THE EMPIRE DISTRICT ELECTRIC COMPANY

ELECTRIC UTILITY PLANT

DEPRECIATION RATE STUDY

AT DECEMBER 31, 2019

ALLIANCE CONSULTING GROUP

http://www.utilityalliance.com

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EXECUTIVE SUMMARY

The Empire District Electric Company ("EDE" or "Company") engaged Alliance Consulting Group to conduct a depreciation study of the Company's Electric utility plant depreciable assets as of December 31, 2019.

For Production accounts including Steam Production, Hydro, and Other Production, the lives of the generating units remained consistent with previous filings with the exception of a select few units. Steam Production unit Asbury 1 retired in early 2020, and Other Production unit Energy Center 1 is extending its estimated retirement date. The study results do not include any terminal dismantlement costs.

Transmission, Distribution and General plant accounts saw a mix of increasing and decreasing lives (depending on the account and jurisdiction) and a general increase in the experienced negative net salvage.

This study recommends an overall increase of approximately $14.1 million in annual depreciation expense. This consists of an increase of $7.3 million in annual depreciation expense for Production facilities compared to the depreciation rates currently in effect and an increase of approximately $6.8 million in Transmission, Distribution, and General annual depreciation expense compared to the depreciation rates currently in effect. Appendix B demonstrates the change in depreciation expense for the various accounts.

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PURPOSE

The purpose of this study is to develop depreciation rates for the depreciable property as recorded on EDE's books at December 31, 2019 for Arkansas, Kansas, Missouri, and Oklahoma. The account-based depreciation rates were designed to recover the total remaining undepreciated investment, adjusted for net salvage, over the remaining life of EDE's property on a straight-line basis. Non-depreciable property and property that is amortized, such as intangible software, were excluded from this study.

EDE is a regulated utility based in Joplin, Missouri that provides electric service to its customers. In 2017 The Empire District Electric Company was acquired by Liberty Utilities (Central) Corp., a subsidiary of Liberty Utilities Co., itself a U.S. subsidiary of Algonquin Power & Utilities Corp. EDE's electric operation generates, purchases, and distributes electricity to approximately 173,000 electric customers in parts of Missouri, Kansas, Oklahoma, and Arkansas. EDE's electric service territory encompasses approximately 10,000 square miles. EDE serves twelve counties in Missouri, three counties in Oklahoma, one county in Kansas, and one county in Arkansas. EDE serves its customers through an interconnected grid of transmission and distribution ("T&D") circuits and substations, which are diverse, and must serve the needs of both its urban customers (located in areas of high service density like Joplin) as well as customers located along rural "feeder" circuits, where loads are low and circuits are long.

STUDY RESULTS

Overall depreciation rates for all EDE depreciable property are shown in Appendix A. These rates translate into an annual depreciation accrual of $79.6 million based on EDE's depreciable investment at December 31, 2019. The annual equivalent depreciation expense calculated by the same method using the approved rates was $65.5 million. These rates translate into an approximate annual depreciation accrual for Steam Production of $13.2 million, Hydraulic Production of $343 thousand, Other Production of $18.2 million, Transmission of $10.2 million, Distribution of $31.7 million, and General Plant of $6.2 million. Depreciation accrual rates are proposed for assets that will be added after December 31, 2019: Wind Production, Solar Production, and AMI meters. Those rates are shown in Appendix B. Appendix A demonstrates the development of the annual depreciation rates and accruals. Appendix B presents a comparison of approved rates versus proposed rates by account. Appendix C presents a summary of mortality and net salvage estimates by account. Appendix D presents the terminal retirement dates for production facilities. Appendix E presents the net salvage analysis for all accounts. Appendix F presents a summary of plant, per book depreciation reserve, allocated depreciation reserves, and theoretical depreciation reserves by depreciation group.

GENERAL DISCUSSION

Definition

The term "depreciation" as used in this study is considered in the accounting sense, that is, a system of accounting that distributes the cost of assets, less net salvage (if any), over the estimated useful life of the assets in a systematic and rational manner. It is a process of allocation, not valuation. This expense is systematically allocated to accounting periods over the life of the properties. The amount allocated to any one accounting period does not necessarily represent the loss or decrease in value that will occur during that particular period. The Company accrues depreciation on the basis of the original cost of all depreciable property included in each functional property group. On retirement, the full cost of depreciable property, less the net salvage value, is charged to the depreciation reserve.

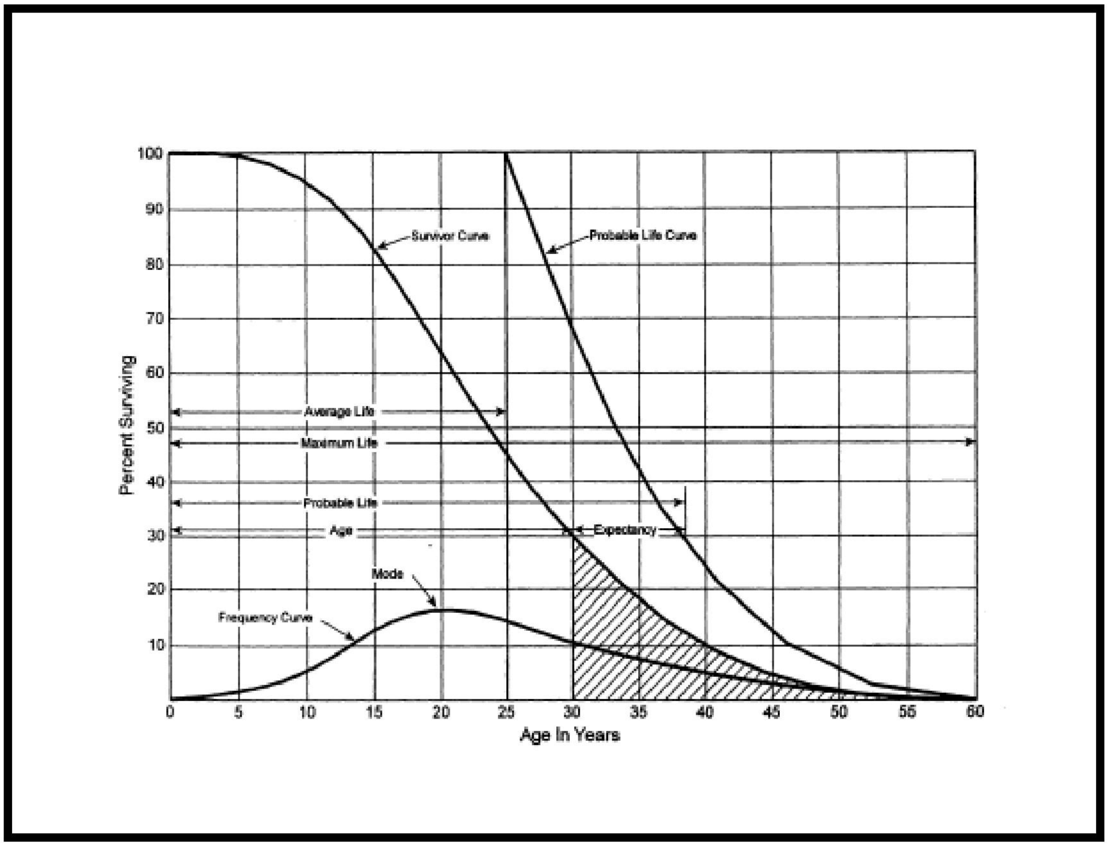
Basis of Depreciation Estimates

The straight-line, broad (average) life group, remaining-life depreciation system was employed to calculate annual and accrued depreciation in this study. In this system, the annual depreciation expense for each group is computed by dividing the original cost of the asset less allocated depreciation reserve less estimated net salvage by its respective average life group remaining life. The resulting annual accrual amounts of all depreciable property within a function were accumulated, and the total was divided by the original cost of all functional depreciable property to determine the depreciation rate. The calculated remaining lives and annual depreciation accrual rates were based on attained ages of plant in service and the estimated service life and salvage characteristics of each depreciable group. The computations of the annual functional depreciation rates are shown in Appendix A.

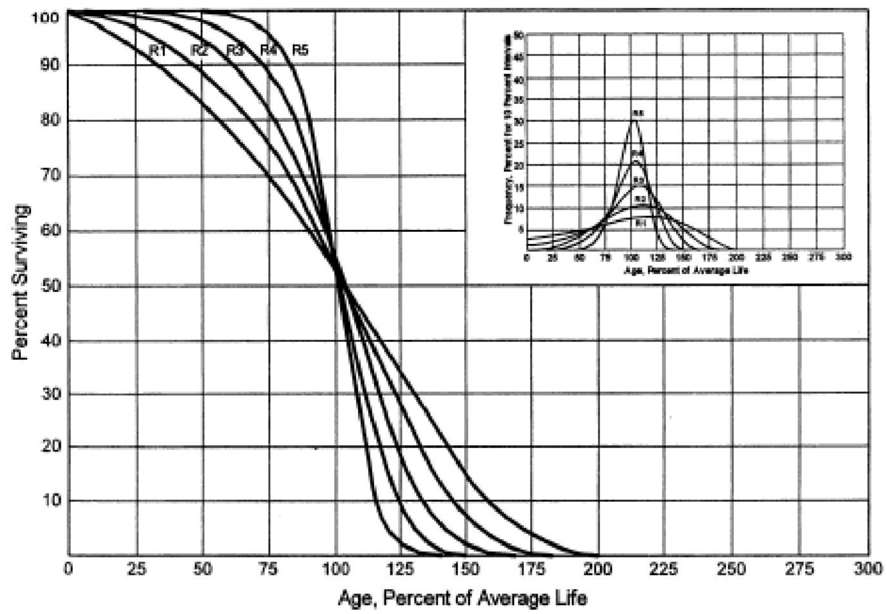
Actuarial analysis was used with each account within a function where sufficient data was available, and judgment was used to some degree on all accounts.

Survivor Curves

To fully understand depreciation projections in a regulated utility setting, there must be a basic understanding of survivor curves. Individual property units within a group do not normally have identical lives or investment amounts. The average life of a group can be determined by first constructing a survivor curve which is plotted as a percentage of the units surviving at each age. A survivor curve represents the percentage of property remaining in service at various age intervals. The Iowa Curves are the result of an extensive investigation of life characteristics of physical property made at Iowa State College Engineering Experiment Station in the first half of the prior century. Through common usage, revalidation and regulatory acceptance, these curves have become a descriptive standard for the life characteristics of industrial property. An example of an Iowa Curve is shown below.



There are four families in the Iowa Curves that are distinguished by the relation of the age at the retirement mode (largest annual retirement frequency) and the average life. For distributions with the mode age greater than the average life, an "R" designation (i.e., Right modal) is used. The family of “R” moded curves is shown below.



Similarly, an "S" designation (i.e., Symmetric modal) is used for the family whose mode age is symmetric about the average life. An "L" designation (i.e., Left modal) is used for the family whose mode age is less than the average life. A special case of left modal dispersion is the "O" or origin modal curve family. Within each curve family, numerical designations are used to describe the relative magnitude of the retirement frequencies at the mode. A "6" indicates that the retirements are not greatly dispersed from the mode (i.e., high mode frequency) while a "1" indicates a large dispersion about the mode (i.e., low mode frequency). For example, a curve with an average life of 30 years and an "L3" dispersion is a moderately dispersed, left modal curve that can be designated as a 30 L3 Curve. An SQ, or square, survivor curve occurs where no dispersion is present (i.e., units of common age retire simultaneously).

Most property groups can be closely fitted to one Iowa Curve with a unique average service life. The blending of judgment concerning current conditions and future trends along with the matching of historical data permits the depreciation analyst to make an informed selection of an account's average life and retirement dispersion pattern.

Life Span Procedure

The life span procedure was used for production facilities for which most components are expected to have a retirement date concurrent with the planned retirement date of the generating unit. The terminal retirement date refers to the year that each unit will cease operations. The terminal retirement date, along with the interim retirement characteristics of the assets that will retire prior to the facility ceasing operation; describe the pattern of retirement of the assets that comprise a generating unit. The estimated terminal retirement dates for the various generating units were determined based on consultation with Company management, financial, and engineering staff. Those estimated terminal retirement dates are shown in Appendix D.

Interim Retirement Factors

Interim retirement curves (or factors) were used to model the retirement of individual assets within primary plant accounts for each generating unit prior to the terminal retirement of the facility. The life span procedure assumes all assets are depreciated (straight-line) for the same number of periods and retire at the same time (the terminal retirement date). Adding interim retirement curves to the procedure reflects the fact that some of the assets at a power plant will not survive to the end of the life of the facility and should be depreciated (straight-line) more quickly and retired earlier than the terminal life of the facility. The goal of interim retirement curves is to project how many of the assets that are currently in service will retire each year in the future using historical analysis and judgment. These curves were chosen based primarily on an analysis of the historical retirement pattern of the Generation assets and consultation with Company personnel. Interim retirements for each plant account were modeled using Iowa Curves discussed above. By applying interim retirements, recognition is given to the obvious fact that generating units will have retirements of depreciable property before the end of their lives.

Although interim retirements have been recognized in the study, interim additions (i.e. future additions) have been excluded from the study. The estimated amount of future additions might or might not occur. However, there is no uncertainty as to whether the full level of interim retirements will happen. The assets that are being modeled for retirement are already in rate base. Depreciation rates using interim retirements are known and measurable in the same way that setting depreciation rates for transmission or distribution property using Iowa Curves is known and measurable. There is no depreciable asset that is expected to live forever. All assets at a power plant will retire at some point. Interim retirements simply model when those retirements will occur in the same way that is done for transmission or distribution assets.

Actuarial Analysis

Actuarial analysis (retirement rate method) was used in evaluating historical asset retirement experience where vintage data were available and sufficient retirement activity was present. In actuarial analysis, interval exposures (total property subject to retirement at the beginning of the age interval, regardless of vintage) and age interval retirements are calculated. The complement of the ratio of interval retirements to interval exposures establishes a survivor ratio. The survivor ratio is the fraction of property surviving to the end of the selected age interval, given that it has survived to the beginning of that age interval. Survivor ratios for all available age intervals were chained by successive multiplications to establish a series of survivor factors, collectively known as an observed life table.

The observed life table shows the experienced mortality characteristic of the account and may be compared to standard mortality curves such as the Iowa Curves. Where data was available, accounts were analyzed using this method. Placement bands were used to illustrate the composite history over a specific era, and experience bands were used to focus on retirement history for all vintages during a set period. The results from these analyses for those accounts which had data sufficient to be analyzed using this method are shown in the Life Analysis section of this report.

Judgment

Any depreciation study requires informed judgment by the analyst conducting the study. A knowledge of the property being studied, company policies and procedures, general trends in technology and industry practice, and a sound basis of understanding depreciation theory are needed to apply this informed judgment. Judgment was used in areas such as survivor curve modeling and selection, depreciation method selection, simulated plant record method analysis, and actuarial analysis.

Judgment is not defined as being used in cases where there are specific, significant pieces of information that influence the choice of a life or curve. Those cases would simply be a reflection of specific facts into the analysis. Where there are multiple factors, activities, actions, property characteristics, statistical inconsistencies, implications of applying certain curves, property mix in accounts or a multitude of other considerations that impact the analysis (potentially in various directions), judgment is used to take all of these factors and synthesize them into a general direction or understanding of the characteristics of the property. Individually, no one factor in these cases may have a substantial impact on the analysis, but overall, may shed light on the utilization and characteristics of assets. Judgment may also be defined as deduction, inference, wisdom, common sense, or the ability to make sensible decisions. There is no single correct result from statistical analysis; hence, there is no answer absent judgment. At the very least for example, any analysis requires choosing which bands to place more emphasis.

The establishment of appropriate average service lives and retirement dispersions for the Production interim retirements, Transmission, Distribution, Distribution, and General Plant accounts requires judgment to incorporate the understanding of the operation of the system with the available accounting information analyzed using the Retirement Rate actuarial methods. The appropriateness of lives and curves depends not only on statistical analyses, but also on how well future retirement patterns will match past retirements.

Current applications and trends in use of the equipment also need to be factored into life and survivor curve choices in order for appropriate mortality characteristics to be chosen.

Average Life Group Depreciation

EDE is regulated by four different state commissions with facilities in the states of Missouri, Oklahoma, Kansas, and Arkansas. Each state has different existing parameters and depreciation systems in the current rates. All four states use straight line, average life group depreciation to establish depreciation rates. The following orders for each jurisdiction established depreciation rates: Missouri Public Service Commission Case No. ER-2016-0023, Corporation Commission of Oklahoma Case No. PUD 201600468, Kansas Corporation Commission Docket 19-EPDE-223-RTS, and Arkansas Public Service Commission Docket 13-111-U. In addition, the Federal Energy Regulatory Commission ("FERC") regulates EDE's formula rates for Generation and Transmission assets. At the request of EDE, this study continues to use the ALG depreciation procedure to group the assets within each account. After an average service life and dispersion were selected for each account, those parameters were used to estimate what portion of the surviving investment of each vintage was expected to retire. The depreciation of the group continues until all investment in the vintage group is retired. An ALG is defined by the group's respective account dispersion, life, and salvage estimates. There are two ways of defining depreciation rates: a whole life approach or a remaining life approach. Production plant currently uses remaining life for all jurisdictions. Transmission, Distribution, and General Plant use different systems depending on the jurisdiction. Missouri and Oklahoma currently use whole life rates, while Arkansas and Kansas use remaining life rates. This depreciation study recommends remaining life depreciation rates for all plant groups.

A straight-line rate for each ALG is calculated by computing a composite remaining life for each group across all vintages within the group, dividing the remaining investment to be recovered by the remaining life to find the annual depreciation expense, and dividing the annual depreciation expense by the surviving investment. The resultant rate for each ALG group is designed to recover all retirements less net salvage when the last unit retires. The ALG procedure recovers net book cost over the life of each account by averaging many components.

Theoretical Depreciation Reserve

The book depreciation reserve was derived from Company records and was reallocated from a functional level to individual accounts and to units for production plant. This study used a reserve model that relied on a prospective concept relating future retirement and accrual patterns for property, given current life and salvage estimates. The theoretical reserve of a group is developed from the estimated remaining life, total life of the property group, and estimated net salvage. The theoretical reserve represents the portion of the group cost that would have been accrued if current forecasts were used throughout the life of the group for future depreciation accruals. The computation involves multiplying the vintage balances within the group by the theoretical reserve ratio for each vintage. The average life group method requires an estimate of dispersion and service life to establish how much of each vintage is expected to be retired in each year until all property within the group is retired. Estimated average service lives and dispersion determine the amount within each average life group. The straight-line remaining-life theoretical reserve ratio at any given age (RR) is calculated as:

$$RR = 1 - \frac{(Average\ Remaining\ Life)}{(Average\ Service\ Life)} * (1 - Net\ Salvage\ Ratio)$$

DETAILED DISCUSSION

Depreciation Study Process

This depreciation study encompassed four distinct phases. The first phase involved data collection and field interviews. The second phase was where the initial data analysis occurred. The third phase was where the information and analysis were evaluated. Once the first three stages were complete, the fourth phase began. This phase involved the calculation of deprecation rates and the documenting of the corresponding recommendations.

During the Phase 1 data collection process, historical data was compiled from continuing property records and general ledger systems. Data was validated for accuracy by extracting and comparing to multiple financial system sources. Audit of this data was validated against historical data from prior periods, historical general ledger sources, and field personnel discussions. This data was reviewed extensively to put in the proper format for a depreciation study. Further discussion on data review and adjustment is found in the Salvage Considerations Section of this study. Numerous discussions were conducted with engineers and field operations personnel to obtain information that would assist in formulating life and salvage recommendations in this study. One of the most important elements of performing a proper depreciation study is to understand how the Company utilizes assets and the environment of those assets. Interviews with engineering and operations personnel are important data-gathering operations that allow the analyst to obtain information that is beneficial when evaluating the output from the life and net salvage programs in relation to the Company's actual asset utilization and environment. Information that was gleaned in these discussions is found in both the Detailed Discussion of this study in the life analysis and salvage analysis sections and in work papers.

Phase 2 is where the actuarial analysis is performed. Phase 2 and 3 overlap to a significant degree. The detailed property records information is used in Phase 2 to develop observed life tables for life analysis. These tables are visually

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Phase 2 is where the actuarial analysis is performed. Phase 2 and 3 overlap to a significant degree. The detailed property records information is used in Phase 2 to develop observed life tables for life analysis. These tables are visually compared to industry standard tables to determine historical life characteristics. It is possible that the analyst would cycle back to this Phase based on the evaluation process performed in Phase 3. Net salvage analysis consists of compiling historical salvage and removal data by functional group to determine values and trends in gross salvage and removal cost. This information was then carried forward into Phase 3 for the evaluation process.

Phase 3 is the evaluation process which synthesizes analysis, interviews, and operational characteristics into a final selection of asset lives and net salvage parameters. The historical analysis from Phase 2 is further enhanced by the incorporation of recent or future changes in the characteristics or operations of assets that were revealed in Phase 1. Phases 2 and 3 allow the depreciation analyst to validate the asset characteristics as seen in the accounting transactions with actual Company operational experience.

Finally, Phase 4 involves calculating accrual rates, making recommendations and documenting the conclusions in the Study. The calculation of accrual rates is found in Appendix A. Recommendations for the various accounts are contained within Section VI of this Study. The depreciation study flow diagram shown as Figure 1[1] below also documents the steps used in conducting this Study. DEPRECIATION SYSTEMS[2], at page 289, documents the same basic processes in performing a depreciation study, which are: statistical analysis, evaluation of statistical analysis, discussions with management, forecast assumptions, and document recommendations.

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[1] INTRODUCTION TO DEPRECIATION FOR PUBLIC UTILITIES & OTHER INDUSTRIES, AGA EEI (2013).
[2] W. C. Fitch and F.K.Wolf, DEPRECIATION SYSTEMS, Iowa State Press, at page 289 (1994).

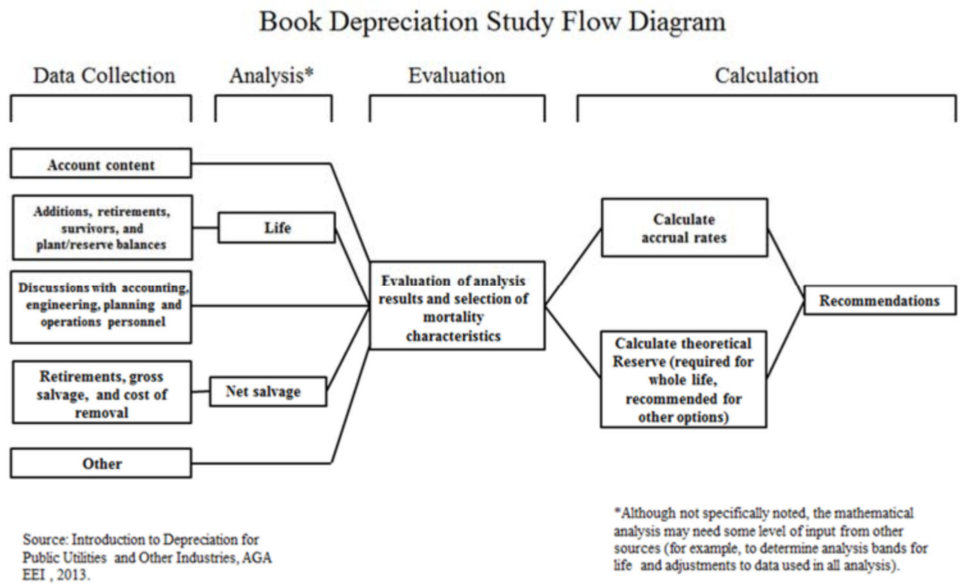


Figure 1

EDE DEPRECIATION STUDY PROCESS

Depreciation Rate Calculation

Annual depreciation expense amounts for the depreciable accounts of EDE were calculated by the straight-line method, average life group procedure, and remaining-life technique. With this approach, remaining lives were calculated according to standard ALG expectancy techniques, using the Iowa Curves noted in the calculation. For each plant account, the difference between the surviving investment, adjusted for estimated net salvage, and the allocated book depreciation reserve was divided by the average remaining life to yield the annual depreciation expense. These calculations are shown in Appendix A.

Remaining Life Calculation

The establishment of appropriate average service lives and retirement dispersions for each account within a functional group was based on engineering judgment that incorporated available accounting information analyzed using the Retirement Rate actuarial methods. After establishment of appropriate average service lives and retirement dispersion, remaining life was computed for each account. Theoretical depreciation reserve with zero net salvage was calculated using theoretical reserve ratios as defined in the theoretical reserve portion of the General Discussion section. The difference between plant balance and theoretical reserve was then spread over the ALG depreciation accruals. Remaining life computations are found for each account in work papers.

Production Depreciation Calculation Process

Annual depreciation expense amounts for the Steam, Hydro, and Other Production accounts were calculated by the straight line, remaining life procedure. In a whole life representation, the annual accrual rate is computed by the following equation,

$$AnnualAccrualRate = \frac{(100\% - NetSalvagePercent)}{AverageServiceLife}$$

In the case of steam production facilities with a terminal life and interim retirement curve, each vintage within the group has a unique average service life and remaining life determined by computing the area under the truncated Iowa Curve coupled with the group's terminal life.

Use of the remaining life depreciation system adds a self-correcting mechanism, which accounts for any differences between theoretical and book depreciation reserve over the remaining life of the group. For each vintage modeled with an interim retirement curve and terminal life,

$$RemainingLife(i) = \frac{AreaUnderSurvivorCurvetotheRightofAge(i)}{Survivors(i)}$$, and

$$AverageServiceLife = \frac{AreaUnderSurvivorCurve}{Survivorsatagezero}$$

With the straight line, remaining life, average life group system using Iowa Curves, composite remaining lives were calculated by computing a direct weighted average of each remaining life by vintage within the group. Within each group (plant account/unit) for each plant account, the difference between the surviving investment, adjusted for estimated net salvage, and the allocated book depreciation reserve was divided by the composite remaining life to yield the annual depreciation expense as noted in this equation.

$$AnnualDepreciationExpense = \frac{OriginalCost - Book\,\mathrm{Re}\,serve - (OriginalCost) * (1 - NetSalvage\%)}{\mathrm{Re}\,mainingLife}$$

where the net salvage percent represents future net salvage.

Within a group, the sum of the group annual depreciation expense amounts, as a percentage of the depreciable original cost investment summed, gives the annual depreciation rate depreciation rate as shown below:

$$AnnualDepreciationRate = \frac{\sum AnnualDepreciationExpense}{\sum OriginalCost}$$

These calculations are shown in Appendix A. The calculations of the theoretical depreciation reserve values and the corresponding remaining life calculations are shown in the work papers. Book depreciation reserves were reallocated from specific functional groups to a plant account/unit level basis within that specific functional group and theoretical reserve computations were used to compute remaining life for each group.

Other Accounts Calculation Process

Annual depreciation expense amounts for accounts other than Production (Transmission, Distribution, and General) were calculated by the straight-line, remaining life procedure.

In a whole life representation, the annual accrual rate is computed by the following equation,

$$AnnualAccrualRate = \frac{(100\% - NetSalvagePercent)}{AverageServiceLife}$$

Use of the remaining life depreciation system adds a self-correcting mechanism, which accounts for any differences between theoretical and book depreciation reserve over the remaining life of the group. With the straight-line, remaining life, average life group system using Iowa Curves, composite remaining lives were calculated according to standard broad group expectancy techniques, noted in the formula below:

$$Composite\,\mathrm{Re}\,mainingLife = \frac{\sum OriginalCost - Theoretical\,\mathrm{Re}\,serve}{\sum WholeLifeAnnualAccrual}$$

For each plant account, the difference between the surviving investment, adjusted for estimated net salvage, and the allocated book depreciation reserve, was divided by the composite remaining life to yield the annual depreciation expense as noted in this equation:

$$AnnualDepreciationExpense = \frac{OriginalCost - Book\,\mathrm{Re}\,serve - (OriginalCost) * (1 - NetSalvage\%)}{Composite\,\mathrm{Re}\,mainingLife}$$

where the net salvage percent represents future net salvage.

Within a group, the sum of the group annual depreciation expense amounts, as a percentage of the depreciable original cost investment summed, gives the annual depreciation rate as shown below:

$$AnnualDepreciationRate = \frac{\sum AnnualDepreciationExpense}{\sum OriginalCost}$$

These calculations are shown in Appendix A. The calculations of the theoretical depreciation reserve values and the corresponding remaining life calculations are shown in work papers. Book depreciation reserves were allocated from a functional level to individual accounts and the theoretical reserve computation was used to compute a composite remaining life for each account.

LIFE ANALYSIS

The retirement rate actuarial analysis method was applied to all accounts for EDE. For each account, an actuarial retirement rate analysis was made with placement and experience bands of varying width. The historical observed life table was plotted and compared with various Iowa Curves to obtain the most appropriate match. A selected curve for each account is shown in the Life Analysis Section of this report. The observed life tables for all analyzed placement and experience bands are provided in work papers.

For each account on the overall band (i.e., placement from earliest vintage year, which varied for each account, through 2019), approved survivor curves from EDE's prior cases, modified by subsequent orders if applicable, were used as a starting point. Then, using the same average life, various dispersion curves were plotted. Frequently, visual matching would confirm one specific dispersion pattern (e.g. L, S, or R) as an obviously better match than others. The next step would be to determine the most appropriate life using that dispersion pattern. Then, after looking at the overall experience band, different experience bands were plotted and analyzed in increments, for instance 1970-2019, and 2000-2019. Next, placement bands of varying width were plotted with each experience band discussed above. Repeated matching usually pointed to a focus on one dispersion family and small range of service lives. The goal of visual matching was to minimize the differential between the observed life table and Iowa Curve in top and mid-range of the plots. These results are used in conjunction with all other factors that may influence asset lives.

Terminal Retirement Date

The terminal retirement date refers to the year in which a generating unit will be retired from service. The retirement can be for a number of reasons such as the physical end of the generating unit but will generally be driven by economic retirement of the unit. EDE personnel provided their estimated retirement dates for each generating unit. These dates are based on the current plans and investment in the generating units. Retirement dates for generating units can be found in Appendix D. As new investment is committed to these units or decisions made that units are not economically viable, these lives may change. At this time, these retirement dates are the best estimate of the current lives remaining in the generating assets.

<u>Interim Retirement Curve</u>

Historical data used to develop interim retirement curves represent an aggregate of many property units in a group. Some of those assets may be long lived, and others may have a short life. The average of those is represented by an interim retirement curve for the group. A group can be a plant account or a functional group. The interim retirement curve is “truncated” (i.e., cut off) at the age the unit will retire. In other words, if one finds through the analysis that 10 percent of the property in an account will be retired and replaced prior to the end of the life of the unit, the interim retirement curve will model those retirements across the rest of the life of the unit. If a pump is only going to last 10 years but the unit is projected to last 20 years, the shorter life of the pump should affect the depreciation expense charged over the next 10 years. When analyzing a large pool of assets like power plant accounts, these shorter-lived items can be accurately modeled together statistically. Thus, given that interim retirements will occur, this statistical analysis enables one to measure the interim retirement curves applicable to property groups. Some examples of “long lived” property that are projected to last until the retirement of a unit are: roads, bridges, railroad track, structural steel (and misc. steel), cooling towers, buildings, cranes, ponds, basins, canals, foundations, stacking and reclaiming equipment, surge silos, crushers, transfer towers, fly ash and bottom ash systems, precipitators, bag houses, stack, turbine (except blades) and piping, generator cooling system, vacuum systems, generator and main leads, station transformers, conduits and ducts, station grounding System, start-up diesel generators, and stores equipment.

Some examples of “shorter lived” property that are projected to retire prior to the retirement of the unit are: fences, signs, sprinkler systems, security systems, roofs, cooling fan units, air compressors, fuel oil heaters, heating, ventilation and air conditioners, piping, motors, pumps, conveyors, pulverizers, air preheaters, economizers, control equipment, feedwater heaters, boiler feedwater pumps, forced draft (FD) and induced draft (ID) fans, scrubbers, continuous emissions monitoring systems (CEM), turbine blades and buckets, turbine plant instruments, condensers, control equipment, station service switchgear, and universal power supply (UPS) batteries.

PRODUCTION PLANT

Special Circumstances:

In 2014-2017, Riverton steam generating facilities were retired. Asbury was retired in early 2020. The retirement of Asbury was treated as a known change and incorporated in the depreciation study. For Production facilities, all jurisdictions use the life span (remaining life) depreciation system. The current depreciation rates for production in Missouri, Oklahoma, and Kansas incorporated interim retirement ratios to estimate retirements that are projected to occur between the current date and the estimated retirement date of the generating facility. Arkansas' current production depreciation rates incorporate Iowa Curves to estimate retirement activity of each generating unit.

In modeling retirement activity for this study, Alliance Consulting recommends the use of Iowa Curves. In our experience, Iowa Curves are the more widely used of the two approaches and have the advantage of incorporating the age of each asset in the depreciation group. The Missouri Public Service Commission has approved the incorporation of Iowa Curves in computing depreciation rates for Ameren in case ER-2014-0258 and Kansas City Power and Light in Case ER 2014-0370 as well as life span remaining life depreciation. The Oklahoma Corporation Commission has approved the use of Iowa Curves in PUD Case 201700496 for Oklahoma Electric and Gas. The Kansas Corporation Commission approved the use of Iowa Curves for Kansas City Power and Light in Docket 18-KCPE-480-RTS.

In performing actuarial analysis on accounts 311-316, the initial data set included all retirements except life span retirements of Riverton and Asbury. After reviewing the results, the interim survivor curves showed a much shorter life than is usually seen in generation assets. We concluded that the retirements near the end of the economic life of those generating units were atypical of the existing steam generation plant at Iatan and Plum Point. It was not possible to remove all life data related to Riverton and Asbury in the history since no segregated source data before 2005 was available. Thus, interim net salvage from 2005-2019 was used to estimate net salvage for accounts 311-316.

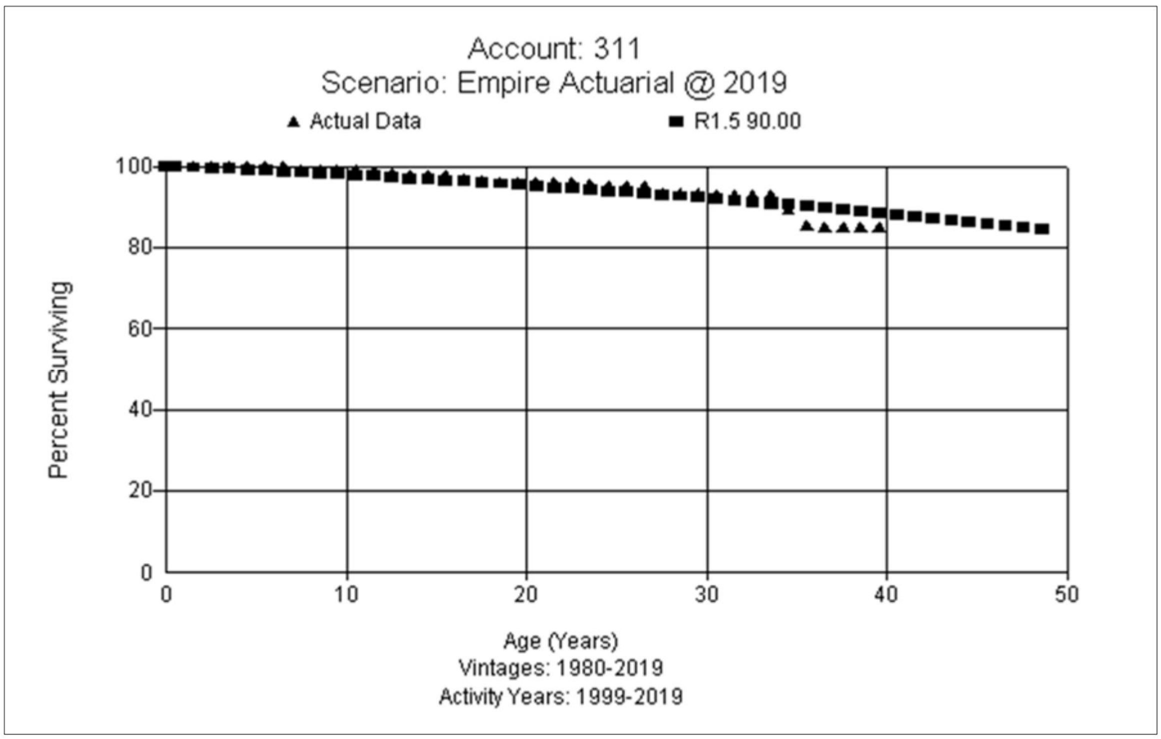
The Iatan Plant is located in Weston, MO and was placed in service in 1980. EDE owns a 12 percent share of Iatan 1 and Iatan 2, or approximately 85 MW and 105 MW respectively. At the end of 2019, the age of Iatan 1 was 39 years and the remaining life is estimated to be 21 years based on the forecast retirement of the unit in 2040. Iatan 2 began commercial operation in 2010 and has an estimated remaining life of 51 years based on the forecast retirement of the unit in 2070. The retirement dates used for Iatan 1 and Iatan 2 in our analysis is consistent with the lives used by the primary owner of the plants, Kansas City Power & Light Company.

The Plum Point Plant is located near Osceola, AR and was placed in service in 2010. EDE owns a 7.52 percent share of Plum Point, or approximately 50 MW. At the end of 2019, the age of the facility was 9 years and the remaining life is estimated to be 41 years based on the forecast retirement of the unit in 2060.

Steam Production

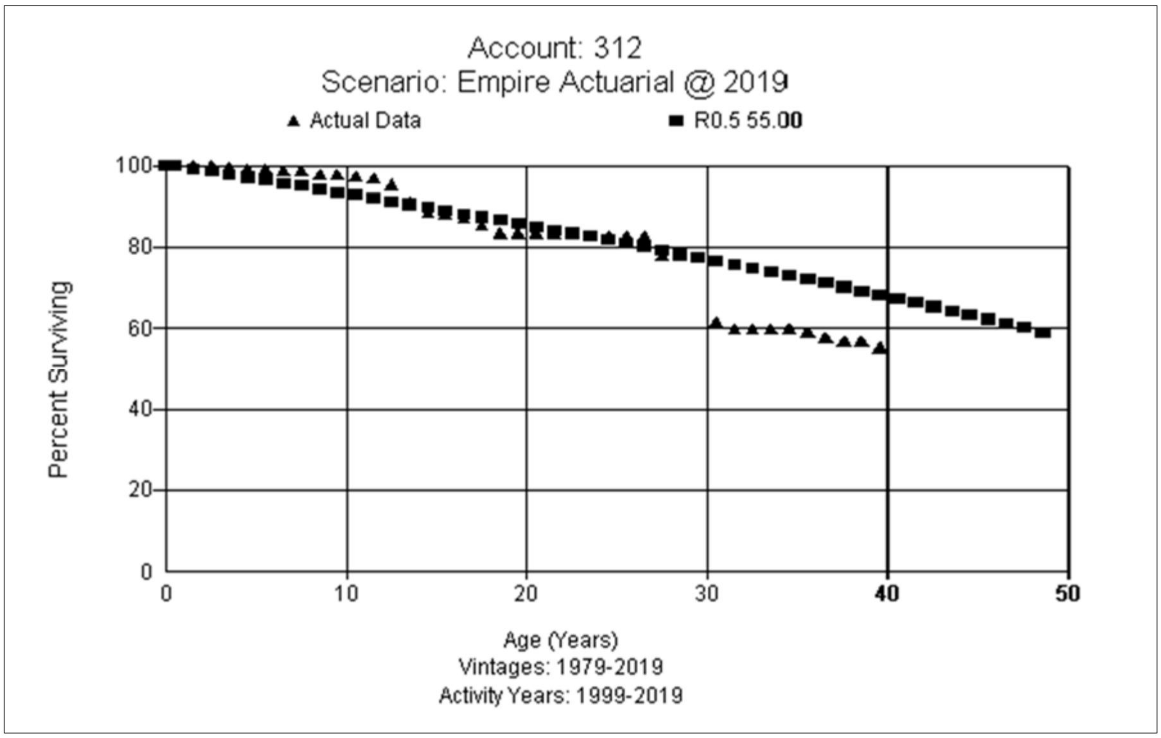
FERC Account 311.00 Structures and Improvements 90 R1.5

This account consists of buildings, structures, fences, lighting systems, railroad tracks, reservoirs, dams, waterways, and other related assets. The balance in this account is $63.9 million. Retirement dates for each unit are found in Appendix D. This study recommends the 90 R1.5 dispersion curve for interim retirements, which is shown below.



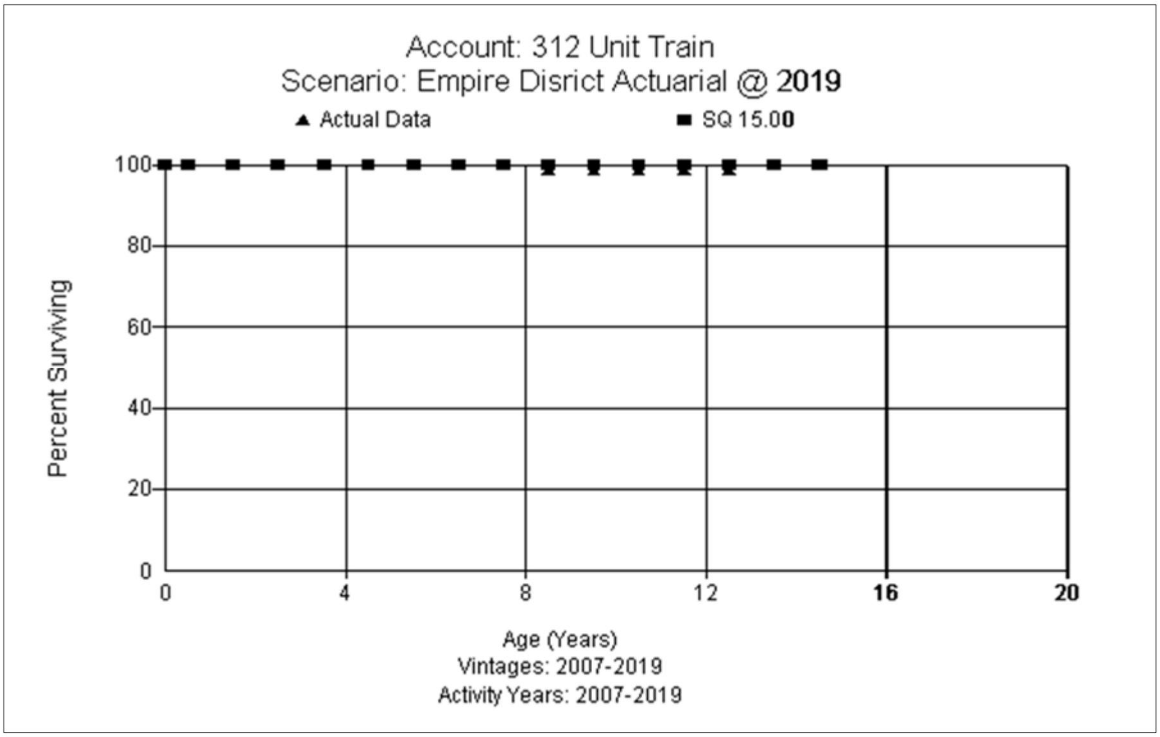
FERC Account 312.00 Boiler Plant Equipment 55 R0.5

This account consists of boiler plant equipment, super heaters, water walls, fuel burning equipment, reheaters. and other related equipment. The balance in this account is $317.9 million. Retirement dates for each unit are found in Appendix D. This study recommends the 55 R0.5 dispersion curve for interim retirements, which is shown below.



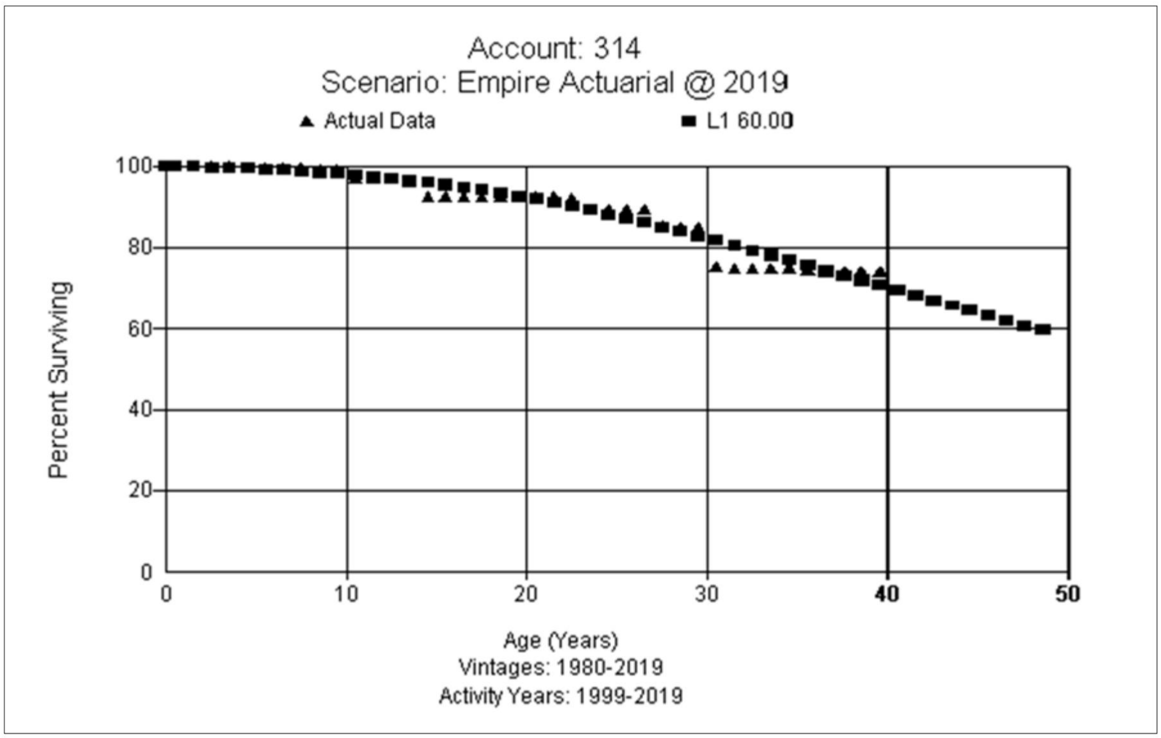
FERC Account 312.01 Boiler Unit Train - Electric 15 SQ

This account consists of unit train Gondola. The balance in this account is $341.3 thousand. Retirement dates for each unit are found in Appendix D. The current approved life is 15 years with a dispersion curve of SQ and is retained.



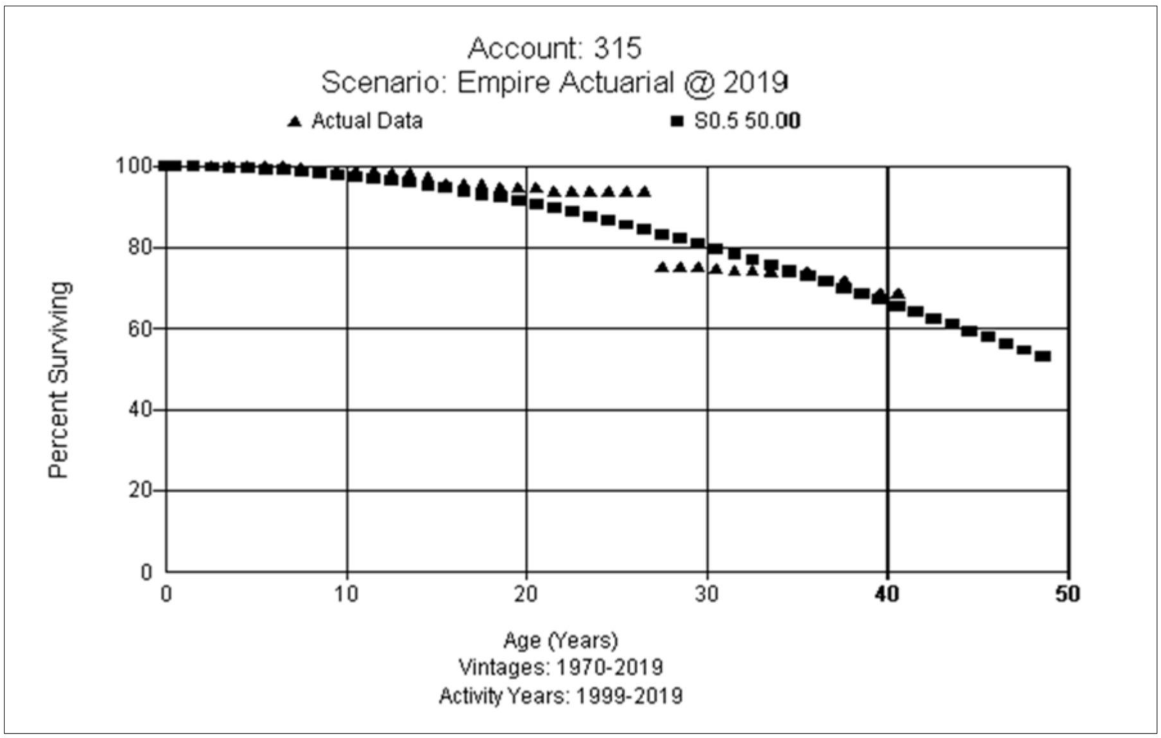
FERC Account 314.00 Turbo-generator Equipment 60 L1

This account consists of turbo-generator main structures, pumps, condensers, rotating blades, and other related assets. The balance in this account is $82.9 million. Retirement dates for each unit are found in Appendix D. The current depreciation study recommends increasing to 60 years and using an L1 dispersion curve for interim retirements, which is shown below.



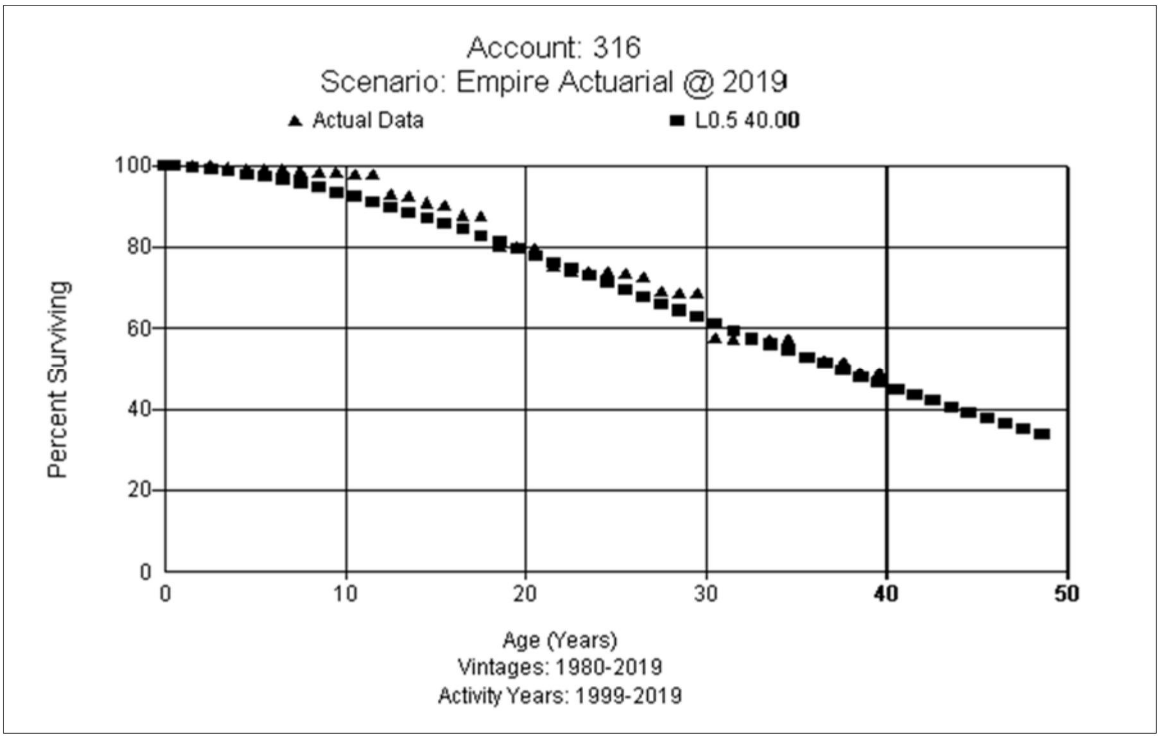
FERC Account 315.00 Accessory Electric Equipment 50 S0.5

This account consists of control system cabinets, wiring, operator consoles, power transformer, regulators, and related assets. The balance in this account is $31.2 million. Retirement dates for each unit are found in Appendix D. This study recommends moving to 50 years with an S0.5 dispersion curve for interim retirements, which is shown below.



FERC Account 316.00 Miscellaneous Power Plant Equipment 40 L0.5

This account consists of compressors, shop welding equipment, work equipment, and other related assets. The account balance is $5.4 million. Retirement dates for each unit are found in Appendix D. This study recommends moving to a 40 year life with an L0.5 dispersion curve for interim retirements. The graph is shown below.



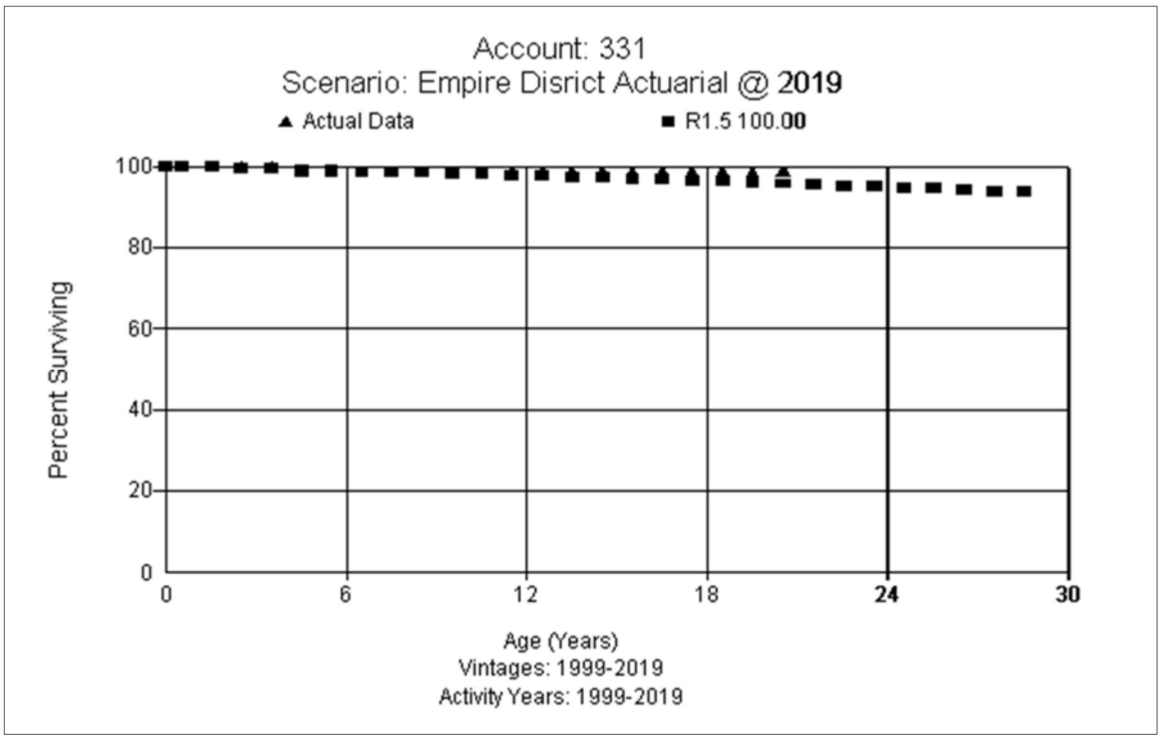
Hydro Production, FERC Accounts 331.00-336.00

Hydroelectric power was once the principal source of power in the United States. EDE owns the Ozark Beach hydraulic production plant, which consists of four generating units installed in 1931. The current licensing period for Ozark Beach ends in 2053. The prior study used an estimated final retirement date of 2053, which corresponds to the expiration of the renewed licensing period. At the end of 2019, the age of the facility was 88 years and the remaining life is estimated to be 34 years based on the forecast retirement of the unit in 2053.

Since the last depreciation study, capital has been spent to keep the facility operating until the end of its forecast retirement date. Additional expenditures may be necessary, which are not captured in the proposed accrual rate for this function.

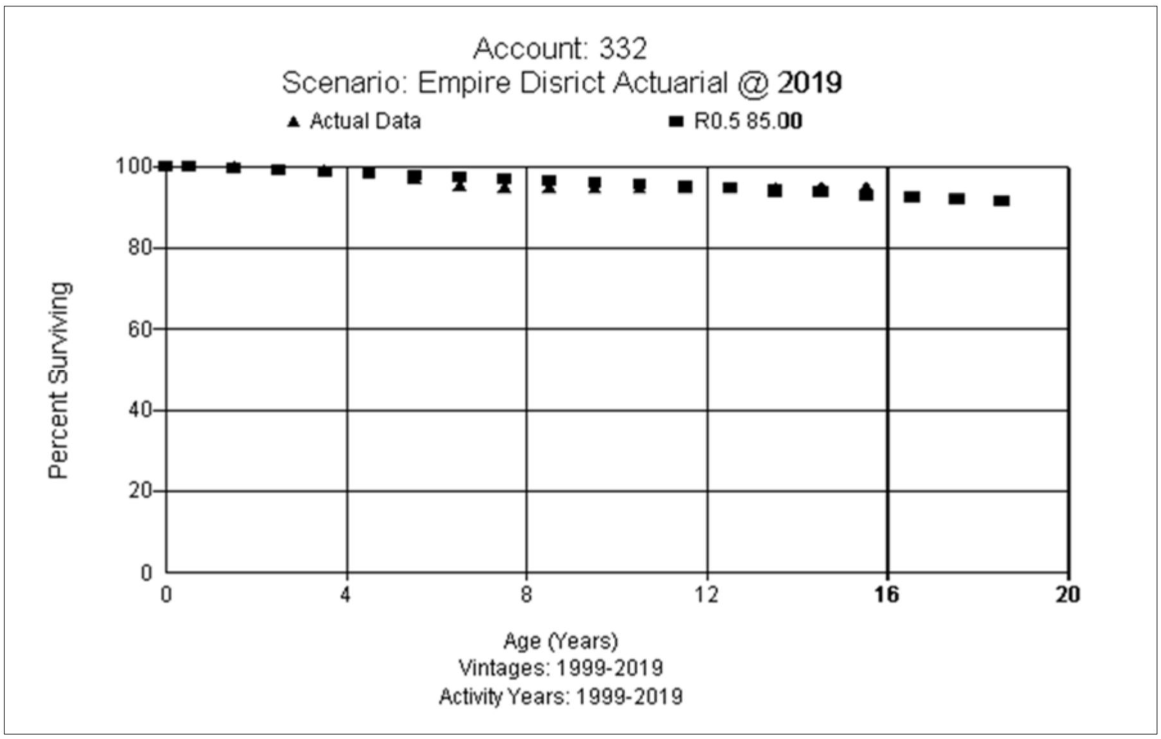
FERC Account 331.00 Structures and Improvements (100 R1.5)

This account consists of buildings, structures, fences, lighting systems, and other related assets. The balance in this account is $1.7 million. Retirement dates for each unit are found in Appendix D. Structure upgrades occurred in 2019 which included HVAC equipment, roofs, and improvements to buildings and doors. The current depreciation study recommends a 100 R1.5 dispersion curve, which is shown below.



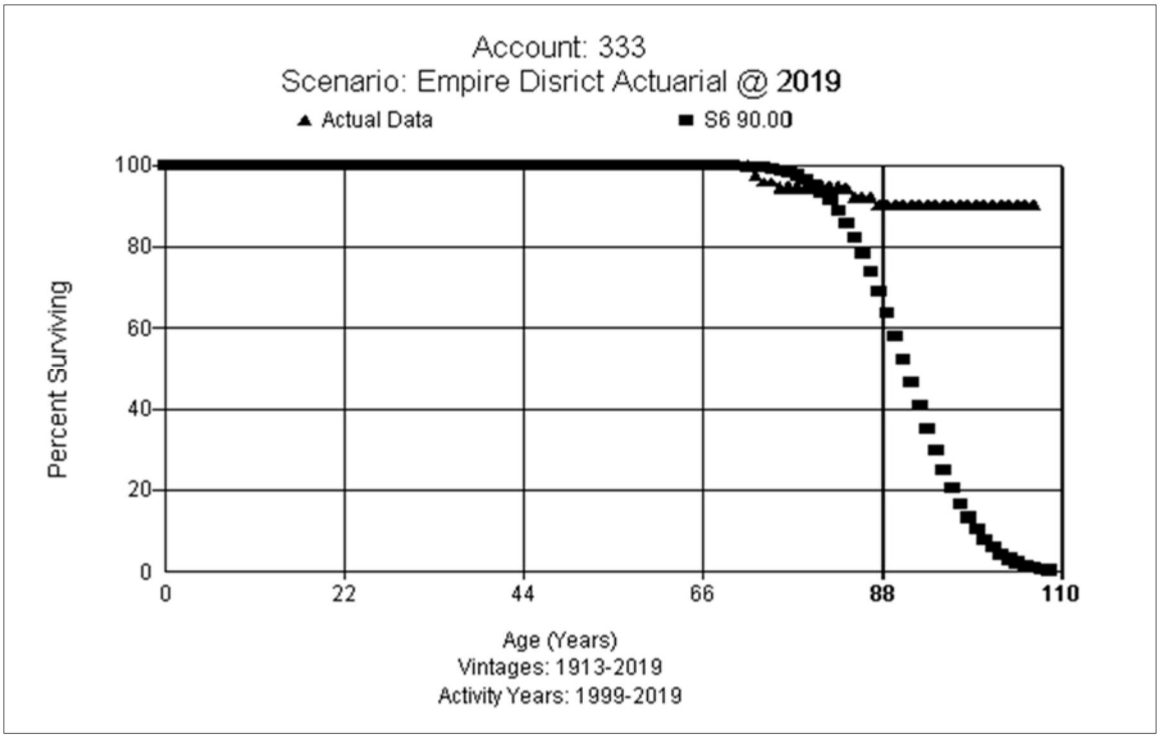
FERC Account 332.00 Reservoirs, Dams, and Waterways (85 R0.5)

This account consists of reservoirs, dams, waterways, and other related assets. The account balance is $3.5 million. Retirement dates for each unit are found in Appendix D. The largest capital replacement in recent years for this account occurred in 2011 when the crest gate and flashboard were replaced. The current depreciation study recommends an 85 year life and an R0.5 dispersion curve, which is shown below.



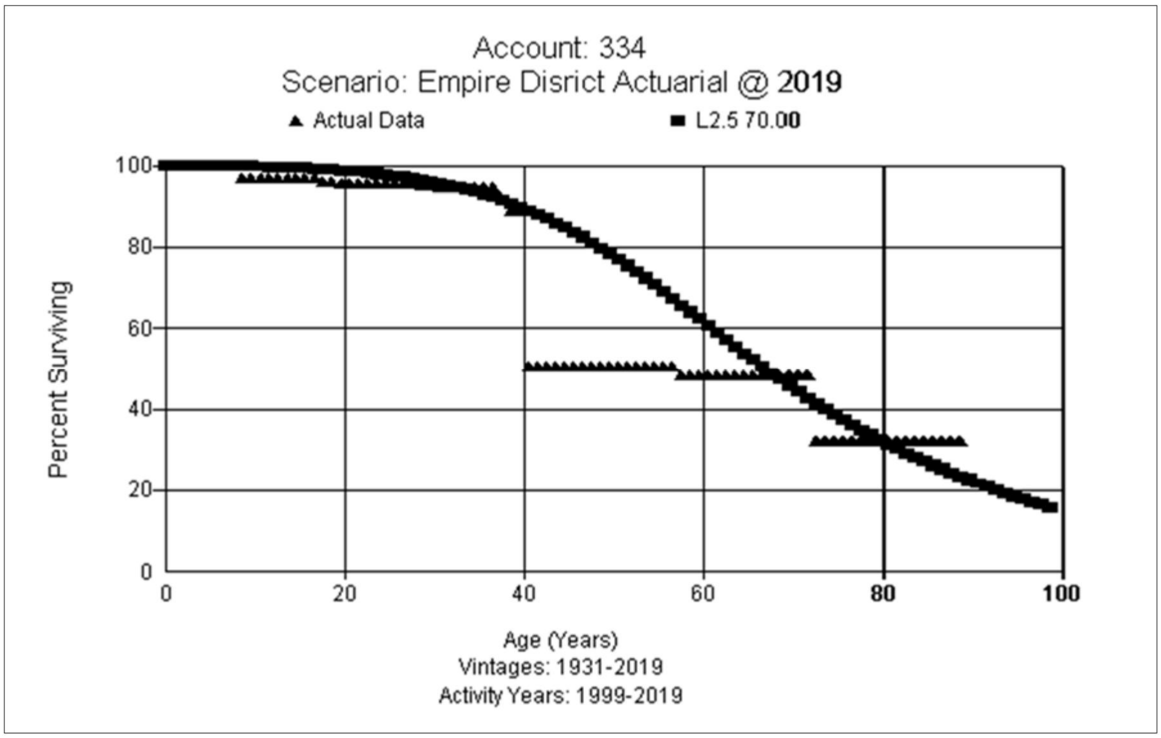
FERC Account 333.00 Water Wheels, Turbines, and Generators (90 S6)

This account consists of water wheels, turbines, and other related assets. The account balance is $4.4 million. Retirement dates for each unit are found in Appendix D. The current depreciation study recommends a 90 year life and an S6 dispersion curve, which is shown below.



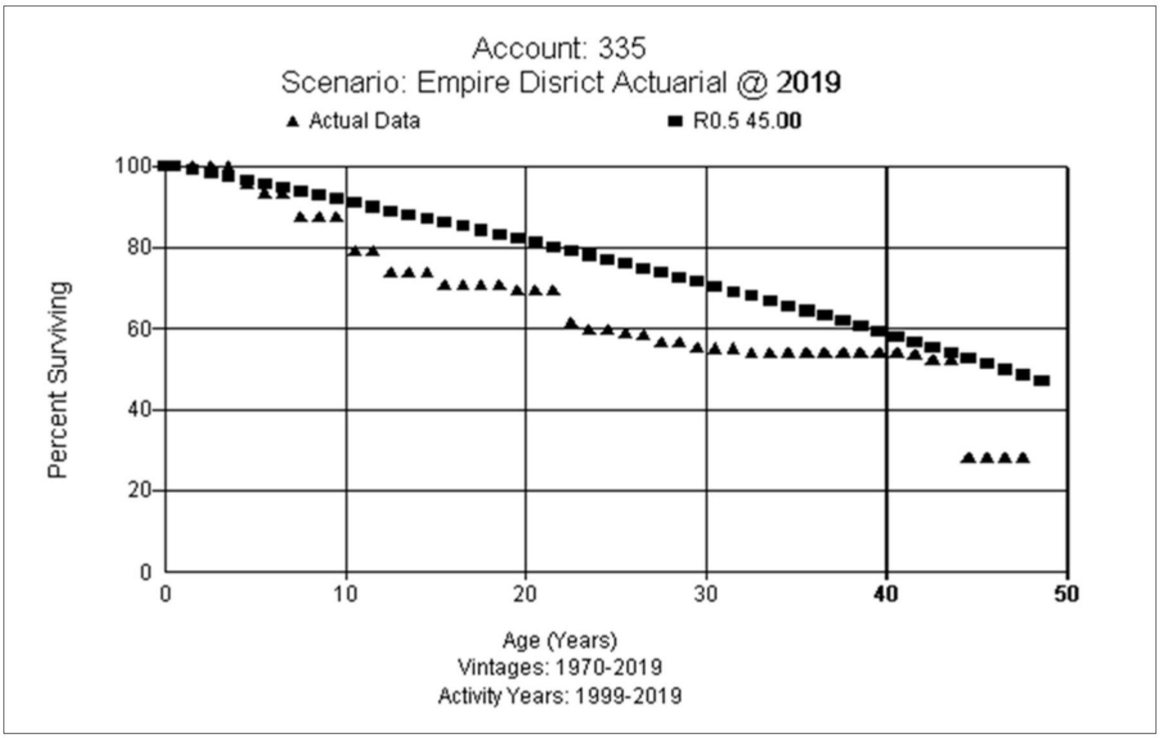
FERC Account 334.00 Accessory Electric Equipment (70 L2.5)

This account consists of generator controls, bus equipment, and other related assets. The account balance is $1.5 million. Retirement dates for each unit are found in Appendix D. Placement and experience bands show a steeper dispersion with a slightly longer life. The current depreciation study recommends a 70 L2.5 dispersion curve, which is shown below.



FERC Account 335.00 Miscellaneous Power Plant Equipment (45 R0.5)

This account consists of storage tanks, boats, test equipment, and other related assets. The account balance is $1.2 million. Retirement dates for each unit are found in Appendix D. In 2019, equipment such as barges, backhoes, security systems, and boats were replaced. A 45 R0.5 dispersion curve is recommended for this account, which is shown below.



Other Production

The Other Production function consists of simple cycle and combined cycle generation. The various plant sites are described below.

Energy Center

The Energy Center is located in LaRussell, MO. Units 1 and 2 are combustion turbines and were installed in 1978 and 1981, respectively, and are forecast to be in service for 45 years. Units 3 and 4 are FT8 combustion turbines. They were installed in 2003 and are forecast to be in service for 40 years. At the end of 2019, the age of Energy Center Units 1 and 2 was 41 and 38 years respectively. The remaining life of Energy Center 1 and 2 is estimated to be 7 years for both based on the forecast retirement of the unit in 2026. At the end of 2019, the age of Energy Center Units 3 and 4 (FT8) was 16 years. The remaining life of Energy Center FT8 is estimated to be 24 years for both units based on the forecast retirement of the unit in 2043.

Riverton

The Riverton Plant is located in Riverton, KS. The existing simple cycle combustion turbines at Riverton were installed in 1988. Units 10 and 11 are forecast to be in service for 45 years. Riverton 12 was placed into service as a simple cycle combustion turbine in 2007 but was subsequently converted into a combined cycle plant in 2016. At the end of 2019, the age of Riverton Units 10 and 11 was 31 years and the remaining life is estimated to be 14 years based on the forecast retirement of the unit in 2033. At the end of 2019, Riverton 12 was 12 years old, and the remaining life is estimated to be 38 years based on the forecast retirement of the unit in 2057.

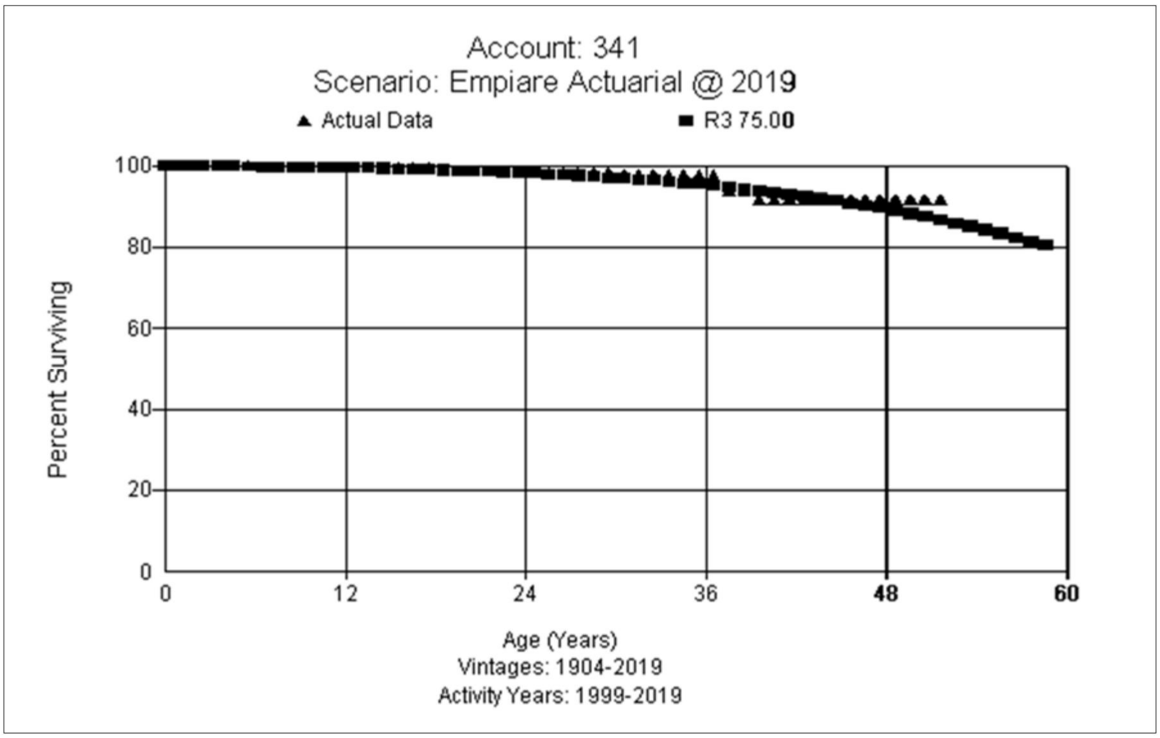
State Line

The State Line plant is located west of Joplin, MO and consists of a combustion turbine installed in 1995 and a combined cycle unit installed in 2001. of which EDE owns a 300MW share. The forecast lifespan for State Line combustion turbine is 45 years and the forecast lifespan for State Line combined cycle is 50 years. At the end of 2019, the age of State Line 1 CT is 24 years and the remaining life is estimated to be 21 years based on the forecast retirement of the unit in 2040. At the end of 2019, the State Line CC was 18 years old and the remaining life is estimated to be 32 years based on the forecast retirement of the unit in 2051.

Various replacement activities are occurring at the other production units. At State Line CC, the Company is replacing rotors and combustion assets as well as the stack damper with extra insulation on the lower stack. EDE has a long-term service agreement ("LTSA") in place for its turbine assets. There are no LTSAs in Energy Center, Hydro, or Steam Production. Items not covered are peripheral components or components that fail due to abuse. Assets covered under the LTSA are retired and recapitalized. This methodology has been in place since inception of the LTP contract (2001) and is based on the philosophy at that time.

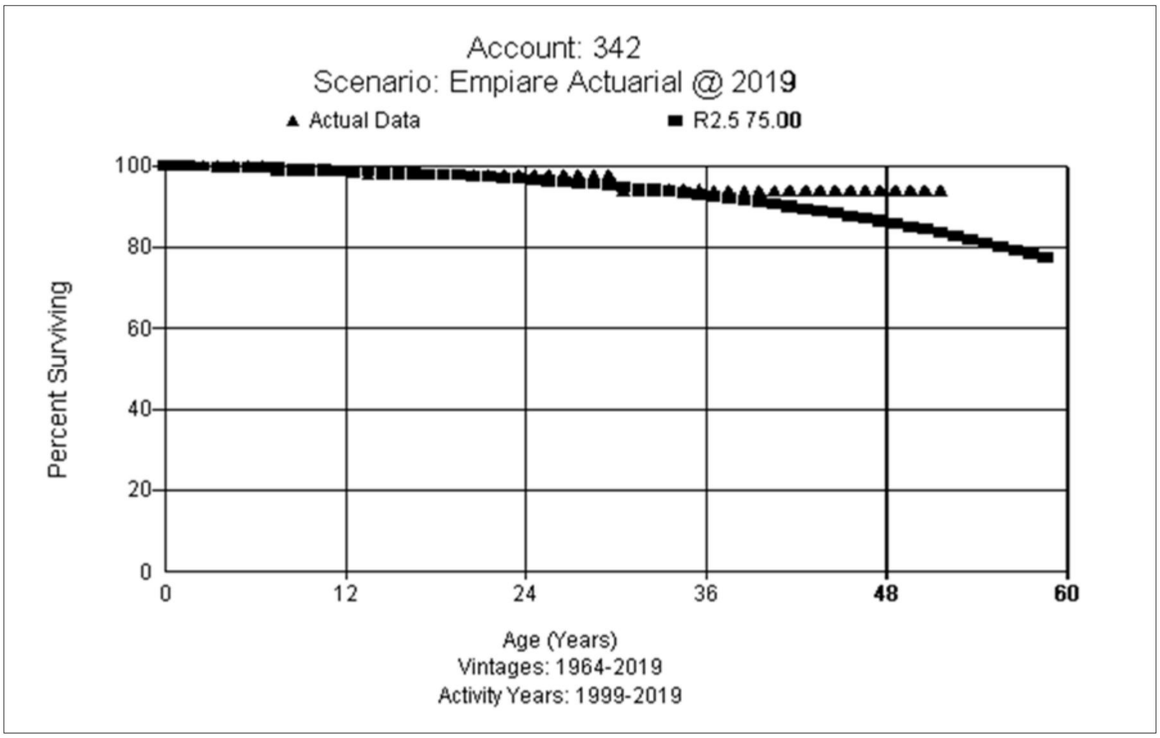
FERC Account 341.00 Structures and Improvements 75 R3

This account consists of buildings, structures, landscape, fences, lighting systems, and other related assets. The account balance is $61.1 million. Retirement dates for each unit are found in Appendix D. This study recommends moving to the 75 R3 dispersion curve for interim retirements, which is shown below.



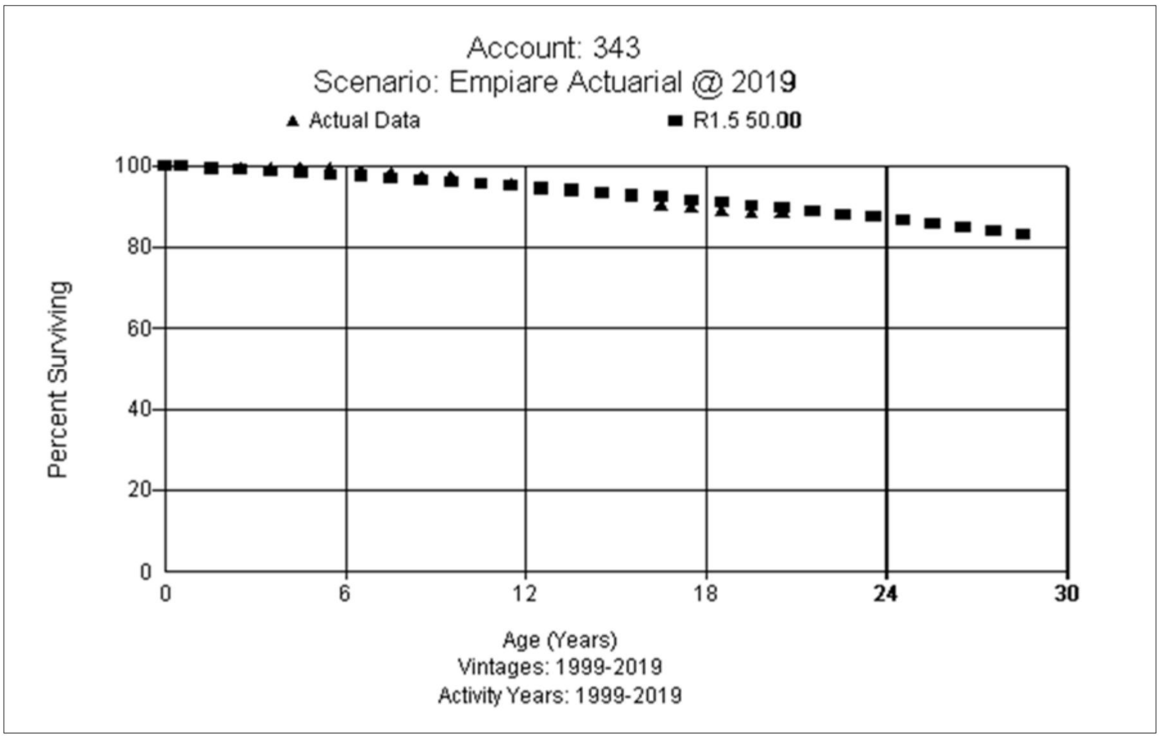
FERC Account 342.00 Fuel Holders, Producers, and Accessories 75 R2.5

This account consists of compressors, storage tanks, natural gas/fuel oil piping, and other related assets. The balance in this account is $10.5 million. Retirement dates for each unit are found in Appendix D. This study recommends moving to the 75 R2.5 dispersion curve for interim retirements, which is shown below.



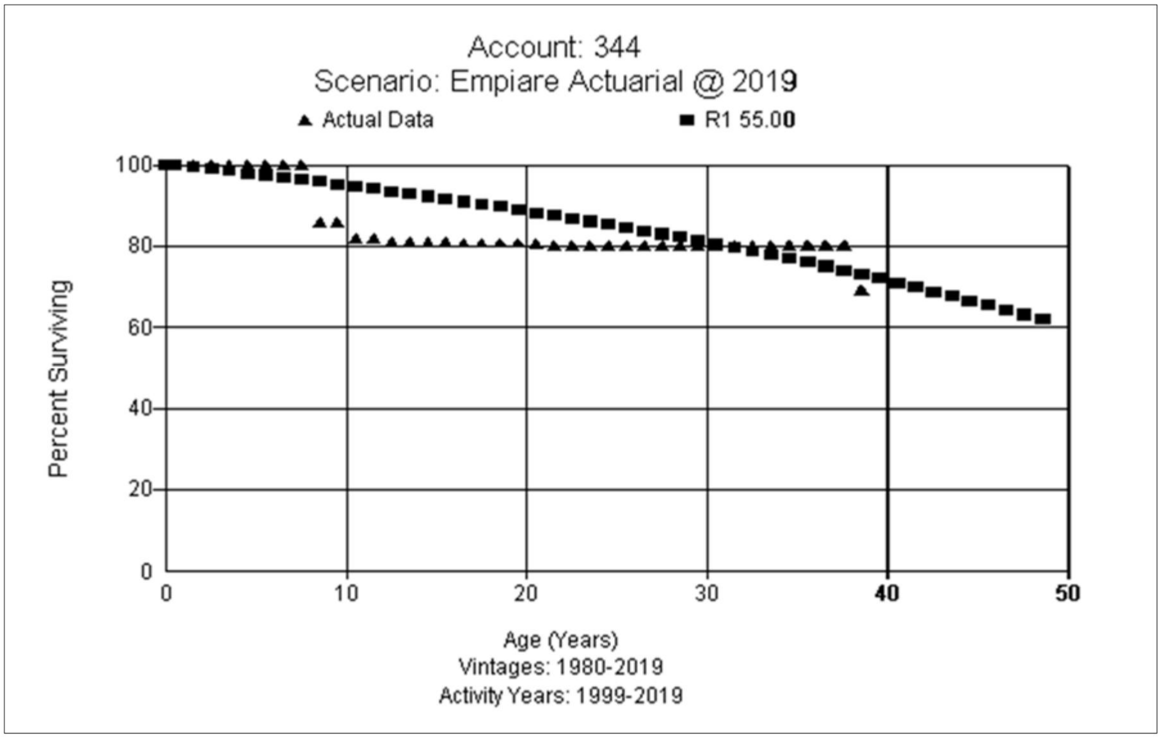
FERC Account 343.00 Prime Movers 50 R1.5

This account consists of foundations, chimneys, demineralizers, fire protection systems, and other related assets at each power plant. The balance in this account is $376.1 million. Retirement dates for each unit are found in Appendix D. This study recommends moving to a 50-year life with an R1.5 dispersion curve for interim retirements, which is shown below.



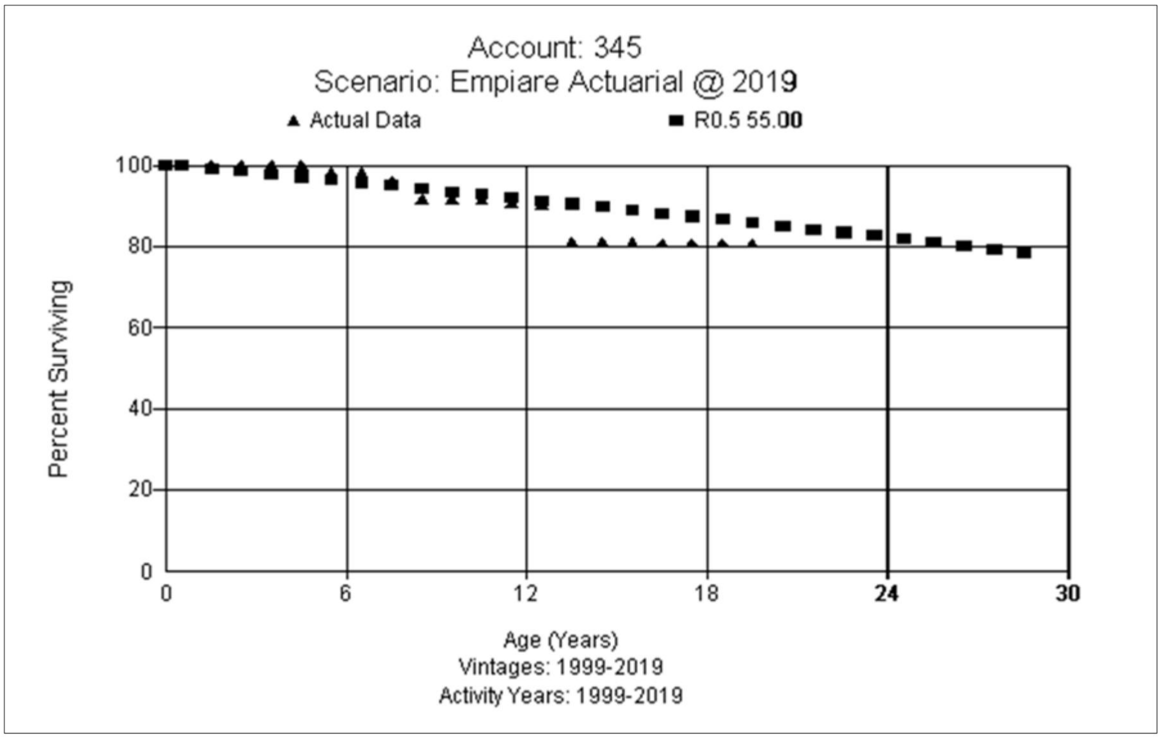
FERC Account 344.00 Generators 55 R1

This account consists of generators, turbine equipment, and other related assets. The balance in this account is $73.4 million. Retirement dates for each unit are found in Appendix D. This study recommends moving to a 55 year life and changing to the R1 dispersion curve for interim retirements, which is shown below.



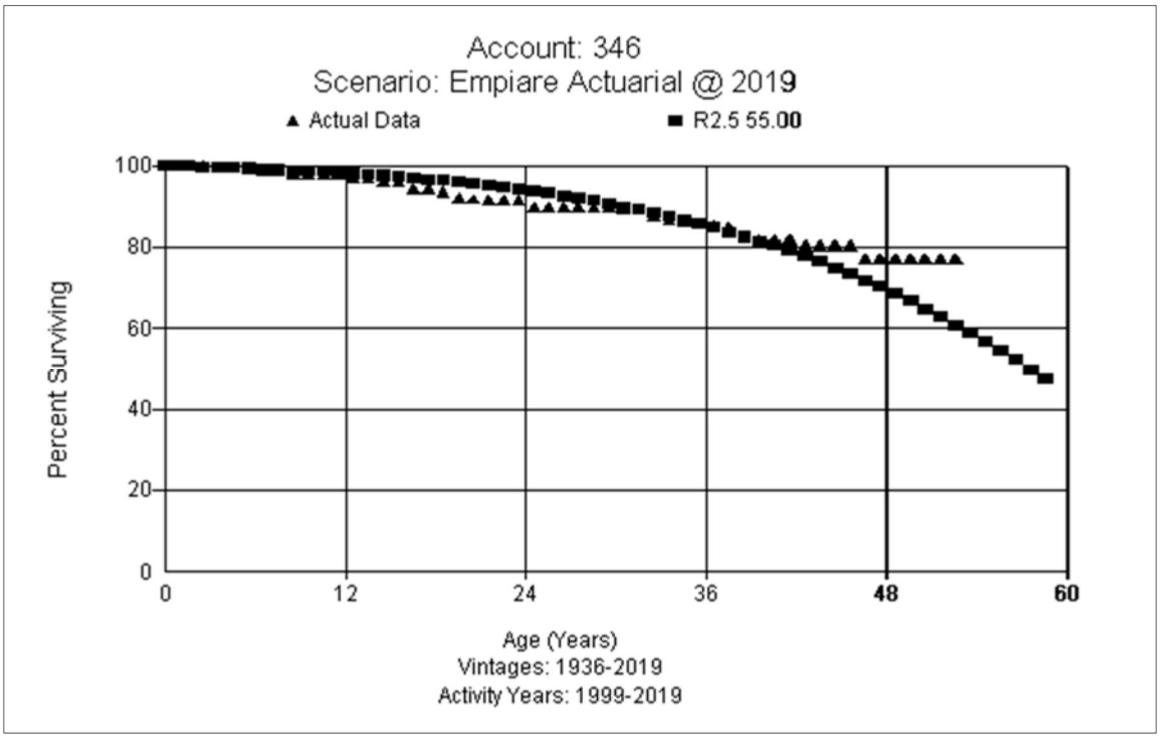
FERC Account 345.00 Accessory Electrical Equipment 55 R0.5

This account consists of cubicles, grounding systems, batteries, and other related assets. The balance in this account is $48.4 million. Retirement dates for each unit are found in Appendix D. This study recommends the 55 R0.5 dispersion curve for interim retirements, which is shown below.



FERC Account 346.00 Miscellaneous Power Plant Equipment 55 R2.5

This account consists of work equipment, pumps, work benches, and other related assets. The balance in this account is $13 million. Retirement dates for each unit are found in Appendix D. Due to similarity of assets between this account and Account 316.00, the interim retirement curve for Account 316.00, 55 R2.5, is used here, which is shown below.

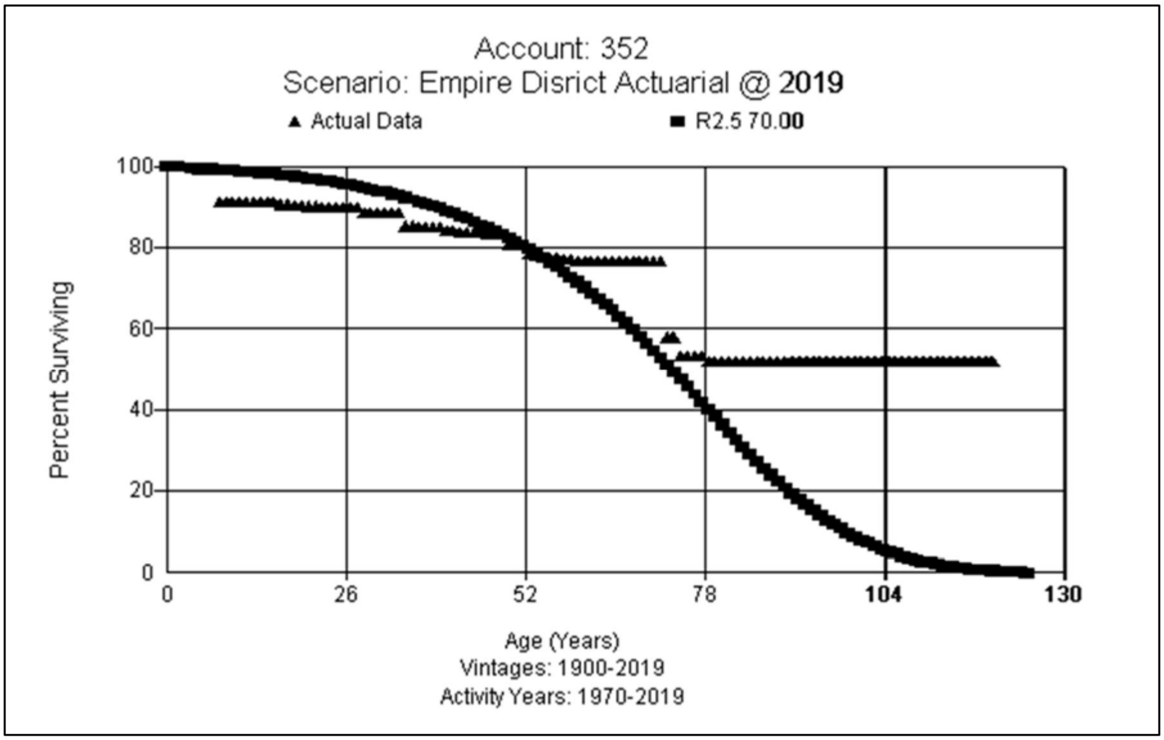


TRANSMISSION PLANT

There are currently four different approved parameters, so in the Transmission, Distribution, and General Plant discussions that follow, we provide and explain the life and net salvage parameters that are being proposed. For a comparison of the proposed to the various existing parameters, refer to Appendix C of this report where the existing for each of the four jurisdictions is shown.

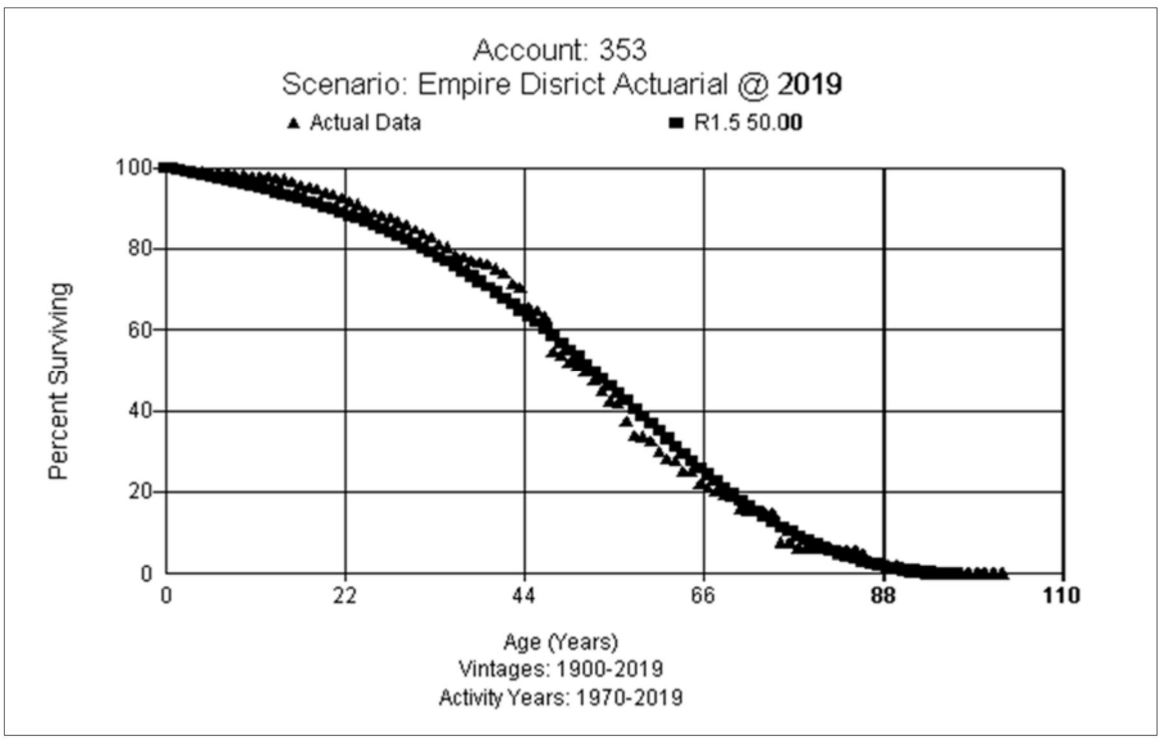
FERC Account 352.00 Structures and Improvements 70 R2.5

This account consists of buildings, structures, fences, lighting systems, and other related assets related to Transmission Plant. The account balance is $4.7 million. The expectation is that structures will live as long as or longer than the station equipment. The analysis in some bands indicates a life that is too long for the type of assets, even for steel buildings. Looking to the full placement band (1900-2019) and more recent (1970-2019) experience band, a 70-year life is a reasonable expectation going forward for structures. This study recommends moving to a 70-year life with an R2.5 dispersion, which is shown below.


Account: 352
Scenario: Empire Disrict Actuarial @ 2019
Actual Data
R2.5 70.00
Percent Surviving
100
80
60
40
20
0
0
26
52
78
104
130
Age (Years)
Vintages: 1900-2019
Activity Years: 1970-2019

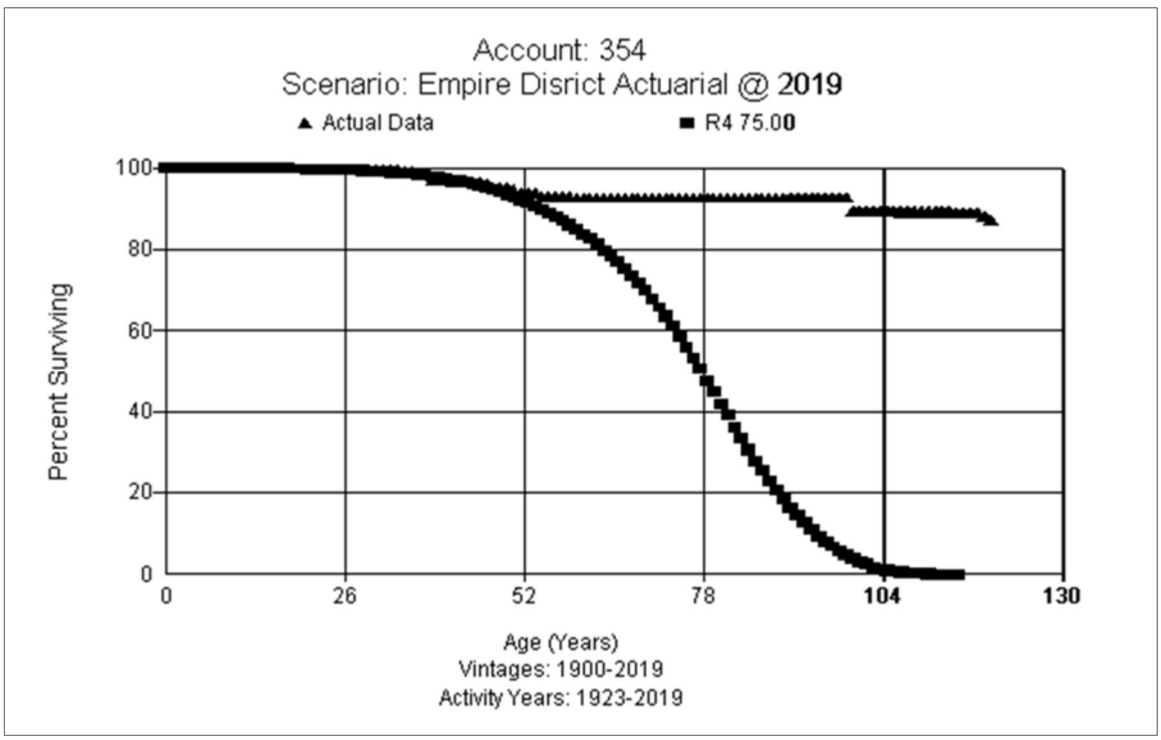
FERC Account 353.00 Station Equipment 50 R1.5

This account consists of conductors, switches, relays, grounding systems, panels, breakers, and other assets related to station equipment. The account balance is $189.9 million. Discussions with Company personnel indicate they are moving to digital relays. They are in the process of changing out the SF6 with dry air relays. The Company is also moving away from oil breakers. There have not been any big changes related to transformers. In the analysis, the full bands and the full placement with more recent experience band provide an excellent fit with the 50 R1.5. Other bands and fits range from 49 to 52 years with some slight variation in the dispersion pattern. Considering Company input and the indications in the life analysis, and with an excellent curve fit as shown below, this study recommends moving to a 50-year life with an R1.5 dispersion curve.



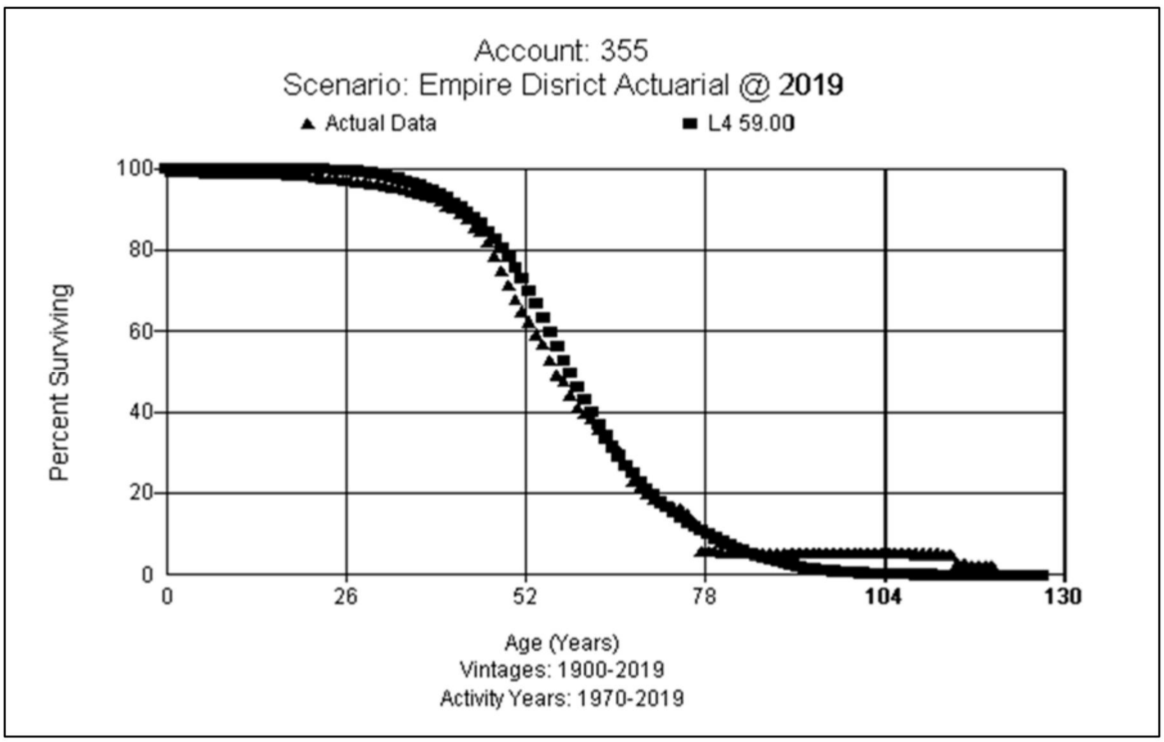
FERC Account 354.00 Towers and Fixtures 75 R4

This account consists of towers, lighting systems, generators, and other related assets. The balance in this account is nearly $2.9 million. Discussions with Company personnel indicated the towers are steel lattice. In some cases, the lattice can be repaired, which goes to O&M. The analysis shows the percent surviving above 80 percent, which indicates there has not been a lot of retirement activity. Giving consideration to the fact that the towers are steel and can be repaired in some cases, the analysis indications for a long life, and Company expectations, this study recommends moving to a 75-year life with an R4 dispersion, which is shown below.



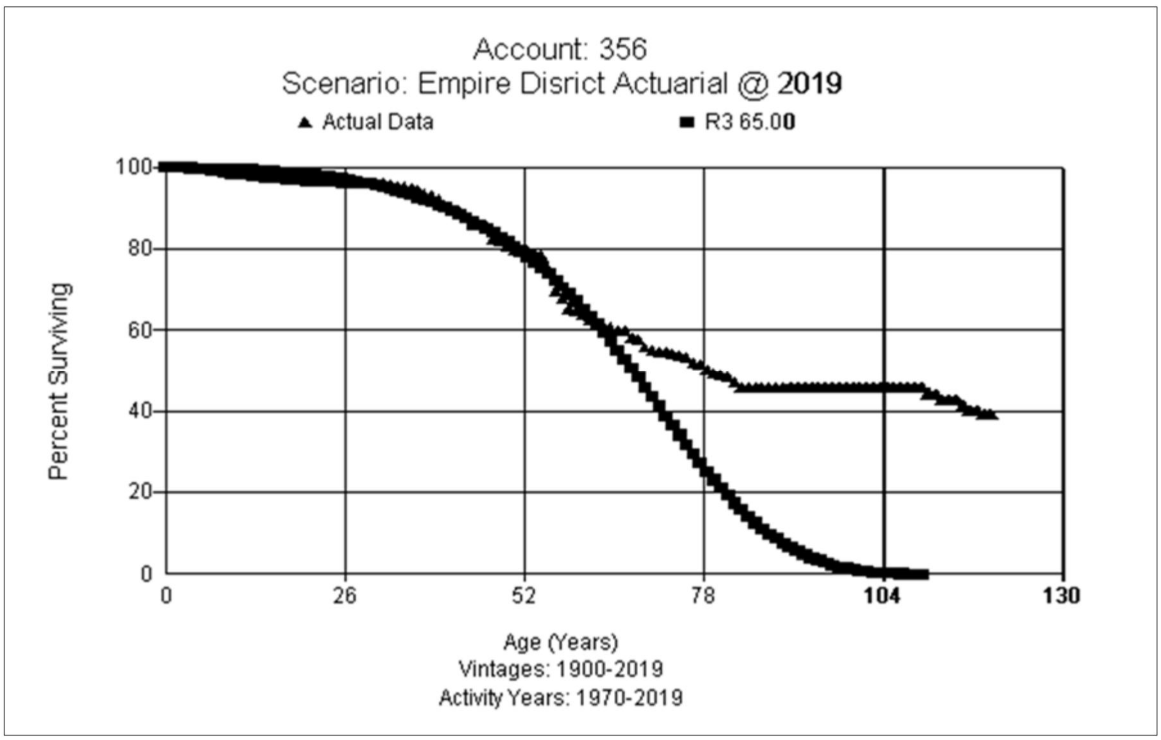
FERC Account 355.00 Poles and Fixtures 59 L4

This account consists of wood and steel poles, frames, wood cross arms, and other related fixtures. The balance in this account is $102.2 million. Discussions with Company personnel indicated that many of the poles in transmission are wood poles, but they are moving from wood to steel. The replacement of 69 kV poles is beginning. The Company's pole inspection program, which changed in 2010, is likely to identify poles for replacement sooner than in the past. The analysis suggests the life of poles is decreasing compared to the prior study, which supports Company input about the pole inspection program. In the full placement band (1900-2019) with a recent experience band (1970-2019), the 59 R4 is a good fit overall. Based on the analysis, discussions, replacement activity, and expectations of the Company, this study recommends moving to a 59-year life with L4 dispersion, which is shown below.



FERC Account 356.00 Overhead Conductors and Devices 65 R3

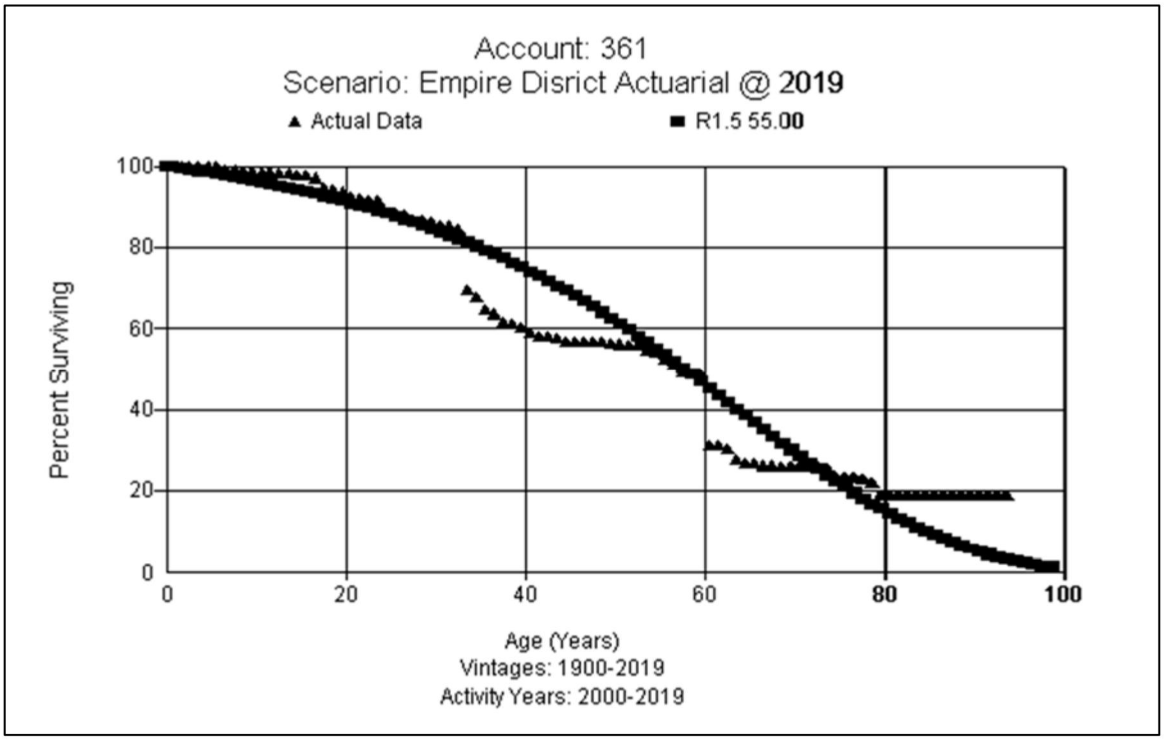
This account consists of conductors, arrestors, switches, and other related devices. The balance in this account is $100.3 million. Discussions with Company personnel indicate that conductor should last longer than poles and as long as towers in some cases. However, overloads, lightning strikes, contact, and re-conductoring can be significant forces of retirement. The analysis has fits across the various bands that are 65 years and longer. In the full placement (1900-2019) and a more recent experience band (1970-2019) the 65 R3 is a good fit to 60 percent surviving. Based on the analysis and discussions with Company personnel, this study recommends moving the life to 65 R3, which is shown below.



DISTRIBUTION PLANT

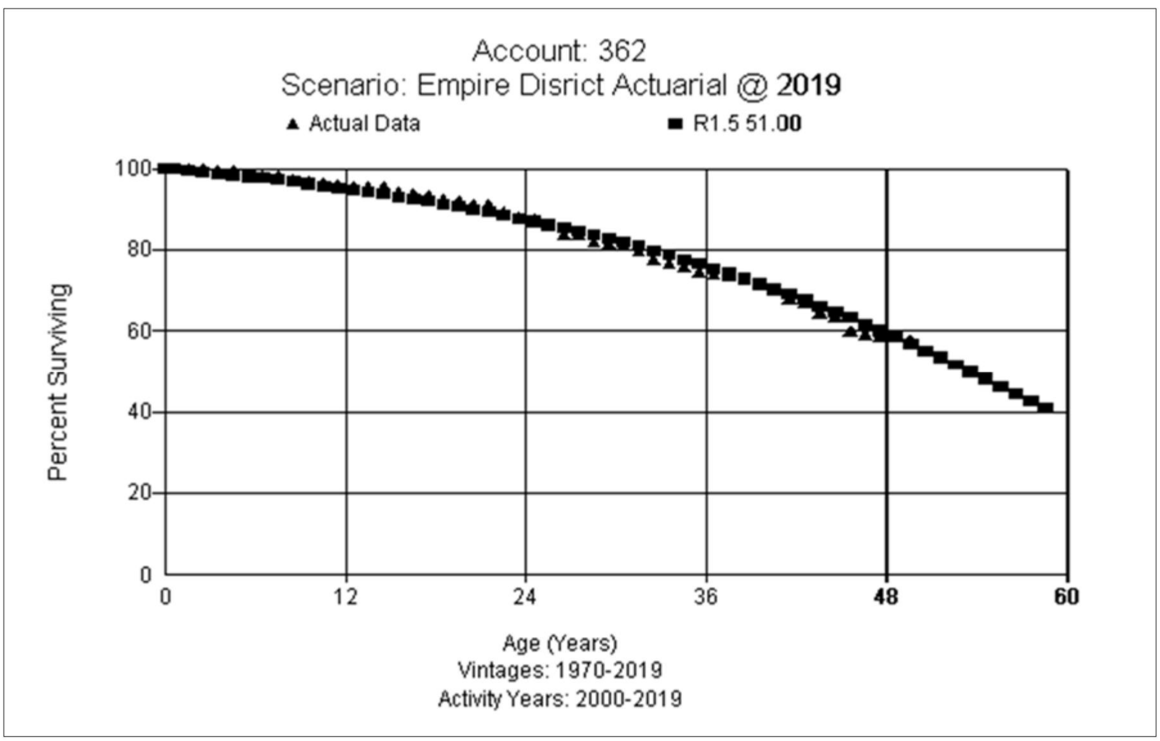
FERC Account 361.00 Structures & Improvements 55 R1.5

This grouping contains facilities ranging from landscaping, main building structures, lighting systems, sewer systems, and other improvements. The current balance is $33.9 million for this account. Discussions with Company personnel indicated that they are no longer using wood in distribution structures, and the change out to steel is ongoing as the Company is focusing on its aging infrastructure. There is a difference in life expectations between transmission and distribution structures, in that transmission structures are stronger and built to last longer. Also, more of these exist on the distribution system than on the transmission system. The majority of the fits are below any of the existing parameters for this account. In the mid-placement band (1970-2019) and experience band (1970-2019), the best fit curves indicate a life below 50 years with L or R dispersion patterns. Other good fits have a steeper R or S pattern with a 52-55 year life indicated. Based on the indications, Company discussion on current infrastructure replacements that are occurring, this study recommends moving the life to 55 years with an R1.5 dispersion, which is shown below.


Account: 361
Scenario: Empire Disrict Actuarial @ 2019
Actual Data
R1.5 55.00
Percent Surviving
100
80
60
40
20
0
0
20
40
60
80
100
Age (Years)
Vintages: 1900-2019
Activity Years: 2000-2019

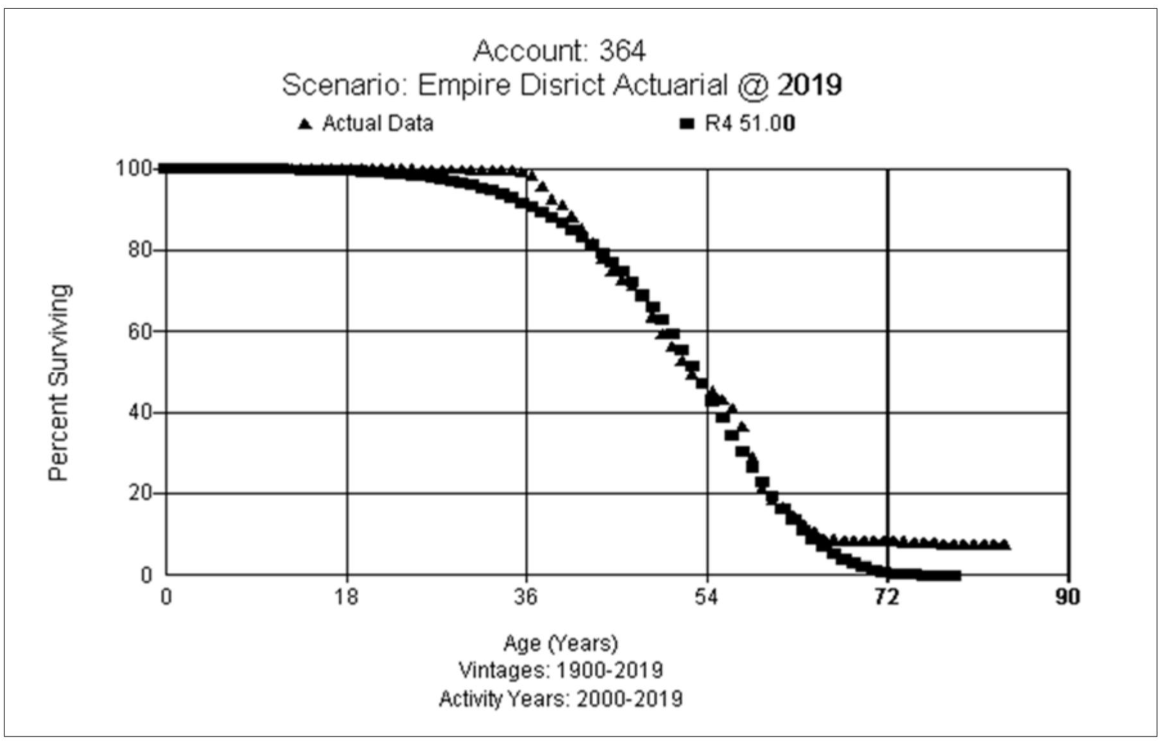
FERC Account 362.00 Station Equipment 51 R1.5

This grouping contains switchboards, station wiring, transformers, and a wide variety of other equipment, from circuit breakers to switchgear. The current balance is $157.4 million for this account. Similar to Account 353.00 Transmission Station Equipment, the discussions with Company personnel indicated that they are moving to digital relays and changing out the SF6 with dry air relays. The Company is also moving away from oil breakers. There have not been any big changes related to transformers. In the analysis, the life indications range from low 50s to 60 years, but the 51 R1.5 is a good fit across multiple bands. Based on the analysis fits and discussions with Company personnel, this study recommends moving the life to 51 years with an R1.5 dispersion, which is shown below.



FERC Account 364.00 Poles, Towers & Fixtures 51 R4

This account contains wood and steel poles in various sizes, wood, fiberglass, and steel cross arms, pole tops, and frames. The current balance is $226.6 million for this account. Discussions with Company personnel indicated that there have been changes to the pole inspections, which began in 2010, and the inspection program would likely identify poles for replacement sooner than in the past. Distribution is inspected at a greater level as they are primarily wood poles. The majority of the curve fits indicate the life range to be 49-54, with the best fits around 50 to 51 years with a steep dispersion. The full placement band (1900-2019) with the most recent experience band (2000-2019) indicates an excellent overall fit with 51 R4. Considering the analysis and Company information, the study recommends moving to 51 years with an R4 dispersion, which is shown below.



FERC Account 365.00 Overhead Conductor 64 R2.5

This account consists of overhead conductor cables and arrestors. The current account balance is $221.0 million for this account. Discussions with Company personnel indicated that the distribution system sees more faults, lines going down, capacity changes, and relocations of lines, which are forces of retirement. Most upgrades are due to distribution loading requirements. Conductor is placed on right of ways. The analysis produces fits with lives in excess of 55 years and higher. Slightly flatter dispersion fits indicate a longer life. The full placement band (1900-2019) and recent experience band (2000-2019) indicates a great fit approaching 60 percent surviving with a 64-year life and an R2.5 dispersion. Considering the analysis and discussions with Company personnel, the study recommends moving the life to 64 years with an R2.5 dispersion, which is shown below.