review of the experience study report for the five-year period ending June 30, 2018.

This review was conducted under the supervision of Kim Nicholl, a Fellow of the Society of Actuaries, a member of the American Academy of Actuaries, and an Enrolled Actuary under ERISA, and Matthew Strom, a Fellow of the Society of Actuaries, a member of the American Academy of Actuaries, and an Enrolled Actuary under ERISA. This review was conducted in accordance with the standards of practice prescribed by the Actuarial Standards Board.

The assistance of the KRS staff and GRS is gratefully acknowledged.

We appreciate the opportunity to serve as an independent actuarial advisor for KRS and we are available to answer any questions you may have on this report.

Sincerely,

Kim Nicholl, FSA, MAAA, EA
Senior Vice President & Actuary

Matthew A. Strom, FSA, MAAA, EA
Senior Vice President & Actuary

Segal

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Executive Summary

The Board of Trustees of the Kentucky Retirement Systems (KRS) retained Segal to conduct an independent actuarial audit of the Systems' June 30, 2019, actuarial valuations and the 2014-2018 experience study, as performed by the KRS Consulting Actuary, Gabriel, Roeder, Smith & Company (GRS). The Board requested an opinion on the reasonableness, consistency, and accuracy of the following:

- Demographic and financial data used in the actuarial valuations;
- Methods, procedures, and assumptions used in the actuarial valuations;
- Format of the actuarial valuation reports;
- Adequacy and reasonableness of the actuarial valuations; and
- Results and the actuarial assumptions generated from the experience study.

The objective of a **limited scope audit** (actuarial review) of any system is to provide validation that the liabilities and costs of the system are reasonable and being calculated as intended. This audit is not a full replication of the actuarial valuation results, but rather is a review of the key components in the valuation process that encompass the derivation of the liabilities and costs for the Systems. These key components are the data, the benefits valued, the actuarial assumptions and funding method used, and the asset valuation method employed. The valuation reports and the valuation output for a select group of test lives provide the detail necessary to validate each of these key components.

We reviewed all information supplied to us. We also requested and reviewed additional information provided by GRS. Finally, we considered the reasonableness of the actuarial assumptions and methods in the context of our own experience, and those of other state and local pension systems.

In summary, we found the following:

1. More detail on the calculation of the Recommended Employer Contribution Rates should be included in the report;
2. The economic assumptions are within norms for the peer group, with the aggregate investment return assumption below the peer group range;
3. The demographic actuarial assumptions recommended in the 2014-2018 experience study are for the most part sound and appropriate;
4. The valuation reports for KERS, CERS and SPRS provide sufficient detail upon which to render opinions; and
5. The review of selected test lives identified a modification to the valuation programming that could be made.

These items and recommendations are described in more detail throughout this report.

Conclusions

This audit reviewed the findings of the June 30, 2019, actuarial valuations and 2014-2018 experience study. We have made a few recommendations for the valuation report and test lives that may improve the usefulness and accuracy, which are described in detail in Section II of this report. We generally agree with the results of the experience study, with a few recommendations for improvement, as described in Section III. We found the actuarial cost method and asset valuation method conform with the Actuarial Standards of Practice.

The data appears complete and with a cursory analysis of the information supplied by KRS staff, we were able to closely match the participant counts reported by GRS.

Finally, we offer ideas to improve the quality and understanding of the valuation reports and experience review process. Several suggestions and recommendations are made throughout this document. We would classify them as either: a) "presentation" suggestions to enhance the valuation process or report; b) something to be examined during the next experience review; and c) something that may affect the cost of the Systems. Where we make a comment in this regard in this report, we have identified the location in the margin with the following icons:

Enhancement to valuation process or report

Examine during next experience review

May affect the cost of the Systems

Section I: Purpose, Scope and Methodology of the Audit

Purpose of the Audit

The KRS Board retained Segal to conduct an independent review of the Systems' current actuarial calculations, assumptions and methods. The Board requested an assessment of the validity of the data used in the valuations, a review of the appropriateness of the current funding method and procedures, an evaluation of both economic and non-economic assumptions, a test of the valuation results, and a review of the actuarial reports to determine if there is consistency in the presentation of the actuarial results and whether they are consistent with professional standards.

Scope of the Audit

This actuarial audit has a specified, limited scope in its review. A full scope audit would include performing the 2019 actuarial valuations from start to finish, in essence, a parallel valuation for each of the three Systems. This limited scope audit reviews the valuations already performed, through reviewing the benefits, assumptions, and methods, without a full replication of the actuarial valuation results. This review is conducted by analyzing detailed output of certain selected test lives from each membership group.

By not performing a full parallel valuation for each System, the following assumptions are made:

1. The current actuary's valuation system is accurately applying each assumption consistent with the test life review; and

2. The valuation system is adding together liabilities appropriately for each decrement (retirement, turnover, disability, and death), for each member, and over the entire population (meaning no participant group is being "dropped off" and no particular liabilities are being omitted).

What a limited scope audit can provide is:

1. Assurance that appropriate benefits are being valued;

2. Confirmation that the valuation system is accurately applying decrements to the test lives;

3. Confirmation that the program is valuing benefits as described in the valuation reports and consistent with applicable statutes;

4. A measurement of economic actuarial assumptions against a peer group and hence an assessment of their reasonableness;

5. A review of the reasonableness of actuarial funding and asset valuation methods;

6. An indication as to whether the liabilities and contribution rates shown are not reasonable or are incorrectly calculated; and

7. An assessment of whether the valuation appropriately reflects information required to be disclosed under required reporting standards (GASB, etc.).

Methodology of the Audit for the 2019 Actuarial Valuation

The purpose of this audit is to express an opinion regarding the reasonableness and accuracy of the actuarial assumptions, methods, valuation results, and contribution rates. The limited scope review is not the same as an actuarial valuation, but represents a "second opinion" of the findings and processes included in the valuation.

The measurement of the reasonableness of the funding levels encompasses three key analyses:

1. A verification of the benefits being projected for future payment;

2. A verification of the appropriateness of the actuarial assumptions that are used in calculating the liability; and

3. A verification of the appropriateness of the funding and asset valuation methods.

Benefits Analysis

Critical to projecting future benefits is receiving complete and accurate data. We reviewed the process by which data is prepared for the actuarial valuation, including:

1. An assessment of the completeness of the data;

2. A review of the data screening process employed; and

3. An examination of individual test life calculations.

We developed computer models that generated test life output, which enabled us to compare our test life results with GRS's results. These models also allowed us to confirm that the GRS valuations project benefits in a manner consistent with the Summary of Plan Provisions in the valuation reports. For purposes of this study, we regard differences of less than 3% to be acceptable for the Total Present Value of Benefits (PVB) and for the review of census data.

Assumptions Analysis

The second critical component in assessing the reasonableness of the funding levels is in the selection and the application of the actuarial assumptions. With respect to the assumptions, we:

1. Reviewed the 2014-2018 experience study report;
2. Independently determined the reasonability of the investment return assumption by using Segal Marco Advisors' capital market assumptions; and
3. Benchmarked the economic assumptions against a survey of state and local employee retirement systems.

Methods Analysis

The third component in assessing funding levels is the selection and application of the actuarial cost method (including the method for amortizing the unfunded actuarial accrued liability) and the asset valuation method (including smoothing techniques).

Section II: Review of Reports and Validation of Benefits Valued

Data Used in the Valuation

We independently obtained data files directly from KRS and GRS. With minimal data scrubbing, we found that the counts for the active and retired files were relatively close, and well within the 3% threshold we established for determining materiality of differences.

All data for actives, inactives, annuitants and beneficiaries was provided as of the valuation date (June 30, 2019). In situations where there is missing or invalid data, we assume the GRS valuation software applies adjustments to the data records for completeness. Given the large size of the data, this shortens the amount of staff time spent on data reconciliation (for both GRS and KRS) without sacrificing any material accuracy in the valuation results.

The tables that follow summarize our determination of key data elements as compared to those shown in the valuation report.

June 30, 2019
Analysis of Participant Data – KERS

	Non-Hazardous			Hazardous		
	GRS	Segal	Ratio of Segal/GRS	GRS	Segal	Ratio of Segal/GRS
Active Members:						
Number	33,696	33,697	1.00	3,705	3,705	1.00
Total payroll (in thousands)	1,437,647	1,437,647	1.00	150,446	150,446	1.00
Average Salary	42,665	42,664	1.00	40,606	40,606	1.00
Average Age	45.4	45.4	1.00	39.8	39.8	1.00
Average Service	11.0	11.0	1.00	7.3	7.3	1.00
Vested Inactive Members:						
Number	31,544	31,545	1.00	2,178	2,178	1.00
Annual Benefits (in thousands)	82,692	82,695	1.00	4,407	4,407	1.00
Average Benefit	2,621	2,622	1.00	2,023	2,023	1.00
Average Age	51.3	51.3	1.00	46.5	46.5	1.00
Nonvested Inactive Members:						
Number	20,370	20,353	1.00	4,070	4,065	1.00
Average Contributions with Interest	1,722	1,723	1.00	1,752	1,754	1.00
Retirees:						
Number	40,519	40,519	1.00	3,913	3,915	1.00
Annual Benefits (in thousands)	870,243	870,243	1.00	61,454	61,473	1.00
Average Benefit	21,477	21,477	1.00	15,705	15,702	1.00
Average Age	69.4	69.4	1.00	64.8	64.8	1.00
Disability Retirees:						
Number	1,949	1,949	1.00	162	162	1.00
Annual Benefits (in thousands)	25,745	25,745	1.00	1,541	1,541	1.00
Average Benefit	13,209	13,209	1.00	9,510	9,510	1.00
Average Age	65.8	65.8	1.00	60.3	60.4	1.00
Beneficiaries:						
Number	4,942	4,941	1.00	462	462	1.00
Annual Benefits (in thousands)	72,718	72,683	1.00	4,528	4,528	1.00
Average Benefit	14,714	14,710	1.00	9,801	9,801	1.00
Average Age	70.6	70.6	1.00	66.0	66.0	1.00

June 30, 2019
Analysis of Participant Data – CERS

	Non-Hazardous			Hazardous		
	GRS	Segal	Ratio of Segal/GRS	GRS	Segal	Ratio of Segal/GRS
Active Members:						
Number	81,506	81,535	1.00	9,474	9,474	1.00
Total payroll (in thousands)	2,521,860	2,521,860	1.00	559,353	559,353	1.00
Average Salary	30,941	30,930	1.00	59,041	59,041	1.00
Average Age	47.7	47.7	1.00	38.6	38.6	1.00
Average Service	9.1	9.1	1.00	10.1	10.1	1.00
Vested Inactive Members:						
Number	50,768	50,771	1.00	1,782	1,784	1.00
Annual Benefits (in thousands)	77,396	77,395	1.00	7,387	7,421	1.00
Average Benefit	1,525	1,524	1.00	4,145	4,160	1.00
Average Age	52.3	52.3	1.00	45.3	45.4	1.00
Nonvested Inactive Members:						
Number	40,775	40,746	1.00	1,640	1,638	1.00
Average Contributions with Interest	1,179	1,180	1.00	3,344	3,347	1.00
Retirees:						
Number	54,493	54,494	1.00	8,275	8,277	1.00
Annual Benefits (in thousands)	644,546	644,546	1.00	231,301	231,318	1.00
Average Benefit	11,828	11,828	1.00	27,952	27,947	1.00
Average Age	70.6	70.6	1.00	62.0	62.0	1.00
Disability Retirees:						
Number	4,198	4,198	1.00	576	576	1.00
Annual Benefits (in thousands)	48,289	48,289	1.00	9,697	9,697	1.00
Average Benefit	11,503	11,503	1.00	16,835	16,835	1.00
Average Age	65.5	65.5	1.00	57.1	57.1	1.00
Beneficiaries:						
Number	5,848	5,849	1.00	1,172	1,173	1.00
Annual Benefits (in thousands)	54,282	54,312	1.00	17,815	17,822	1.00
Average Benefit	9,282	9,286	1.00	15,200	15,194	1.00
Average Age	68.2	68.2	1.00	58.6	58.6	1.00

Section II: Review of Reports and Validation of Benefits Valued

June 30, 2019
Analysis of Participant Data – SPRS

	Hazardous		
	GRS	Segal	Ratio of Segal/GRS
Active Members:			
Number	883	883	1.00
Total payroll (in thousands)	47,752	47,752	1.00
Average Salary	54,079	54,079	1.00
Average Age	36.7	36.7	1.00
Average Service	10.0	10.0	1.00
Vested Inactive Members:			
Number	289	289	1.00
Annual Benefits (in thousands)	811	811	1.00
Average Benefit	2,806	2,806	1.00
Average Age	43.5	43.5	1.00
Nonvested Inactive Members:			
Number	268	268	1.00
Average Contributions with Interest	1,264	1,264	1.00
Retirees:			
Number	1,363	1,363	1.00
Annual Benefits (in thousands)	54,142	54,142	1.00
Average Benefit	39,723	39,723	1.00
Average Age	63.0	63.0	1.00
Disability Retirees:			
Number	54	54	1.00
Annual Benefits (in thousands)	959	959	1.00
Average Benefit	17,757	17,757	1.00
Average Age	58.0	58.0	1.00
Beneficiaries:			
Number	230	231	1.00
Annual Benefits (in thousands)	6,303	6,307	1.00
Average Benefit	27,404	27,301	1.00
Average Age	67.1	66.9	1.00

As previously mentioned, we were able to match most information reported by GRS to within 1% with minimal data scrubbing.

Valuation Results

We have reviewed the Recommended Employer Contribution Rate for each System and have the following observation:

1. The required employer contributions are equal to the sum of the employer's share of normal cost (i.e., total normal cost, less expected member contributions), plus administrative expenses, plus an unfunded accrued liability amortization payment. We were unable to exactly replicate the Recommended Employer Contribution Rates shown in the valuation report, although our independent calculations are reasonably close. Providing additional detail with respect to how the unfunded liability amortization payment is calculated would be beneficial and would provide a degree of transparency as to the mechanics of that calculation.

Valuation Report

While the accuracy of the actuarial valuation is the primary focus of an actuarial review, the content and presentation of the actuarial valuation results to a layperson and professional are also important. Our report recommendations are to provide clarity to the existing report. Based on our review of the actuarial valuation report, we offer the following comments:

1. The July 1, 2019 valuation reports included the recommended assumptions in the experience study for the period ending June 30, 2018. All of the assumptions that were updated were identified in the beginning of the valuation reports and the reports included the effect of the assumption changes in all the calculations. The reports disclosed the effect of the assumption changes on the actuarial accrued liabilities. However, the effect of the assumption changes on other funding metrics, such as the funded percentage and the Actuarially Determined Contribution Rate, were not disclosed. Since these changes could provide useful insight to users of the reports, we recommend showing the impact of assumption changes on these funding metrics.

2. In the tables labeled as "Experience Gain or (Loss)," plan changes and assumption changes are identified as actuarial gains and losses. In addition, the footnotes to the tables also describe these changes in liabilities as actuarial losses. As these changes in liabilities are not actuarial losses, we recommend that the descriptions in the tables and the footnotes be modified.

3. Also related to the liability gain or (loss), it would be informative to show the gain or loss attributable to each source as well as to actual contributions that are more or less than expected.

4. Section 5 of the Annual Actuarial Valuation Report contains information related to discussion of risks, which is required information for funding valuations and pricing valuations pursuant to Actuarial Standards of Practice Statement No. 51 (ASOP 51). The discussion of risk includes two and a half pages of relatively generic language that outlines the general risks that affect a pension system. This section also includes two tables with ratios and other calculations specific to KRS. In general, we believe this section complies with the spirit of ASOP 51 and the risk discussion. However, these disclosures may not help the intended users of the actuarial

valuation reports gain a better understanding of risks inherent in the measurements of liabilities and actuarially determined contributions.

Some observations and suggestions for improvement in the June 30, 2019 Actuarial Valuation Reports are as follows:

a. Section 3.6 of ASOP 51 states, "*If, in the actuary's professional judgment, a more detailed assessment would be significantly beneficial for the intended user to understand the risks identified by the actuary, the actuary should recommend to the intended user that such an assessment be performed*." Section 5 does not contain such a recommendation. This implies that the actuary does not believe a more detailed risk assessment is necessary or that one would not be useful to the intended user. However, we believe there is enough risk inherent in KRS that a more detailed risk assessment would be useful.

b. One suggestion to improve the usefulness of this section would be to keep (and expand) the existing language and add commentary specific to KRS when discussing each risk element. For example, the information in this section could be reformatted to explain each risk, show the particular KRS metric related to that risk, and provide commentary. The current format makes it challenging for the intended user to grasp the concepts and understand the risks inherent in KRS.

5. The reports do not include any projections of future funded percentages or contribution requirements. Adding a projection of liabilities, assets, and required contribution rates throughout the remaining amortization period (24 years for the 2019 valuation reports) could be helpful for the long-term planning for the future funding requirements of the System.

Projected Benefits in the Valuation

We requested test lives in order to compare the benefit amounts projected in the valuations against our understanding of the CERS, KERS and SPRS benefits summarized in the valuation report. We did not run "parallel" valuations of each System, which is beyond the scope of this audit. We reproduced the present value of future salary, present value of future benefits, actuarial accrued liability, and normal cost for the test lives received to determine whether GRS correctly projected plan benefits and whether the costs and liabilities were determined in accordance with the actuary's stated methods and assumptions.

Based on our review of the individual test life calculations, we have the following observations and/or recommendations:

1. There is an inconsistency between how service to determine benefit eligibility and service to determine benefit amounts are calculated. Service for eligibility purposes is calculated as a rounded amount and service for benefit amount purposes is calculated as an exact amount. We would expect both to be calculated with the same methodology. Furthermore, using rounded service for benefit eligibility may not be appropriate, as it would allow some participants to retire within the valuation program at an age when they are not actually eligible. For example, if a participant needs 10 credits to retire at a certain age, they would not be able to retire at that age

if they only had 9.9 credits. Rounding the 9.9 credits to 10 allows the valuation program to treat them as retiring earlier than actually allowable. We recommend using exact service for eligibility purposes.

The individual test life comparison exhibits on the following pages summarize the calculations performed by Segal and GRS and show the differences by each liability category, as well as the ratio of Segal's results to GRS's results.

As shown in the following tables, we have generally matched the GRS calculations to within our 3% threshold. In the handful of instances where the ratio of Segal to GRS is outside of that tolerance, we have reviewed these test lives in further detail. Primarily, these discrepancies are due to different rounding of ages during interim step in the valuation process that, in aggregate across all members, should net out to an immaterial amount.

Section II: Review of Reports and Validation of Benefits Valued

June 30, 2019 Valuation of the
Kentucky Employees Retirement System – Non-Hazardous
Test Life Comparison

	Present Value of Future Salary			Present Value of Benefits			Accrued Liability			Normal Cost Rate		
Test Life Description	GRS	Segal	Ratio of Segal/ GRS	GRS	Segal	Ratio of Segal/ GRS	GRS	Segal	Ratio of Segal/ GRS	GRS	Segal	Ratio of Segal/ GRS
Pension Retiree 1				164,202	164,645	1.00						
Pension Disabled Retiree				285,110	285,649	1.00						
Pension Surviving Spouse				114,508	117,025	1.02						
Pension Vested Terminated				38,064	38,643	1.02						
Pension Due Refund				298	298	1.00						
Pension Active Tier 1	254,261	260,645	1.03	222,698	223,160	1.00	186,901	185,082	0.99	14.08%	14.61%	1.04
Pension Active Tier 2	193,779	198,595	1.02	50,304	50,078	1.00	27,783	27,493	0.99	11.62%	11.37%	0.98
Insurance Retiree 1				67,531	66,212	0.98						
Insurance Retiree 2				15,691	15,987	1.02						
Insurance Vested Terminated				27,694	27,838	1.01						
Insurance Active 1	244,108	251,393	1.03	130,166	127,385	0.98	110,944	106,987	0.96	7.87%	8.38%	1.06
Insurance Active 2	186,762	193,970	1.04	4,038	3,960	0.98	2,236	2,169	0.97	0.97%	0.97%	1.00

* Items above that are blank are not applicable to that test life.

Section II: Review of Reports and Validation of Benefits Valued

June 30, 2019 Valuation of the
Kentucky Employees Retirement System – Hazardous
Test Life Comparison

	Present Value of Future Salary			Present Value of Benefits			Accrued Liability			Normal Cost		
Test Life Description	GRS	Segal	Ratio of Segal/ GRS	GRS	Segal	Ratio of Segal/ GRS	GRS	Segal	Ratio of Segal/ GRS	GRS	Segal	Ratio of Segal/ GRS
Pension Retiree 1				133,573	134,522	1.01						
Pension Surviving Spouse				113,256	114,193	1.01						
Pension Active Tier 1	228,380	235,143	1.03	191,905	191,865	1.00	145,768	143,059	0.98	20.20%	20.76%	1.03
Pension Active Tier 3	394,293	398,700	1.01	78,828	77,028	0.98	27,748	28,367	1.02	12.95%	12.20%	0.94
Insurance Retiree 1				45,733	46,513	1.02						
Insurance Surviving Spouse				26,920	26,991	1.00						
Insurance Active 1	228,380	235,143	1.03	60,241	60,206	1.00	47,309	46,905	0.99	5.66%	5.86%	1.03
Insurance Active 2	394,293	403,875	1.02	25,345	25,625	1.01	11,225	11,164	0.99	3.58%	3.76%	1.05

* Items above that are blank are not applicable to that test life.

Section II: Review of Reports and Validation of Benefits Valued

June 30, 2019 Valuation of the
County Employees Retirement System – Non-Hazardous
Test Life Comparison

	Present Value of Future Salary			Present Value of Benefits			Accrued Liability			Normal Cost		
Test Life Description	GRS	Segal	Ratio of Segal/ GRS	GRS	Segal	Ratio of Segal/ GRS	GRS	Segal	Ratio of Segal/ GRS	GRS	Segal	Ratio of Segal/ GRS
Pension Retiree 1				40,980	41,143	1.00						
Pension Surviving Spouse 1				12,379	12,593	1.02						
Pension Surviving Spouse 2				18,432	18,227	0.99						
Pension Vested Terminated				47,246	48,926	1.04						
Pension Due Refund				3,146	3,146	1.00						
Pension Active Tier 1	162,134	167,000	1.03	41,933	41,996	1.00	20,324	20,125	0.99	13.32%	13.10%	0.98
Pension Active Tier 3	445,156	454,901	1.02	58,672	59,139	1.01	23,047	20,535	0.89	8.00%	8.49%	1.06
Insurance Retiree 1				30,187	30,250	1.00						
Insurance Vested Terminated				25,230	25,612	1.02						
Insurance Active 1	445,156	458,265	1.03	12,003	11,924	0.99	4,856	4,768	0.98	1.61%	1.63%	1.01
Insurance Active 2	162,134	168,233	1.04	17,694	17,297	0.98	9,159	8797	0.96	5.26%	5.25%	1.00

* Items above that are blank are not applicable to that test life.

Section II: Review of Reports and Validation of Benefits Valued

June 30, 2019 Valuation of the
County Employees Retirement System – Hazardous
Test Life Comparison

	Present Value of Future Salary			Present Value of Benefits			Accrued Liability			Normal Cost		
Test Life Description	GRS	Segal	Ratio of Segal/ GRS	GRS	Segal	Ratio of Segal/ GRS	GRS	Segal	Ratio of Segal/ GRS	GRS	Segal	Ratio of Segal/ GRS
Pension Retiree 1				541,594	544,587	1.01						
Pension Surviving Spouse				360,419	360,628	1.00						
Pension Active Tier 1	333,511	343,288	1.03	486,338	487,050	1.00	409,471	408,280	1.00	23.05%	22.95%	1.00
Pension Active Tier 2	648,791	668,327	1.03	270,809	272,323	1.01	155,823	154,801	0.99	17.72%	17.58%	0.99
Insurance Retiree 1				287,718	287,352	1.00						
Insurance Surviving Spouse				124,737	121,106	0.97						
Insurance Active 1	333,511	344,128	1.03	314,592	303,321	0.96	264,958	256,489	0.97	14.88%	14.09%	0.95
Insurance Active 2	648,791	668,327	1.03	46,161	44,917	0.97	27,532	26,810	0.97	2.87%	2.81%	0.98

* Items above that are blank are not applicable to that test life.

Section II: Review of Reports and Validation of Benefits Valued

June 30, 2019 Valuation of the
State Police Retirement System
Test Life Comparison

	Present Value of Future Salary			Present Value of Benefits			Accrued Liability			Normal Cost		
Test Life Description	GRS	Segal	Ratio of Segal/ GRS	GRS	Segal	Ratio of Segal/ GRS	GRS	Segal	Ratio of Segal/ GRS	GRS	Segal	Ratio of Segal/ GRS
Pension Retiree 1				900,573	902,217	1.00						
Pension Surviving Spouse				714,979	719,225	1.01						
Pension Vested Terminated				288,226	291,466	1.01						
Pension Due Refund				661	661	1.00						
Pension Active Tier 1	327,240	335,327	1.02	485,133	484,668	1.00	383,022	370,904	0.97	31.20%	33.93%	1.09
Pension Active Tier 1	427,582	432,552	1.01	391,589	390,132	1.00	268,685	266,182	0.99	28.75%	28.66%	1.00
Pension Active Tier 2	731,157	749,876	1.03	268,940	268,805	1.00	58,329	56,774	0.97	28.80%	28.28%	0.98
Pension Active Tier 3	222,465	231,013	1.04	38,386	38,607	1.01	396	0	N/A	17.07%	16.71%	0.98
Insurance Retiree 1				93,366	93,898	1.01						
Insurance Surviving Spouse				52,997	53,253	1.00						
Insurance Vested Termination				219,665	217,741	0.99						
Insurance Active 1	412,213	419,126	1.02	62,640	62,257	0.99	44,329	44,020	0.99	4.44%	4.51%	1.01
Insurance Active 2	209,926	206,098	0.98	2,614	2,657	1.02	0	0	1.00	1.25%	1.29%	1.03
Insurance Active 3	317,264	326,582	1.03	319,612	314,773	0.98	259,330	262,112	1.01	19.00%	18.16%	0.96
Insurance Active 4	669,526	674,778	1.01	47,462	48,151	1.01	19,842	21,194	1.07	4.13%	4.00%	0.97

* Items above that are blank are not applicable to that test life.

Section III: Analysis of Actuarial Assumptions Employed

Economic Assumptions

Actuarial Standard of Practice No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations* (ASOP No. 27), provides guidance for setting economic assumptions used in actuarial valuations. GRS references ASOP No. 27 in its Experience Study report, and appears to have taken the guidance into account when making its recommendations for the economic assumptions.

As part of our review, we also compared the recommended set of economic assumptions to those used by a peer group of 200 pension plans covering state and local employees, the Public Plans Data (PPD). The PPD is maintained by the Center for Retirement Research at Boston College in partnership with the Center for State and Local Government Excellence and the National Association of State Retirement Administrators (NASRA). The current database is populated with information from Comprehensive Annual Financial Reports through the 2019 fiscal year.

Economic assumptions have a significant effect on the development of KRS liabilities. Changes to these assumptions can substantially alter the results determined by the actuary. The goal is to have a consistent set of economic assumptions that appropriately reflect expected future economic trends. However, economic assumptions are uncertain, and, as a result, there may be a reasonable range of potential recommendations. Different actuaries will apply different professional judgment and may choose different reasonable assumptions.

Inflation

The underlying inflation assumption of 2.30% is at the low end of the range of 2.25% to 3.28% (based on the 5th to 95th percentile range from valuations primarily covering fiscal years ending in 2019). The Experience Study report cited several sources of data that supports the reasonableness of the 2.3% inflation assumption.

Investment Return

KRS maintains five retirement and five health insurance plans. Due to differences in external liquidity requirements of the systems, there are differences in how plan assets are invested. The investment return assumption is 6.25% for the CERS retirement system (non-hazardous and hazardous), KERS hazardous retirement system, and all five health insurance plans. The return assumption for the KERS non-hazardous retirement system and SPRS is 5.25%. These assumptions, when compared to the peer group, are below the low end of the range of 6.67% to 7.66% (based on the 5th to 95th percentile range). 5.25% and 6.25% represent two of the lowest investment return assumptions in use for public sector systems. The asset allocation policy for the severely underfunded systems (i.e., KERS non-hazardous and SPRS) is an allocation that has approximately a 60% likelihood of achieving an assumed rate of return of 5.25%, while decreasing short-term volatility by 10% and lowering the

portfolio's sensitivity to the economic growth cycle by 14%. The asset allocation policy for the other systems has approximately a 50% likelihood of achieving a 6.25% rate of return, while increasing projected liquidity and maintaining a similar investment risk profile as the prior allocation. Given the analysis presented by GRS and the characteristics of KRS, the 5.25% and 6.25% investment return assumptions recommended by GRS appear to be reasonable.

The data presented in the Experience Study Report relies on capital market assumptions covering 7 to 10 year expectations for most of the investment consultants considered. These relatively short-term expectations were used to model distributions of 20-year geometric nominal returns. Applying the 7 to 10 year assumptions to a 20-year period typically would understate the expected geometric returns (assuming an environment where longer time horizons have higher expected returns).

Payroll Growth

In 2017, the KRS Board decreased the payroll growth assumption from 4.0% to 0.0% for both KERS systems (non-hazardous and hazardous) and the SPRS. The Board also decreased the payroll growth assumption from 4.0% to 2.0% for both CERS systems (non-hazardous and hazardous). GRS recommended that these assumptions be maintained. GRS also recommended that KRS work with the General assembly to enact legislation modifying the method by which employers collect employer contributions toward the unfunded actuarial accrued liability such that the System invoices the employer the required amortization payment and the employer contributes only the normal cost as a percentage of payroll. Given the funded status of KRS, we believe the payroll growth assumptions are reasonable and the recommendation is appropriate.

Salary Scale

For all members, the salary scale assumption is comprised of inflation, productivity, and step rate/promotional. Inflation is 2.3% for all systems. Productivity is 1% for non-hazardous members and 1.25% for hazardous members. The report does not include an analysis of the method for determining the proposed productivity increase.

The step rate/promotional increase analysis was performed by reviewing year-over-year increases, net of the actual inflation experienced in each year of the study period. The proposed assumptions look reasonable.

Demographic Assumptions

The demographic assumptions used to value KRS reflect the expected occurrence of various events among participants. The assumptions should reflect specific characteristics of the System and produce reasonable results. A reasonable assumption is one that is expected to model the contingency being measured and not expected to produce significant gains and losses. The types of demographic assumptions used to measure pension obligations include, but are not limited to the following:

- Mortality;
- Termination of employment;
- Retirement;

- Disability;
- Retiree medical participation; and
- Others, including refunds, marriage assumptions, and health care trend.

Actuarial Standard of Practice No. 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations* provides guidance for setting noneconomic assumptions used in actuarial valuations. The standard recommends that the actuary follow a general process for selecting demographic assumptions.

The first step of this general process is to identify the types of assumptions to use. The actuary should consider relevant system provisions that will affect timing and value of any potential benefit payments, all contingencies that give rise to benefits or loss of benefits, and the characteristics of the covered group.

The next step in the process is to identify the relevant assumption universe. The assumption universe may include prior experience studies or general studies of trends relevant to the specific type of demographic assumption and system experience to the extent that it is credible.

The third step in the process is to consider the assumption format. The format may include different tables for different segments of the covered population (such as different turnover rates for general employees versus public safety).

The final step in the process is to select the assumptions and evaluate the reasonableness of each assumption. The specific experience of KRS should be incorporated but not given undue weight if recent experience is attributable to a phenomenon that is unlikely to continue. For example, if recent rates of termination were due to a one-time reduction in workforce it may be unreasonable to assume that such rates will continue.

Overall, the methodology that GRS used to review experience and set proposed assumptions is similar to the approach that Segal would take for an experience review.

Mortality

The base mortality rates for retirees age 58 to 94 are based on the System's experience, using a benefits weighted approach and a polynomial model to provide a smooth fit to the midpoint of the experience. Mortality rates for ages under 58 and over 98 are equal to the most recently published Pub-2010 mortality assumptions for general employees. The preliminary mortality table was projected from the center point of the analysis period (2015) to 2019 using the MP-Ultimate mortality improvement assumption. Future mortality improvements are projected using the MP-Ultimate scale. The base mortality rates for disabled retirees is the Pub-2010 Disabled mortality table, with a four-year set forward for both male and female rates. The Pub-2010 mortality table is used for active employees. The General Employees table is used for non-hazardous systems and the Public Safety table if used for the hazardous and State Police Systems. Future improvements in mortality are based on the MP-Ultimate mortality improvement assumption.

GRS assumes that the number of total death by gender indicates that System experience is fully credible. Segal believes that if the base mortality table is based on System experience, every age would need to have some threshold of deaths. In addition, with roughly the same number of deaths for males and females over the experience period (5,078 and 5,060, respectively), it is unclear why the

female data is considered more credible than the male data (99% confidence that experience is within 5% for males, but within 3% for females).

Although the employee groups are allocated between “hazardous and non-hazardous” categories, the mortality data is not studied separately for retirees in former hazardous occupations. While it is conceivable that upon achieving retirement age, all retirees would exhibit the same mortality experience, it would be worth studying the information separately and have the conclusion drawn from the data. We note that there is no mention of this distinction in the report.

Generational mortality improvement is reflected by using only the flat 1% improvement rate per year beyond the first 15 years from the Society of Actuaries’ Retirement Plans Experience Committee mortality improvement tables (MP series). We believe this is a non-standard approach and should be supported with analysis as to why 1% mortality improvement across the board is appropriate for the System.

Retirement Rates

Retirement liability is the most significant portion of the liability for active employees, and therefore the assumed rates of retirement are important. The valuation employs retirement rates for some groups that are based on age (KERS and CERS non-hazardous) and other groups that are based on years of service (KERS and CERS hazardous and SPRS members).

The retirement experience was analyzed on a benefits-weighted basis and modifications were proposed to better reflect experience. In general, we believe the retirement rates proposed by GRS are reasonable. However, it would be useful to provide some analysis or graphs in this section to better understand the rationale for the recommended retirement rates.

Termination Rates

Separate unisex, service-based tables for separation from active service apply to the various membership groups. Termination experience was analyzed on a salary-weighted basis and modifications were proposed to better reflect experience. It is unclear whether termination rates were studied net of rehires; that distinction should be outlined in the report. In general, we believe the termination rates proposed by GRS are reasonable.

Disability Rates

Age-based, unisex disability rates are applied only to eligible members. Based on the analysis in the Experience Study Report, we believe the current and proposed disability rates are reasonable.

Other Comments

To improve the usefulness of the analysis and communicate how the rates were developed, it would be beneficial to include additional analysis and/or graphs to understand why there were recommended changes to rates.

Overall, the economic and demographic actuarial assumptions adopted by the KRS Board are reasonable and consistent with generally accepted actuarial standards and practices contained in Actuarial Standard of Practice No. 27 covering economic assumptions and Actuarial Standard of Practice No. 35 covering demographic and non-economic assumptions.

Funding Method for Liabilities

The funding method employed is the entry age normal (EAN) actuarial cost method and is the same method used by the majority of plans in the Public Plans Database. We find the current method to be reasonable.

Asset Valuation Method

The June 30, 2019 actuarial valuation uses an "actuarial" value of assets for purposes of establishing the required employer contributions. The current method smooths investment gains and losses for each fiscal year by recognizing these gains and losses evenly over a five-year period. This method does not impose a corridor, which would place a limit on the spread between actuarial value of assets (AVA) and market value of assets (MVA).

An essential part of the public sector budgeting process is that material budget items, including pension contributions, should have a level cost pattern from year to year to the extent possible. Segal recognizes the importance of this requirement and assists clients in establishing reasonable methodologies for recognizing investment gains and losses and limiting the potential volatility that may result in increased contributions due to investment results.

The actuary's guide for determining the reasonableness of an asset smoothing method is ASOP No. 44. The following is an excerpt from this ASOP that establishes the qualities a reasonable asset smoothing method must exhibit.

From the Actuarial Standard of Practice No. 44:

3.3 Selecting Methods Other Than Market Value -- If the considerations in section 3.2 have led the actuary to conclude that an asset valuation method other than market value may be appropriate, the actuary should select an asset valuation method that is designed to produce actuarial values of assets that bear a reasonable relationship to the corresponding market values. The qualities of such an asset valuation method include the following:

a. The asset valuation method is likely to produce actuarial values of assets that are sometimes greater than and sometimes less than the corresponding market values.

b. The asset valuation method is likely to produce actuarial values of assets that, in the actuary's professional judgment, satisfy both of the following:

1. The asset values fall within a reasonable range around the corresponding market values. For example, there might be a corridor centered at market value, outside

of which the actuarial value of assets may not fall, in order to assure that the difference from market value is not greater than the actuary deems reasonable.

2. *Any differences between the actuarial value of assets and the market value are recognized within a reasonable period of time. For example, the actuary might use a method where the actuarial value of assets converges toward market value at a pace that the actuary deems reasonable, if the investment return assumption is realized in future periods.*

In lieu of satisfying both (1) and (2) above, an asset valuation method could satisfy section 3.3(b) if, in the actuary's professional judgment, the asset valuation method either (i) produces values within a sufficiently narrow range around market value or (ii) recognizes differences from market value in a sufficiently short period.

Two key principles arise from ASOP 44. These are that acceptable asset smoothing must create asset values that fall within a reasonable range around market value and are recognized in a reasonable period of time. In lieu of satisfying both of these principles, a smoothing method could satisfy the requirements if, in the actuary's professional judgment, the range around market value is sufficiently narrow or the differences are recognized in a sufficiently short period.

Segal has established an internal policy, which is consistent with others in the actuarial community, that five years is a sufficiently short period to constitute a reasonable asset smoothing method even if no corridor is used. Therefore, it is our opinion that the method utilized by KRS is reasonable.

Funding Policy Contribution

By statute, the KRS Board of Trustees must approve the employer contribution rates for the two upcoming fiscal years for KERS and SPRS and for the upcoming fiscal year for CERS, based upon the results of the most recent actuarial valuation The funding policy set by the Board of Trustees provides that the contribution rate consists of the normal cost and an amortization payment (level percentage of payroll) on the unfunded accrued liability (UAL). The amortization period was reestablished as a closed 30 year period beginning with the June 30, 2013, actuarial valuation. The amortization period will decrease by one each year in the future. This type of closed period amortization provides a contribution schedule that, if actual experience is reasonably close to expected, will amortize the existing unfunded liability over time.

However, House Bill 362 passed during the 2018 legislative session provides for a phase-in of contributions to the CERS systems. In addition, the funded ratio for KERS Non-Hazardous was 13.4% as of June 30, 2019. For the remaining systems, we believe this funding policy is sufficient and provides a reasonable contribution rate schedule for adequately funding the Systems. For CERS, we recommend that the employers pay the actuarially determined contribution rates. For KERS Non-Hazardous, we recommend that contributions continue to exceed benefit payments and that the actuarially determined contributions be contributed in order to avoid the risk of insolvency.

Insurance Assumptions

Health Care Trend Rate

Trend is a measure of the rate of change, over time, of the per capita health care rates. It includes factors such as medical inflation, utilization, plan design, and technology improvements. GRS currently bases their assumption on the model issued by the Society of Actuaries "Getzen model of Long-Run Medical Costs Trends for the SOA;" Thomas E. Getzen, iHEA and Temple University 2014 © Society of Actuaries. GRS has developed separate assumptions for Medicare and non-Medicare plans. We agree with their approach. Additionally, the trend rates developed are reasonable and produce results consistent with trend rates used for other similar plans.

Age-Related Morbidity

Morbidity or aging factors are used to estimate variation in per capita health care rates by age for the benefits being modeled. To model the impact of aging on the underlying health care costs for Medicare retirees, GRS relied on the Society of Actuaries' 2013 Study "Health Care Costs – From Birth to Death" Table 4 (Development of Plan Specific Medicare Age Curve) to model the impact of aging for ages 65 and over. For Medicare retirees, this approach and the aging factors used by GRS are reasonable and appropriate for the valuation.

As GRS correctly noted, Actuarial Standards of Practice No. 6 requires aging subsidies to be recognized and GASB Statements No. 74 and No. 75 require adhering to ASOP No. 6. However, no aging factors are applied to non-Medicare retirees. Since the health insurance trusts are designed to reimburse the employer's portion of the non-Medicare premium, this approach is reasonable solely for the purposes of a funding valuation.

Plan Election

GRS assumes that the proportion of current retirees electing each coverage option will remain unchanged. There are separate assumptions for Medicare and non-Medicare retirees. This approach is supported by the data, reasonable and appropriate for the valuation.

Participation

The participation assumption is used to project what percentage of members elect retiree health care coverage upon retirement.

For members retiring from active status who were hired before July 1, 2003, GRS has continued their approach to base participation on retiree contribution percentage, which is based on service at retirement. This approach is reasonable and appropriate for the valuation.

Section III: Analysis of Actuarial Assumptions Employed

For members retiring from active or inactive vested status who were hired after July 1, 2003, GRS recommends continuing to use the current assumptions of 100% participation. We believe this assumption may be conservative, especially for non-hazardous non-Medicare retirees. We would suggest that when the experience is next reviewed, in addition to considering service-based participation rates, rates of participation may also vary by Medicare status at retirement.

Members who become disabled in the line of duty, and surviving spouses and dependents of members who die in the line of duty, receive 100% of their health care paid by KRS. Continuing to assume that 100% will participate is reasonable and appropriate for the valuation.

Section IV: Conclusions and Recommendations

This limited scope audit reviewed the data used, the benefits valued, the valuation results, and the actuarial methods and assumptions employed in the June 30, 2019, actuarial valuations. We provided a few recommendations for the valuation report and test lives, and we generally agree with the results of the experience study, with a few recommendations for improvement. We found the actuarial cost method and asset valuation method conform with the Actuarial Standards of Practice. The data appears complete and with a cursory analysis of the information supplied by KRS staff, we were able to closely match the participant counts reported by GRS.

Below we summarize our comments and recommendations for your consideration:

A. Valuation Results

1. Additional detail relative to the calculation of Recommended Employer Contribution Rates would be beneficial to the user and improve transparency.

B. Valuation Report

1. The report disclosed the effect of the assumption changes on the actuarial accrued liabilities. However, the effect of the assumption changes on other funding metrics, such as the funded percentage and the Actuarially Determined Contribution Rate, were not disclosed. Since these changes could provide useful insight to users of the reports, we recommend showing the impact of assumption changes on these funding metrics.

2. In the tables labeled as “Experience Gain or (Loss),” we believe it is clearer and more appropriate that plan changes and assumption changes not be classified as actuarial gains and losses.

3. Also related to the liability gain or (loss), it would be informative to show the gain or loss attributable to each source as well as to actual contributions that are more or less than expected.

4. Section 5 of the Annual Actuarial Valuation Report contains information related to discussion of risks, which is required information for funding valuations and pricing valuations pursuant to Actuarial Standards of Practice Statement No. 51 (ASOP 51). We recommend this section be expanded to add commentary specific to KRS when discussing each risk element. In addition, we believe this section should contain a recommendation for a more detailed risk assessment since there is, in our opinion, enough risk inherent in KRS that a more detailed risk assessment would be useful.

5. The reports do not include any projections of future funded percentages or contribution requirements. Adding a projection of liabilities, assets, and required contribution rates throughout the remaining amortization period (24 years for the 2019 valuation reports) could be helpful for the long-term planning for the future funding requirements of the System.

C. Projected Benefits

1. There is an inconsistency between how service to determine benefit eligibility and service to determine benefit amounts are calculated. Service for eligibility purposes is calculated as a rounded amount and service for benefit amount purposes is calculated as an exact amount. We would expect both to be calculated with the same methodology. Furthermore, using rounded service for benefit eligibility may not be appropriate, as it would allow some participants to retire within the valuation program at an age when they are not actually eligible. For example, if a participant needs 10 credits to retire at a certain age, they would not be able to retire at that age if they only had 9.9 credits. Rounding the 9.9 credits to 10 allows the valuation program to treat them as retiring earlier than actually allowable. We recommend using exact service for eligibility purposes.

2. The trend rates for insurance test lives appears to include the adjustment for known 2020 Medicare premiums for current retirees but not for future retirees.

D. Assumptions and Methods

1. We believe that the investment return assumption recommendations are reasonable.

2. The experience study report does not include an analysis of the method for determining the proposed productivity increase.

3. GRS should expand their analysis of post-retirement mortality to verify mortality experience after retirement is similar for both hazardous and non-hazardous employees.

4. There is no documented support that 1% mortality improvement across the board is appropriate for the System.

5. It is unclear whether termination rates were studied net of rehires; that distinction should be outlined in the report.

6. To improve the usefulness of the analysis and communicate how the rates were developed, it would be beneficial to include additional analysis and/or graphs to understand why there were recommended changes to rates.

In this report, we have noted areas that we believe will improve the usefulness and clarity of the KRS annual actuarial valuations and experience study, and improve the valuation results. We are available to discuss any aspect of our review with KRS staff or the Systems' actuary.

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