**DEPARTMENT OF PUBLIC SERVICE REGULATION**
**BEFORE THE PUBLIC SERVICE COMMISSION**
**OF THE STATE OF MONTANA**

* * * * *

| | | |
|---|---|---|
| IN THE MATTER OF the Application | ) | REGULATORY DIVISION |
| of Montana-Dakota Utilities Co. for | ) | |
| Authority to Establish Increased Rates | ) | DOCKET NO. D2017.9.79 |
| for Natural Gas Service in the State of | ) | |
| Montana | ) | |

**DIRECT TESTIMONY OF**

# DAVID J. GARRETT

**ON BEHALF OF**

# THE MONTANA CONSUMER COUNSEL

**FEBRUARY 6, 2018**

# TABLE OF CONTENTS

## APPENDICES



## LIST OF EXHIBITS

# I. INTRODUCTION

**Q. STATE YOUR NAME AND OCCUPATION.**

A. My name is David J. Garrett. I am a consultant specializing in public utility regulation. I am the managing member of Resolve Utility Consulting, PLLC. I focus my practice on the primary capital recovery mechanisms for public utility companies: cost of capital and depreciation.

**Q. SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL EXPERIENCE.**

A. I received a B.B.A. degree with a major in Finance, an M.B.A. degree, and a Juris Doctor degree from the University of Oklahoma. I worked in private legal practice for several years before accepting a position as assistant general counsel at the Oklahoma Corporation Commission in 2011, where I worked in the Office of General Counsel in regulatory proceedings. In 2012, I began working for the Public Utility Division as a regulatory analyst providing testimony in regulatory proceedings. In 2016 I formed Resolve Utility Consulting, PLLC, where I have represented various consumer groups and state agencies in utility regulatory proceedings, primarily in the areas of cost of capital and depreciation. I am a Certified Depreciation Professional with the Society of Depreciation Professionals. I am also a Certified Rate of Return Analyst with the Society of Utility and Regulatory Financial Analysts. A more complete description of my qualifications and regulatory experience is included in my curriculum vitae.[1]

[1] Exhibit DJG-1.

**Q. DESCRIBE THE PURPOSE AND SCOPE OF YOUR TESTIMONY IN THIS PROCEEDING.**

A. I am testifying on behalf of the Montana Consumer Counsel ("MCC") regarding the depreciation study and proposed depreciation expense of Montana-Dakota Utilities Company ("MDU" or the "Company"). I am responding to the Direct Testimony of Earl M. Robinson, who sponsored the Company's depreciation study.

## II. EXECUTIVE SUMMARY

**Q. SUMMARIZE THE KEY POINTS OF YOUR TESTIMONY.**

A. In the context of utility ratemaking, "depreciation" refers to a cost allocation system designed to measure the rate by which a utility may recover its capital investments in a systematic and rational manner. I employed a well-established depreciation system and used actuarial analysis to statistically analyze the Company's depreciable assets to develop reasonable depreciation rates in this case. The table below compares the proposed depreciation rates and accruals.

**Figure 1:**
**Depreciation Expense Comparison by Plant Function**

| Plant | Original | Company Position | | MCC Position | | Difference | |
|---|---|---|---|---|---|---|---|
| Function | Cost | Rate | Accrual | Rate | Accrual | Rate | Accrual |
| Distributrion | 395,274,934 | 4.15% | 16,423,189 | 3.42% | 13,514,817 | -0.74% | (2,908,372) |
| General | 33,665,703 | 5.08% | 1,709,320 | 4.28% | 1,439,808 | -0.80% | (269,512) |
| **Total** | $ 428,940,636 | 4.23% | $ 18,132,509 | 3.49% | $ 14,954,625 | -0.74% | **$ (3,177,884)** |

The original cost and accrual amounts correspond to plant balances as of the study date. MCC's adjustment to the Company's proposed depreciation expense is addressed in the direct testimony and exhibits of MCC witness Mr. Ralph Smith.

**Q. SUMMARIZE THE PRIMARY FACTORS DRIVING MCC'S ADJUSTMENT.**

A. I am proposing adjustments to several distribution and general accounts. For each of these accounts, I propose a longer average remaining life, which results in lower depreciation rates and expense. These accounts will be discussed in more detail below.[2]

**Q. DESCRIBE WHY IT IS IMPORTANT NOT TO OVERESTIMATE DEPRECIATION RATES.**

A. Under the rate base rate of return model, the utility is allowed to recover the original cost of its prudent investments required to provide service. Depreciation systems are designed to allocate those costs in a systematic and rational manner – specifically, over the service lives of the utility's assets. If depreciation rates are overestimated (i.e., service lives are underestimated), economic inefficiency is encouraged. Unlike competitive firms, regulated utility companies are not always incentivized by natural market forces to make the most economically efficient decisions.[3] If a utility is allowed to recover the cost of an asset before the end of its useful life, this could incentivize the utility to unnecessarily replace the asset in order to increase rate base, which results in economic waste. Thus, from a public policy perspective, it is preferable for regulators to ensure that assets are not depreciated before the end of their true useful lives.

---

[2] *See* Exhibit DJG-4.

## III. LEGAL STANDARDS

**Q. DISCUSS THE STANDARD BY WHICH REGULATED UTILITIES ARE ALLOWED TO RECOVER DEPRECIATION EXPENSE.**

A. In *Lindheimer v. Illinois Bell Telephone Co.*, the U.S. Supreme Court stated that "depreciation is the loss, not restored by current maintenance, which is due to all the factors causing the ultimate retirement of the property. These factors embrace wear and tear, decay, inadequacy, and obsolescence."[4] The *Lindheimer* Court also recognized that the original cost of plant assets, rather than present value or some other measure, is the proper basis for calculating depreciation expense.[5] Moreover, the *Lindheimer* Court found:

> [T]he company has the burden of making a convincing showing that the amounts it has charged to operating expenses for depreciation have not been excessive. That burden is not sustained by proof that its general accounting system has been correct. The calculations are mathematical, but the predictions underlying them are essentially matters of opinion.[6]

Thus, the Commission must ultimately determine if the Company has met its burden of proof by making a convincing showing that its proposed depreciation rates are not excessive.

---

[4] *Lindheimer v. Illinois Bell Tel. Co.*, 292 U.S. 151, 167 (1934).

[5] *Id*. (Referring to the straight-line method, the *Lindheimer* Court stated that "[a]ccording to the principle of this accounting practice, the loss is computed upon the actual cost of the property as entered upon the books, less the expected salvage, and the amount charged each year is one year's pro rata share of the total amount."). The original cost standard was reaffirmed by the Court in *Federal Power Commission v. Hope Natural Gas Co.*, 320 U.S. 591, 606 (1944). The *Hope* Court stated: "Moreover, this Court recognized in [*Lindheimer*], supra, the propriety of basing annual depreciation on cost. By such a procedure the utility is made whole and the integrity of its investment maintained. No more is required."

[6] *Id*. at 169.

**Q. SHOULD DEPRECIATION REPRESENT AN ALLOCATED COST OF CAPITAL TO OPERATION, RATHER THAN A MECHANISM TO DETERMINE LOSS OF VALUE?**

A. Yes. While the *Lindheimer* case and other early literature recognized depreciation as a necessary expense, the language indicated that depreciation was primarily a mechanism to determine loss of value.[7] Adoption of this "value concept" would require annual appraisals of extensive utility plant, and is thus not practical in this context. Rather, the "cost allocation concept" recognizes that depreciation is a cost of providing service, and that in addition to receiving a "return on" invested capital through the allowed rate of return, a utility should also receive a "return of" its invested capital in the form of recovered depreciation expense. The cost allocation concept also satisfies several fundamental accounting principles, including verifiability, neutrality, and the matching principle.[8] The definition of "depreciation accounting" published by the American Institute of Certified Public Accountants ("AICPA") properly reflects the cost allocation concept:

---

[7] *See* Frank K. Wolf & W. Chester Fitch, *Depreciation Systems* 71 (Iowa State University Press 1994).

[8] National Association of Regulatory Utility Commissioners, *Public Utility Depreciation Practices* 12 (NARUC 1996).

> Depreciation accounting is a system of accounting that aims to distribute cost or other basic value of tangible capital assets, less salvage (if any), over the estimated useful life of the unit (which may be a group of assets) in a systematic and rational manner. It is a process of allocation, not of valuation.[9]

Thus, the concept of depreciation as "the allocation of cost has proven to be the most useful and most widely used concept."[10]

## IV. ANALYTIC METHODS

**Q. DISCUSS YOUR APPROACH TO ANALYZING THE COMPANY'S DEPRECIABLE PROPERTY IN THIS CASE.**

A. I obtained and reviewed all the data that was used to conduct the Company's depreciation study. The depreciation rates proposed by Mr. Robinson were developed based on depreciable property recorded as of December 31, 2015 for distribution plant and December 31, 2014 for general plant. I used the same plant balances to develop my proposed depreciation rates, and applied those rates to the Company's updated plant balances to arrive at MCC's final adjustment to the Company's proposed depreciation rates.[11] I used a reasonable depreciation system to develop my proposed depreciation rates.

---

[9] American Institute of Accountants, *Accounting Terminology Bulletins Number 1: Review and Résumé* 25 (American Institute of Accountants 1953).

[10] Wolf *supra* n. 7, at 73.

[11] *See* Exhibit DJG-3 for a detailed comparison between rates and accrual amounts as of the study date.

**Q. DISCUSS THE DEFINITION AND PURPOSE OF A DEPRECIATION SYSTEM, AS WELL AS THE DEPRECIATION SYSTEM YOU EMPLOYED FOR THIS PROJECT.**

A. The legal standards set forth above do not mandate a specific procedure for conducting depreciation analysis. These standards, however, direct that analysts use a system for estimating depreciation rates that will result in the "systematic and rational" allocation of capital recovery for the utility. Over the years, analysts have developed "depreciation systems" designed to analyze grouped property in accordance with this standard. A depreciation system may be defined by several primary parameters: 1) a <u>method</u> of allocation; 2) a <u>procedure</u> for applying the method of allocation; 3) a <u>technique</u> of applying the depreciation rate; and 4) a <u>model</u> for analyzing the characteristics of vintage property groups.[12] In this case, I used the straight line method, the average life procedure, the remaining life technique, and the broad group model to analyze the Company's actuarial data; this system would be denoted as an "SL-AL-RL-BG" system. This depreciation system conforms to the legal standards set forth above, and is commonly used by depreciation analysts in regulatory proceedings. I provide a more detailed discussion of depreciation system parameters, theories, and equations in Appendix A.

**Q. ARE THERE OTHER REASONABLE DEPRECIATION SYSTEMS THAT ANALYSTS MAY USE?**

A. Yes. There are multiple combinations of depreciation systems that analysts may use to develop deprecation rates. For example, many analysts use the broad group model

---

[12] *See* Wolf *supra* n. 7, at 70, 140.

instead of the equal life group model. In this case, however, I used the same depreciation system that Mr. Robinson used. Although some of our assumptions and inputs differed, the analytical systems we used are essentially the same.

**Q. DESCRIBE THE COMPANY'S PLANT DATA AND HOW IT AFFECTED YOUR APPROACH AND ANALYSIS IN THIS CASE.**

A. In response to discovery, the Company provided the aged data that were used to conduct the depreciation study. "Aged" data refers to a collection of property data for which the dates of placements, retirements, transfers, and other actions are known. In keeping aged data, when a utility retires an asset, it would not only record the year it was retired, but it would also track the year the asset was placed into service, or the "vintage" year. When aged data is not available, the year-end balances of each account are known. In that case, analysts must "simulate" an actuarial analysis by estimating the proportion that each vintage group contributed to year-end balances. For this reason, simulated data is not as reliable as aged data. In order to analyze accounts that do not contain aged data, analysts use the "simulated plant record" ("SPR") method. According to the Company, SPR was used to conduct analysis in the prior depreciation study; however, in the current depreciation study, sufficient levels of investment activity records were available to perform actuarial analysis under the retirement rate method.[13]

---

[13] *See* Company's response to Data Request MCC-007.

**Q. DO YOU AGREE WITH THE COMPANY THAT SUFFICIENT LEVELS OF INVESTMENT ACTIVITY WERE AVAILABLE TO PERFORM ACTUARIAL ANALYSIS UNDER THE RETIREMENT RATE METHOD?**

A. Generally, I agree. As discussed further below, however, the historical data provided for some accounts were not necessarily sufficient to yield ideal observed life tables upon which to conduct conventional curve fitting analyses and techniques. For those accounts, it was necessary to give more consideration to industry norms and professional judgment.

## V. ACTUARIAL ANALYSIS

**Q. DESCRIBE THE ACTUARIAL PROCESS YOU USED TO ANALYZE THE COMPANY'S DEPRECIABLE PROPERTY.**

A. The study of retirement patterns of industrial property is derived from the actuarial process used to study human mortality. Just as actuarial analysts study historical human mortality data to predict how long a group of people will live, depreciation analysts study historical plant data to estimate the average lives of property groups. The most common actuarial method used by depreciation analysts is called the "retirement rate method." In the retirement rate method, original property data, including additions, retirements, transfers, and other transactions, are organized by vintage and transaction year.[14] The retirement rate method is ultimately used to develop an "observed life table," ("OLT") which shows the percentage of property

[14] The "vintage" year refers to the year that a group of property was placed in service (aka "placement" year). The "transaction" year refers to the accounting year in which a property transaction occurred, such as an addition, retirement, or transfer (aka "experience" year).

surviving at each age interval. This pattern of property retirement is described as a "survivor curve." The survivor curve derived from the observed life table, however, must be fitted and smoothed with a complete curve in order to determine the ultimate average life of the group.[15] The most widely used survivor curves for this curve fitting process were developed at Iowa State University in the early 1900s and are commonly known as the "Iowa curves."[16] A more detailed explanation of how the Iowa curves are used in the actuarial analysis of depreciable property is set forth in Appendix C.

### A. <u>Service Life Estimates</u>

**Q. DESCRIBE YOUR APPROACH IN ESTIMATING THE SERVICE LIVES OF MASS PROPERTY.**

A. I used the aged property data provided by the Company to create an observed life table ("OLT") for each account. The data points on the OLT can be plotted to form a curve (the "OLT curve"). The OLT curve is not a theoretical curve, rather, it is actual observed data from the Company's records that indicate the rate of retirement for each property group. An OLT curve by itself, however, is rarely a smooth curve, and is often not a "complete" curve (i.e., it does not end at zero percent surviving). In order to calculate average life (the area under a curve), a complete survivor curve is required. The Iowa curves are empirically-derived curves based on the extensive studies of the actual mortality patterns of many different types of industrial property. The curve-fitting process involves selecting the best Iowa curve to fit the OLT curve. This can be

---

[15] *See* Appendix C for a more detailed discussion of the actuarial analysis used to determine the average lives of grouped industrial property.

[16] *See* Appendix B for a more detailed discussion of the Iowa curves.

accomplished through a combination of visual and mathematical curve-fitting techniques, as well as professional judgment. The first step of my approach to curve-fitting involves visually inspecting the OLT curve for any irregularities. For example, if the "tail" end of the curve is erratic and shows a sharp decline over a short period of time, it may indicate that this portion of the data is less reliable, as further discussed below. After inspecting the OLT curve, I use a mathematical curve-fitting technique which essentially involves measuring the distance between the OLT curve and the selected Iowa curve to get an objective, mathematical assessment of how well the curve fits. After selecting an Iowa curve, I observe the OLT curve along with the Iowa curve on the same graph to determine how well the curve fits. I may repeat this process several times for any given account to ensure that the most reasonable Iowa curve is selected.

**Q. DO YOU ALWAYS SELECT THE MATHEMATICALLY BEST-FITTING CURVE?**

A. Not necessarily. Mathematical fitting is an important part of the curve-fitting process because it promotes objective, unbiased results. While mathematical curve fitting is important, however, it may not always yield the optimum result. For example, if there is insufficient historical data in a particular account and the OLT curve derived from that data is relatively short and flat, the mathematically "best" curve may be one with a very long average life. However, when there are sufficient data available, mathematical curve fitting can be used as part of an objective service life analysis.

**Q. SHOULD EVERY PORTION OF THE OLT CURVE BE GIVEN EQUAL WEIGHT?**

A. Not necessarily. Many analysts have observed that the points comprising the "tail end" of the OLT curve may often have less analytical value than other portions of the curve. In fact, "[p]oints at the end of the curve are often based on fewer exposures and may be given less weight than points based on larger samples. The weight placed on those points will depend on the size of the exposures."[17] In accordance with this standard, an analyst may decide to truncate the tail end of the OLT curve at a certain percent of initial exposures, such as one percent. Using this approach puts a greater emphasis on the most valuable portions of the curve. For my analysis in this case, I not only considered the entirety of the OLT curve, but also conducted further analyses that involved fitting Iowa curves to the most significant part of the OLT curve for certain accounts. In other words, to verify the accuracy of my curve selection, I narrowed the focus of my additional calculation to consider the top 99% of the "exposures" (i.e., dollars exposed to retirement) and to eliminate the tail end of the curve representing the bottom 1% of exposures for some accounts, if necessary. I will illustrate an example of this approach in the discussion below.

**Q. GENERALLY, DESCRIBE THE DIFFERENCES BETWEEN THE COMPANY'S SERVICE LIFE PROPOSALS AND YOUR SERVICE LIFE PROPOSALS.**

A. The Company included 35 distribution and general accounts in its depreciation study. I am proposing service life adjustments to seven accounts. For each of these accounts,

---

[17] Wolf *supra* n. 7, at 46.

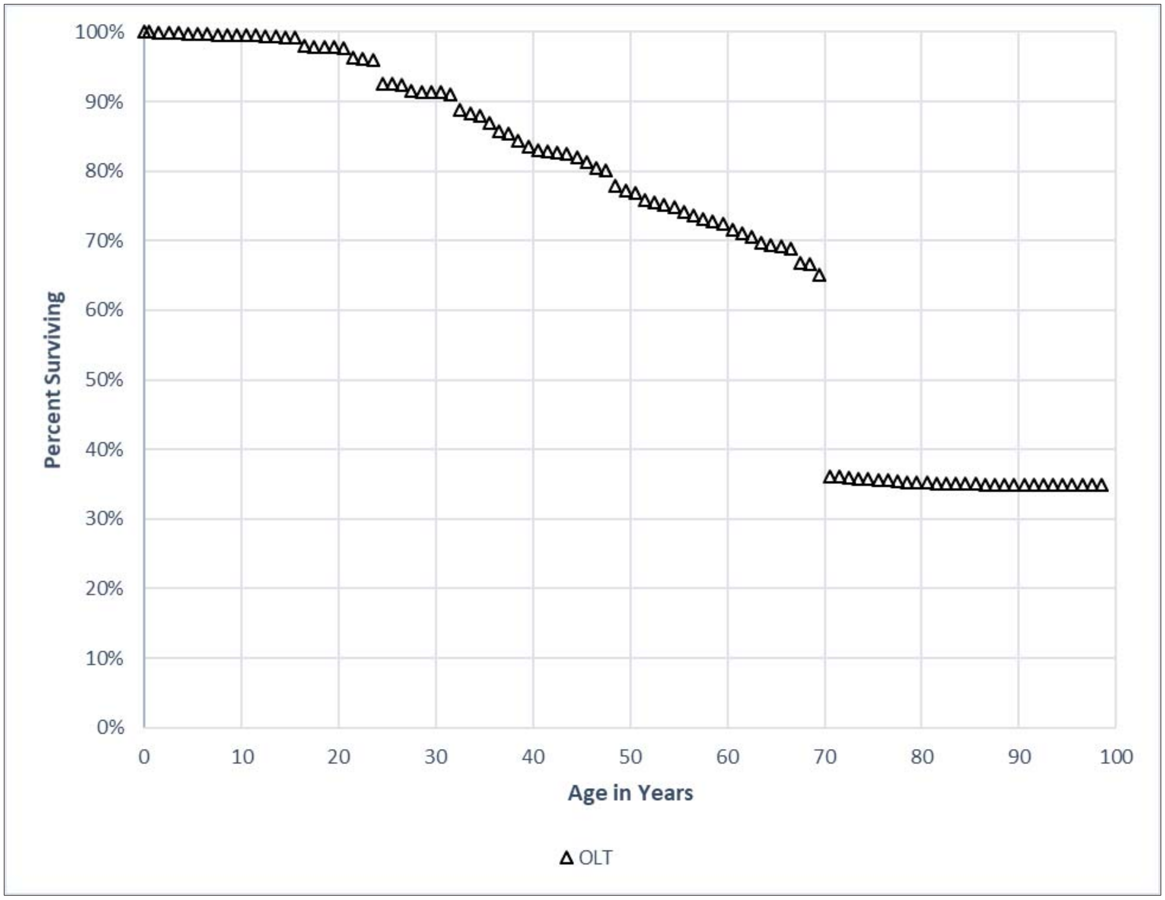
the Company's proposed service life, as estimated through an Iowa curve, is too short to accurately describe the mortality characteristics of the account in my opinion. For most of the accounts in which I propose a longer service life, such proposal is based on the objective approach of choosing an Iowa curve that provides a better mathematical and/or visual fit to the observed historical retirement pattern derived from the Company's plant data. For other accounts, the data provided were insufficient to derive a statistically reliable OLT curve. In those cases, it was necessary to give more consideration to industry norms and professional judgment. I will discuss each of these seven adjusted accounts further below.

### B. Account 376.10 – Mains – Steel

**Q. DESCRIBE YOUR SERVICE LIFE ESTIMATE FOR THIS ACCOUNT, AND COMPARE IT WITH THE COMPANY'S ESTIMATE.**

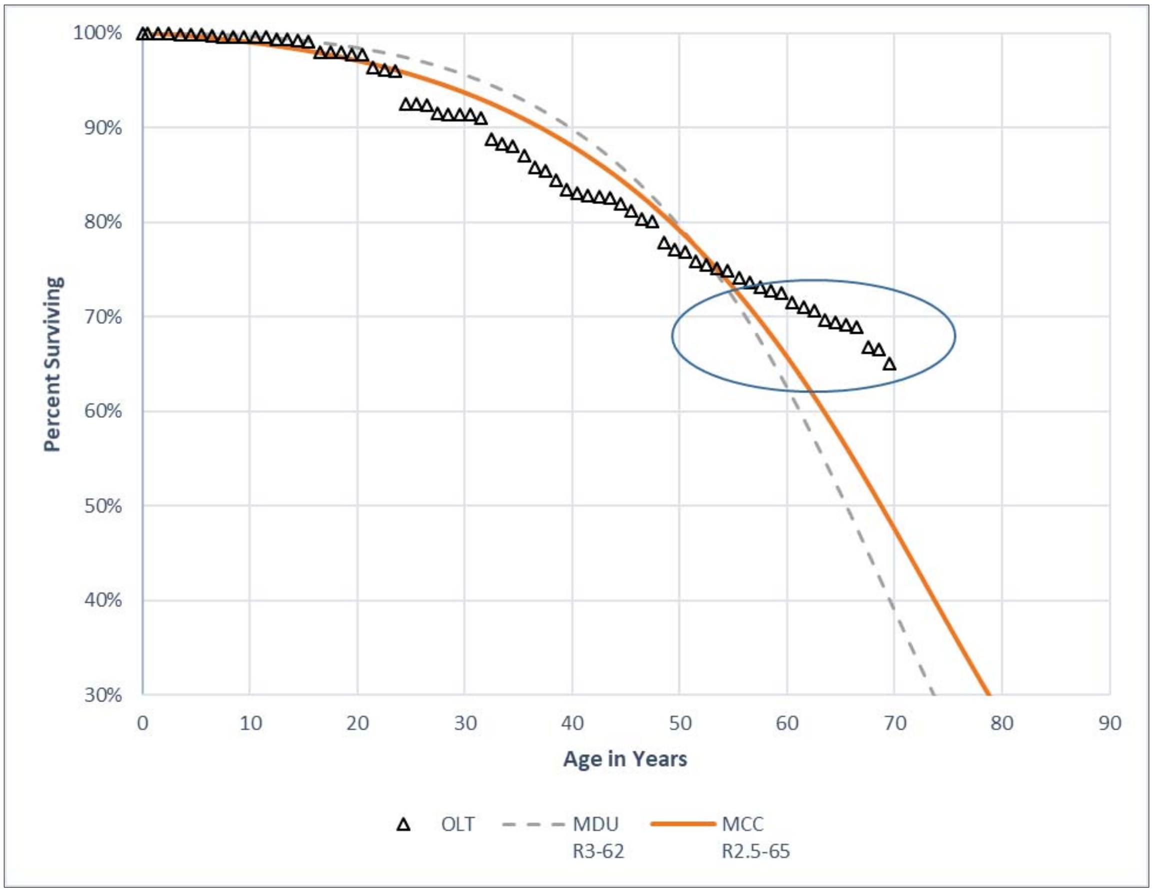
A. The observed survivor curve derived from the Company's data for this account is relatively smooth and well-suited for Iowa curve fitting up to the 70-year age interval. This OLT curve provides a good example of the value of visual curve fitting combined with mathematical curve fitting. The graph below shows the OLT curve (black triangles) for this account.

**Figure 2:**
**Account 376.10 – Mains – Steel**




From age zero until age 70, the OLT smoothly declines in a pattern that is typical for the retirement of certain utility property, and is thus well-suited for Iowa curve fitting. However, there is a sharp and obvious drop in the OLT curve at age 70. A visual observation indicates that the data after this sharp drop is less statistically relevant than the portions of the OLT curve up to that point. An examination of the observed life table shows a decline of nearly 30% in the percent surviving at that point in the OLT curve. Thus, analysts should not attempt to give undue statistical weight to the portion of the OLT curve after this point when conducting the curve fitting process. The graph below shows the same OLT curve without the statistically insignificant "tail," along with the Iowa R3-62 curve selected by the Company and the R2.5-65 curve I selected.

**Figure 3:**
**Account 376.10 – Mains – Steel**




As shown in the graph, both curves track relatively close to the OLT curve, however, the R2.5-65 curve I selected provides a more accurate representation of the historical data. The Company's curve appears less well fitted in years 20-50, and appears to ignore relevant historical data from ages 55 – 70 years (circled on the graph). Specifically, the Company's curve declines too sharply at the 55-year age interval. In fact, an even longer, flatter curve than the R3-62 curve would have provided a better fit through this age interval, but I chose the R2.5-65 in the interest of moderation.

Regardless, the Company's Iowa curve is arguably too short to describe the historical and future retirement pattern for this account. All else held constant, shorter Iowa curves represent shorter average remaining lives, which result in higher depreciation expense rates.

**Q. IS YOUR SELECTED IOWA CURVE A BETTER MATHEMATICAL FIT TO THE RELEVANT PORTION OF THE OLT CURVE?**

A. Yes. While visual curve fitting techniques helped us to identify the most statistically relevant portions of the OLT curve for this account, mathematical curve fitting techniques can help us determine which of the two Iowa curves provides the better fit. Mathematical curve fitting essentially involves measuring the distance between the OLT curve and the selected Iowa curve. The best mathematically-fitted curve is the one that minimizes the distance between the OLT curve and the Iowa curve, thus providing the closest fit. The "distance" between the curves is calculated using the "sum-of-squared differences" ("SSD") technique. In Account 376.10, the total SSD, or "distance" between the Company's curve and the OLT curve is 0.4903, while the total SSD between the R2.5-65 curve and the OLT curve is only 0.2263. Thus, the R2.5-65 curve is a better mathematical fit and provides a more reasonable service life estimate and depreciation rate for this account. Applying the R2.5-65 curve to this account results in a remaining life of 46.2 years and a depreciation accrual rate of 2.20%.[18]

---

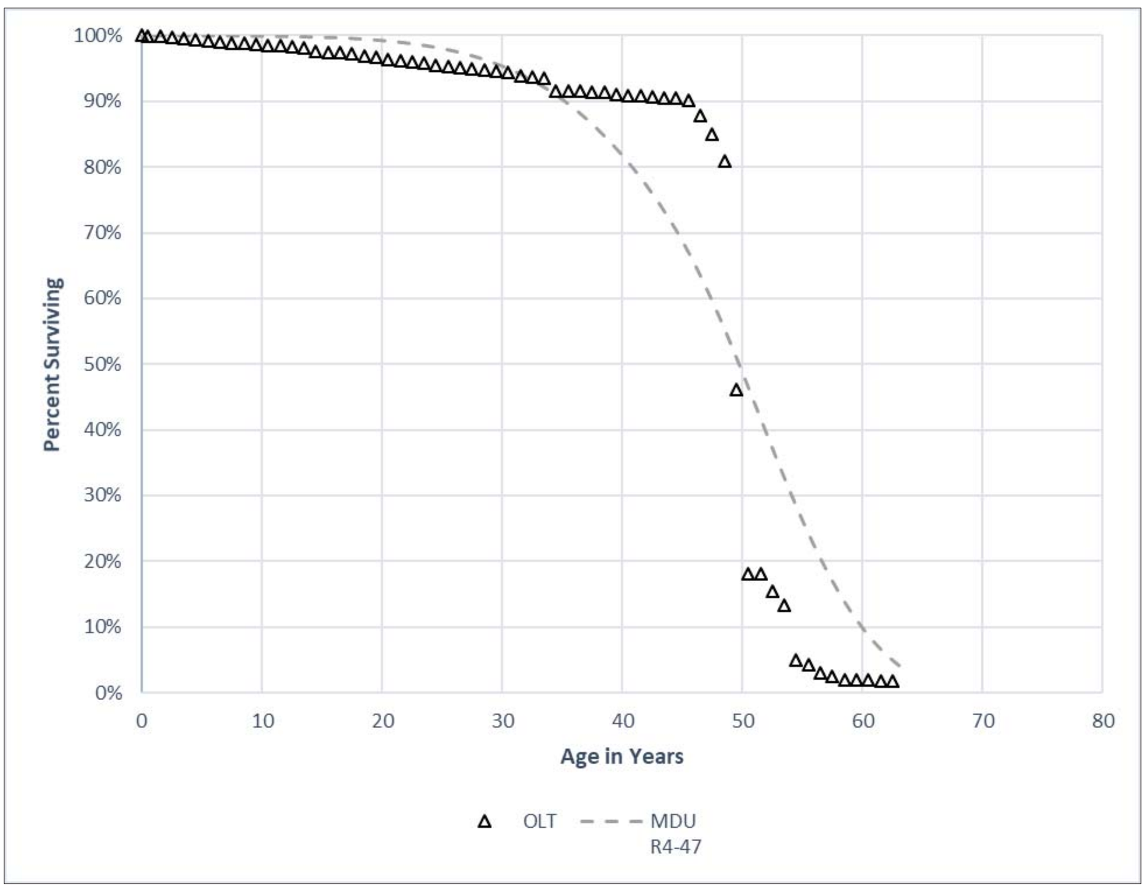
[18] *See* Exhibit DJG-5 for depreciation calculation; *see also* Exhibit DJG-13 for detailed remaining life calculations.

### C. Account 376.20 – Mains – Plastic

**Q. DESCRIBE YOUR SERVICE LIFE ESTIMATE FOR THIS ACCOUNT, AND COMPARE IT WITH THE COMPANY'S ESTIMATE.**

A. The observed survivor curve derived from the Company's data for this account is not well-suited for conventional curve fitting techniques. For this account, the Company selected the R4-47 curve to describe the remaining life of the Company's plastic mains. The graph below shows the OLT curve and the Company's R4-47 curve.

**Figure 4:**
**Account 376.20 – Mains – Plastic**




As with the account discussed above, this OLT curve is another example of why depreciation analysts should not necessarily give equal statistical weighting to the entire OLT curve. In the graph for Account 376.20, we see that the OLT curve declines smoothly until age interval 48 years, where it drops suddenly to 80% surviving, and in the very next year makes another significant drop to 18% surviving. The problem with the Company's selected Iowa curve is that it is giving equal statistical weight to this irrelevant "tail" end of the OLT curve, whether intentionally or inadvertently. As shown in the graph, the Company's R4-47 curve passes directly through the most problematic portion of the OLT curve and connects with the tail-end data points at the bottom of the graph.

**Q. PLEASE PROVIDE A MATHEMATICAL DEMONSTRATION WHY THE TAIL END OF THIS OLT CURVE IS INSIGNIFICANT.**

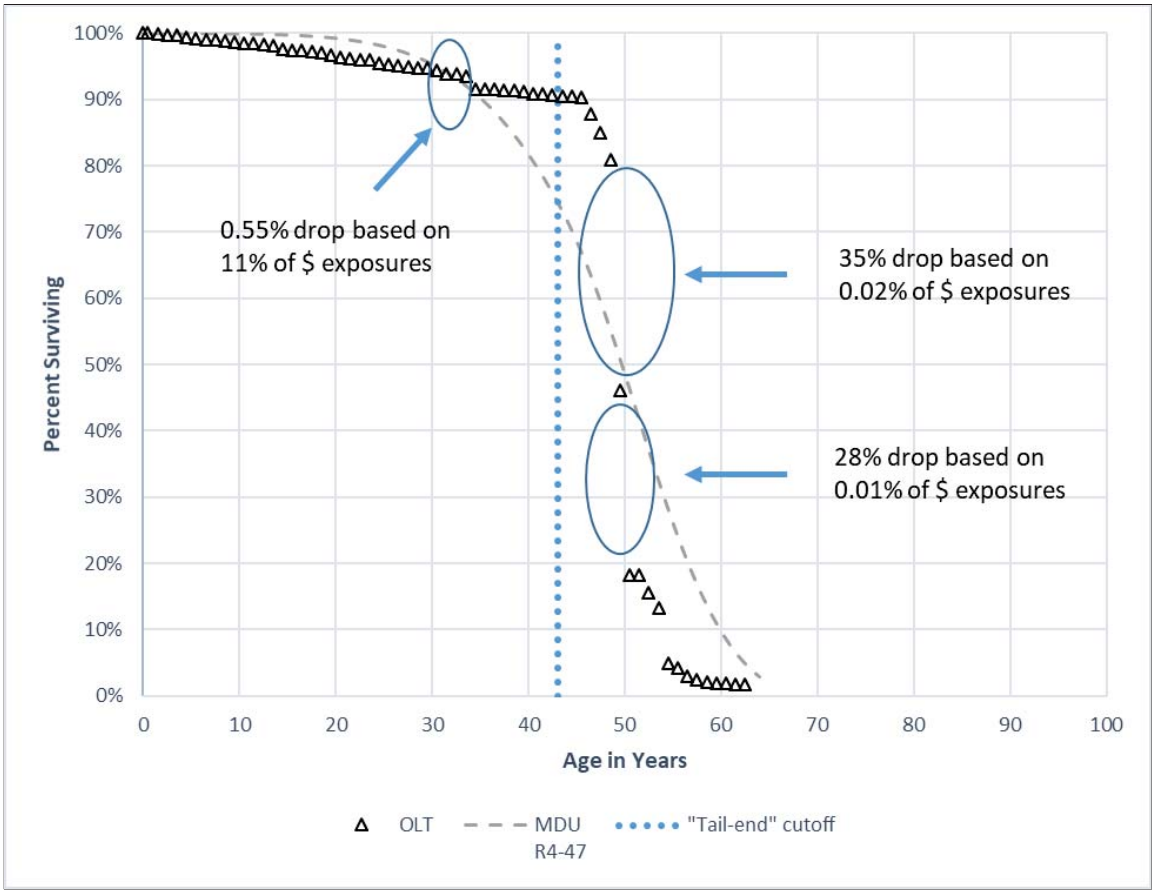
A. While there might be an intuitive understanding why the tail end of this OLT curve is statistically irrelevant from a visual perspective, we can also demonstrate this fact mathematically. To do this we need to examine the actual data points in the observed life table that comprise this OLT curve. The chart below shows portions of the observed life table for this account.

**Figure 5:**
**Account 376.20 – Portion of Observed Life Table**

| Age (Years) | Exposures (Dollars) | Observed Life Table (OLT) |
|---|---|---|
| 0.0 | 102,527,986 | 100.00% |
| 0.5 | 93,798,517 | 99.99% |
| 1.5 | 83,030,476 | 99.89% |
| 2.5 | 73,856,751 | 99.69% |
| 3.5 | 58,571,173 | 99.61% |
| | | |
| 45.5 | 47,292 | 90.21% |
| 46.5 | 46,045 | 87.84% |
| 47.5 | 44,639 | 84.92% |
| 48.5 | 42,491 | 80.83% |
| 49.5 | 24,297 | 46.15% |
| 50.5 | 9,573 | 18.18% |
| 51.5 | 9,573 | 18.18% |

This observed life table shows the dollars exposed to retirement (or "exposures") at the beginning of each age interval. The beginning amount of dollars exposed to retirement in this account (at age interval zero) is $102.5 million. This number is significant because we will base the statistical relevance of further data points on the OLT curve on the amount of exposures at that age interval relative to the beginning exposures. Notice in age intervals 0 – 3.5 years, there is a steady decline in the percentage surviving in the far-right column (100%, 99.99%, 98.89%, etc.). Then, when we skip ahead to age interval 48.5 years, there is a substantial drop in the percent surviving from 80.83% to 46.15%. Then in the next age interval, there is another significant drop in the percent surviving to 18.18%. This is where the OLT curve "falls apart" and is no longer valuable from a statistical standpoint. The graph below illustrates this concept.

**Figure 1:**
**Account 376.20 – Mains – Plastic – With OLT Drops**




This graph shows the same OLT curve in the previous graph, as well as the Company's R4-47 Iowa curve. The graph also shows a vertical dotted line. The data points to the right of this line occur after the benchmark 1% "cutoff" for beginning dollars exposed to retirement. Even without calculating this benchmark however, it is clear that the OLT curve falls apart shortly thereafter. Notice at the 31-year age interval, there is a mere 0.55% decline in the percent surviving, which is based on 11% of the beginning dollars exposed to retirement. This is a normal decline in percent surviving, and occurs in the statistically relevant, middle portion of this OLT curve. In contrast, there is a 35% drop in percent surviving at age interval 49 years, but it is based on only 0.02%

of the beginning dollars exposed to retirement. Put in terms of dollars, the slight decline in the OLT curve at age interval 31 years was based on $10 million, while the substantial decline in the OLT curve at age interval 49 years was based on a mere $24,000. Thus, it is clear from a visual and mathematical standpoint that this portion of the curve is statistically irrelevant when compared to the upper and middle portions. Yet, the Company's selected Iowa curve gives the same statistical significance to the tail end of this OLT curve. Consequently, the Company's selected Iowa curve is too short and results in overstated depreciation expense for this account.

**Q. WHAT IS THE BASIS FOR THE CURRENT 47-YEAR SERVICE LIFE FOR ACCOUNT 376.20?**

A. The current average service life estimate for this account is 47 years. This was based on the Simulated Plant Record ("SPR") method of analysis. According to the Company, SPR was used to conduct analysis in the prior depreciation study; however, in the current depreciation study, sufficient levels of investment activity records were available to perform actuarial analysis under the retirement rate method.[19] As discussed briefly above, the SPR method is used when aged data is not available. When aged data is available, however, the actuarial-based retirement rate method is superior because plant balances are known and do not have to be "simulated." Therefore, the current service life estimate for this account was based on data that is inferior to what was provided in this case. The data provided in this case indicate that the average service life in this account should be longer than 47 years, as discussed above.

[19] *See* Company's response to Data Request MCC-007.

**Q. SINCE THE OLT CURVE FOR THIS ACCOUNT IS NOT WELL-SUITED FOR TRADITIONAL CURVE FITTING TECHNIQUES, WHAT ARE OTHER OBJECTIVE WAYS TO DETERMINE A REASONABLE SERVICE LIFE ESTIMATE FOR THIS ACCOUNT?**

A. When the OLT curve for a particular account is not well suited for conventional curve fitting techniques, it is instructive to consider and compare the retirement patterns of the same account for other utilities. At the very least, this technique may provide an objective basis upon which to gauge the reasonableness of a recommendation.

**Q. HAVE OTHER UTILITY DEPRECIATION WITNESSES RECOMMENDED SERVICE LIFE ESTIMATES UP TO 63 YEARS FOR THIS ACCOUNT?**

A. Yes, in CenterPoint Energy's last rate case, the company filed a depreciation study that proposed a 63-year average service life for the plastic mains account in that case.[20] In Oklahoma Natural Gas Company's 2015 rate case, the company's witness proposed a 55-year service life for the same account.[21]

**Q. ARE YOU AWARE OF OTHER EVIDENCE INDICATING THAT PLASTIC MAINS CAN LAST MUCH LONGER THAN THE 47-YEAR SERVICE LIFE PROPOSED BY THE COMPANY?**

A. Yes. Several studies of PVC and other plastic pipe indicate that these kinds of pipes can last 100 years or more. According to the Plastics Industry Pipe Association of Australia:

---

[20] *See* Exhibit DAW-2, p. 26 to Direct Testimony of Dane A. Watson, filed Before the Railroad Commission of Texas, GUD No. 10567 – Statement of Intent of CenterPoint Energy Resources Corp.

[21] *See* Direct Testimony of Dr. Ronal E. White, filed July 8, 2015 before the Corporation Commission of Oklahoma, Cause No. PUD 201500213.

> Based on the use of 50 year stress regression data, it has been incorrectly assumed that plastics pipe systems have a life expectancy of 50 years. In reality, such systems can reasonably be expected to last 100 years or more.[22]

While I am not suggesting that the Company's plastic mains should have an estimated service life of 100 years, this study provides further evidence suggesting that the Company's proposed service life of only 47 years is far too conservative.

**Q. WHAT IS YOUR RECOMMENDATION FOR ACCOUNT 376.20?**

A. The evidence presented above indicates that a 47-year service life for plastic mains is too short. Although the historical data provided by the Company was not ideal for conventional curve fitting techniques, the OLT curve derived from that data showed the Company's proposed Iowa curve and service life appeared to give undue statistical significance to irrelevant data. Furthermore, there have been recent proposals from other utility depreciation experts for service lives up to 63 years for this account. In the interest of moderation, I am proposing an average service life of only 54 years for this account, as described by an R2-54 Iowa curve. This results in a remaining life of 44.6 years and a depreciation rate of 2.54%.[23]

---

[22] Plastics Industry Pipe Association of Australia Limited, "Life Expectancy for Plastic Pipes," Polyolefins Technical Information (accessed 2018).

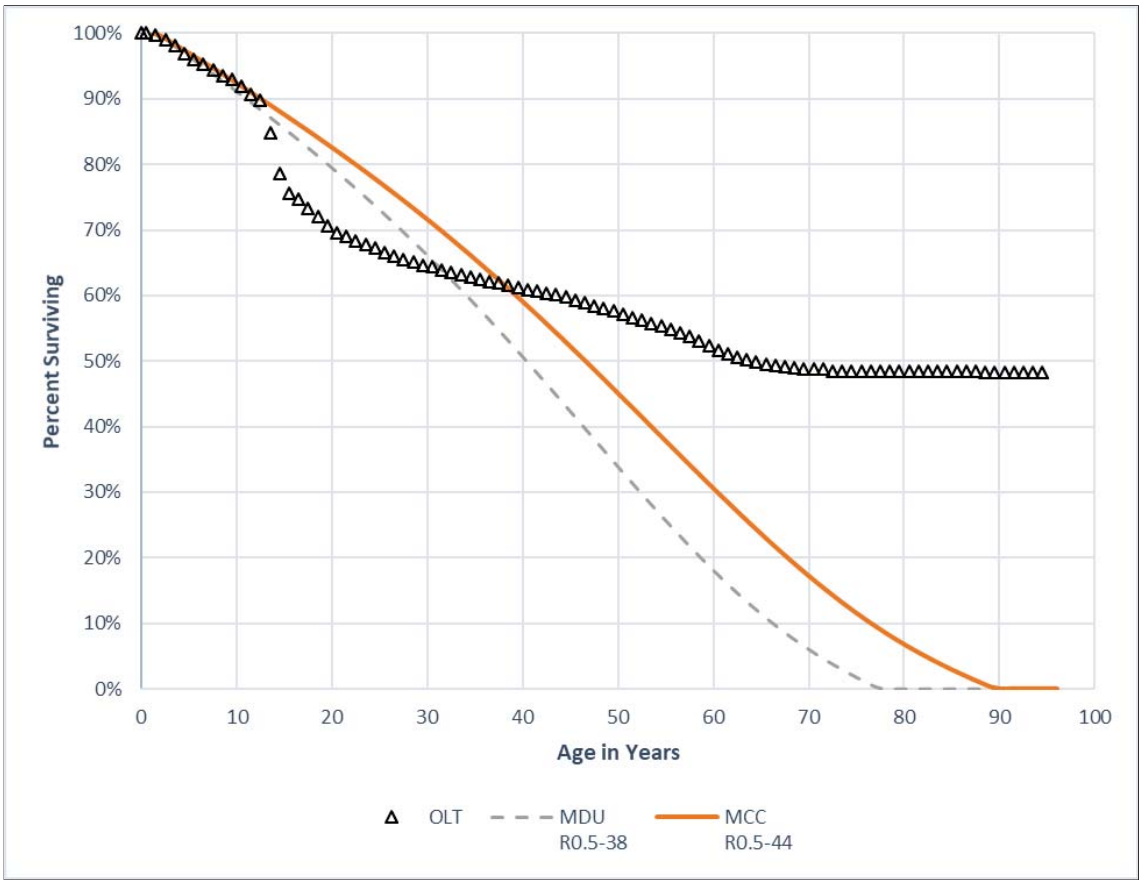
[23] *See* Exhibit DJG-4 for depreciation calculation; *see also* Exhibit DJG-13 for detailed remaining life calculations.

## D. Account 380.10 – Services – Steel

**Q. DESCRIBE YOUR SERVICE LIFE ESTIMATE FOR THIS ACCOUNT, AND COMPARE IT WITH THE COMPANY'S ESTIMATE.**

A. The observed survivor curve derived from the Company's data for this account is presented in the graph below, along with the Company's R0.5-38 curve and my R0.5-44 curve.

**Figure 2:**
**Account 380.10 – Services – Steel**




As shown in the graph, the OLT curve becomes unusually flat in early age intervals and does not decline in a typical fashion for the assets in this account. However, based on the beginning amount of dollars exposed to retirement, a good portion of this OLT curve is arguably relevant from a statistical standpoint.

**Q. IS YOUR SELECTED IOWA CURVE A BETTER MATHEMATICAL FIT TO THE RELEVANT PORTION OF THE OLT CURVE?**

A. Yes. While I would acknowledge that attempting to fit this OLT curve with the mathematically "best-fitting" Iowa curve would result in an average service life that would be unreasonably long, it appears the Company's R0.5-38 curve has not given enough weight to relevant historical data, and as a result, is too short. In this account, the total SSD, or "distance" between the Company's curve and the OLT curve is 8.8540, while the total SSD between the R0.5-44 curve and the OLT curve is only 0.2263. Thus, the R0.5-44 curve is a better mathematical fit. This curve results in a remaining life of 17.9 years and a depreciation rate of 4.82%.[24]

**Q. HAVE OTHER UTILITY DEPRECIATION WITNESSES RECENTLY RECOMMENDED LONGER SERVICE LIFE ESTIMATES FOR THIS ACCOUNT?**

A. Yes, in Florida City Gas's recently-filed rate case, the company filed a depreciation study proposing a 45-year service life for this account.[25] In light of this fact, along with the statistical evidence discussed above, a 44-year service life estimate for this account is fair and reasonable.

---

[24] *See* Exhibit DJG-4 for depreciation calculation; *see also* Exhibit DJG-13 for detailed remaining life calculations. My net salvage adjustments for this account also affect the depreciation rate, as discussed later in the testimony.

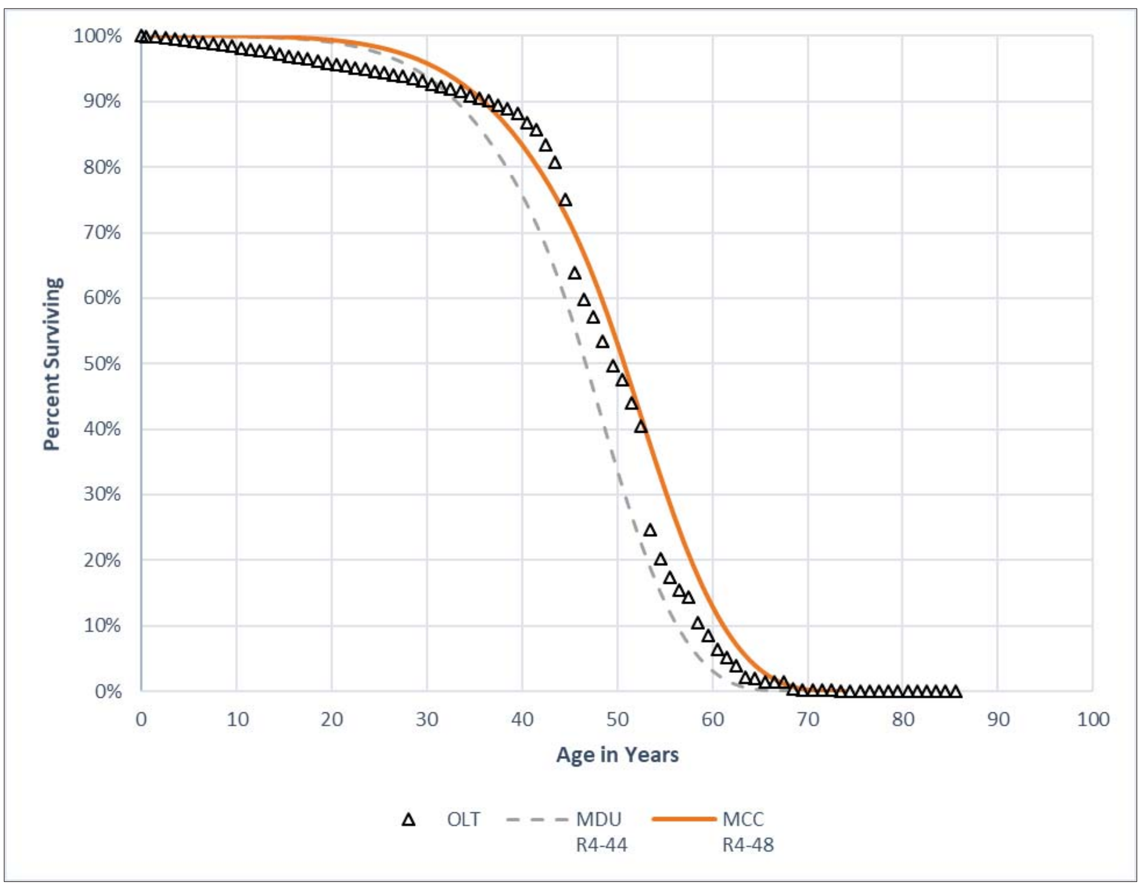
[25] *See* Direct Testimony and Exhibits of Dane A. Watson, filed October 23, 2017 before the Florida Public Service Commission in the Petition for Rate Increase by Florida City Gas, Docket No. 20170179-GU.

### E. Account 380.20 – Services – Plastic

**Q. DESCRIBE YOUR SERVICE LIFE ESTIMATE FOR THIS ACCOUNT, AND COMPARE IT WITH THE COMPANY'S ESTIMATE.**

A. The OLT curve derived from the Company's data for this account is very well-suited for Iowa curve fitting. The two primary purposes of Iowa curve fitting are to get a smooth and complete survivor curve to calculate average life. If we use the complete data band for this account, the OLT curved derived from that data is already relatively smooth and complete, as shown in the graph below.

**Figure 3:**
**Account 380.20 – Services – Plastic**



For this account, the Company selected the R4-44 curve and I selected the R4-48 curve. Both Iowa curves provide close fits to the OLT curves, and thus it is difficult to tell which curve provides a better fit through mere visual inspection. Mathematical curve fitting techniques are especially useful in situations like this.

**Q. DOES THE IOWA CURVE YOU SELECTED PROVIDE A BETTER MATHEMATICAL FIT TO THE OBSERVED DATA THAN THE COMPANY'S CURVE?**

A. Yes. Regardless of whether we consider the entire OLT curve, or the portion of the OLT curve without the 1% tail end, the R4-48 curve I selected provides a better mathematical fit, and thus results in a more reasonable service life estimate and depreciation rate for this account. The SSD for the Company's curve is 0.7075, while the SSD for the R4-48 curve I selected is only 0.0831, which means it is mathematically "closer" to the OLT curve. The R4-48 curve results in a remaining life of 37.7 years and a depreciation rate of 5.67%.[26]

### F. <u>Account 385.00 – Industrial Measuring & Regulating Station Equipment</u>

**Q. DESCRIBE YOUR SERVICE LIFE ESTIMATE FOR THIS ACCOUNT, AND COMPARE IT WITH THE COMPANY'S ESTIMATE.**

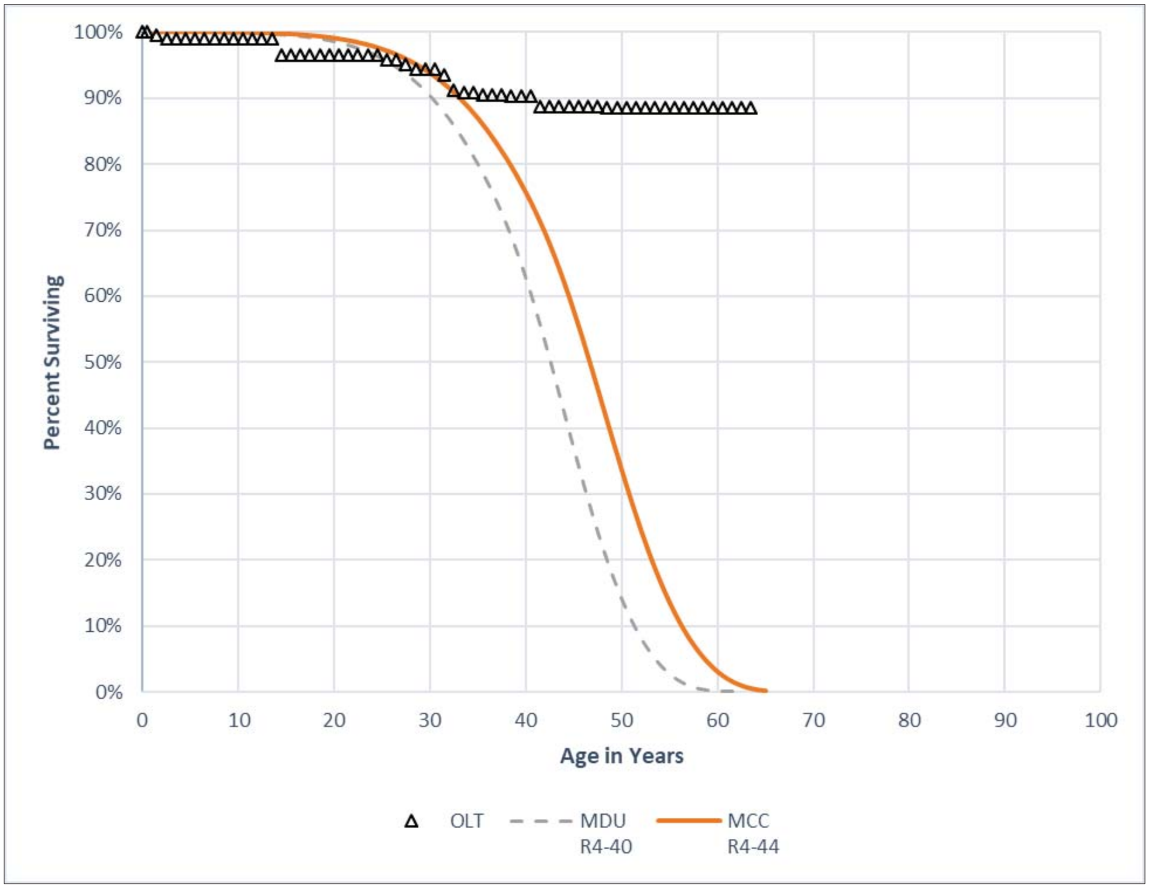
A. The OLT curve derived from the Company's data for this account does not fall below 85% surviving, and is relatively incomplete in that regard. The Company selected the

---

[26] *See* Exhibit DJG-4 for depreciation calculation; *see also* Exhibit DJG-13 for detailed remaining life calculations. My net salvage adjustments for this account also affect the depreciation rate, as discussed later in the testimony.

R4-40 curve for this account, and I selected the R4-44 curve. All three curves are shown in the following graph.

**Figure 4:**
**Account 385.00 – Industrial Measuring & Regulating Station Equipment**




For this particular OLT curve, attempting to fit it with the mathematically-best Iowa curve would yield an unreasonably long service life. In fact, the mathematically best fitting curve for this account is the R1-147. An average service life of 147 years is far longer than any service life estimate used for this account in the industry. However, it appears the Company's R4-40 curve has not given enough weight to relevant historical data, and as a result, is too short.

**Q. HAS THE COMPANY MET ITS BURDEN TO MAKE A CONVINCING SHOWING THAT ITS PROPOSED DEPRECIATION RATE FOR THIS ACCOUNT IS NOT EXCESSIVE?**

A. No. As demonstrated above, the Company's selected Iowa curve appears to be too short given the historical data provided. According to Mr. Robinson, "[m]uch of the property within this asset class is getting older, with the increased occurrence of obsolescence and manufacture discontinuance. To the extent that this continues to occur, increase replacement activity during future years is possible/probable."[27] While I might agree with Mr. Robinson's general prediction of increased future obsolescence in this account, the Company has nonetheless failed to show why a 40-year service life does not result in an excessive depreciation rate. As the company accumulates a longer period of historical data for this account, we will have the benefit of seeing a more reliable historical retirement pattern and OLT curve. However, the Company's historical data to this point indicates a longer service life than 40 years for this account. Specifically, at the 60-year age interval, there are still 88% surviving. Thus, for this account to have an <u>average</u> life of only 40 years, there would soon have to be a sudden increase in the amount of retirements in this account. Although Mr. Robinson is predicting an increase in the rate of obsolescence in this account, I think his prediction is too aggressive.

**Q. WHAT IS YOUR RECOMMENDATION FOR THIS ACCOUNT?**

A. I recommend applying the R4-44 curve to estimate the average remaining life for this account. The R4 curve shape is the same shape proposed by Mr. Robinson, and gives

[27] *See* Depreciation Study, Section 4, Account 385.00.

credit to his prediction of increased obsolescence in this account (i.e., an R4 curve shape suggests a more sudden decrease in percent surviving, rather than a gradual one). However, a 44-year service life is more representative of the retirement pattern observed thus far for this account than a 40-year service life. Although an even longer Iowa curve (i.e., lower depreciation rate) would provide a better mathematical fit to the observed data, a 44-year service life is reasonable under the circumstances. The R4-44 curve results in a remaining life of 29.9 years and a depreciation rate of 2.69%.[28]

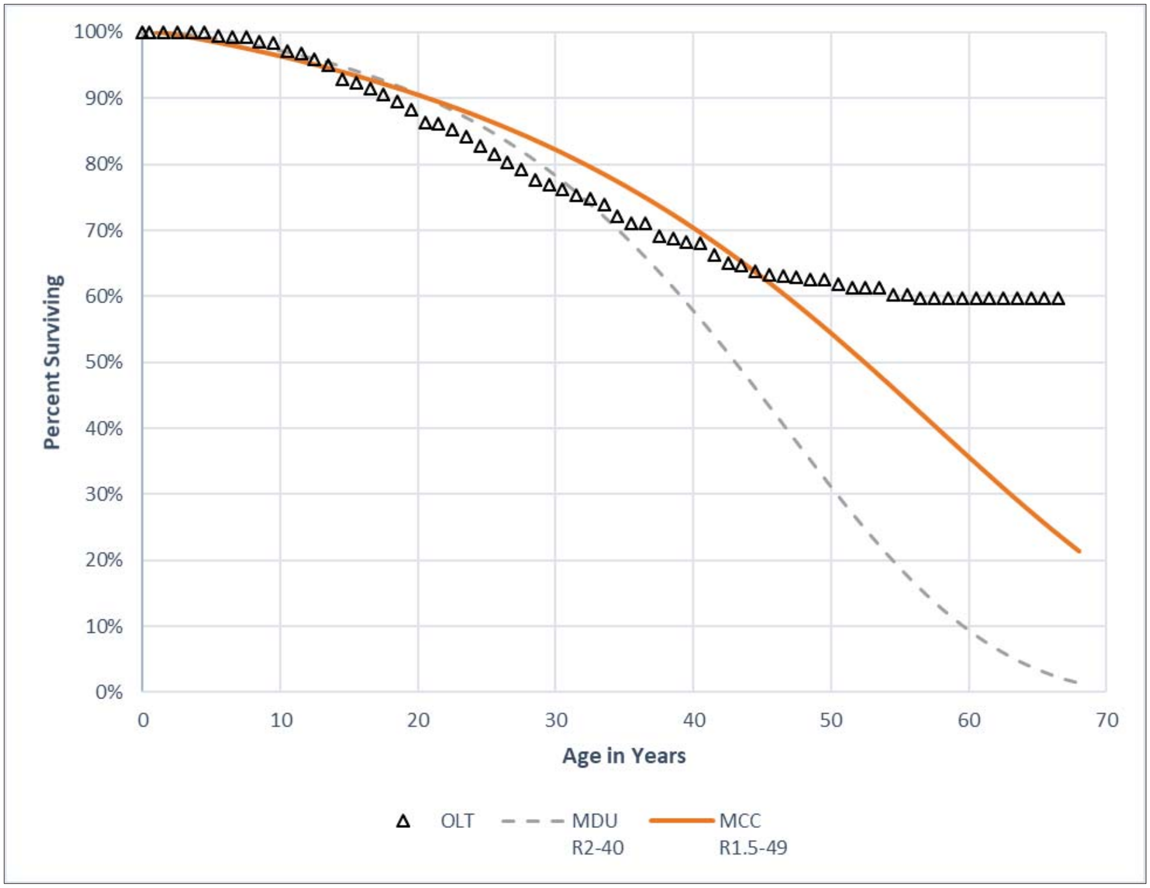
### G. Account 387.10 – Cathodic Protection Equipment

**Q. DESCRIBE YOUR SERVICE LIFE ESTIMATE FOR THIS ACCOUNT, AND COMPARE IT WITH THE COMPANY'S ESTIMATE.**

A. The OLT curve for this account is relatively well-suited for Iowa curve fitting. The OLT curve declines steadily and smoothly in a pattern typical of certain types of utility property. The Company selected the R2-40 curve for this account, and I selected the R1.5-49 curve. All three curves are shown in the graph below.

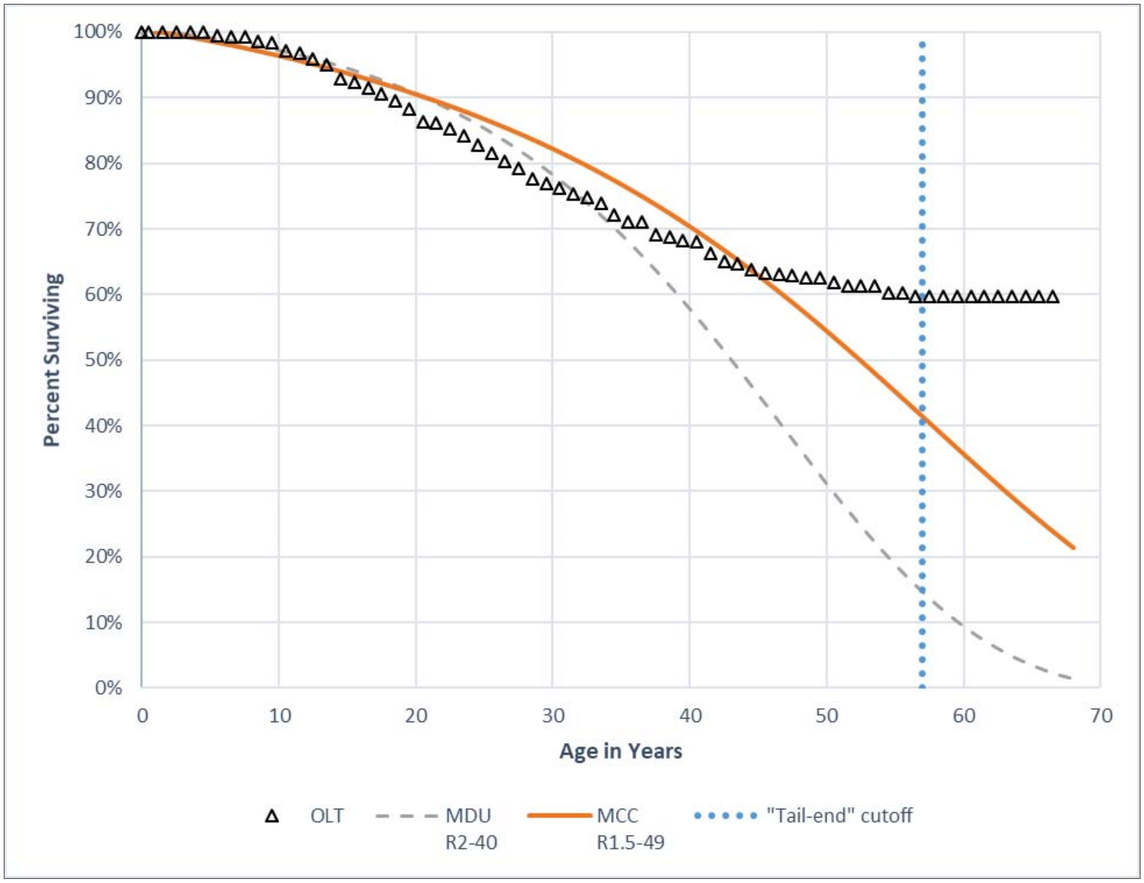
[28] *See* Exhibit DJG-4 for depreciation calculation; *see also* Exhibit DJG-13 for detailed remaining life calculations.

**Figure 5:**
**Account 387.10 – Cathodic Protection Equipment**




The fact that the OLT curve becomes consistently flat toward the tail end of the curve indicates from a visual perspective that a portion of the tail end may be statistically unreliable. If we use the 1% cut-off benchmark, we would give little to no statistical weight to the data points occurring after the 57-year age interval. The graph below shows the same two curves with the 1% cutoff line.

**Figure 6:**
**Account 387.10 – Cathodic Protection Equipment – With 1% Cutoff**

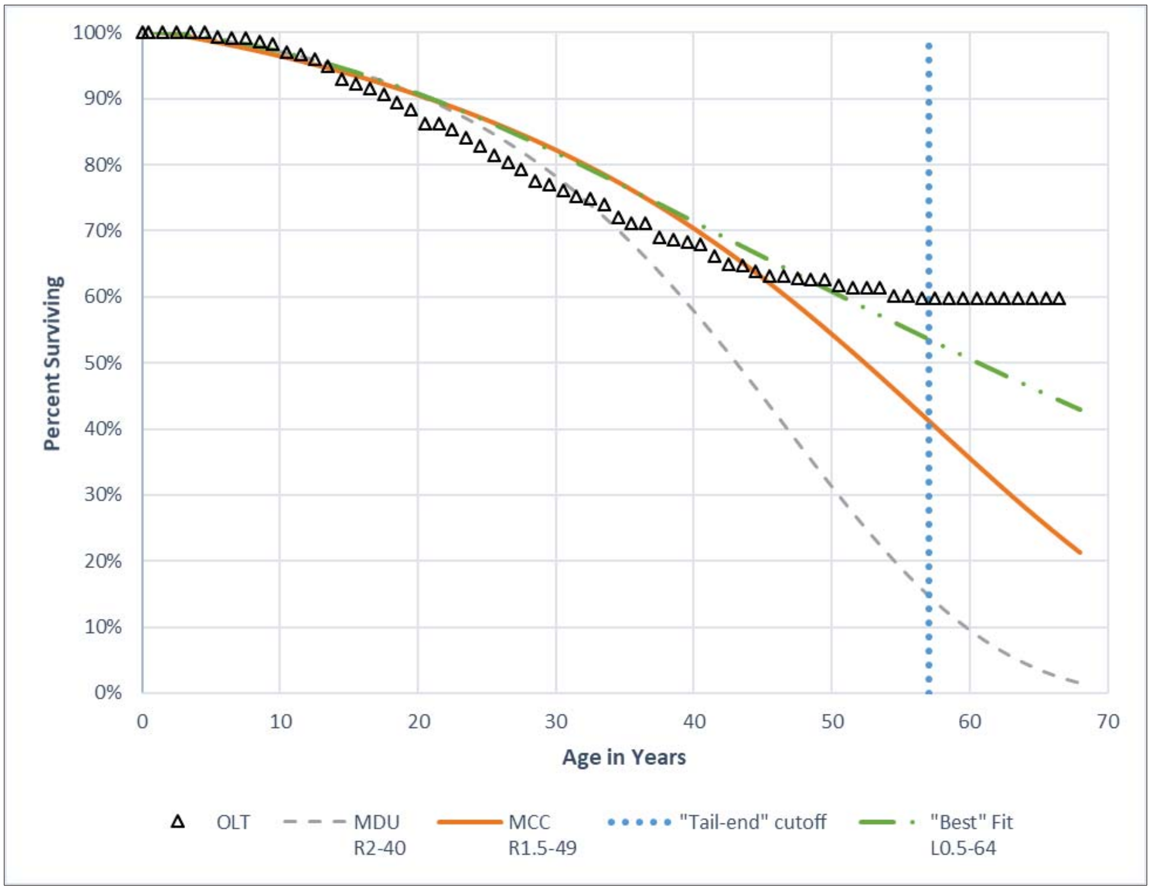



Consideration of the 1% cutoff is important because it provides an indication of how much of the tail end of the curve we should ignore. Now that we can visualize the 1% cutoff, it is apparent that the Company's R2-40 curve fails to give enough consideration to relevant portions of the OLT curve. Specifically, the R2-40 curve starts declining more rapidly than the OLT curve at about the 35-year age interval. As a result, the R2-40 curve is too short to provide an accurate fit to the historical and future retirement pattern for this account.

**Q. DID YOU SELECT THE MATHEMATICALLY BEST-FITTING IOWA CURVE FOR THIS ACCOUNT?**

A. No. The graph below shows the "best" fitting of the three curves, which is the L0.5-64 curve.

**Figure 7:**
**Account 387.10 – Cathodic Protection Equipment – With "Best" Fitting Curve**




Applying the L0.5-64 curve to this account suggests that the average life of these assets will be 64 years.

**Q. WHAT IS YOUR RECOMMENDATION FOR THIS ACCOUNT?**

A. I recommend applying the R1.5-49 curve to this account. This recommendation represents a balance between the Company's R2-40 curve (which understates the average life in this account) and the mathematically best-fitting L0.5-64 curve (which would represent a significant departure from the currently-approved service life for this account). Applying the R1.5-49 curve to this account results in a remaining life of 38.0 years and a depreciation rate of 1.24%.[29]

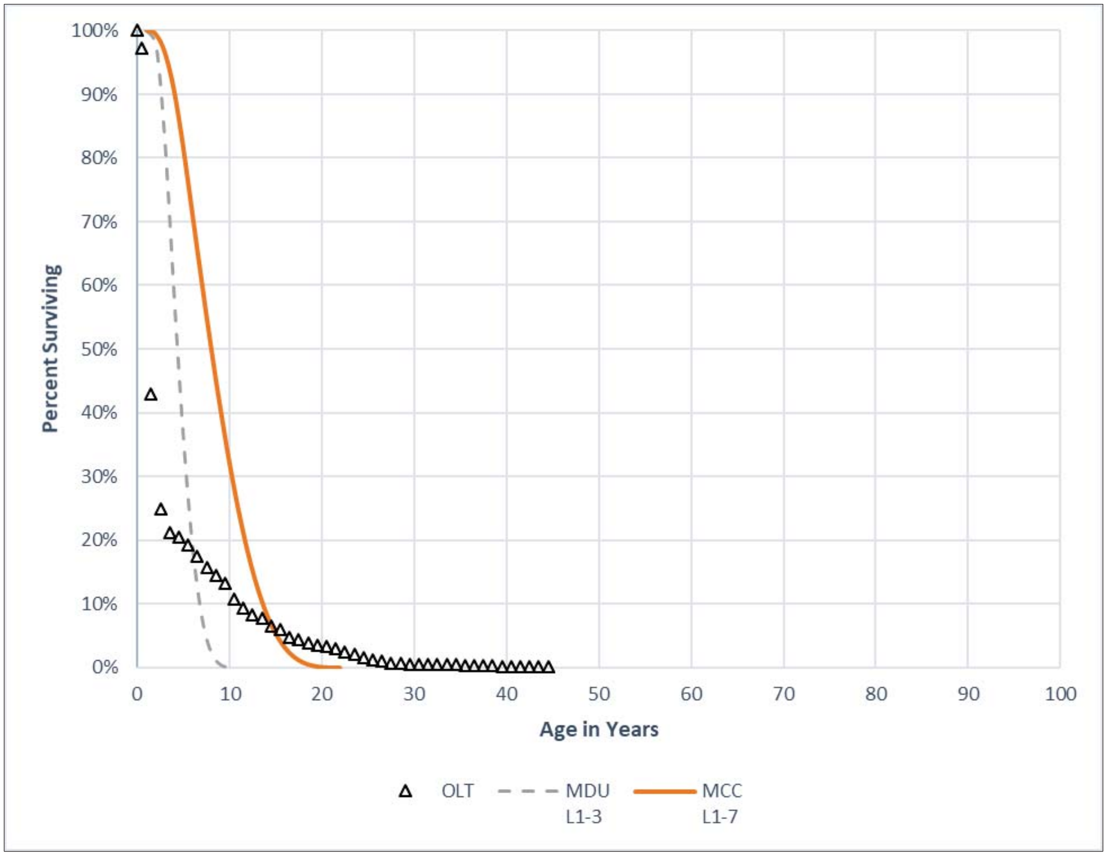
### H. Account 396.20 – Power Operated Equipment

**Q. DESCRIBE YOUR SERVICE LIFE ESTIMATE FOR THIS ACCOUNT, AND COMPARE IT WITH THE COMPANY'S ESTIMATE.**

A. The OLT curve for this account is not well suited for Iowa curve fitting. There is a substantial drop in the OLT curve of more than 50% at a very early age interval. The following graph shows the OLT curve along with the two selected Iowa curves.

[29] *See* Exhibit DJG-4 for depreciation calculation; *see also* Exhibit DJG-13 for detailed remaining life calculations.

**Figure 8:**
**Account 396.20 – Power Operated Equipment**




The Company is proposing a three-year average life for this account, and I am proposing a seven-year average life. Although the OLT curve for this account is not ideal for curve fitting, the Company's L1-3 curve nonetheless appears to ignore significant portions of the curve beyond the 10-year age interval. When the OLT curve is not ideal for conventional Iowa curve fitting techniques, it can be instructive to consider the service lives used by other utilities for the same account.

**Q. DESCRIBE THE SERVICE LIVES PROPOSED BY OTHER UTILITIES FOR ACCOUNT 396.20.**

A. In Florida City Gas's recently-filed rate case, the company filed a depreciation study proposing a 15-year service life for this account.[30] In CenterPoint Energy's last rate case, the company filed a depreciation study proposing a 10-year service life for this account.[31] Finally, in Oklahoma Natural Gas Company's 2015 rate case, the company's witness proposed a 20-year service life for this account.[32] Thus, on average, these other gas utilities have proposed service lives of about 15 years for their power operated equipment, which is five times longer than MDU's proposal in this case.

**Q. WHAT IS YOUR RECOMMENDATION FOR THIS ACCOUNT?**

A. A three-year average life is by far the shortest proposal I have seen for this account that I can recall. I recommend applying the L1-7 curve to this account, which represents a balance between the Company's proposal of a 3-year average life and the average proposal of a 15-year service life from other gas utilities. Applying the L1-7 curve to this account results in a remaining life of 4.8 years and a depreciation rate of 2.11%.[33]

---

[30] *See* Direct Testimony and Exhibits of Dane A. Watson, filed October 23, 2017 before the Florida Public Service Commission in the Petition for Rate Increase by Florida City Gas, Docket No. 20170179-GU.

[31] *See* Exhibit DAW-2, p. 26 to Direct Testimony of Dane A. Watson, filed Before the Railroad Commission of Texas, GUD No. 10567 – Statement of Intent of CenterPoint Energy Resources Corp.

[32] *See* Direct Testimony of Dr. Ronal E. White, filed July 8, 2015 before the Corporation Commission of Oklahoma, Cause No. PUD 201500213.

[33] *See* Exhibit DJG-4 for depreciation calculation; *see also* Exhibit DJG-13 for detailed remaining life calculations.

## VI. NET SALVAGE ANALYSIS

**Q. DESCRIBE THE CONCEPT OF NET SALVAGE.**

A. If an asset has any value left when it is retired from service, a utility might decide to sell the asset. The proceeds from this transaction are called "gross salvage." The corresponding expense associated with the removal of the asset from service is called the "cost of removal." The term "net salvage" equates to gross salvage less the cost of removal. Often, the net salvage for utility assets is a negative number (or percentage) because the cost of removing the assets from service exceeds any proceeds received from selling the assets. When a negative net salvage rate is applied to an account to calculate the depreciation rate, it results in increasing the total depreciable base to be recovered over a particular period of time and increases the depreciation rate. Therefore, a greater <u>negative</u> net salvage rate equates to a higher depreciation rate and expense, all else held constant.

**Q. DESCRIBE HOW YOU ANALYZED THE COMPANY'S NET SALVAGE RATES.**

A. In this case, I examined the Company's historical net salvage data over different periods of time.

**Q. ARE YOU RECOMMENDING ANY ADJUSTMENTS TO THE COMPANY'S PROPOSED NET SALVAGE RATES?**

A. Yes. I am recommending net salvage rate adjustments on two accounts: 380.10 Services – Steel, and 380.20 Services - Plastic.

**Q. DESCRIBE THE COMPANY'S NET SALVAGE PROPOSALS FOR ACCOUNT 380.10 AND ACCOUNT 380.20.**

A. Mr. Robinson proposes a negative 200% net salvage for these accounts.[34] A negative net salvage percentage means the Company estimates that the cost to remove an asset from service will be greater than the proceeds received from selling the asset once it is removed. In fact, a negative net salvage in excess of 100% means that the cost of removing the asset will be greater than the original cost of the asset itself if there is no gross salvage. For example, if the original cost of an asset being retired is $100,000, the gross salvage is $0, and the cost of removal is $200,000, it would equate to a negative net salvage rate of 200%.

**Q. DO YOU AGREE WITH THE COMPANY'S PROPOSED NET SALVAGE RATES FOR THESE ACCOUNTS?**

A. No. Negative net salvage rates of 200% are much higher than what is observed among other gas utilities for this account. By comparison, Florida City Gas recently proposed negative 80% and negative 45% net salvage values for Accounts 380.10 and 380.20 respectively.[35] Similarly, CenterPoint Energy recently proposed negative 60% and negative 45% net salvage values for the same accounts.[36] Finally, Oklahoma Natural Gas Company recently proposed a negative 75 percent net salvage rate for its plastic

[34] *See* Depreciation Study, Section 7, p. 7-4.

[35] *See* Direct Testimony and Exhibits of Dane A. Watson, filed October 23, 2017 before the Florida Public Service Commission in the Petition for Rate Increase by Florida City Gas, Docket No. 20170179-GU.

[36] *See* Exhibit DAW-2, p. 104 to Direct Testimony of Dane A. Watson, filed Before the Railroad Commission of Texas, GUD No. 10567 – Statement of Intent of CenterPoint Energy Resources Corp.

services account.[37] On average, these other gas companies are utilizing negative net salvage rates of about 60% for these accounts. In stark contrast, MDU is proposing negative net salvage rates more than three times that amount.

**Q. DOES MDU'S RECENT NET SALVAGE DATA INDICATE NET NEGATIVE SALVAGE RATES OF LESS THAN 200% FOR THOSE TWO ACCOUNTS?**

A. Yes. According to the depreciation study, MDU has experienced negative net salvage rates of less than 200% over the past four years, and an average negative net salvage rate of 163% from 1968 – 2015.[38]

**Q. WHAT ARE YOUR RECOMMENDED NET SALVAGE RATES FOR THESE ACCOUNTS?**

A. Although comparable gas utilities are utilizing much less negative net salvage rates for these accounts, I propose negative net salvage rates of 175% for Accounts 380.10 and 380.20. While I believe that a negative net salvage rate of 175% is still excessive when compared to other gas utilities, it represents a gradual move toward a more reasonable level.

**Q. ARE YOU MAKING ANY OTHER RECOMMENDATIONS REGARDING THE NET SALVAGE RATES FOR THESE ACCOUNTS?**

A. Yes. The extreme negative net salvage values proposed for these accounts highlight a trend toward higher negative net salvage values in the utility industry (though I have not seen any proposed negative net salvage rates as high as 200%). This is problematic

---

[37] *See* Direct Testimony of Dr. Ronal E. White, filed July 8, 2015 before the Corporation Commission of Oklahoma, Cause No. PUD 201500213.

[38] *See* Depreciation Study, Section 7, p. 7-41.

because it leads to more volatility in attempting to estimate future net salvage values and the current depreciation rates for a particular account. I recommend the Commission advise MDU to provide a detailed analysis of why its recorded levels of negative net salvage are substantially higher than those observed among other gas utilities. MDU should also reevaluate its retirement and replacement process before its next depreciation study for the purpose of examining how the Company might shift a greater percentage of the total costs of removal/replacement toward installation and away from removal. For example, when a utility retires a section of plastic mains and replaces it with new mains, it would be arguably preferable to maximize the percentage of total removal/replacement costs to the installation of the new mains. This practice would reduce (and perhaps reverse) the trend of increasing negative net salvage rates and promote more accurate and less volatile cost estimates.

## VII. CONCLUSION AND RECOMMENDATION

**Q. SUMMARIZE THE KEY POINTS OF YOUR TESTIMONY.**

A. I employed a well-established depreciation system and used actuarial and simulated analysis to statistically analyze the Company's depreciable assets in order to develop reasonable depreciation rates in this case. I made adjustments to the Company's proposed service lives and net salvage rates for several of its distribution and general accounts. I used a combination of visual and mathematical Iowa curve fitting techniques along with professional judgment and comparisons to other gas utilities when necessary to arrive at fair and reasonable depreciation rate proposals.

**Q. WHAT IS YOUR RECOMMENDATION TO THE COMMISSION REGARDING DEPRECIATION RATES AND EXPENSE?**

A. I recommend the Commission adopt the depreciation rates presented in this testimony and Exhibit DJG-3. My proposed depreciation rates were applied to the Company's updated plant balances in order to calculate MCC's proposed adjustment to depreciation expense, which is presented in the direct testimony and exhibits of MCC witness Mr. Ralph Smith.

**Q. DOES THIS CONCLUDE YOUR TESTIMONY?**

A. Yes, including any exhibits, appendices, and other items attached hereto.

# Appendix A

## D2017.9.79

## Montana-Dakota Utilities

# APPENDIX A:

# THE DEPRECIATION SYSTEM

A depreciation accounting system may be thought of as a dynamic system in which estimates of life and salvage are inputs to the system, and the accumulated depreciation account is a measure of the state of the system at any given time.[39] The primary objective of the depreciation system is the timely recovery of capital. The process for calculating the annual accruals is determined by the factors required to define the system. A depreciation system should be defined by four primary factors: 1) a method of allocation; 2) a procedure for applying the method of allocation to a group of property; 3) a technique for applying the depreciation rate; and 4) a model for analyzing the characteristics of vintage groups comprising a continuous property group.[40] The figure below illustrates the basic concept of a depreciation system and includes some of the available parameters.[41]

There are hundreds of potential combinations of methods, procedures, techniques, and models, but in practice, analysts use only a few combinations. Ultimately, the system selected must result in the systematic and rational allocation of capital recovery for the utility. Each of the four primary factors defining the parameters of a depreciation system is discussed further below.

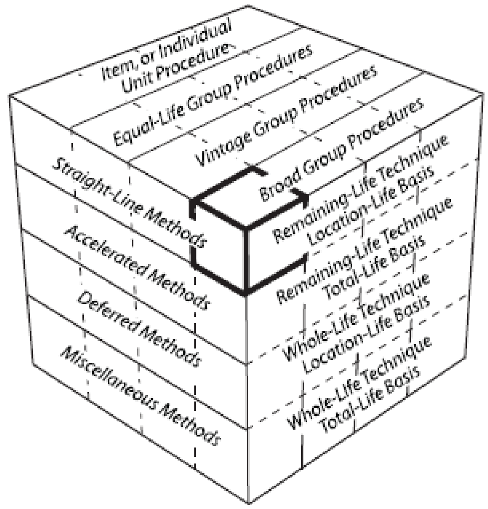
---

[39] Wolf *supra* n. 7, at 69-70.

[40] *Id.* at 70, 139-40.

[41] Edison Electric Institute, *Introduction to Depreciation* (inside cover) (EEI April 2013). Some definitions of the terms shown in this diagram are not consistent among depreciation practitioners and literature due to the fact that depreciation analysis is a relatively small and fragmented field. This diagram simply illustrates some of the available parameters of a depreciation system.

**Figure 9:**
**The Depreciation System Cube**




1. <u>Allocation Methods</u>

The "method" refers to the pattern of depreciation in relation to the accounting periods. The method most commonly used in the regulatory context is the "straight-line method" – a type of age-life method in which the depreciable cost of plant is charged in equal amounts to each accounting period over the service life of plant.[42] Because group depreciation rates and plant balances often change, the amount of the annual accrual rarely remains the same, even when the straight-line method is employed.[43] The basic formula for the straight-line method is as follows:[44]

[42] NARUC *supra* n. 8, at 56.

[43] *Id*.

[44] *Id*.

**Equation 1:**
**Straight-Line Accrual**

$$Annual\ Accrual = \frac{Gross\ Plant - Net\ Salavage}{Service\ Life}$$

Gross plant is a known amount from the utility's records, while both net salvage and service life must be estimated to calculate the annual accrual. The straight-line method differs from accelerated methods of recovery, such as the "sum-of-the-years-digits" method and the "declining balance" method. Accelerated methods are primarily used for tax purposes and are rarely used in the regulatory context for determining annual accruals.[45] In practice, the annual accrual is expressed as a rate which is applied to the original cost of plant to determine the annual accrual in dollars. The formula for determining the straight-line rate is as follows:[46]

**Equation 2:**
**Straight-Line Rate**

$$Depreciation\ Rate\ \% = \frac{100 - Net\ Salvage\ \%}{Service\ Life}$$

2. <u>Grouping Procedures</u>

The "procedure" refers to the way the allocation method is applied through subdividing the total property into groups.[47] While single units may be analyzed for depreciation, a group plan of depreciation is particularly adaptable to utility property. Employing a grouping procedure allows for a composite application of depreciation rates to groups of similar property, rather than

[45] *Id*. at 57.

[46] *Id*. at 56.

[47] Wolf *supra* n. 7, at 74-75.

conducting calculations for each unit. Whereas an individual unit of property has a single life, a group of property displays a dispersion of lives and the life characteristics of the group must be described statistically.[48] When analyzing mass property categories, it is important that each group contains homogenous units of plant that are used in the same general manner throughout the plant and operated under the same general conditions.[49]

The "average life" and "equal life" grouping procedures are the two most common. In the average life procedure, a constant annual accrual rate based on the average life of all property in the group is applied to the surviving property. While property having shorter lives than the group average will not be fully depreciated, and likewise, property having longer lives than the group average will be over-depreciated, the ultimate result is that the group will be fully depreciated by the time of the final retirement.[50] Thus, the average life procedure treats each unit as though its life is equal to the average life of the group. In contrast, the equal life procedure treats each unit in the group as though its life was known.[51] Under the equal life procedure the property is divided into subgroups that each has a common life.[52]

3. Application Techniques

The third factor of a depreciation system is the "technique" for applying the depreciation rate. There are two commonly used techniques: "whole life" and "remaining life." The whole life

[48] *Id*. at 74.

[49] NARUC *supra* n. 8, at 61-62.

[50] *See* Wolf *supra* n. 7, at 74-75.

[51] *Id*. at 75.

[52] *Id*.

technique applies the depreciation rate on the estimated average service life of a group, while the remaining life technique seeks to recover undepreciated costs over the remaining life of the plant.[53]

In choosing the application technique, consideration should be given to the proper level of the accumulated depreciation account. Depreciation accrual rates are calculated using estimates of service life and salvage. Periodically these estimates must be revised due to changing conditions, which cause the accumulated depreciation account to be higher or lower than necessary. Unless some corrective action is taken, the annual accruals will not equal the original cost of the plant at the time of final retirement.[54] Analysts can calculate the level of imbalance in the accumulated depreciation account by determining the "calculated accumulated depreciation," (a.k.a. "theoretical reserve" and referred to in these appendices as "CAD"). The CAD is the calculated balance that would be in the accumulated depreciation account at a point in time using <u>current</u> depreciation parameters.[55] An imbalance exists when the actual accumulated depreciation account does not equal the CAD. The choice of application technique will affect how the imbalance is dealt with.

Use of the whole life technique requires that an adjustment be made to accumulated depreciation after calculation of the CAD. The adjustment can be made in a lump sum or over a period of time. With use of the remaining life technique, however, adjustments to accumulated depreciation are amortized over the remaining life of the property and are automatically included

---

[53] NARUC *supra* n. 8, at 63-64.

[54] Wolf *supra* n. 7, at 83.

[55] NARUC *supra* n. 8, at 325.

in the annual accrual.[56] This is one reason that the remaining life technique is popular among practitioners and regulators. The basic formula for the remaining life technique is as follows:[57]

**Equation 3:**
**Remaining Life Accrual**

$$Annual\ Accrual = \frac{Gross\ Plant - Accumulated\ Depreciation - Net\ Salvage}{Average\ Remaining\ Life}$$

The remaining life accrual formula is similar to the basic straight-line accrual formula above with two notable exceptions. First, the numerator has an additional factor in the remaining life formula: the accumulated depreciation. Second, the denominator is "average remaining life" instead of "average life." Essentially, the future accrual of plant (gross plant less accumulated depreciation) is allocated over the remaining life of plant. Thus, the adjustment to accumulated depreciation is "automatic" in the sense that it is built into the remaining life calculation.[58]

4. <u>Analysis Model</u>

The fourth parameter of a depreciation system, the "model," relates to the way of viewing the life and salvage characteristics of the vintage groups that have been combined to form a continuous property group for depreciation purposes.[59] A continuous property group is created when vintage groups are combined to form a common group. Over time, the characteristics of the property may change, but the continuous property group will continue. The two analysis models

---

[56] NARUC *supra* n. 8, at 65 ("The desirability of using the remaining life technique is that any necessary adjustments of [accumulated depreciation] . . . are accrued automatically over the remaining life of the property. Once commenced, adjustments to the depreciation reserve, outside of those inherent in the remaining life rate would require regulatory approval.").

[57] *Id*. at 64.

[58] Wolf *supra* n. 7, at 178.

[59] *See* Wolf *supra* n. 7, at 139 (I added the term "model" to distinguish this fourth depreciation system parameter from the other three parameters).

used among practitioners, the “broad group” and the “vintage group,” are two ways of viewing the life and salvage characteristics of the vintage groups that have been combined to form a continuous property group.

The broad group model views the continuous property group as a collection of vintage groups that each have the same life and salvage characteristics. Thus, a single survivor curve and a single salvage schedule are chosen to describe all the vintages in the continuous property group. In contrast, the vintage group model views the continuous property group as a collection of vintage groups that may have different life and salvage characteristics. Typically, there is not a significant difference between vintage group and broad group results unless vintages within the applicable property group experienced dramatically different retirement levels than anticipated in the overall estimated life for the group. For this reason, many analysts utilize the broad group procedure because it is more efficient.

# Appendix B

## D2017.9.79

## Montana-Dakota Utilities

# APPENDIX B:

# IOWA CURVES

Early work in the analysis of the service life of industrial property was based on models that described the life characteristics of human populations.[60] This explains why the word "mortality" is often used in the context of depreciation analysis. In fact, a group of property installed during the same accounting period is analogous to a group of humans born during the same calendar year. Each period the group will incur a certain fraction of deaths / retirements until there are no survivors. Describing this pattern of mortality is part of actuarial analysis, and is regularly used by insurance companies to determine life insurance premiums. The pattern of mortality may be described by several mathematical functions, particularly the survivor curve and frequency curve. Each curve may be derived from the other so that if one curve is known, the other may be obtained. A survivor curve is a graph of the percent of units remaining in service expressed as a function of age.[61] A frequency curve is a graph of the frequency of retirements as a function of age. Several types of survivor and frequency curves are illustrated in the figures below.

## 1. Development

The survivor curves used by analysts today were developed over several decades from extensive analysis of utility and industrial property. In 1931, Edwin Kurtz and Robley Winfrey used extensive data from a range of 65 industrial property groups to create survivor curves representing the life characteristics of each group of property.[62] They generalized the 65 curves

---

[60] Wolf *supra* n. 7, at 276.

[61] *Id*. at 23.

[62] *Id*. at 34.

into 13 survivor curve types and published their results in *Bulletin 103: Life Characteristics of Physical Property*. The 13 type curves were designed to be used as valuable aids in forecasting probable future service lives of industrial property. Over the next few years, Winfrey continued gathering additional data, particularly from public utility property, and expanded the examined property groups from 65 to 176.[63] This resulted in 5 additional survivor curve types for a total of 18 curves. In 1935, Winfrey published *Bulletin 125: Statistical Analysis of Industrial Property Retirements*. According to Winfrey, "[t]he 18 type curves are expected to represent quite well all survivor curves commonly encountered in utility and industrial practices."[64] These curves are known as the "Iowa curves" and are used extensively in depreciation analysis in order to obtain the average service lives of property groups. (Use of Iowa curves in actuarial analysis is further discussed in Appendix C.)

In 1942, Winfrey published *Bulletin 155: Depreciation of Group Properties*. In Bulletin 155, Winfrey made some slight revisions to a few of the 18 curve types, and published the equations, tables of the percent surviving, and probable life of each curve at five-percent intervals.[65] Rather than using the original formulas, analysts typically rely on the published tables containing the percentages surviving. This is because absent knowledge of the integration technique applied to each age interval, it is not possible to recreate the exact original published table values. In the 1970s, John Russo collected data from over 2,000 property accounts reflecting

---

[63] *Id*.

[64] Robley Winfrey, *Bulletin 125: Statistical Analyses of Industrial Property Retirements* 85, Vol. XXXIV, No. 23 (Iowa State College of Agriculture and Mechanic Arts 1935).

[65] Robley Winfrey, Bulletin 155: Depreciation of Group Properties 121-28, Vol XLI, No. 1 (The Iowa State College Bulletin 1942); see also Wolf supra n. 7, at 305-38 (publishing the percent surviving for each Iowa curve, including "O" type curve, at one percent intervals).

observations during the period 1965 – 1975 as part of his Ph.D. dissertation at Iowa State. Russo essentially repeated Winfrey's data collection, testing, and analysis methods used to develop the original Iowa curves, except that Russo studied industrial property in service several decades after Winfrey published the original Iowa curves. Russo drew three major conclusions from his research:[66]

1. No evidence was found to conclude that the Iowa curve set, as it stands, is not a valid system of standard curves;

2. No evidence was found to conclude that new curve shapes could be produced at this time that would add to the validity of the Iowa curve set; and

3. No evidence was found to suggest that the number of curves within the Iowa curve set should be reduced.

Prior to Russo's study, some had criticized the Iowa curves as being potentially obsolete because their development was rooted in the study of industrial property in existence during the early 1900s. Russo's research, however, negated this criticism by confirming that the Iowa curves represent a sufficiently wide range of life patterns, and that though technology will change over time, the underlying patterns of retirements remain constant and can be adequately described by the Iowa curves.[67]

Over the years, several more curve types have been added to Winfrey's 18 Iowa curves. In 1967, Harold Cowles added four origin-modal curves. In addition, a square curve is sometimes used to depict retirements which are all planned to occur at a given age. Finally, analysts

---

[66] *See* Wolf *supra* n. 7, at 37.

[67] *Id*.

commonly rely on several "half curves" derived from the original Iowa curves. Thus, the term "Iowa curves" could be said to describe up to 31 standardized survivor curves.

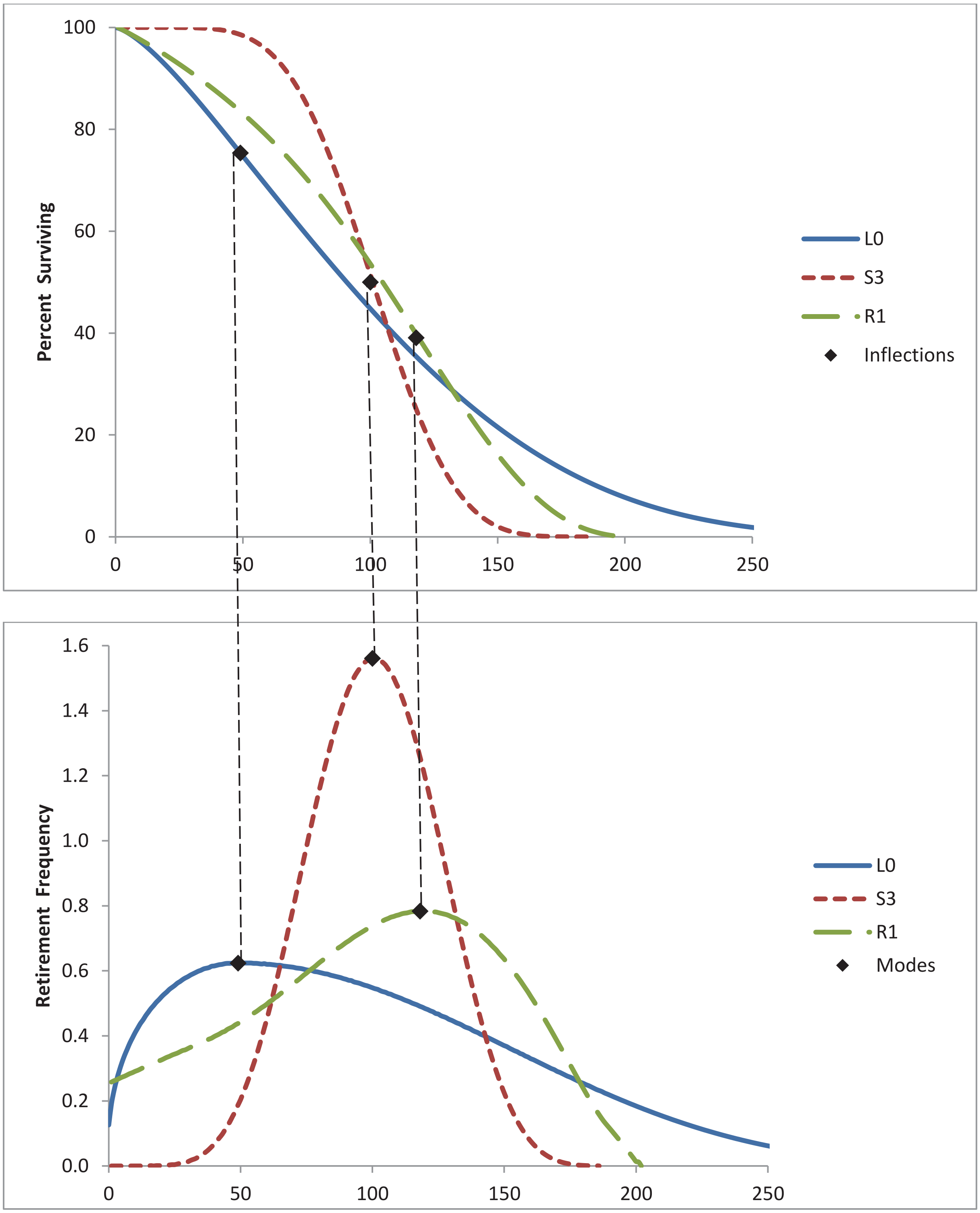
2. Classification

The Iowa curves are classified by three variables: modal location, average life, and variation of life. First, the mode is the percent life that results in the highest point of the frequency curve and the "inflection point" on the survivor curve. The modal age is the age at which the greatest rate of retirement occurs. As illustrated in the figure below, the modes appear at the steepest point of each survivor curve in the top graph, as well as the highest point of each corresponding frequency curve in the bottom graph.

The classification of the survivor curves was made according to whether the mode of the retirement frequency curves was to the left, to the right, or coincident with average service life. There are three modal "families" of curves: six left modal curves (L0, L1, L2, L3, L4, L5); five right modal curves (R1, R2, R3, R4, R5); and seven symmetrical curves (S0, S1, S2, S3, S4, S5, S6).[68] In the figure below, one curve from each family is shown: L0, S3 and R1, with average life at 100 on the x-axis. It is clear from the graphs that the modes for the L0 and R1 curves appear to the left and right of average life respectively, while the S3 mode is coincident with average life.

[68] In 1967, Harold A. Cowles added four origin-modal curves known as "O type" curves. There are also several "half" curves and a square curve, so the total amount of survivor curves commonly called "Iowa" curves is about 31 (see NARUC supra n. 8, at 68).

**Figure 10:**
**Modal Age Illustration**



The second Iowa curve classification variable is average life. The Iowa curves were designed using a single parameter of age expressed as a percent of average life instead of actual age. This was necessary for the curves to be of practical value. As Winfrey notes:

> Since the location of a particular survivor on a graph is affected by both its span in years and the shape of the curve, it is difficult to classify a group of curves unless one of these variables can be controlled. This is easily done by expressing the age in percent of average life."[69]

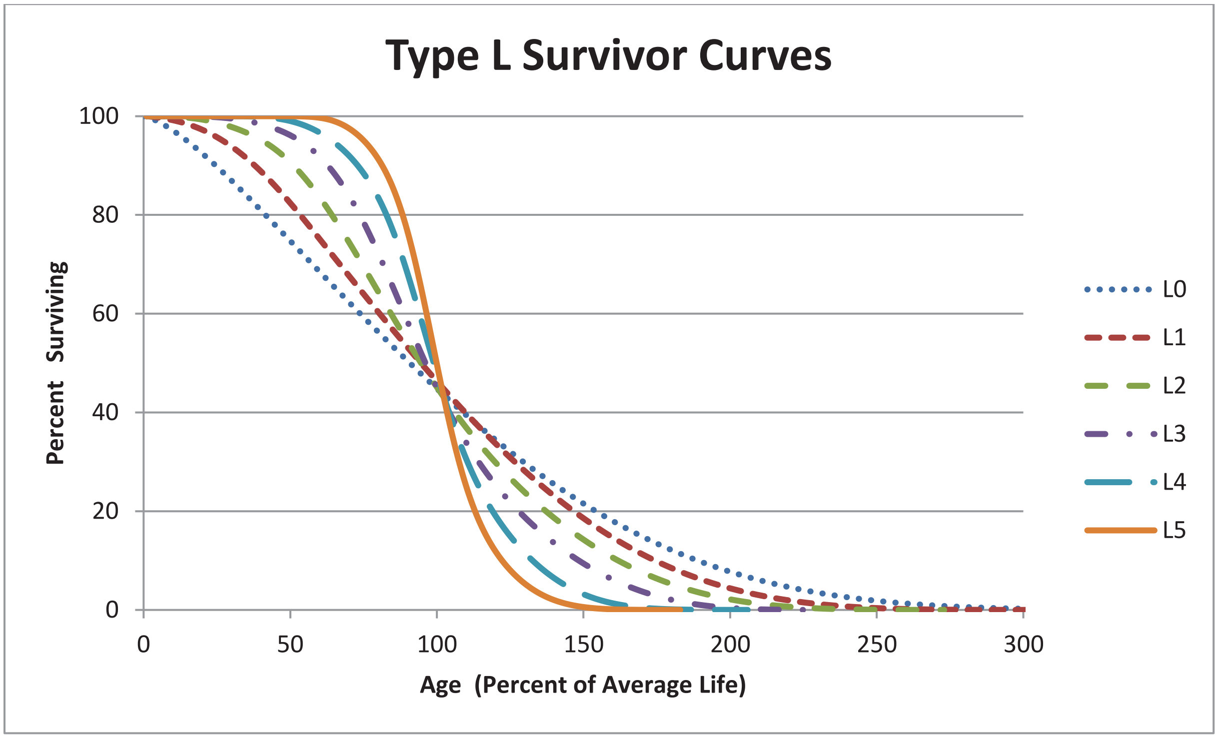
Because age is expressed in terms of percent of average life, any particular Iowa curve type can be modified to forecast property groups with various average lives.

The third variable, variation of life, is represented by the numbers next to each letter. A lower number (e.g., L1) indicates a relatively low mode, large variation, and large maximum life; a higher number (e.g., L5) indicates a relatively high mode, small variation, and small maximum life. All three classification variables – modal location, average life, and variation of life – are used to describe each Iowa curve. For example, a 13-L1 Iowa curve describes a group of property with a 13-year average life, with the greatest number of retirements occurring before (or to the left of) the average life, and a relatively low mode. The graphs below show these 18 survivor curves, organized by modal family.

---

[69] Winfrey *supra* n. 75, at 60.

**Figure 11:**
**Type L Survivor and Frequency Curves**



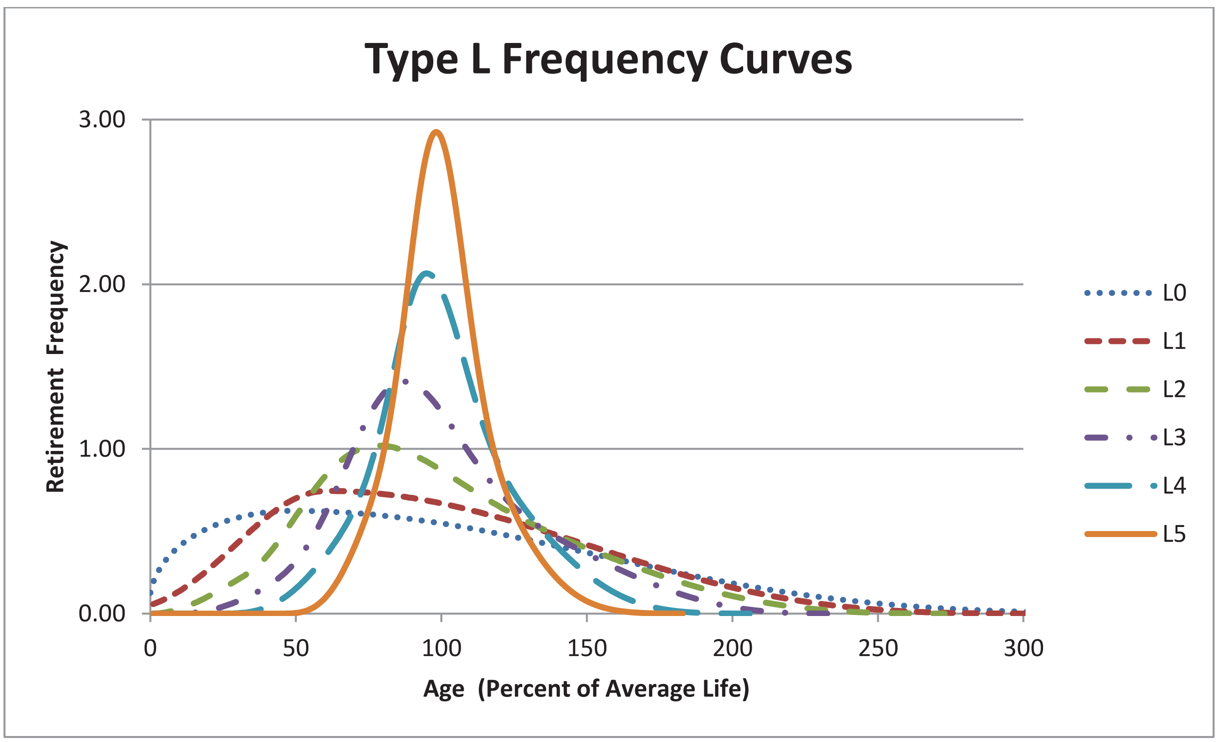
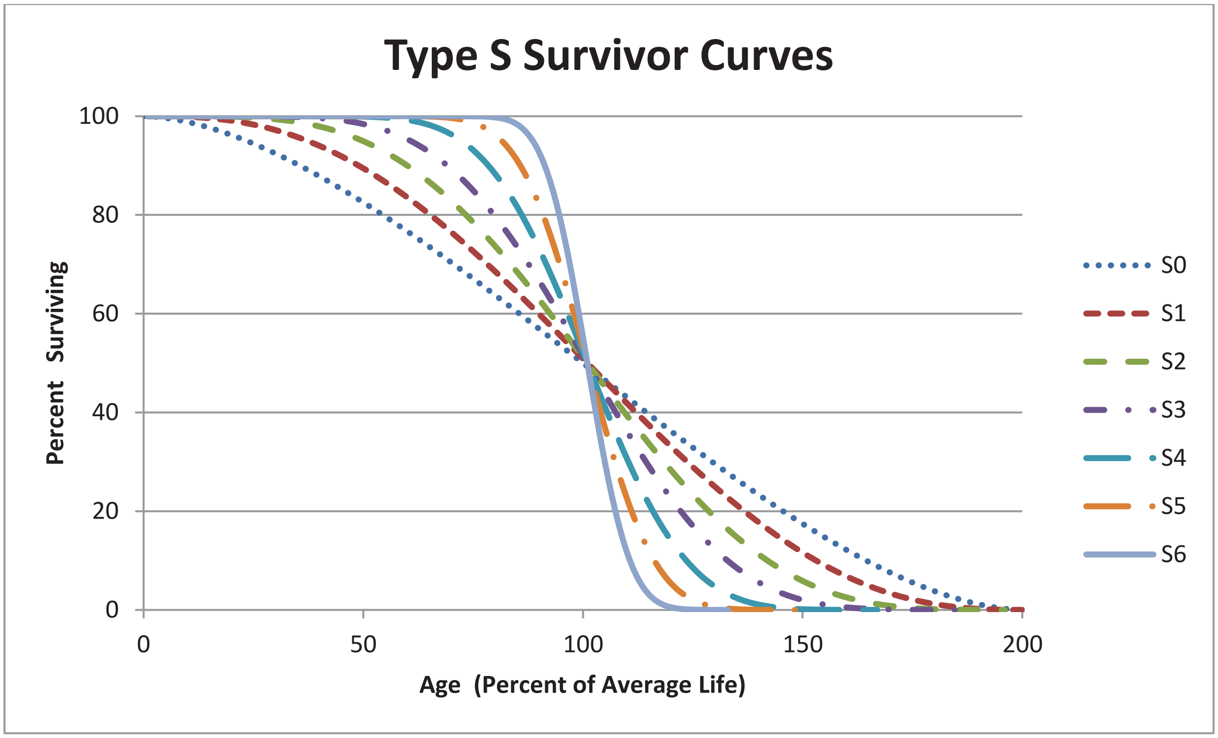



**Figure 12:**
**Type S Survivor and Frequency Curves**



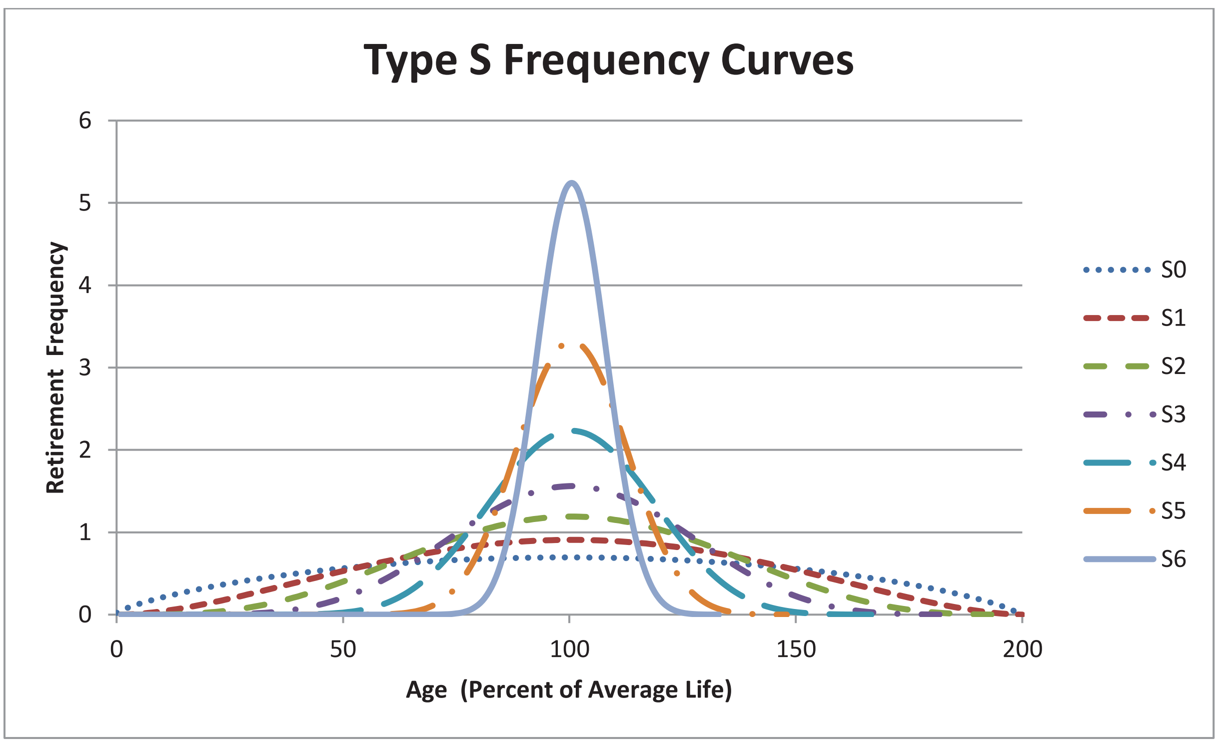
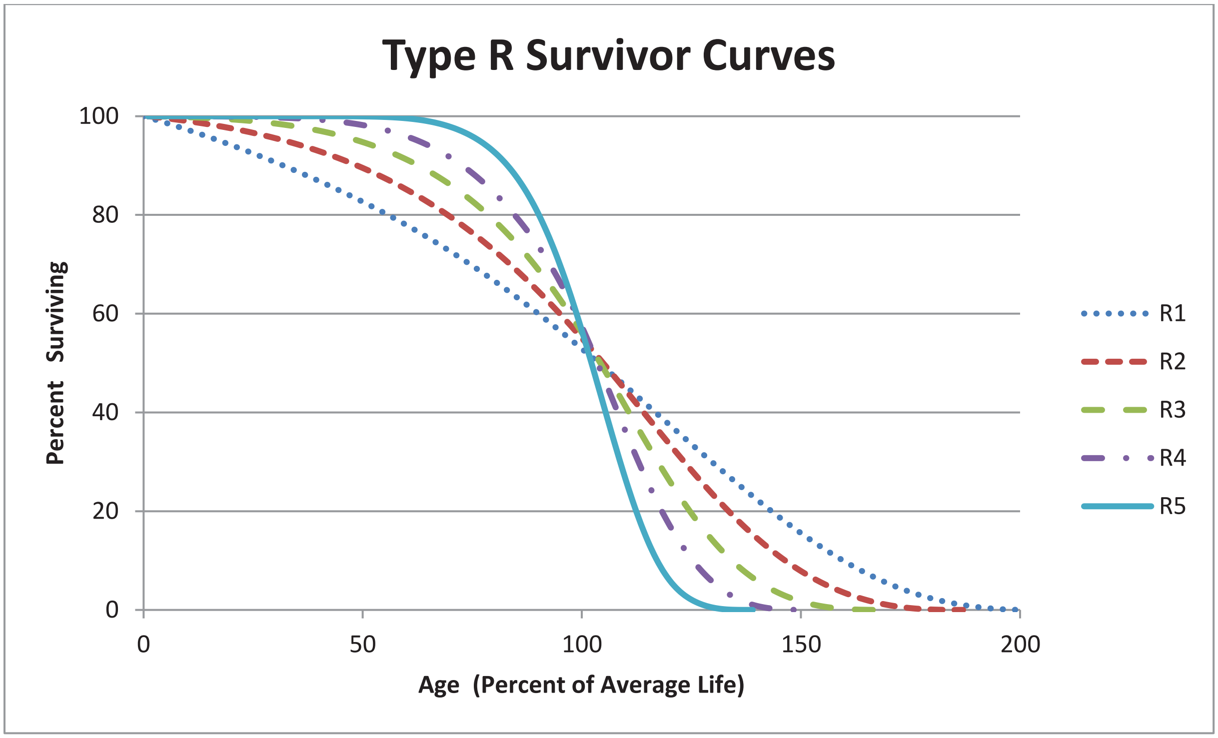
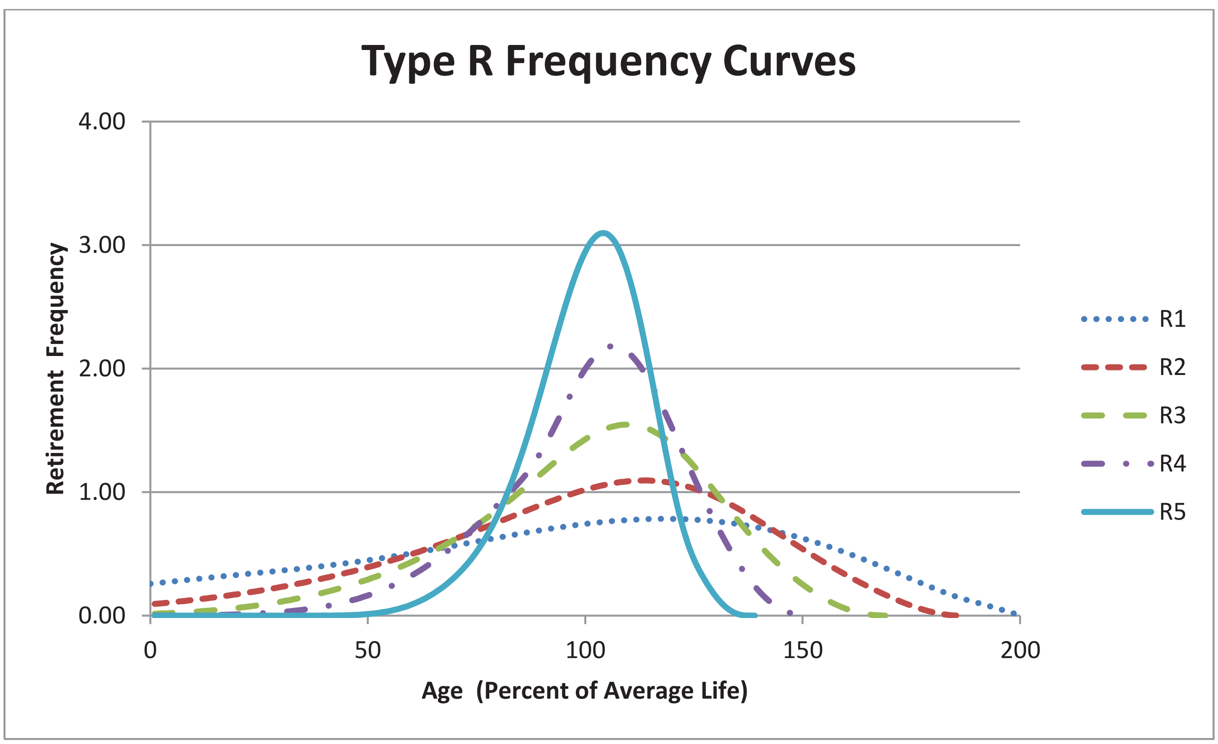



**Figure 13:**
**Type R Survivor and Frequency Curves**



As shown in the graphs above, the modes for the L family frequency curves occur to the left of average life (100% on the x-axis), while the S family modes occur at the average, and the R family modes occur after the average.

3. Types of Lives

Several other important statistical analyses and types of lives may be derived from an Iowa curve. These include: 1) average life; 2) realized life; 3) remaining life; and 4) probable life. The figure below illustrates these concepts. It shows the frequency curve, survivor curve, and probable life curve. Age $M_x$ on the x-axis represents the modal age, while age $AL_x$ represents the average age. Thus, this figure illustrates an "L type" Iowa curve since the mode occurs before the average.[70]

First, average life is the area under the survivor curve from age zero to maximum life. Because the survivor curve is measured in percent, the area under the curve must be divided by 100% to convert it from percent-years to years. The formula for average life is as follows:[71]

**Equation 4:**
**Average Life**

$$Average\ Life\ = \frac{Area\ Under\ Survivor\ Curve\ from\ Age\ 0\ to\ Max\ Life}{100\%}$$

Thus, average life may not be determined without a complete survivor curve. Many property groups being analyzed will not have experienced full retirement. This results in a "stub" survivor

[70] From age zero to age $M_x$ on the survivor curve, it could be said that the percent surviving from this property group is decreasing at an increasing rate. Conversely, from point $M_x$ to maximum on the survivor curve, the percent surviving is decreasing at a decreasing rate.

[71] *See* NARUC *supra* n. 8, at 71.

curve. Iowa curves are used to extend stub curves to maximum life in order for the average life calculation to be made (see Appendix C).

Realized life is similar to average life, except that realized life is the average years of service experienced to date from the vintage's original installations.[72] As shown in the figure below, realized life is the area under the survivor curve from zero to age $RL_X$. Likewise, unrealized life is the area under the survivor curve from age $RL_X$ to maximum life. Thus, it could be said that average life equals realized life plus unrealized life.

Average remaining life represents the future years of service expected from the surviving property.[73] Remaining life is sometimes referred to as "average remaining life" and "life expectancy." To calculate average remaining life at age x, the area under the estimated future portion of the survivor curve is divided by the percent surviving at age x (denoted $S_X$). Thus, the average remaining life formula is:

**Equation 5:**
**Average Remaining Life**

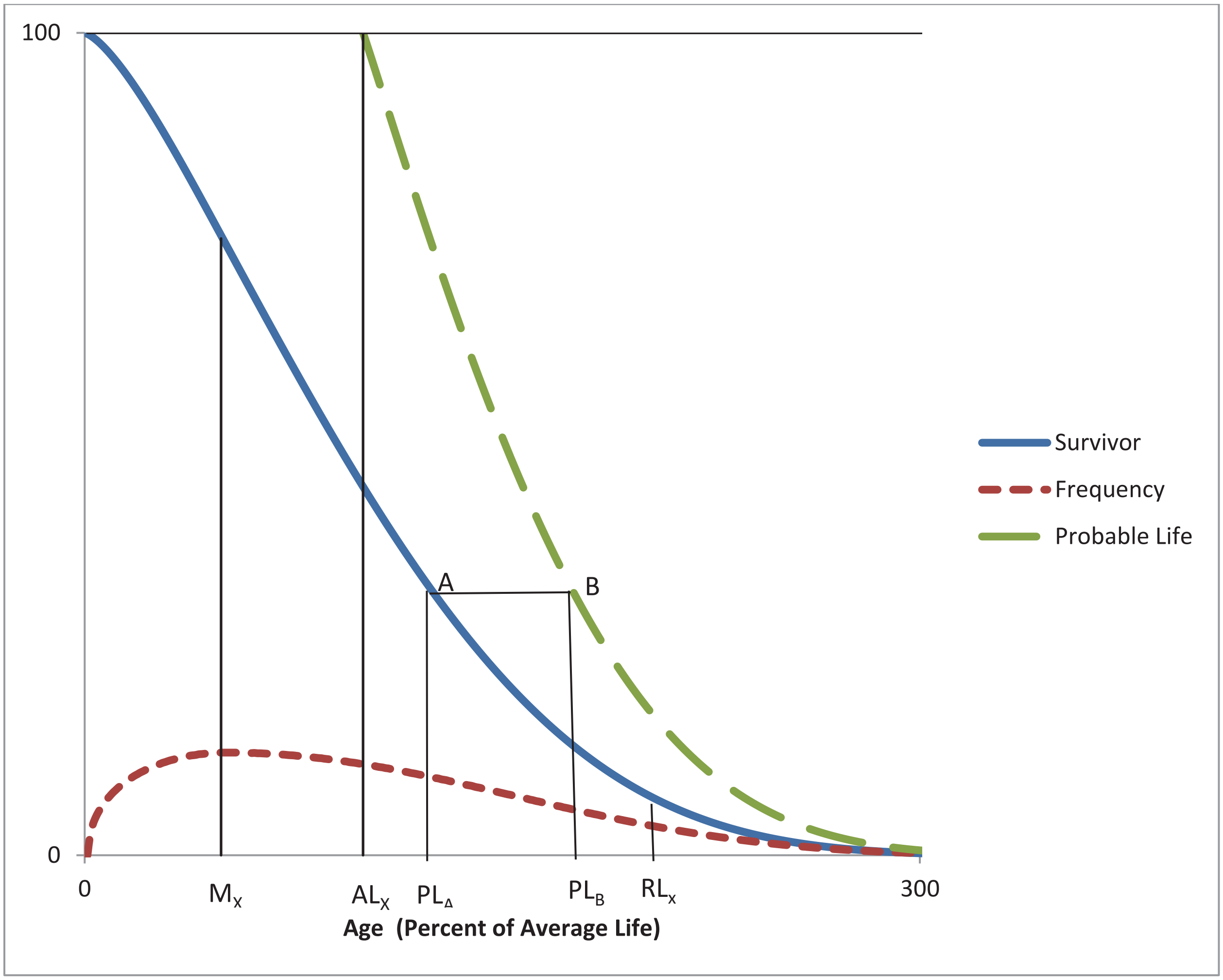
$$Average\ Remaining\ Life = \frac{Area\ Under\ Survivor\ Curve\ from\ Age\ x\ to\ Max\ Life}{S_X}$$

It is necessary to determine average remaining life to calculate the annual accrual under the remaining life technique.

[72] *Id*. at 73.

[73] *Id*. at 74.

**Figure 14:**
**Iowa Curve Derivations**




Finally, the probable life may also be determined from the Iowa curve. The probable life of a property group is the total life expectancy of the property surviving at any age and is equal to the remaining life plus the current age.[74] The probable life is also illustrated in this figure. The probable life at age $PL_A$ is the age at point $PL_B$. Thus, to read the probable life at age $PL_A$, see the

[74] Wolf *supra* n. 7, at 28.

corresponding point on the survivor curve above at point "A," then horizontally to point "B" on the probable life curve, and back down to the age corresponding to point "B." It is no coincidence that the vertical line from $AL_X$ connects at the top of the probable life curve. This is because at age zero, probable life equals average life.

# Appendix C

## D2017.9.79

## Montana-Dakota Utilities

# APPENDIX C:

# ACTUARIAL ANALYSIS

Actuarial science is a discipline that applies various statistical methods to assess risk probabilities and other related functions. Actuaries often study human mortality. The results from historical mortality data are used to predict how long similar groups of people who are alive today will live. Insurance companies rely on actuarial analysis in determining premiums for life insurance policies.

The study of human mortality is analogous to estimating service lives of industrial property groups. While some humans die solely from chance, most deaths are related to age; that is, death rates generally increase as age increases. Similarly, physical plant is also subject to forces of retirement. These forces include physical, functional, and contingent factors, as shown in the table below.[75]

**Figure 15:**
**Forces of Retirement**

| Physical Factors | Functional Factors | Contingent Factors |
|---|---|---|
| Wear and tear<br>Decay or deterioration<br>Action of the elements | Inadequacy<br>Obsolescence<br>Changes in technology<br>Regulations<br>Managerial discretion | Casualties or disasters<br>Extraordinary obsolescence |

While actuaries study historical mortality data in order to predict how long a group of people will live, depreciation analysts must look at a utility's historical data in order to estimate the average lives of property groups. A utility's historical data is often contained in the Continuing Property Records ("CPR"). Generally, a CPR should contain 1) an inventory of property record

---

[75] NARUC *supra* n. 8, at 14-15.

units; 2) the association of costs with such units; and 3) the dates of installation and removal of plant. Since actuarial analysis includes the examination of historical data to forecast future retirements, the historical data used in the analysis should not contain events that are anomalous or unlikely to recur.[76] Historical data is used in the retirement rate actuarial method, which is discussed further below.

The Retirement Rate Method

There are several systematic actuarial methods that use historical data to calculate observed survivor curves for property groups. Of these methods, the retirement rate method is superior, and is widely employed by depreciation analysts.[77] The retirement rate method is ultimately used to develop an observed survivor curve, which can be fitted with an Iowa curve discussed in Appendix B to forecast average life. The observed survivor curve is calculated by using an observed life table ("OLT"). The figures below illustrate how the OLT is developed. First, historical property data are organized in a matrix format, with placement years on the left forming rows, and experience years on the top forming columns. The placement year (a.k.a. "vintage year" or "installation year") is the year of placement into service of a group of property. The experience year (a.k.a. "activity year") refers to the accounting data for a particular calendar year. The two matrices below use aged data – that is, data for which the dates of placements, retirements, transfers, and other transactions are known. Without aged data, the retirement rate actuarial method may not be employed. The first matrix is the exposure matrix, which shows the exposures

---

[76] *Id*. at 112-13.

[77] Anson Marston, Robley Winfrey & Jean C. Hempstead, *Engineering Valuation and Depreciation* 154 (2nd ed., McGraw-Hill Book Company, Inc. 1953).

at the beginning of each year.[78] An exposure is simply the depreciable property subject to retirement during a period. The second matrix is the retirement matrix, which shows the annual retirements during each year. Each matrix covers placement years 2003–2015, and experience years 2008-2015. In the exposure matrix, the number in the 2012 experience column and the 2003 placement row is $192,000. This means at the beginning of 2012, there was $192,000 still exposed to retirement from the vintage group placed in 2003. Likewise, in the retirement matrix, $19,000 of the dollars invested in 2003 were retired during 2012.

**Figure 16:**
**Exposure Matrix**

| | Experience Years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Exposures at January 1 of Each Year (Dollars in 000's) | | | | | | | | | |
| Placement Years | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total at Start of Age Interval | Age Interval |
| 2003 | 261 | 245 | 228 | 211 | **192** | 173 | 152 | 131 | 131 | 11.5 - 12.5 |
| 2004 | 267 | 252 | 236 | 220 | 202 | **184** | 165 | 145 | 297 | 10.5 - 11.5 |
| 2005 | 304 | 291 | 277 | 263 | 248 | 232 | **216** | 198 | 536 | 9.5 - 10.5 |
| 2006 | 345 | 334 | 322 | 310 | 298 | 284 | 270 | **255** | **847** | 8.5 - 9.5 |
| 2007 | 367 | 357 | 347 | 335 | 324 | 312 | 299 | 286 | 1,201 | 7.5 - 8.5 |
| 2008 | 375 | 366 | 357 | 347 | 336 | 325 | 314 | 302 | 1,581 | 6.5 - 7.5 |
| 2009 | | 377 | 366 | 356 | 346 | 336 | 327 | 319 | 1,986 | 5.5 - 6.5 |
| 2010 | | | 381 | 369 | 358 | 347 | 336 | 327 | 2,404 | 4.5 - 5.5 |
| 2011 | | | | 386 | 372 | 359 | 346 | 334 | 2,559 | 3.5 - 4.5 |
| 2012 | | | | | 395 | 380 | 366 | 352 | 2,722 | 2.5 - 3.5 |
| 2013 | | | | | | 401 | 385 | 370 | 2,866 | 1.5 - 2.5 |
| 2014 | | | | | | | 410 | 393 | 2,998 | 0.5 - 1.5 |
| 2015 | | | | | | | | 416 | 3,141 | 0.0 - 0.5 |
| Total | 1919 | 2222 | 2514 | 2796 | 3070 | 3333 | 3586 | 3827 | 23,268 | |

[78] Technically, the last numbers in each column are "gross additions" rather than exposures. Gross additions do not include adjustments and transfers applicable to plant placed in a previous year. Once retirements, adjustments, and transfers are factored in, the balance at the beginning of the next accounting period is called an "exposure" rather than an addition.

**Figure 17:**
**Retirement Matrix**

| Placement Years | Experience Years<br>Retirments During the Year (Dollars in 000's)<br>2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total During Age Interval | Age Interval |
|---|---|---|---|---|---|---|---|---|---|---|
| 2003 | 16 | 17 | 18 | 19 | **19** | 20 | 21 | 23 | 23 | 11.5 - 12.5 |
| 2004 | 15 | 16 | 17 | 17 | 18 | **19** | 20 | 21 | 43 | 10.5 - 11.5 |
| 2005 | 13 | 14 | 14 | 15 | 16 | 17 | **17** | 18 | 59 | 9.5 - 10.5 |
| 2006 | 11 | 12 | 12 | 13 | 13 | 14 | 15 | **15** | **71** | 8.5 - 9.5 |
| 2007 | 10 | 11 | 11 | 12 | 12 | 13 | 13 | 14 | 82 | 7.5 - 8.5 |
| 2008 | 9 | 9 | 10 | 10 | 11 | 11 | 12 | 13 | 91 | 6.5 - 7.5 |
| 2009 | | 11 | 10 | 10 | 9 | 9 | 9 | 8 | 95 | 5.5 - 6.5 |
| 2010 | | | 12 | 11 | 11 | 10 | 10 | 9 | 100 | 4.5 - 5.5 |
| 2011 | | | | 14 | 13 | 13 | 12 | 11 | 93 | 3.5 - 4.5 |
| 2012 | | | | | 15 | 14 | 14 | 13 | 91 | 2.5 - 3.5 |
| 2013 | | | | | | 16 | 15 | 14 | 93 | 1.5 - 2.5 |
| 2014 | | | | | | | 17 | 16 | 100 | 0.5 - 1.5 |
| 2015 | | | | | | | | 18 | 112 | 0.0 - 0.5 |
| Total | 74 | 89 | 104 | 121 | 139 | 157 | 175 | 194 | 1,052 | |

These matrices help visualize how exposure and retirement data are calculated for each age interval. An age interval is typically one year. A common convention is to assume that any unit installed during the year is installed in the middle of the calendar year (i.e., July 1st). This convention is called the "half-year convention" and effectively assumes that all units are installed uniformly during the year.[79] Adoption of the half-year convention leads to age intervals of 0-0.5 years, 0.5-1.5 years, etc., as shown in the matrices.

The purpose of the matrices is to calculate the totals for each age interval, which are shown in the second column from the right in each matrix. This column is calculated by adding each number from the corresponding age interval in the matrix. For example, in the exposure matrix, the total amount of exposures at the beginning of the 8.5-9.5 age interval is $847,000. This number was calculated by adding the numbers shown on the "stairs" to the left (192+184+216+255=847).

---

[79] Wolf *supra* n. 7, at 22.

The same calculation is applied to each number in the column. The amounts retired during the year in the retirements matrix affect the exposures at the beginning of each year in the exposures matrix. For example, the amount exposed to retirement in 2008 from the 2003 vintage is $261,000. The amount retired during 2008 from the 2003 vintage is $16,000. Thus, the amount exposed to retirement at the beginning of 2009 from the 2003 vintage is $245,000 ($261,000 - $16,000). The company's property records may contain other transactions which affect the property, including sales, transfers, and adjusting entries. Although these transactions are not shown in the matrices above, they would nonetheless affect the amount exposed to retirement at the beginning of each year.

The totaled amounts for each age interval in both matrices are used to form the exposure and retirement columns in the OLT, as shown in the chart below. This chart also shows the retirement ratio and the survivor ratio for each age interval. The retirement ratio for an age interval is the ratio of retirements during the interval to the property exposed to retirement at the beginning of the interval. The retirement ratio represents the probability that the property surviving at the beginning of an age interval will be retired during the interval. The survivor ratio is simply the complement to the retirement ratio (1 – retirement ratio). The survivor ratio represents the probability that the property surviving at the beginning of an age interval will survive to the next age interval.

**Figure 18:**
**Observed Life Table**

| Age at Start of Interval | Exposures at Start of Age Interval | Retirements During Age Interval | Retirement Ratio | Survivor Ratio | Percent Surviving at Start of Age Interval |
|---|---|---|---|---|---|
| A | B | C | D = C / B | E = 1 - D | F |
| 0.0 | 3,141 | 112 | 0.036 | 0.964 | **100.00** |
| 0.5 | 2,998 | 100 | 0.033 | 0.967 | **96.43** |
| 1.5 | 2,866 | 93 | 0.032 | 0.968 | **93.21** |
| 2.5 | 2,722 | 91 | 0.033 | 0.967 | **90.19** |
| 3.5 | 2,559 | 93 | 0.037 | 0.963 | **87.19** |
| 4.5 | 2,404 | 100 | 0.042 | 0.958 | **84.01** |
| 5.5 | 1,986 | 95 | 0.048 | 0.952 | **80.50** |
| 6.5 | 1,581 | 91 | 0.058 | 0.942 | **76.67** |
| 7.5 | 1,201 | 82 | 0.068 | 0.932 | **72.26** |
| 8.5 | 847 | 71 | 0.084 | 0.916 | **67.31** |
| 9.5 | 536 | 59 | 0.110 | 0.890 | **61.63** |
| 10.5 | 297 | 43 | 0.143 | 0.857 | **54.87** |
| 11.5 | 131 | 23 | 0.172 | 0.828 | **47.01** |
| | | | | | **38.91** |
| Total | 23,268 | 1,052 | | | |

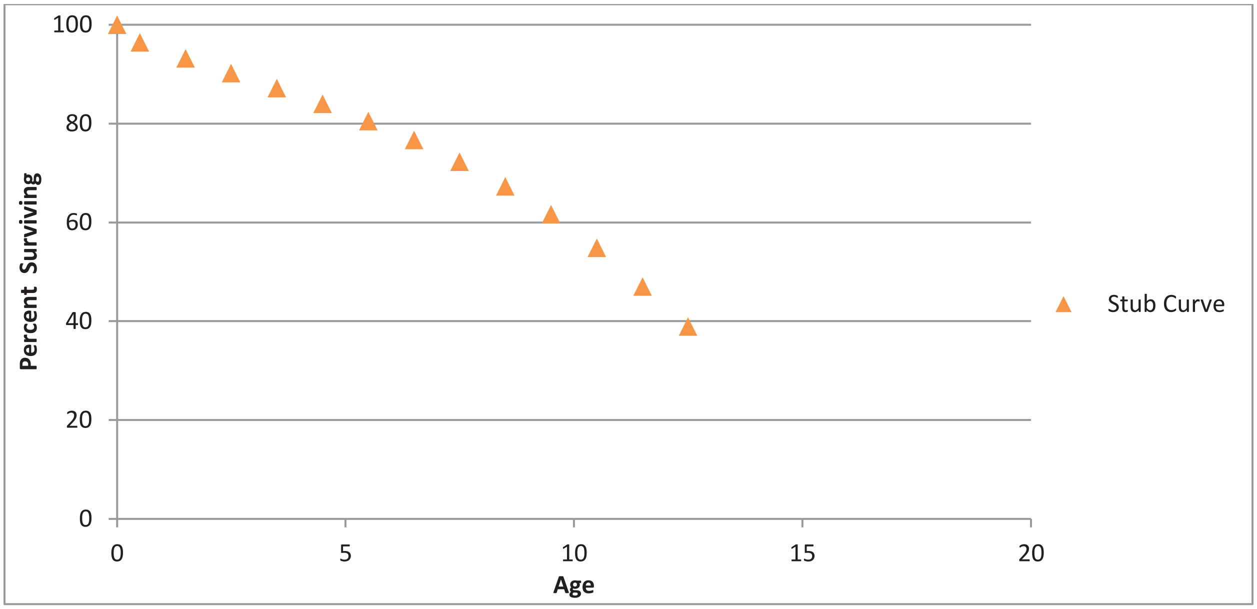
Column F on the right shows the percentages surviving at the beginning of each age interval. This column starts at 100% surviving. Each consecutive number below is calculated by multiplying the percent surviving from the previous age interval by the corresponding survivor ratio for that age interval. For example, the percent surviving at the start of age interval 1.5 is 93.21%, which was calculated by multiplying the percent surviving for age interval 0.5 (96.43%) by the survivor ratio for age interval 0.5 (0.967)[80].

The percentages surviving in Column F are the numbers that are used to form the original survivor curve. This particular curve starts at 100% surviving and ends at 38.91% surviving. An

[80] Multiplying 96.43 by 0.967 does not equal 93.21 exactly due to rounding.

observed survivor curve such as this that does not reach zero percent surviving is called a "stub" curve. The figure below illustrates the stub survivor curve derived from the OLT above.

**Figure 19:**
**Original "Stub" Survivor Curve**




The matrices used to develop the basic OLT and stub survivor curve provide a basic illustration of the retirement rate method in that only a few placement and experience years were used. In reality, analysts may have several decades of aged property data to analyze. In that case, it may be useful to use a technique called "banding" in order to identify trends in the data.

<u>Banding</u>

The forces of retirement and characteristics of industrial property are constantly changing. A depreciation analyst may examine the magnitude of these changes. Analysts often use a technique called "banding" to assist with this process. Banding refers to the merging of several years of data into a single data set for further analysis, and it is a common technique associated with the retirement rate method.[81] There are three primary benefits of using bands in depreciation analysis:

1. <u>Increasing the sample size</u>. In statistical analyses, the larger the sample size in relation to the body of total data, the greater the reliability of the result;

2. <u>Smooth the observed data</u>. Generally, the data obtained from a single activity or vintage year will not produce an observed life table that can be easily fit; and

3. <u>Identify trends</u>. By looking at successive bands, the analyst may identify broad trends in the data that may be useful in projecting the future life characteristics of the property.[82]

Two common types of banding methods are the "placement band" method and the "experience band" method." A placement band, as the name implies, isolates selected placement years for analysis. The figure below illustrates the same exposure matrix shown above, except that only the placement years 2005-2008 are considered in calculating the total exposures at the beginning of each age interval.

---

[81] NARUC *supra* n. 8, at 113.

[82] *Id*.

**Figure 20:**
**Placement Bands**

| | Experience Years Exposures at January 1 of Each Year (Dollars in 000's) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Placement Years | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total at Start of Age Interval | Age Interval |
| 2003 | 261 | 245 | 228 | 211 | 192 | 173 | 152 | 131 | | 11.5 - 12.5 |
| 2004 | 267 | 252 | 236 | 220 | 202 | 184 | 165 | 145 | | 10.5 - 11.5 |
| 2005 | 304 | 291 | 277 | 263 | 248 | 232 | 216 | 198 | 198 | 9.5 - 10.5 |
| 2006 | 345 | 334 | 322 | 310 | 298 | 284 | 270 | 255 | 471 | 8.5 - 9.5 |
| 2007 | 367 | 357 | 347 | 335 | 324 | 312 | 299 | 286 | 788 | 7.5 - 8.5 |
| 2008 | 375 | 366 | 357 | 347 | 336 | 325 | 314 | 302 | 1,133 | 6.5 - 7.5 |
| 2009 | | 377 | 366 | 356 | 346 | 336 | 327 | 319 | 1,186 | 5.5 - 6.5 |
| 2010 | | | 381 | 369 | 358 | 347 | 336 | 327 | 1,237 | 4.5 - 5.5 |
| 2011 | | | | 386 | 372 | 359 | 346 | 334 | 1,285 | 3.5 - 4.5 |
| 2012 | | | | | 395 | 380 | 366 | 352 | 1,331 | 2.5 - 3.5 |
| 2013 | | | | | | 401 | 385 | 370 | 1,059 | 1.5 - 2.5 |
| 2014 | | | | | | | 410 | 393 | 733 | 0.5 - 1.5 |
| 2015 | | | | | | | | 416 | 375 | 0.0 - 0.5 |
| Total | 1919 | 2222 | 2514 | 2796 | 3070 | 3333 | 3586 | 3827 | 9,796 | |

The shaded cells within the placement band equal the total exposures at the beginning of age interval 4.5–5.5 ($1,237). The same placement band would be used for the retirement matrix covering the same placement years of 2005 – 2008. This of course would result in a different OLT and original stub survivor curve than those that were calculated above without the restriction of a placement band.

Analysts often use placement bands for comparing the survivor characteristics of properties with different physical characteristics.[83] Placement bands allow analysts to isolate the effects of changes in technology and materials that occur in successive generations of plant. For example, if in 2005 an electric utility began placing transmission poles into service with a special chemical treatment that extended the service lives of those poles, an analyst could use placement bands to isolate and analyze the effect of that change in the property group's physical characteristics. While

[83] Wolf *supra* n. 7, at 182.

placement bands are very useful in depreciation analysis, they also possess an intrinsic dilemma. A fundamental characteristic of placement bands is that they yield fairly complete survivor curves for older vintages. However, with newer vintages, which are arguably more valuable for forecasting, placement bands yield shorter survivor curves. Longer "stub" curves are considered more valuable for forecasting average life. Thus, an analyst must select a band width broad enough to provide confidence in the reliability of the resulting curve fit, yet narrow enough so that an emerging trend may be observed.[84]

Analysts also use "experience bands." Experience bands show the composite retirement history for all vintages during a select set of activity years. The figure below shows the same data presented in the previous exposure matrices, except that the experience band from 2011 – 2013 is isolated, resulting in different interval totals.

[84] NARUC *supra* n. 8, at 114.

**Figure 21:**
**Experience Bands**

| | Experience Years<br>Exposures at January 1 of Each Year (Dollars in 000's) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Placement Years | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total at Start of Age Interval | Age Interval |
| 2003 | 261 | 245 | 228 | 211 | 192 | 173 | 152 | 131 | | 11.5 - 12.5 |
| 2004 | 267 | 252 | 236 | 220 | 202 | 184 | 165 | 145 | | 10.5 - 11.5 |
| 2005 | 304 | 291 | 277 | 263 | 248 | 232 | 216 | 198 | 173 | 9.5 - 10.5 |
| 2006 | 345 | 334 | 322 | 310 | 298 | 284 | 270 | 255 | 376 | 8.5 - 9.5 |
| 2007 | 367 | 357 | 347 | 335 | 324 | 312 | 299 | 286 | 645 | 7.5 - 8.5 |
| 2008 | 375 | 366 | 357 | 347 | 336 | 325 | 314 | 302 | 752 | 6.5 - 7.5 |
| 2009 | | 377 | 366 | 356 | 346 | 336 | 327 | 319 | 872 | 5.5 - 6.5 |
| 2010 | | | 381 | 369 | 358 | 347 | 336 | 327 | 959 | 4.5 - 5.5 |
| 2011 | | | | 386 | 372 | 359 | 346 | 334 | 1,008 | 3.5 - 4.5 |
| 2012 | | | | | 395 | 380 | 366 | 352 | 1,039 | 2.5 - 3.5 |
| 2013 | | | | | | 401 | 385 | 370 | 1,072 | 1.5 - 2.5 |
| 2014 | | | | | | | 410 | 393 | 1,121 | 0.5 - 1.5 |
| 2015 | | | | | | | | 416 | 1,182 | 0.0 - 0.5 |
| Total | 1919 | 2222 | 2514 | 2796 | 3070 | 3333 | 3586 | 3827 | 9,199 | |

The shaded cells within the experience band equal the total exposures at the beginning of age interval 4.5–5.5 ($1,237). The same experience band would be used for the retirement matrix covering the same experience years of 2011 – 2013. This of course would result in a different OLT and original stub survivor than if the band had not been used. Analysts often use experience bands to isolate and analyze the effects of an operating environment over time.[85] Likewise, the use of experience bands allows analysis of the effects of an unusual environmental event. For example, if an unusually severe ice storm occurred in 2013, destruction from that storm would affect an electric utility's line transformers of all ages. That is, each of the line transformers from each placement year would be affected, including those recently installed in 2012, as well as those installed in 2003. Using experience bands, an analyst could isolate or even eliminate the 2013 experience year from the analysis. In contrast, a placement band would not effectively isolate the

[85] *Id*.

ice storm's effect on life characteristics. Rather, the placement band would show an unusually large rate of retirement during 2013, making it more difficult to accurately fit the data with a smooth Iowa curve. Experience bands tend to yield the most complete stub curves for recent bands because they have the greatest number of vintages included. Longer stub curves are better for forecasting. The experience bands, however, may also result in more erratic retirement dispersion making the curve fitting process more difficult.

Depreciation analysts must use professional judgment in determining the types of bands to use and the band widths. In practice, analysts may use various combinations of placement and experience bands in order to increase the data sample size, identify trends and changes in life characteristics, and isolate unusual events. Regardless of which bands are used, observed survivor curves in depreciation analysis rarely reach zero percent. This is because, as seen in the OLT above, relatively newer vintage groups have not yet been fully retired at the time the property is studied. An analyst could confine the analysis to older, fully retired vintage groups to get complete survivor curves, but such analysis would ignore some of the property currently in service and would arguably not provide an accurate description of life characteristics for current plant in service. Because a complete curve is necessary to calculate the average life of the property group, however, curve fitting techniques using Iowa curves or other standardized curves may be employed in order to complete the stub curve.

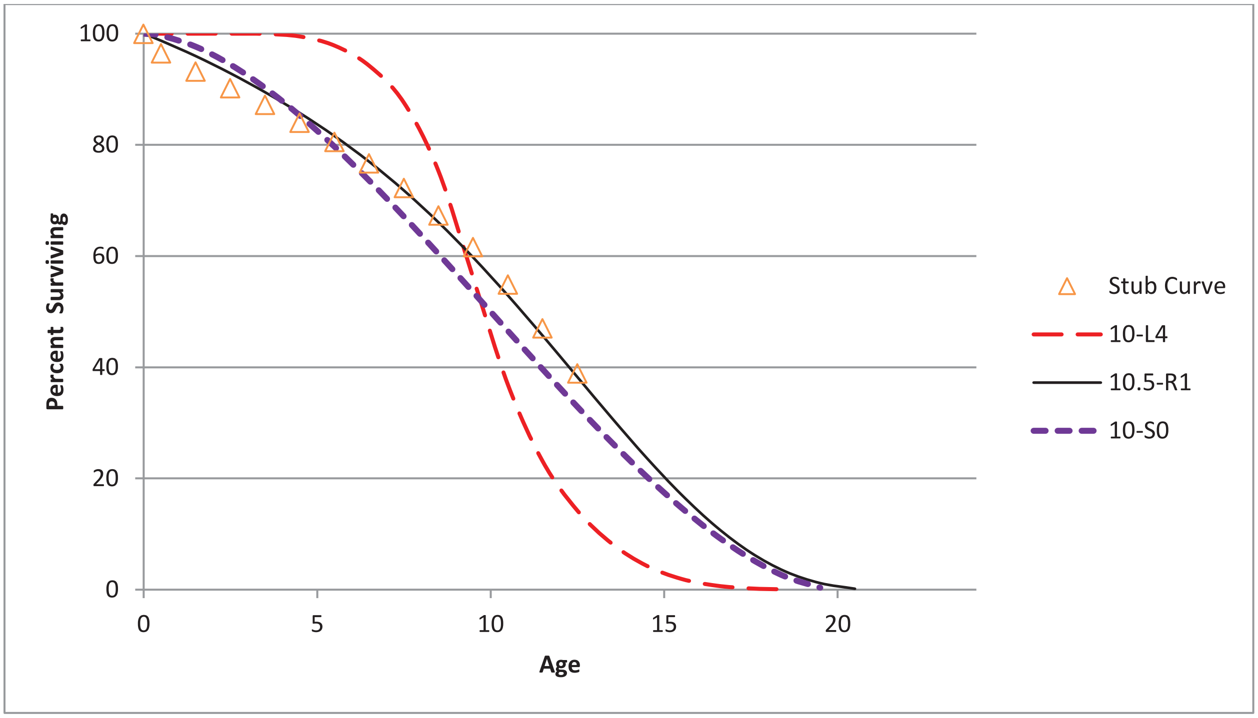
Curve Fitting

Depreciation analysts typically use the survivor curve rather than the frequency curve to fit the observed stub curves. The most commonly used generalized survivor curves in the curve fitting process are the Iowa curves discussed above. As Wolf notes, if "the Iowa curves are adopted as a model, an underlying assumption is that the process describing the retirement pattern is one of the 22 [or more] processes described by the Iowa curves."[86]

Curve fitting may be done through visual matching or mathematical matching. In visual curve fitting, the analyst visually examines the plotted data to make an initial judgment about the Iowa curves that may be a good fit. The figure below illustrates the stub survivor curve shown above. It also shows three different Iowa curves: the 10-L4, the 10.5-R1, and the 10-S0. Visually, it is clear that the 10.5-R1 curve is a better fit than the other two curves.

[86] Wolf *supra* n. 7, at 46 (22 curves includes Winfrey's 18 original curves plus Cowles's four "O" type curves).

**Figure 22:**
**Visual Curve Fitting**




In mathematical fitting, the least squares method is used to calculate the best fit. This mathematical method would be excessively time consuming if done by hand. With the use of modern computer software however, mathematical fitting is an efficient and useful process. The typical logic for a computer program, as well as the software employed for the analysis in this testimony is as follows:

> First (an Iowa curve) curve is arbitrarily selected. . . . If the observed curve is a stub curve, . . . calculate the area under the curve and up to the age at final data point. Call this area the realized life. Then systematically vary the average life of the theoretical survivor curve and calculate its realized life at the age corresponding to the study date. This trial and error procedure ends when you find an average life such that the realized life of the theoretical curve equals the realized life of the observed curve. Call this the average life.
>
> Once the average life is found, calculate the difference between each percent surviving point on the observed survivor curve and the corresponding point on the Iowa curve. Square each difference and sum them. The sum of squares is used as a measure of goodness of fit for that particular Iowa type curve. This procedure is

> repeated for the remaining 21 Iowa type curves. The "best fit" is declared to be the type of curve that minimizes the sum of differences squared.[87]

Mathematical fitting requires less judgment from the analyst, and is thus less subjective. Blind reliance on mathematical fitting, however, may lead to poor estimates. Thus, analysts should employ both mathematical and visual curve fitting in reaching their final estimates. This way, analysts may utilize the objective nature of mathematical fitting while still employing professional judgment. As Wolf notes: "The results of mathematical curve fitting serve as a guide for the analyst and speed the visual fitting process. But the results of the mathematical fitting should be checked visually, and the final determination of the best fit be made by the analyst."[88]

In the graph above, visual fitting was sufficient to determine that the 10.5-R1 Iowa curve was a better fit than the 10-L4 and the 10-S0 curves. Using the sum of least squares method, mathematical fitting confirms the same result. In the chart below, the percentages surviving from the OLT that formed the original stub curve are shown in the left column, while the corresponding percentages surviving for each age interval are shown for the three Iowa curves. The right portion of the chart shows the differences between the points on each Iowa curve and the stub curve. These differences are summed at the bottom. Curve 10.5-R1 is the best fit because the sum of the squared differences for this curve is less than the same sum for the other two curves. Curve 10-L4 is the worst fit, which was also confirmed visually.

---

[87] Wolf *supra* n. 7, at 47.

[88] *Id*. at 48.

**Figure 23:**
**Mathematical Fitting**

| Age Interval | Stub Curve | Iowa Curves 10-L4 | Iowa Curves 10-S0 | Iowa Curves 10.5-R1 | Squared Differences 10-L4 | Squared Differences 10-S0 | Squared Differences 10.5-R1 |
|---|---|---|---|---|---|---|---|
| 0.0 | 100.0 | 100.0 | 100.0 | 100.0 | 0.0 | 0.0 | 0.0 |
| 0.5 | 96.4 | 100.0 | 99.7 | 98.7 | 12.7 | 10.3 | 5.3 |
| 1.5 | 93.2 | 100.0 | 97.7 | 96.0 | 46.1 | 19.8 | 7.6 |
| 2.5 | 90.2 | 100.0 | 94.4 | 92.9 | 96.2 | 18.0 | 7.2 |
| 3.5 | 87.2 | 100.0 | 90.2 | 89.5 | 162.9 | 9.3 | 5.2 |
| 4.5 | 84.0 | 99.5 | 85.3 | 85.7 | 239.9 | 1.6 | 2.9 |
| 5.5 | 80.5 | 97.9 | 79.7 | 81.6 | 301.1 | 0.7 | 1.2 |
| 6.5 | 76.7 | 94.2 | 73.6 | 77.0 | 308.5 | 9.5 | 0.1 |
| 7.5 | 72.3 | 87.6 | 67.1 | 71.8 | 235.2 | 26.5 | 0.2 |
| 8.5 | 67.3 | 75.2 | 60.4 | 66.1 | 62.7 | 48.2 | 1.6 |
| 9.5 | 61.6 | 56.0 | 53.5 | 59.7 | 31.4 | 66.6 | 3.6 |
| 10.5 | 54.9 | 36.8 | 46.5 | 52.9 | 325.4 | 69.6 | 3.9 |
| 11.5 | 47.0 | 23.1 | 39.6 | 45.7 | 572.6 | 54.4 | 1.8 |
| 12.5 | 38.9 | 14.2 | 32.9 | 38.2 | 609.6 | 36.2 | 0.4 |
| **SUM** | | | | | **3004.2** | **371.0** | **41.0** |

# Exhibit No._(DJG-1)

## D2017.9.79

## Montana-Dakota Utilities

100 Park Avenue, Suite 700
Oklahoma City, OK 73102

# DAVID J. GARRETT

405.249.1050
dgarrett@resolveuc.com

## EDUCATION

University of Oklahoma — Norman, OK
**Master of Business Administration** — 2014
Areas of Concentration: Finance, Energy

University of Oklahoma College of Law — Norman, OK
**Juris Doctor** — 2007
Member, American Indian Law Review

University of Oklahoma — Norman, OK
**Bachelor of Business Administration** — 2003
Major: Finance

## PROFESSIONAL DESIGNATIONS

Society of Depreciation Professionals
**Certified Depreciation Professional (CDP)**

Society of Utility and Regulatory Financial Analysts
**Certified Rate of Return Analyst (CRRA)**

The Mediation Institute
**Certified Civil / Commercial & Employment Mediator**

## WORK EXPERIENCE

Resolve Utility Consulting PLLC — Oklahoma City, OK
**Managing Member** — 2016 – Present
Provide expert analysis and testimony specializing in depreciation and cost of capital issues for clients in utility regulatory proceedings.

Oklahoma Corporation Commission — Oklahoma City, OK
**Public Utility Regulatory Analyst** — 2012 – 2016
**Assistant General Counsel** — 2011 – 2012
Represented commission staff in utility regulatory proceedings and provided legal opinions to commissioners. Provided expert analysis and testimony in depreciation, cost of capital, incentive compensation, payroll and other issues.

Perebus Counsel, PLLC — Oklahoma City, OK
**Managing Member** — 2009 – 2011
Represented clients in the areas of family law, estate planning, debt negotiations, business organization, and utility regulation.

Moricoli & Schovanec, P.C. — Oklahoma City, OK
**Associate Attorney** — 2007 – 2009
Represented clients in the areas of contracts, oil and gas, business structures and estate administration.

## TEACHING EXPERIENCE

**University of Oklahoma** — Norman, OK
Adjunct Instructor – "Conflict Resolution" — 2014 – Present
Adjunct Instructor – "Ethics in Leadership"

**Rose State College** — Midwest City, OK
Adjunct Instructor – "Legal Research" — 2013 – 2015
Adjunct Instructor – "Oil & Gas Law"

## PUBLICATIONS

**American Indian Law Review** — Norman, OK
"Vine of the Dead: Reviving Equal Protection Rites for Religious Drug Use" — 2006
(31 Am. Indian L. Rev. 143)

## VOLUNTEER EXPERIENCE

**Calm Waters** — Oklahoma City, OK
Board Member — 2015 – Present
Participate in management of operations, attend meetings, review performance, compensation, and financial records. Assist in fundraising events.

Group Facilitator & Fundraiser — 2014 – Present
Facilitate group meetings designed to help children and families cope with divorce and tragic events. Assist in fundraising events.

**St. Jude Children's Research Hospital** — Oklahoma City, OK
Oklahoma Fundraising Committee — 2008 – 2010
Raised money for charity by organizing local fundraising events.

## PROFESSIONAL ASSOCIATIONS

**Oklahoma Bar Association** 2007 – Present

**Society of Depreciation Professionals** 2014 – Present
Board Member – President 2017
Participate in management of operations, attend meetings, review performance, organize presentation agenda.

**Society of Utility Regulatory Financial Analysts** 2014 – Present

## SELECTED CONTINUING PROFESSIONAL EDUCATION

Society of Depreciation Professionals — Austin, TX
**"Life and Net Salvage Analysis"** — 2015
Extensive instruction on utility depreciation, including actuarial and simulation life analysis modes, gross salvage, cost of removal, life cycle analysis, and technology forecasting.

Society of Depreciation Professionals — New Orleans, LA
**"Introduction to Depreciation" and "Extended Training"** — 2014
Extensive instruction on utility depreciation, including average lives and net salvage.

Society of Utility and Regulatory Financial Analysts — Indianapolis, IN
**46th Financial Forum. "The Regulatory Compact: Is it Still Relevant?"** — 2014
Forum discussions on current issues.

New Mexico State University, Center for Public Utilities — Santa Fe, NM
**Current Issues 2012, "The Santa Fe Conference"** — 2012
Forum discussions on various current issues in utility regulation.

Michigan State University, Institute of Public Utilities — Clearwater, FL
**"39th Eastern NARUC Utility Rate School"** — 2011
One-week, hands-on training emphasizing the fundamentals of the utility ratemaking process.

New Mexico State University, Center for Public Utilities — Albuquerque, NM
**"The Basics: Practical Regulatory Training for the Changing Electric Industries"** — 2010
One-week, hands-on training designed to provide a solid foundation in core areas of utility ratemaking.

The Mediation Institute — Oklahoma City, OK
**"Civil / Commercial & Employment Mediation Training"** — 2009
Extensive instruction and mock mediations designed to build foundations in conducting mediations in civil matters.

# Utility Regulatory Proceedings

| State | Regulatory Agency / Company-Applicant | Docket Number | Testimony / Analysis: Issues | Type | Date |
|---|---|---|---|---|---|
| WA | Washington Utilities & Transportation Commission<br>Avista Corporation | UE-170485<br>UG-170486 | Cost of capital and authorized rate of return | Prefiled | 10/27/2017 |
| WY | Wyoming Public Services Commission<br>Powder River Energy Corporation | PUD 201700151 | Risk and credit analysis | Prefiled<br>Live | 8/28/2017<br>9/29/2017 |
| OK | Oklahoma Corporation Commission<br>Public Service Co. of Oklahoma | PUD 201700151 | Depreciation rates, terminal salvage, risk analysis | Prefiled<br>Live | 9/21/2017<br>11/6/2017 |
| TX | Public Utility Commission of Texas<br>Oncor Electric Delivery Company | PUC 46957 | Depreciation rates, simulated plant record analysis | Pending | |
| NV | Nevada Public Utilities Commission<br>Nevada Power Company | 17-06004 | Depreciation rates, net salvage | Prefiled | 10/6/2017 |
| TX | Public Utility Commission of Texas<br>El Paso Electric Company | PUC 46831 | Depreciation rates, interim retirements | Prefiled | 6/23/2017 |
| ID | Idaho Public Utilities Commission<br>Idaho Power Company | IPC-E-16-24 | Accelerated depreciation of North Valmy plant | Settled | 5/31/2017 |
| ID | Idaho Public Utilities Commission<br>Idaho Power Company | IPC-E-16-23 | Depreciation rates | Settled | 5/31/2017 |
| TX | Public Utility Commission of Texas<br>Southwestern Electric Power Company | PUC 46449 | Depreciation rates, decommissioning costs, terminal net salvage | Prefiled<br>Live | 4/25/2017<br>6/8/2017 |
| MA | Massachusetts Department of Public Utilities<br>Eversource Energy | D.P.U. 17-05 | Cost of capital, capital structure, and rate of return | Prefiled | 4/28/2017 |
| TX | Railroad Commission of Texas<br>Atmos Pipeline - Texas | GUD 10580 | Depreciation rates, depreciation grouping procedure | Prefiled | 3/22/2017 |
| TX | Public Utility Commission of Texas<br>Sharyland Utility Co. | PUC 45414 | Depreciation rates, simulated and actuarial analysis | Prefiled | 2/28/2017 |
| OK | Oklahoma Corporation Commission<br>Empire District Electric Co. | PUD 201600468 | Cost of capital, depreciation rates, terminal salvage, lifespans | Prefiled<br>Live | 3/13/2017<br>5/11/2017 |

# Utility Regulatory Proceedings

| State | Regulatory Agency / Company-Applicant | Docket Number | Testimony / Analysis: Issues | Type | Date |
|---|---|---|---|---|---|
| TX | Railroad Commission of Texas<br>CenterPoint Energy Texas Gas | GUD 10567 | Depreciation rates, simulated and actuarial analysis | Prefiled | 2/21/2017 |
| AR | Arkansas Public Service Commission<br>Oklahoma Gas & Electric Co. | 160-159-GU | Cost of capital, depreciation rates, terminal salvage, lifespans | Prefiled | 1/31/2017 |
| FL | Florida Public Service Commission<br>Peoples Gas | 16-159-GU | Depreciation rates | Report | 11/4/2016 |
| AZ | Arizona Corporation Commission<br>Arizona Public Service Co. | E-01345A-16-0036 | Cost of capital, depreciation rates, terminal salvage, lifespans | Pre-filed | 12/28/2016 |
| NV | Nevada Public Utilities Commission<br>Sierra Pacific Power Co. | 16-06008 | Depreciation rates, terminal salvage, lifespans, theoretical reserve | Pre-filed | 9/23/2016 |
| OK | Oklahoma Corporation Commission<br>Oklahoma Gas & Electric Co. | PUD 201500273 | Cost of capital, depreciation rates, terminal salvage, lifespans | Pre-filed<br>Live | 3/21/2016<br>5/3/2016 |
| OK | Oklahoma Corporation Commission<br>Public Service Co. of Oklahoma | PUD 201500208 | Cost of capital, depreciation rates, terminal salvage, lifespans | Pre-filed<br>Live | 10/14/2015<br>12/8/2015 |
| OK | Oklahoma Corporation Commission<br>Oklahoma Natural Gas Co. | PUD 201500213 | Cost of capital and depreciation rates | Pre-filed | 10/19/2015 |
| OK | Oklahoma Corporation Commission<br>Oak Hills Water System | PUD 201500123 | Cost of capital and depreciation rates | Pre-filed<br>Live | 7/8/2015<br>8/14/2015 |
| OK | Oklahoma Corporation Commission<br>CenterPoint Energy Oklahoma Gas | PUD 201400227 | Fuel prudence review and fuel adjustment clause | Pre-filed<br>Live | 11/3/2014<br>2/10/2015 |
| OK | Oklahoma Corporation Commission<br>Public Service Co. of Oklahoma | PUD 201400233 | Certificate of authority to issue new debt securities | Pre-filed<br>Live | 9/12/2014<br>9/25/2014 |
| OK | Oklahoma Corporation Commission<br>Empire District Electric Co. | PUD 201400226 | Fuel prudence review and fuel adjustment clause | Pre-filed<br>Live | 12/9/2014<br>1/22/2015 |
| OK | Oklahoma Corporation Commission<br>Fort Cobb Fuel Authority | PUD 201400219 | Fuel prudence review and fuel adjustment clause | Pre-filed<br>Live | <br>1/29/2015 |
| OK | Oklahoma Corporation Commission<br>Fort Cobb Fuel Authority | PUD 201400140 | Outside services, legislative advocacy, payroll expense, and insurance expense | Pre-filed | 12/16/2014 |

# Utility Regulatory Proceedings

| State | Regulatory Agency / Company-Applicant | Docket Number | Testimony / Analysis: Issues | Type | Date |
|---|---|---|---|---|---|
| OK | Oklahoma Corporation Commission<br>Public Service Co. of Oklahoma | PUD 201300201 | Authorization of standby and supplemental tariff | Pre-filed<br>Live | 12/9/2013<br>12/19/2013 |
| OK | Oklahoma Corporation Commission<br>Fort Cobb Fuel Authority | PUD 201300134 | Fuel prudence review and fuel adjustment clause | Pre-filed<br>Live | 10/23/2013<br>1/30/2014 |
| OK | Oklahoma Corporation Commission<br>Empire District Electric Co. | PUD 201300131 | Fuel prudence review and fuel adjustment clause | Pre-filed<br>Live | 11/21/2013<br>12/19/2013 |
| OK | Oklahoma Corporation Commission<br>CenterPoint Energy Oklahoma Gas | PUD 201300127 | Fuel prudence review and fuel adjustment clause | Pre-filed<br>Live | 10/21/2013<br>1/23/2014 |
| OK | Oklahoma Corporation Commission<br>Oklahoma Gas & Electric Co. | PUD 201200185 | Gas transportation contract extension | Pre-filed<br>Live | 9/20/2012<br>10/9/2012 |
| OK | Oklahoma Corporation Commission<br>Empire District Electric Co. | PUD 201200170 | Fuel prudence review and fuel adjustment clause | Pre-filed<br>Live | 10/31/2012<br>12/13/2012 |
| OK | Oklahoma Corporation Commission<br>Oklahoma Gas & Electric Co. | PUD 201200169 | Fuel prudence review and fuel adjustment clause | Pre-filed<br>Live | 12/19/2012<br>4/4/2013 |

# Exhibit No._(DJG-2)

## D2017.9.79

## Montana-Dakota Utilities

# Summary Expense Adjustment

## Summary Rate and Accrual Comparison

| Plant | Original | Company Position | | MCC Position | | Difference | |
|---|---|---|---|---|---|---|---|
| Function | Cost | Rate | Accrual | Rate | Accrual | Rate | Accrual |
| Distributrion | 395,274,934 | 4.15% | 16,423,189 | 3.42% | 13,514,817 | -0.74% | (2,908,372) |
| General | 33,665,703 | 5.08% | 1,709,320 | 4.28% | 1,439,808 | -0.80% | (269,512) |
| **Total** | $ 428,940,636 | 4.23% | $ 18,132,509 | 3.49% | $ 14,954,625 | -0.74% | **$ (3,177,884)** |

* See Exhibit DJG-4 for detailed expense adjustment; accrual differences as of the depreciation study date
* See Direct Testimony of Ralph Smith for MCC adjustment to Company depreciation expense

# Exhibit No._(DJG-3)

## D2017.9.79

## Montana-Dakota Utilities

# Detailed Rate Comparison

| | | [1] | [2] | | | | [3] | | | | [4] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Company Proposal | | | | MCC Proposal | | | | Difference | |
| | | | Iowa Curve | | | | Iowa Curve | | | | | |
| Account No. | Description | Original Cost | Type | AL | Rate | Annual Accrual | Type | AL | Rate | Annual Accrual | Rate | Annual Accrual |
| | **Distribution Plant** | | | | | | | | | | | |
| 374.20 | Rights of Way | 431,148 | R3 | 65 | 1.37% | 5,907 | R3 | 65 | 1.37% | 5,907 | 0.00% | - |
| 375.00 | Distr. Meas & Reg Station Structures | 842,394 | R3 | 60 | 2.49% | 20,976 | R3 | 60 | 2.49% | 20,976 | 0.00% | - |
| 376.10 | Mains-Steel | 69,466,301 | R3 | 62 | 2.39% | 1,660,245 | R2.5 | 65 | 2.20% | 1,526,612 | -0.19% | (133,633) |
| 376.20 | Mains-Plastic | 133,632,165 | R4 | 47 | 3.41% | 4,556,857 | R2 | 54 | 2.54% | 3,388,862 | -0.87% | (1,167,995) |
| 376.30 | Mains-Valves | 2,585,180 | R3 | 40 | 3.74% | 96,686 | R3 | 40 | 3.74% | 96,686 | 0.00% | - |
| 376.40 | Mains-Manholes | 3,287 | R3 | 55 | 2.70% | 89 | R3 | 55 | 2.70% | 89 | 0.00% | - |
| 376.50 | Mains-Bridge & River Crossings | 92,767 | R3 | 45 | 3.31% | 3,071 | R3 | 45 | 3.31% | 3,071 | 0.00% | - |
| 378.00 | Meas & Reg Station Equip-General | 3,438,764 | R2 | 50 | 2.40% | 82,530 | R2 | 50 | 2.40% | 82,530 | 0.00% | - |
| 379.00 | Meas & Reg Station Equip-City Gate | 6,204,779 | R2.5 | 45 | 2.50% | 155,119 | R2.5 | 45 | 2.51% | 155,119 | 0.01% | - |
| 380.10 | Services-Steel | 7,315,314 | R0.5 | 38 | 8.29% | 606,439 | R0.5 | 44 | 4.82% | 352,447 | -3.47% | (253,993) |
| 380.20 | Services-Plastic | 86,602,561 | R4 | 44 | 7.06% | 6,114,141 | R4 | 48 | 5.67% | 4,910,283 | -1.39% | (1,203,857) |
| 380.30 | Farm & Fuel Lines | 89,508 | R1.5 | 30 | 10.22% | 9,148 | R1.5 | 30 | 10.22% | 9,148 | 0.00% | - |
| 381.00 | Meters | 70,002,134 | R3 | 31 | 4.13% | 2,891,088 | R3 | 32 | 3.94% * | 2,891,088 | -0.19% | - |
| 383.00 | Service Regulators | 9,356,598 | R3 | 60 | 1.47% | 137,542 | R3 | 60 | 1.48% | 137,542 | 0.01% | - |
| 385.00 | Industrial Meas. & Reg. Station Equip | 1,276,281 | R4 | 40 | 3.03% | 38,671 | R4 | 44 | 2.69% | 34,381 | -0.34% | (4,290) |
| 386.10 | Misc Property on Customers Premise | 1,680 | R3 | 15 | 0.00% | - | R3 | 15 | 0.00% | - | 0.00% | - |
| 386.20 | CNG Refueling station | 113,207 | R3 | 15 | -19.37% | (21,928) | R3 | 15 | -19.37% | (21,928) | 0.00% | - |
| 386.30 | CNG Lease/Demo | - | R3 | 15 | 0.00% | - | R3 | 15 | 0.00% | - | 0.00% | - |
| 387.10 | Cathodic Protection Equipment | 3,157,815 | R2 | 40 | 1.66% | 52,420 | R1.5 | 49 | 1.24% | 39,303 | -0.42% | (13,117) |
| 387.20 | Other Distribution Equipment | 663,051 | R3 | 25 | 2.14% | 14,189 | R3 | 25 | 2.14% | 14,189 | 0.00% | - |
| | Total Distribution Plant | 395,274,934 | | | 4.15% | 16,423,189 | | | 3.42% | 13,514,817 | -0.74% | (2,908,372) |
| | **General Plant** | | | | | | | | | | | |
| 390.00 | General Structures | 8,943,375 | R2 | 40 | 2.42% | 216,430 | R2 | 40 | 2.42% | 216,430 | 0.00% | - |
| 391.10 | Office Furniture & Equipment | 288,341 | R1 | 15 | 3.89% | 11,221 | R1 | 15 | 3.89% | 11,221 | 0.00% | - |
| 391.30 | Computer Equipment - PC | 363,388 | R2 | 5 | 17.22% | 62,559 | R2 | 5 | 17.22% | 62,559 | 0.00% | - |
| 392.10 | Transportation Equipment (Trailers) | 456,602 | R1.5 | 19 | 0.38% | 1,735 | R1.5 | 19 | 0.38% | 1,735 | 0.00% | - |
| 392.20 | Trans Equipment (Cars & Trucks) | 9,713,348 | R3 | 9 | 7.25% | 704,218 | R3 | 9 | 7.24% | 704,218 | -0.01% | - |
| 393.00 | Stores Equipment | 57,183 | R3 | 35 | 2.71% | 1,552 | R3 | 35 | 2.71% | 1,552 | 0.00% | - |
| 394.10 | Tools, Shop & Garage Equip. (Non-Unitized) | 2,982,790 | R1.5 | 18 | 5.62% | 167,777 | R1.5 | 18 | 5.62% | 167,777 | 0.00% | - |
| 394.30 | Vehicle Maintenance Equipment | 5,923 | R3 | 20 | 5.62% | 333 | R3 | 20 | 5.62% | 333 | 0.00% | - |
| 395.00 | Laboratory Equipment | 195,762 | R2 | 20 | 2.06% | 4,026 | R2 | 20 | 2.06% | 4,026 | 0.00% | - |
| 396.10 | Work Equipment (Trailers) | 804,548 | R2 | 28 | 1.23% | 9,896 | R2 | 28 | 1.22% | 9,896 | -0.01% | - |
| 396.20 | Power Operated Equipment | 8,408,368 | L1 | 3 | 5.30% | 445,643 | L1 | 7 | 2.11% | 177,395 | -3.19% | (268,249) |
| 397.10 | Radio Communication Equip. (Fixed) | 995,297 | R3 | 15 | 6.26% | 62,315 | R3 | 15 | 6.26% | 62,315 | 0.00% | - |
| 397.20 | Radio Communication Equip. (Mobile) | 392,159 | R3 | 15 | 6.34% | 24,863 | R3 | 15 | 6.34% | 24,863 | 0.00% | - |
| 397.30 | General Telephone Communication Equip. | 16,430 | R1 | 10 | 8.67% | 1,425 | R1 | 10 | 8.67% | 1,425 | 0.00% | - |
| 398.00 | Miscellaneous Equipment | 42,189 | R2 | 20 | -11.07% | (4,672) | R2 | 20 | -11.07% | (4,672) | 0.00% | - |

# Detailed Rate Comparison



| | | [1] | [2] | | | | [3] | | | | [4] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Company Proposal | | | | MCC Proposal | | | | Difference | |
| | | | Iowa Curve | | | | Iowa Curve | | | | | |
| Account No. | Description | Original Cost | Type | AL | Rate | Annual Accrual | Type | AL | Rate | Annual Accrual | Rate | Annual Accrual |
| | Total General Plant | 33,665,703 | | | 5.08% | 1,709,320 | | | 4.28% | 1,439,808 | -0.80% | (269,512) |
| | **TOTAL PLANT STUDIED** | **428,940,637** | | | **4.23%** | **18,132,509** | | | **3.49%** | **14,954,625** | **-0.74%** | **(3,177,884)** |

[1] From Company depreciation study; plant balances as of the study date

[2] Company Depreciation Study, Table 1 (Attachment to Response to MCC-002)

[3] Rates and Accruals from Rate Development exhibit; some unadjusted accounts hard coded to match the Company's proposal due to immaterial rounding differences.

[4] = [3] - [2]

* Accept MCU's proposal of 3.41% depreciation rate on Account 381 (see response to MCC-111) ; See Direct Testimony of Ralph Smith for MCC adjustment to Company depreciation expense

# Exhibit No._(DJG-4)

## D2017.9.79

## Montana-Dakota Utilities

# Depreciation Rate Development

Exhibit DJG-4

| Account No. | Description | [1] Original Cost | [2] Iowa Curve Type | Iowa Curve AL | [3] Net Salvage | [4] Depreciable Base | [5] Book Reserve | [6] Future Accruals | [7] Remaining Life | [8] Service Life Accrual | [9] Service Life Rate | [10] Net Salvage Accrual | [11] Net Salvage Rate | [12] Total Accrual | [13] Total Rate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Distribution Plant** | | | | | | | | | | | | | | |
| 374.20 | Rights of Way | 431,148 | R3 | 65 | 0.0% | 431,148 | 115,390 | 315,758 | 53.4 | 5,913 | 1.37% | - | 0.00% | 5,913 | 1.37% |
| 375.00 | Distr. Meas & Reg Station Structures | 842,394 | R3 | 60 | -50.0% | 1,263,591 | 477,830 | 785,761 | 37.4 | 9,748 | 1.16% | 11,262 | 1.34% | 21,010 | 2.49% |
| 376.10 | Mains-Steel | 69,466,301 | R2.5 | 65 | -50.0% | 104,199,451 | 33,669,995 | 70,529,456 | 46.2 | 774,812 | 1.12% | 751,800 | 1.08% | 1,526,612 | 2.20% |
| 376.20 | Mains-Plastic | 133,632,165 | R2 | 54 | -50.0% | 200,448,248 | 49,440,576 | 151,007,672 | 44.6 | 1,889,398 | 1.41% | 1,499,463 | 1.12% | 3,388,862 | 2.54% |
| 376.30 | Mains-Valves | 2,585,180 | R3 | 40 | -50.0% | 3,877,771 | 293,883 | 3,583,887 | 37.1 | 61,760 | 2.39% | 34,841 | 1.35% | 96,601 | 3.74% |
| 376.40 | Mains-Manholes | 3,287 | R3 | 55 | -50.0% | 4,931 | 1,704 | 3,227 | 36.4 | 44 | 1.32% | 45 | 1.37% | 89 | 2.70% |
| 376.50 | Mains-Bridge & River Crossings | 92,767 | R3 | 45 | -50.0% | 139,150 | 30,712 | 108,439 | 35.3 | 1,758 | 1.90% | 1,314 | 1.42% | 3,072 | 3.31% |
| 378.00 | Meas & Reg Station Equip-General | 3,438,764 | R2 | 50 | -30.0% | 4,470,393 | 1,447,015 | 3,023,378 | 36.7 | 54,271 | 1.58% | 28,110 | 0.82% | 82,381 | 2.40% |
| 379.00 | Meas & Reg Station Equip-City Gate | 6,204,779 | R2.5 | 45 | -15.0% | 7,135,496 | 1,082,973 | 6,052,523 | 38.9 | 131,666 | 2.12% | 23,926 | 0.39% | 155,592 | 2.51% |
| 380.10 | Services-Steel | 7,315,314 | R0.5 | 44 | -175.0% | 20,117,112 | 13,822,417 | 6,294,695 | 17.9 | -364,340 | -4.98% | 716,786 | 9.80% | 352,447 | 4.82% |
| 380.20 | Services-Plastic | 86,602,561 | R4 | 48 | -175.0% | 238,157,042 | 53,186,663 | 184,970,379 | 37.7 | 887,069 | 1.02% | 4,023,214 | 4.65% | 4,910,283 | 5.67% |
| 380.30 | Farm & Fuel Lines | 89,508 | R1.5 | 30 | -200.0% | 268,524 | 61,758 | 206,765 | 22.6 | 1,228 | 1.37% | 7,921 | 8.85% | 9,149 | 10.22% |
| 381.00 | Meters | 70,002,134 | R3 | 32 | -20.0% | 84,002,560 | 23,335,200 | 60,667,361 | 22.0 | 2,122,189 | 3.03% | 636,672 | 0.91% | 2,758,861 * | 3.94% |
| 383.00 | Service Regulators | 9,356,598 | R3 | 60 | 0.0% | 9,356,598 | 3,242,161 | 6,114,438 | 44.3 | 138,023 | 1.48% | - | 0.00% | 138,023 | 1.48% |
| 385.00 | Industrial Meas. & Reg. Station Equip | 1,276,281 | R4 | 44 | -15.0% | 1,467,723 | 439,723 | 1,028,000 | 29.9 | 27,979 | 2.19% | 6,403 | 0.50% | 34,381 | 2.69% |
| 386.10 | Misc Property on Customers Premise | 1,680 | R3 | 15 | 0.0% | 1,680 | 1,680 | - | 1.5 | 0 | 0.00% | - | 0.00% | - | 0.00% |
| 386.20 | CNG Refueling station | 113,207 | R3 | 15 | 0.0% | 113,207 | 141,707 | (28,500) | 1.3 | -21,923 | -19.37% | - | 0.00% | (21,923) | -19.37% |
| 386.30 | CNG Lease/Demo | - | R3 | 15 | 0.0% | - | - | - | 0.0 | | | | | | 0.00% |
| 387.10 | Cathodic Protection Equipment | 3,157,815 | R1.5 | 49 | 0.0% | 3,157,815 | 1,665,104 | 1,492,712 | 38.0 | 39,303 | 1.24% | - | 0.00% | 39,303 | 1.24% |
| 387.20 | Other Distribution Equipment | 663,051 | R3 | 25 | 0.0% | 663,051 | 551,166 | 111,885 | 7.9 | 14,163 | 2.14% | - | 0.00% | 14,163 | 2.14% |
| | Total Distribution Plant | 395,274,934 | | | | 679,275,492 | 183,007,656 | 496,267,836 | 36.7 | 5,773,060 | 1.46% | 7,741,757 | 1.96% | 13,514,817 | 3.42% |
| | **General Plant** | | | | | | | | | | | | | | |
| 390.00 | General Structures | 8,943,375 | R2 | 40 | -10.0% | 9,837,713 | 3,439,218 | 6,398,494 | 29.6 | 185,951 | 2.08% | 30,214 | 0.34% | 216,165 | 2.42% |
| 391.10 | Office Furniture & Equipment | 288,341 | R1 | 15 | 0.0% | 288,341 | 224,559 | 63,782 | N/A | | | | | 11,221 | 3.89% |
| 391.30 | Computer Equipment - PC | 363,388 | R2 | 5 | 0.0% | 363,388 | 216,979 | 146,409 | N/A | | | | | 62,559 | 17.22% |
| 392.10 | Transportation Equipment (Trailers) | 456,602 | R1.5 | 19 | 15.0% | 388,112 | 367,673 | 20,439 | 11.9 | 7,473 | 1.64% | (5,755) | -1.26% | 1,718 | 0.38% |
| 392.20 | Trans Equipment (Cars & Trucks) | 9,713,348 | R3 | 9 | 20.0% | 7,770,679 | 4,957,460 | 2,813,219 | 4.0 | 1,188,972 | 12.24% | (485,667) | -5.00% | 703,305 | 7.24% |
| 393.00 | Stores Equipment | 57,183 | R3 | 35 | 0.0% | 57,183 | 20,489 | 36,694 | N/A | | | | | 1,552 | 2.71% |
| 394.10 | Tools, Shop & Garage Equip. (Non-Unitized) | 2,982,790 | R1.5 | 18 | 0.0% | 2,982,790 | 1,207,124 | 1,775,666 | N/A | | | | | 167,777 | 5.62% |
| 394.30 | Vehicle Maintenance Equipment | 5,923 | R3 | 20 | 0.0% | 5,923 | 2,937 | 2,987 | N/A | | | | | 333 | 5.62% |
| 395.00 | Laboratory Equipment | 195,762 | R2 | 20 | 0.0% | 195,762 | 62,041 | 133,721 | N/A | | | | | 4,026 | 2.06% |
| 396.10 | Work Equipment (Trailers) | 804,548 | R2 | 28 | 20.0% | 643,638 | 441,184 | 202,454 | 20.6 | 17,639 | 2.19% | (7,811) | -0.97% | 9,828 | 1.22% |
| 396.20 | Power Operated Equipment | 8,408,368 | L1 | 7 | 85.0% | 1,261,255 | 415,081 | 846,174 | 4.8 | 1,675,741 | 19.93% | (1,498,346) | -17.82% | 177,395 | 2.11% |
| 397.10 | Radio Communication Equip. (Fixed) | 995,297 | R3 | 15 | 0.0% | 995,297 | 262,964 | 732,332 | N/A | | | | | 62,315 | 6.26% |
| 397.20 | Radio Communication Equip. (Mobile) | 392,159 | R3 | 15 | 0.0% | 392,159 | 158,721 | 233,438 | N/A | | | | | 24,863 | 6.34% |
| 397.30 | General Telephone Communication Equip. | 16,430 | R1 | 10 | 0.0% | 16,430 | 8,937 | 7,493 | N/A | | | | | 1,425 | 8.67% |
| 398.00 | Miscellaneous Equipment | 42,189 | R2 | 20 | 0.0% | 42,189 | (11,709) | 53,898 | N/A | | | | | (4,672) | -11.07% |
| | Total General Plant | 33,665,703 | | | | 25,240,858 | 11,773,660 | 13,467,199 | 9.4 | 3,075,777 | 9.14% | (1,967,366) | -4.86% | 1,439,808 | 4.28% |
| | **TOTAL PLANT STUDIED** | **428,940,637** | | | | **704,516,350** | **194,781,315** | **509,735,035** | **34.1** | **8,848,837** | **2.06%** | **5,774,391** | **1.42%** | **14,954,625** | **3.49%** |

[1] From Company depreciation study; plant balances as of the study date

[2] Selected Iowa curve type and average life through mathematical and visual curve fitting-techniques and professional judgement.

[3] For life span accounts, weighted net salvage considering interim and terminal retirements. For mass accounts, estimated net salvage through historical analysis.

[4] = [1]*(1-[3])

[5] From the Company's property records; any negative book reserve balances were replaced with the Company's redistibuted reserve calculations

[6] = [4] - [5]

[7] Average remaining life based on Iowas Curve in Column [2]

[8] = ([1] - [5]) / [7]

[9] = [8] / [1]

[10] = [12] - [8]

[11] = [13] - [9]

[12] = [6] / [7]. Some unadjusted accruals may be hard coded to match the Company's proposed accrual to account for immaterial rounding differences.

# Depreciation Rate Development

| | | [1] | [2] | | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Account No. | Description | Original Cost | Iowa Curve Type | Iowa Curve AL | Net Salvage | Depreciable Base | Book Reserve | Future Accruals | Remaining Life | Service Life Accrual | Service Life Rate | Net Salvage Accrual | Net Salvage Rate | Total Accrual | Total Rate |

[13] = [12] / [1]. Some unadjusted rates may be hard coded to match the Company's proposed rate.

* Accept MCU's proposal of 3.41% depreciation rate on Account 381 (see response to MCC-111) ; See Direct Testimony of Ralph Smith for MCC adjustment to Company depreciation expense

# Exhibit No._(DJG-5)

# D2017.9.79

# Montana-Dakota Utilities

# Account 376.10 Detailed Curve Comparison

| [1] Age (Years) | [2] Exposures (Dollars) | [3] Observed Life Table (OLT) | [4] MDU R3-62 | [5] MCC R2.5-65 | [6] MDU SSD | [7] MCC SSD |
|---|---|---|---|---|---|---|
| 0.0 | 6,559,053 | 100.00% | 100.00% | 100.00% | 0.0000 | 0.0000 |
| 0.5 | 28,407,923 | 100.00% | 99.99% | 99.96% | 0.0000 | 0.0000 |
| 1.5 | 5,827,921 | 99.99% | 99.96% | 99.87% | 0.0000 | 0.0000 |
| 2.5 | 8,011,639 | 99.91% | 99.93% | 99.78% | 0.0000 | 0.0000 |
| 3.5 | 6,689,225 | 99.89% | 99.89% | 99.67% | 0.0000 | 0.0000 |
| 4.5 | 5,037,806 | 99.82% | 99.85% | 99.57% | 0.0000 | 0.0000 |
| 5.5 | 6,029,809 | 99.82% | 99.81% | 99.45% | 0.0000 | 0.0000 |
| 6.5 | 6,550,662 | 99.69% | 99.76% | 99.33% | 0.0000 | 0.0000 |
| 7.5 | 4,104,197 | 99.63% | 99.70% | 99.20% | 0.0000 | 0.0000 |
| 8.5 | 4,311,052 | 99.62% | 99.63% | 99.07% | 0.0000 | 0.0000 |
| 9.5 | 4,091,935 | 99.62% | 99.56% | 98.92% | 0.0000 | 0.0000 |
| 10.5 | 2,953,704 | 99.62% | 99.48% | 98.77% | 0.0000 | 0.0001 |
| 11.5 | 2,302,145 | 99.62% | 99.39% | 98.60% | 0.0000 | 0.0001 |
| 12.5 | 1,630,484 | 99.38% | 99.29% | 98.43% | 0.0000 | 0.0001 |
| 13.5 | 1,153,069 | 99.36% | 99.18% | 98.24% | 0.0000 | 0.0001 |
| 14.5 | 1,200,670 | 99.22% | 99.06% | 98.05% | 0.0000 | 0.0001 |
| 15.5 | 1,060,880 | 99.15% | 98.92% | 97.84% | 0.0000 | 0.0002 |
| 16.5 | 1,169,335 | 98.00% | 98.77% | 97.62% | 0.0001 | 0.0000 |
| 17.5 | 1,981,670 | 97.92% | 98.61% | 97.38% | 0.0000 | 0.0000 |
| 18.5 | 2,299,892 | 97.92% | 98.43% | 97.13% | 0.0000 | 0.0001 |
| 19.5 | 2,546,804 | 97.78% | 98.24% | 96.87% | 0.0000 | 0.0001 |
| 20.5 | 2,756,436 | 97.75% | 98.03% | 96.59% | 0.0000 | 0.0001 |
| 21.5 | 2,522,388 | 96.34% | 97.80% | 96.30% | 0.0002 | 0.0000 |
| 22.5 | 1,984,942 | 96.12% | 97.55% | 95.99% | 0.0002 | 0.0000 |
| 23.5 | 1,871,949 | 95.93% | 97.28% | 95.66% | 0.0002 | 0.0000 |
| 24.5 | 2,410,199 | 92.50% | 96.99% | 95.32% | 0.0020 | 0.0008 |
| 25.5 | 2,698,914 | 92.50% | 96.67% | 94.95% | 0.0017 | 0.0006 |
| 26.5 | 2,567,211 | 92.44% | 96.33% | 94.57% | 0.0015 | 0.0005 |
| 27.5 | 2,758,469 | 91.47% | 95.97% | 94.16% | 0.0020 | 0.0007 |
| 28.5 | 3,320,323 | 91.45% | 95.57% | 93.74% | 0.0017 | 0.0005 |
| 29.5 | 3,130,405 | 91.45% | 95.15% | 93.29% | 0.0014 | 0.0003 |
| 30.5 | 3,119,339 | 91.41% | 94.70% | 92.81% | 0.0011 | 0.0002 |
| 31.5 | 3,493,476 | 91.02% | 94.22% | 92.32% | 0.0010 | 0.0002 |
| 32.5 | 3,110,564 | 88.77% | 93.70% | 91.80% | 0.0024 | 0.0009 |
| 33.5 | 2,480,225 | 88.35% | 93.16% | 91.25% | 0.0023 | 0.0008 |
| 34.5 | 2,275,466 | 88.05% | 92.57% | 90.67% | 0.0020 | 0.0007 |
| 35.5 | 1,715,766 | 87.03% | 91.95% | 90.07% | 0.0024 | 0.0009 |
| 36.5 | 1,456,614 | 85.77% | 91.29% | 89.44% | 0.0030 | 0.0013 |
| 37.5 | 1,811,712 | 85.46% | 90.58% | 88.77% | 0.0026 | 0.0011 |
| 38.5 | 2,106,782 | 84.47% | 89.84% | 88.08% | 0.0029 | 0.0013 |
| 39.5 | 2,147,665 | 83.45% | 89.04% | 87.35% | 0.0031 | 0.0015 |
| 40.5 | 4,537,373 | 83.01% | 88.21% | 86.59% | 0.0027 | 0.0013 |
| 41.5 | 4,993,995 | 82.82% | 87.32% | 85.80% | 0.0020 | 0.0009 |
| 42.5 | 5,160,040 | 82.67% | 86.38% | 84.97% | 0.0014 | 0.0005 |
| 43.5 | 5,273,868 | 82.55% | 85.39% | 84.10% | 0.0008 | 0.0002 |
| 44.5 | 5,218,863 | 81.92% | 84.34% | 83.20% | 0.0006 | 0.0002 |
| 45.5 | 3,577,538 | 81.24% | 83.23% | 82.25% | 0.0004 | 0.0001 |
| 46.5 | 3,681,516 | 80.38% | 82.07% | 81.26% | 0.0003 | 0.0001 |
| 47.5 | 3,765,152 | 80.10% | 80.83% | 80.23% | 0.0001 | 0.0000 |
| 48.5 | 3,974,137 | 77.91% | 79.53% | 79.16% | 0.0003 | 0.0002 |
| 49.5 | 4,079,747 | 77.17% | 78.17% | 78.04% | 0.0001 | 0.0001 |
| 50.5 | 4,105,721 | 76.81% | 76.73% | 76.88% | 0.0000 | 0.0000 |
| 51.5 | 3,915,266 | 75.92% | 75.22% | 75.66% | 0.0000 | 0.0000 |
| 52.5 | 3,607,728 | 75.45% | 73.63% | 74.40% | 0.0003 | 0.0001 |
| 53.5 | 3,081,996 | 75.15% | 71.96% | 73.09% | 0.0010 | 0.0004 |
| 54.5 | 3,150,069 | 74.87% | 70.22% | 71.73% | 0.0022 | 0.0010 |
| 55.5 | 3,267,907 | 74.14% | 68.40% | 70.32% | 0.0033 | 0.0015 |
| 56.5 | 3,145,339 | 73.62% | 66.50% | 68.85% | 0.0051 | 0.0023 |
| 57.5 | 3,078,104 | 73.17% | 64.53% | 67.34% | 0.0075 | 0.0034 |
| 58.5 | 3,212,930 | 72.70% | 62.47% | 65.77% | 0.0105 | 0.0048 |
| 59.5 | 2,838,818 | 72.45% | 60.35% | 64.15% | 0.0146 | 0.0069 |

# Account 376.10 Detailed Curve Comparison



| [1] | [2] | [3] | [4] | [5] | [6] | [7] |
|---|---|---|---|---|---|---|
| **Age (Years)** | **Exposures (Dollars)** | **Observed Life Table (OLT)** | **MDU R3-62** | **MCC R2.5-65** | **MDU SSD** | **MCC SSD** |
| 60.5 | 2,303,158 | 71.57% | 58.15% | 62.48% | 0.0180 | 0.0083 |
| 61.5 | 1,907,959 | 71.04% | 55.89% | 60.76% | 0.0229 | 0.0106 |
| 62.5 | 1,558,775 | 70.59% | 53.57% | 58.99% | 0.0290 | 0.0135 |
| 63.5 | 1,108,622 | 69.70% | 51.20% | 57.18% | 0.0342 | 0.0157 |
| 64.5 | 883,406 | 69.45% | 48.78% | 55.32% | 0.0427 | 0.0200 |
| 65.5 | 482,127 | 69.14% | 46.33% | 53.43% | 0.0520 | 0.0247 |
| 66.5 | 363,542 | 68.92% | 43.85% | 51.50% | 0.0628 | 0.0303 |
| 67.5 | 235,399 | 66.79% | 41.36% | 49.54% | 0.0646 | 0.0298 |
| 68.5 | 118,961 | 66.57% | 38.87% | 47.56% | 0.0767 | 0.0362 |
| 69.5 | 196 | 65.11% | 36.39% | 45.55% | 0.0825 | 0.0383 |
| 70.5 | 119,587 | 36.08% | 33.93% | 43.53% | 0.0005 | 0.0056 |
| 71.5 | 234,670 | 36.05% | 31.50% | 41.51% | 0.0021 | 0.0030 |
| 72.5 | 347,344 | 35.98% | 29.12% | 39.48% | 0.0047 | 0.0012 |
| 73.5 | 455,632 | 35.81% | 26.81% | 37.46% | 0.0081 | 0.0003 |
| 74.5 | 561,741 | 35.76% | 24.56% | 35.46% | 0.0125 | 0.0000 |
| 75.5 | 546,392 | 35.61% | 22.40% | 33.47% | 0.0175 | 0.0005 |
| 76.5 | 533,081 | 35.54% | 20.33% | 31.51% | 0.0231 | 0.0016 |
| 77.5 | 519,781 | 35.35% | 18.35% | 29.59% | 0.0289 | 0.0033 |
| 78.5 | 506,415 | 35.32% | 16.49% | 27.71% | 0.0355 | 0.0058 |
| 79.5 | 495,103 | 35.32% | 14.73% | 25.88% | 0.0424 | 0.0089 |
| 80.5 | 484,372 | 35.26% | 13.09% | 24.11% | 0.0492 | 0.0124 |
| 81.5 | 469,787 | 35.05% | 11.56% | 22.39% | 0.0552 | 0.0160 |
| 82.5 | 458,865 | 35.05% | 10.14% | 20.73% | 0.0620 | 0.0205 |
| 83.5 | 447,541 | 35.00% | 8.85% | 19.14% | 0.0684 | 0.0251 |
| 84.5 | 436,626 | 35.00% | 7.66% | 17.62% | 0.0747 | 0.0302 |
| 85.5 | 426,503 | 35.00% | 6.58% | 16.18% | 0.0808 | 0.0354 |
| 86.5 | 415,568 | 34.96% | 5.61% | 14.80% | 0.0861 | 0.0406 |
| 87.5 | 405,432 | 34.96% | 4.73% | 13.51% | 0.0914 | 0.0460 |
| 88.5 | 395,543 | 34.94% | 3.96% | 12.28% | 0.0960 | 0.0513 |
| 89.5 | 385,896 | 34.94% | 3.27% | 11.13% | 0.1003 | 0.0567 |
| 90.5 | 376,484 | 34.94% | 2.65% | 10.05% | 0.1042 | 0.0619 |
| 91.5 | 367,301 | 34.94% | 2.13% | 9.05% | 0.1077 | 0.0670 |
| 92.5 | 358,343 | 34.94% | 1.67% | 8.11% | 0.1107 | 0.0720 |
| 93.5 | 349,603 | 34.94% | 1.29% | 7.24% | 0.1133 | 0.0767 |
| 94.5 | 314,193 | 34.94% | 0.96% | 6.44% | 0.1154 | 0.0812 |
| 95.5 | 242,568 | 34.94% | 0.70% | 5.70% | 0.1173 | 0.0855 |
| 96.5 | 172,690 | 34.94% | 0.49% | 5.02% | 0.1187 | 0.0895 |
| 97.5 | 104,517 | 34.94% | 0.32% | 4.40% | 0.1198 | 0.0933 |
| 98.5 | 38,006 | 34.94% | 0.20% | 3.84% | 0.1207 | 0.0967 |
| Sum of Squared Differences for Relevant OLT | | | | [8] | 0.4903 | 0.2263 |

[1] Age in years using half-year convention
[2] Dollars exposed to retirement at the beginning of each age interval
[3] Observed life table based on the Company's property records. These numbers form the original survivor curve.
[4] The Company's selected Iowa curve to be fitted to the OLT.
[5] My selected Iowa curve to be fitted to the OLT.
[6] = ([4] - [3])^2. This is the squared difference between each point on the Company's curve and the observed survivor curve.
[7] = ([5] - [3])^2. This is the squared difference between each point on my curve and the observed survivor curve.
[8] = Sum of squared differences excluding less than 1% of beginning exposures or other statistically-relevant cut-off point when applicable
*Below the bold horizontal line represents statistically less relevant data.

# Exhibit No._(DJG-6)

## D2017.9.79

## Montana-Dakota Utilities

# Account 376.20 Detailed Curve Comparison



| [1] Age (Years) | [2] Exposures (Dollars) | [3] Observed Life Table (OLT) | [4] MDU R4-47 | [5] MCC R2-54 | [6] MDU SSD | [7] MCC SSD |
|---|---|---|---|---|---|---|
| 0.0 | 102,527,986 | 100.00% | 100.00% | 100.00% | 0.0000 | 0.0000 |
| 0.5 | 93,798,517 | 99.99% | 100.00% | 99.91% | 0.0000 | 0.0000 |
| 1.5 | 83,030,476 | 99.89% | 100.00% | 99.73% | 0.0000 | 0.0000 |
| 2.5 | 73,856,751 | 99.69% | 99.99% | 99.53% | 0.0000 | 0.0000 |
| 3.5 | 58,571,173 | 99.61% | 99.99% | 99.32% | 0.0000 | 0.0000 |
| 4.5 | 53,570,271 | 99.32% | 99.98% | 99.10% | 0.0000 | 0.0000 |
| 5.5 | 50,112,510 | 99.20% | 99.98% | 98.87% | 0.0001 | 0.0000 |
| 6.5 | 48,394,997 | 99.03% | 99.97% | 98.62% | 0.0001 | 0.0000 |
| 7.5 | 45,581,352 | 98.92% | 99.96% | 98.36% | 0.0001 | 0.0000 |
| 8.5 | 43,944,747 | 98.82% | 99.94% | 98.08% | 0.0001 | 0.0001 |
| 9.5 | 41,951,850 | 98.71% | 99.92% | 97.78% | 0.0001 | 0.0001 |
| 10.5 | 39,797,054 | 98.54% | 99.89% | 97.47% | 0.0002 | 0.0001 |
| 11.5 | 38,451,604 | 98.42% | 99.86% | 97.14% | 0.0002 | 0.0002 |
| 12.5 | 37,064,902 | 98.32% | 99.82% | 96.79% | 0.0002 | 0.0002 |
| 13.5 | 36,144,546 | 98.17% | 99.77% | 96.42% | 0.0003 | 0.0003 |
| 14.5 | 35,817,209 | 97.65% | 99.70% | 96.04% | 0.0004 | 0.0003 |
| 15.5 | 35,401,977 | 97.44% | 99.62% | 95.63% | 0.0005 | 0.0003 |
| 16.5 | 34,800,341 | 97.37% | 99.53% | 95.20% | 0.0005 | 0.0005 |
| 17.5 | 33,670,170 | 97.27% | 99.41% | 94.74% | 0.0005 | 0.0006 |
| 18.5 | 32,610,045 | 96.95% | 99.27% | 94.27% | 0.0005 | 0.0007 |
| 19.5 | 31,602,546 | 96.75% | 99.10% | 93.77% | 0.0006 | 0.0009 |
| 20.5 | 30,381,156 | 96.40% | 98.90% | 93.24% | 0.0006 | 0.0010 |
| 21.5 | 26,346,317 | 96.15% | 98.66% | 92.69% | 0.0006 | 0.0012 |
| 22.5 | 21,037,727 | 96.01% | 98.37% | 92.11% | 0.0006 | 0.0015 |
| 23.5 | 19,308,147 | 95.91% | 98.04% | 91.50% | 0.0005 | 0.0019 |
| 24.5 | 18,318,461 | 95.52% | 97.65% | 90.86% | 0.0005 | 0.0022 |
| 25.5 | 17,412,513 | 95.22% | 97.20% | 90.19% | 0.0004 | 0.0025 |
| 26.5 | 16,785,425 | 95.12% | 96.67% | 89.49% | 0.0002 | 0.0032 |
| 27.5 | 15,951,572 | 94.98% | 96.07% | 88.75% | 0.0001 | 0.0039 |
| 28.5 | 14,676,043 | 94.76% | 95.38% | 87.99% | 0.0000 | 0.0046 |
| 29.5 | 13,496,554 | 94.67% | 94.59% | 87.18% | 0.0000 | 0.0056 |
| 30.5 | 12,234,895 | 94.41% | 93.70% | 86.34% | 0.0001 | 0.0065 |
| 31.5 | 10,943,454 | 93.86% | 92.69% | 85.47% | 0.0001 | 0.0070 |
| 32.5 | 9,790,525 | 93.77% | 91.56% | 84.55% | 0.0005 | 0.0085 |
| 33.5 | 8,643,403 | 93.54% | 90.30% | 83.60% | 0.0011 | 0.0099 |
| 34.5 | 7,333,394 | 91.62% | 88.90% | 82.60% | 0.0007 | 0.0081 |
| 35.5 | 5,812,509 | 91.58% | 87.35% | 81.56% | 0.0018 | 0.0100 |
| 36.5 | 4,717,184 | 91.50% | 85.65% | 80.48% | 0.0034 | 0.0121 |
| 37.5 | 4,203,174 | 91.37% | 83.80% | 79.36% | 0.0057 | 0.0144 |
| 38.5 | 3,883,689 | 91.31% | 81.78% | 78.19% | 0.0091 | 0.0172 |
| 39.5 | 3,231,074 | 91.11% | 79.59% | 76.97% | 0.0133 | 0.0200 |
| 40.5 | 2,359,070 | 90.88% | 77.22% | 75.71% | 0.0186 | 0.0230 |
| 41.5 | 2,116,116 | 90.81% | 74.65% | 74.39% | 0.0261 | 0.0269 |
| 42.5 | 1,810,721 | 90.64% | 71.82% | 73.04% | 0.0354 | 0.0310 |
| 43.5 | 548,800 | 90.45% | 68.71% | 71.63% | 0.0473 | 0.0354 |
| 44.5 | 408,294 | 90.42% | 65.28% | 70.17% | 0.0632 | 0.0410 |
| 45.5 | 47,292 | 90.21% | 61.54% | 68.67% | 0.0822 | 0.0464 |
| 46.5 | 46,045 | 87.84% | 57.50% | 67.11% | 0.0921 | 0.0430 |
| 47.5 | 44,639 | 84.92% | 53.20% | 65.51% | 0.1006 | 0.0377 |

# Account 376.20 Detailed Curve Comparison

| [1] Age (Years) | [2] Exposures (Dollars) | [3] Observed Life Table (OLT) | [4] MDU R4-47 | [5] MCC R2-54 | [6] MDU SSD | [7] MCC SSD |
|---|---|---|---|---|---|---|
| 48.5 | 42,491 | 80.83% | 48.70% | 63.87% | 0.1032 | 0.0288 |
| 49.5 | 24,297 | 46.15% | 44.09% | 62.17% | 0.0004 | 0.0257 |
| 50.5 | 9,573 | 18.18% | 39.46% | 60.43% | 0.0453 | 0.1785 |
| 51.5 | 9,573 | 18.18% | 34.88% | 58.65% | 0.0279 | 0.1638 |
| 52.5 | 8,162 | 15.50% | 30.44% | 56.83% | 0.0223 | 0.1708 |
| 53.5 | 6,998 | 13.29% | 26.22% | 54.97% | 0.0167 | 0.1737 |
| 54.5 | 2,594 | 4.93% | 22.27% | 53.07% | 0.0301 | 0.2318 |
| 55.5 | 2,244 | 4.26% | 18.64% | 51.14% | 0.0207 | 0.2198 |
| 56.5 | 1,571 | 2.98% | 15.36% | 49.19% | 0.0153 | 0.2135 |
| 57.5 | 1,282 | 2.43% | 12.43% | 47.21% | 0.0100 | 0.2005 |
| 58.5 | 1,068 | 2.03% | 9.87% | 45.21% | 0.0061 | 0.1864 |
| 59.5 | 1,024 | 1.94% | 7.66% | 43.19% | 0.0033 | 0.1702 |
| 60.5 | 1,024 | 1.94% | 5.78% | 41.17% | 0.0015 | 0.1539 |
| 61.5 | 930 | 1.77% | 4.23% | 39.14% | 0.0006 | 0.1397 |
| 62.5 | 930 | 1.77% | 2.97% | 37.12% | 0.0001 | 0.1250 |
| Sum of Squared Differences | | | | [8] | 0.1238 | 0.2268 |

[1] Age in years using half-year convention
[2] Dollars exposed to retirement at the beginning of each age interval
[3] Observed life table based on the Company's property records. These numbers form the original survivor curve.
[4] The Company's selected Iowa curve to be fitted to the OLT.
[5] My selected Iowa curve to be fitted to the OLT.
[6] = ([4] - [3])^2. This is the squared difference between each point on the Company's curve and the observed survivor curve.
[7] = ([5] - [3])^2. This is the squared difference between each point on my curve and the observed survivor curve.
[8] = Sum of squared differences excluding less than 1% of beginning exposures or other statistically-relevant cut-off point when applicable
*Below the bold horizontal line represents statistically less relevant data.

# Exhibit No._(DJG-7)

## D2017.9.79

## Montana-Dakota Utilities

# Account 380.10 Detailed Curve Comparison



| [1] | [2] | [3] | [4] | [5] | [6] | [7] |
|---|---|---|---|---|---|---|
| **Age (Years)** | **Exposures (Dollars)** | **Observed Life Table (OLT)** | **MDU R0.5-38** | **MCC R0.5-44** | **MDU SSD** | **MCC SSD** |
| 0.0 | 363,914 | 100.00% | 100.00% | 100.00% | 0.0000 | 0.0000 |
| 0.5 | 348,125 | 100.00% | 99.50% | 99.57% | 0.0000 | 0.0000 |
| 1.5 | 473,602 | 99.78% | 98.49% | 98.70% | 0.0002 | 0.0001 |
| 2.5 | 510,039 | 99.04% | 97.47% | 97.82% | 0.0002 | 0.0001 |
| 3.5 | 531,142 | 98.15% | 96.44% | 96.93% | 0.0003 | 0.0001 |
| 4.5 | 563,933 | 96.85% | 95.39% | 96.04% | 0.0002 | 0.0001 |
| 5.5 | 607,722 | 95.92% | 94.34% | 95.13% | 0.0003 | 0.0001 |
| 6.5 | 653,782 | 95.31% | 93.27% | 94.22% | 0.0004 | 0.0001 |
| 7.5 | 733,665 | 94.43% | 92.18% | 93.29% | 0.0005 | 0.0001 |
| 8.5 | 805,751 | 93.51% | 91.09% | 92.36% | 0.0006 | 0.0001 |
| 9.5 | 877,040 | 92.96% | 89.98% | 91.41% | 0.0009 | 0.0002 |
| 10.5 | 948,735 | 91.95% | 88.86% | 90.46% | 0.0010 | 0.0002 |
| 11.5 | 1,037,216 | 90.67% | 87.73% | 89.50% | 0.0009 | 0.0001 |
| 12.5 | 1,170,080 | 89.73% | 86.59% | 88.53% | 0.0010 | 0.0001 |
| 13.5 | 1,244,481 | 84.80% | 85.44% | 87.55% | 0.0000 | 0.0008 |
| 14.5 | 1,285,923 | 78.63% | 84.27% | 86.56% | 0.0032 | 0.0063 |
| 15.5 | 1,336,957 | 75.60% | 83.09% | 85.57% | 0.0056 | 0.0099 |
| 16.5 | 1,429,696 | 74.72% | 81.89% | 84.56% | 0.0051 | 0.0097 |
| 17.5 | 1,509,378 | 73.24% | 80.68% | 83.54% | 0.0055 | 0.0106 |
| 18.5 | 1,613,903 | 72.10% | 79.45% | 82.52% | 0.0054 | 0.0109 |
| 19.5 | 1,743,637 | 70.67% | 78.21% | 81.48% | 0.0057 | 0.0117 |
| 20.5 | 1,826,685 | 69.64% | 76.95% | 80.43% | 0.0053 | 0.0116 |
| 21.5 | 2,054,064 | 68.99% | 75.66% | 79.37% | 0.0045 | 0.0108 |
| 22.5 | 2,354,689 | 68.34% | 74.36% | 78.29% | 0.0036 | 0.0099 |
| 23.5 | 2,607,135 | 67.78% | 73.04% | 77.21% | 0.0028 | 0.0089 |
| 24.5 | 3,404,358 | 67.18% | 71.70% | 76.10% | 0.0020 | 0.0080 |
| 25.5 | 3,547,604 | 66.55% | 70.33% | 74.99% | 0.0014 | 0.0071 |
| 26.5 | 3,664,775 | 66.01% | 68.95% | 73.85% | 0.0009 | 0.0062 |
| 27.5 | 3,801,748 | 65.51% | 67.54% | 72.71% | 0.0004 | 0.0052 |
| 28.5 | 3,908,036 | 65.04% | 66.11% | 71.54% | 0.0001 | 0.0042 |
| 29.5 | 4,039,101 | 64.65% | 64.65% | 70.37% | 0.0000 | 0.0033 |
| 30.5 | 4,200,188 | 64.35% | 63.18% | 69.17% | 0.0001 | 0.0023 |
| 31.5 | 4,333,264 | 63.94% | 61.68% | 67.96% | 0.0005 | 0.0016 |
| 32.5 | 4,473,274 | 63.60% | 60.16% | 66.73% | 0.0012 | 0.0010 |
| 33.5 | 4,506,686 | 63.19% | 58.62% | 65.48% | 0.0021 | 0.0005 |
| 34.5 | 4,526,131 | 62.83% | 57.06% | 64.22% | 0.0033 | 0.0002 |
| 35.5 | 4,569,490 | 62.55% | 55.48% | 62.94% | 0.0050 | 0.0000 |
| 36.5 | 4,583,885 | 62.14% | 53.88% | 61.65% | 0.0068 | 0.0000 |
| 37.5 | 4,603,107 | 61.88% | 52.26% | 60.33% | 0.0093 | 0.0002 |
| 38.5 | 4,679,137 | 61.52% | 50.63% | 59.01% | 0.0119 | 0.0006 |
| 39.5 | 4,642,840 | 61.15% | 48.98% | 57.66% | 0.0148 | 0.0012 |
| 40.5 | 4,588,599 | 60.85% | 47.33% | 56.31% | 0.0183 | 0.0021 |
| 41.5 | 4,598,390 | 60.63% | 45.66% | 54.93% | 0.0224 | 0.0032 |
| 42.5 | 4,449,886 | 60.37% | 43.98% | 53.55% | 0.0269 | 0.0047 |
| 43.5 | 4,225,396 | 60.12% | 42.30% | 52.15% | 0.0318 | 0.0064 |
| 44.5 | 4,011,323 | 59.79% | 40.61% | 50.74% | 0.0368 | 0.0082 |
| 45.5 | 3,234,490 | 59.33% | 38.92% | 49.32% | 0.0417 | 0.0100 |
| 46.5 | 3,072,163 | 58.89% | 37.23% | 47.89% | 0.0469 | 0.0121 |
| 47.5 | 2,931,544 | 58.44% | 35.55% | 46.46% | 0.0524 | 0.0144 |
| 48.5 | 2,779,969 | 58.00% | 33.87% | 45.01% | 0.0582 | 0.0169 |
| 49.5 | 2,612,521 | 57.59% | 32.20% | 43.56% | 0.0645 | 0.0197 |
| 50.5 | 2,404,345 | 57.08% | 30.54% | 42.10% | 0.0704 | 0.0224 |
| 51.5 | 2,186,030 | 56.66% | 28.90% | 40.65% | 0.0771 | 0.0256 |
| 52.5 | 1,978,893 | 56.17% | 27.28% | 39.19% | 0.0835 | 0.0288 |
| 53.5 | 1,754,047 | 55.74% | 25.68% | 37.73% | 0.0904 | 0.0324 |
| 54.5 | 1,629,778 | 55.34% | 24.10% | 36.27% | 0.0976 | 0.0364 |
| 55.5 | 1,529,662 | 54.76% | 22.55% | 34.82% | 0.1038 | 0.0398 |
| 56.5 | 1,396,289 | 54.21% | 21.03% | 33.38% | 0.1101 | 0.0434 |
| 57.5 | 1,287,240 | 53.70% | 19.54% | 31.94% | 0.1167 | 0.0474 |

# Account 380.10 Detailed Curve Comparison



| [1] | [2] | [3] | [4] | [5] | [6] | [7] |
|---|---|---|---|---|---|---|
| **Age (Years)** | **Exposures (Dollars)** | **Observed Life Table (OLT)** | **MDU R0.5-38** | **MCC R0.5-44** | **MDU SSD** | **MCC SSD** |
| 58.5 | 1,170,406 | 53.00% | 18.09% | 30.51% | 0.1219 | 0.0506 |
| 59.5 | 997,618 | 52.35% | 16.68% | 29.09% | 0.1273 | 0.0541 |
| 60.5 | 914,085 | 51.66% | 15.30% | 27.68% | 0.1322 | 0.0575 |
| 61.5 | 808,448 | 51.13% | 13.98% | 26.29% | 0.1380 | 0.0617 |
| 62.5 | 724,566 | 50.62% | 12.69% | 24.92% | 0.1438 | 0.0661 |
| 63.5 | 629,263 | 50.24% | 11.46% | 23.57% | 0.1504 | 0.0711 |
| 64.5 | 561,185 | 49.94% | 10.27% | 22.23% | 0.1573 | 0.0768 |
| 65.5 | 518,745 | 49.53% | 9.14% | 20.92% | 0.1631 | 0.0818 |
| 66.5 | 507,653 | 49.30% | 8.06% | 19.64% | 0.1701 | 0.0880 |
| 67.5 | 497,247 | 49.14% | 7.02% | 18.38% | 0.1774 | 0.0946 |
| 68.5 | 486,610 | 49.03% | 6.04% | 17.15% | 0.1848 | 0.1016 |
| 69.5 | 474,603 | 48.86% | 5.11% | 15.95% | 0.1914 | 0.1083 |
| 70.5 | 497,313 | 48.76% | 4.22% | 14.79% | 0.1984 | 0.1154 |
| 71.5 | 520,217 | 48.73% | 3.38% | 13.65% | 0.2057 | 0.1231 |
| 72.5 | 540,093 | 48.48% | 2.57% | 12.55% | 0.2108 | 0.1291 |
| 73.5 | 561,939 | 48.46% | 1.79% | 11.49% | 0.2178 | 0.1367 |
| 74.5 | 583,090 | 48.43% | 1.05% | 10.46% | 0.2245 | 0.1442 |
| 75.5 | 548,306 | 48.42% | 0.34% | 9.47% | 0.2312 | 0.1517 |
| 76.5 | 514,073 | 48.41% | 0.00% | 8.52% | 0.2344 | 0.1591 |
| 77.5 | 480,466 | 48.40% | 0.00% | 7.60% | 0.2343 | 0.1664 |
| 78.5 | 447,764 | 48.40% | 0.00% | 6.73% | 0.2343 | 0.1737 |
| 79.5 | 415,783 | 48.39% | 0.00% | 5.89% | 0.2342 | 0.1806 |
| 80.5 | 384,655 | 48.38% | 0.00% | 5.09% | 0.2341 | 0.1874 |
| 81.5 | 354,308 | 48.38% | 0.00% | 4.32% | 0.2341 | 0.1941 |
| 82.5 | 324,754 | 48.38% | 0.00% | 3.58% | 0.2341 | 0.2007 |
| 83.5 | 295,868 | 48.38% | 0.00% | 2.87% | 0.2341 | 0.2071 |
| 84.5 | 267,688 | 48.38% | 0.00% | 2.19% | 0.2341 | 0.2133 |
| 85.5 | 240,706 | 48.37% | 0.00% | 1.53% | 0.2340 | 0.2194 |
| 86.5 | 213,883 | 48.37% | 0.00% | 0.90% | 0.2340 | 0.2253 |
| 87.5 | 187,653 | 48.36% | 0.00% | 0.29% | 0.2339 | 0.2310 |
| 88.5 | 162,101 | 48.35% | 0.00% | 0.00% | 0.2338 | 0.2338 |
| 89.5 | 137,194 | 48.35% | 0.00% | 0.00% | 0.2338 | 0.2338 |
| 90.5 | 112,894 | 48.35% | 0.00% | 0.00% | 0.2338 | 0.2338 |
| 91.5 | 89,186 | 48.35% | 0.00% | 0.00% | 0.2338 | 0.2338 |
| 92.5 | 66,057 | 48.35% | 0.00% | 0.00% | 0.2338 | 0.2338 |
| 93.5 | 43,492 | 48.35% | 0.00% | 0.00% | 0.2338 | 0.2338 |
| 94.5 | 21,478 | 48.35% | 0.00% | 0.00% | 0.2338 | 0.2338 |
| Sum of Squared Differences | | | | [8] | 8.8540 | 6.2251 |

[1] Age in years using half-year convention
[2] Dollars exposed to retirement at the beginning of each age interval
[3] Observed life table based on the Company's property records. These numbers form the original survivor curve.
[4] The Company's selected Iowa curve to be fitted to the OLT.
[5] My selected Iowa curve to be fitted to the OLT.
[6] = ([4] - [3])^2. This is the squared difference between each point on the Company's curve and the observed survivor curve.
[7] = ([5] - [3])^2. This is the squared difference between each point on my curve and the observed survivor curve.
[8] = Sum of squared differences excluding less than 1% of beginning exposures or other statistically-relevant cut-off point when applicable
*Below the bold horizontal line represents statistically less relevant data.

# Exhibit No._(DJG-8)

## D2017.9.79

## Montana-Dakota Utilities

# Account 380.20 Detailed Curve Comparison



| [1] Age (Years) | [2] Exposures (Dollars) | [3] Observed Life Table (OLT) | [4] MDU R4-44 | [5] MCC R4-48 | [6] MDU SSD | [7] MCC SSD |
|---|---|---|---|---|---|---|
| 0.0 | 72,285,489 | 100.00% | 100.00% | 100.00% | 0.0000 | 0.0000 |
| 0.5 | 66,773,886 | 99.98% | 100.00% | 100.00% | 0.0000 | 0.0000 |
| 1.5 | 59,573,486 | 99.82% | 100.00% | 100.00% | 0.0000 | 0.0000 |
| 2.5 | 52,127,305 | 99.66% | 99.99% | 99.99% | 0.0000 | 0.0000 |
| 3.5 | 44,781,716 | 99.52% | 99.99% | 99.99% | 0.0000 | 0.0000 |
| 4.5 | 39,951,325 | 99.37% | 99.98% | 99.98% | 0.0000 | 0.0000 |
| 5.5 | 36,567,390 | 99.21% | 99.97% | 99.98% | 0.0001 | 0.0001 |
| 6.5 | 33,790,031 | 99.05% | 99.96% | 99.97% | 0.0001 | 0.0001 |
| 7.5 | 30,589,664 | 98.84% | 99.95% | 99.96% | 0.0001 | 0.0001 |
| 8.5 | 28,230,205 | 98.64% | 99.93% | 99.94% | 0.0002 | 0.0002 |
| 9.5 | 26,082,733 | 98.43% | 99.90% | 99.92% | 0.0002 | 0.0002 |
| 10.5 | 24,005,939 | 98.19% | 99.87% | 99.90% | 0.0003 | 0.0003 |
| 11.5 | 22,257,405 | 97.98% | 99.83% | 99.87% | 0.0003 | 0.0004 |
| 12.5 | 20,819,104 | 97.69% | 99.77% | 99.83% | 0.0004 | 0.0005 |
| 13.5 | 20,071,317 | 97.53% | 99.71% | 99.78% | 0.0005 | 0.0005 |
| 14.5 | 19,579,660 | 97.18% | 99.62% | 99.72% | 0.0006 | 0.0006 |
| 15.5 | 19,128,659 | 96.93% | 99.52% | 99.65% | 0.0007 | 0.0007 |
| 16.5 | 18,517,552 | 96.71% | 99.39% | 99.56% | 0.0007 | 0.0008 |
| 17.5 | 17,689,606 | 96.49% | 99.24% | 99.46% | 0.0008 | 0.0009 |
| 18.5 | 16,797,356 | 96.13% | 99.05% | 99.33% | 0.0009 | 0.0010 |
| 19.5 | 15,576,017 | 95.90% | 98.82% | 99.17% | 0.0009 | 0.0011 |
| 20.5 | 15,064,056 | 95.63% | 98.55% | 98.99% | 0.0009 | 0.0011 |
| 21.5 | 13,290,577 | 95.40% | 98.22% | 98.77% | 0.0008 | 0.0011 |
| 22.5 | 12,547,022 | 95.14% | 97.84% | 98.51% | 0.0007 | 0.0011 |
| 23.5 | 11,700,545 | 94.85% | 97.38% | 98.21% | 0.0006 | 0.0011 |
| 24.5 | 11,011,276 | 94.60% | 96.85% | 97.86% | 0.0005 | 0.0011 |
| 25.5 | 10,493,663 | 94.36% | 96.23% | 97.45% | 0.0004 | 0.0010 |
| 26.5 | 10,012,627 | 94.09% | 95.52% | 96.97% | 0.0002 | 0.0008 |
| 27.5 | 9,427,330 | 93.79% | 94.69% | 96.42% | 0.0001 | 0.0007 |
| 28.5 | 8,837,432 | 93.48% | 93.75% | 95.80% | 0.0000 | 0.0005 |
| 29.5 | 8,155,961 | 93.11% | 92.68% | 95.08% | 0.0000 | 0.0004 |
| 30.5 | 7,263,645 | 92.55% | 91.46% | 94.28% | 0.0001 | 0.0003 |
| 31.5 | 6,488,156 | 92.25% | 90.10% | 93.36% | 0.0005 | 0.0001 |
| 32.5 | 5,602,111 | 91.84% | 88.58% | 92.34% | 0.0011 | 0.0000 |
| 33.5 | 4,885,069 | 91.52% | 86.89% | 91.19% | 0.0021 | 0.0000 |
| 34.5 | 4,265,901 | 90.86% | 85.02% | 89.92% | 0.0034 | 0.0001 |
| 35.5 | 3,532,006 | 90.56% | 82.96% | 88.51% | 0.0058 | 0.0004 |
| 36.5 | 2,881,842 | 90.08% | 80.73% | 86.96% | 0.0087 | 0.0010 |
| 37.5 | 2,458,615 | 89.51% | 78.30% | 85.26% | 0.0126 | 0.0018 |
| 38.5 | 2,056,244 | 88.95% | 75.64% | 83.41% | 0.0177 | 0.0031 |
| 39.5 | 1,476,203 | 88.24% | 72.72% | 81.40% | 0.0241 | 0.0047 |
| 40.5 | 1,164,221 | 86.83% | 69.49% | 79.23% | 0.0301 | 0.0058 |
| 41.5 | 645,842 | 85.64% | 65.89% | 76.89% | 0.0390 | 0.0077 |
| 42.5 | 418,543 | 83.42% | 61.93% | 74.34% | 0.0462 | 0.0082 |
| 43.5 | 174,588 | 80.82% | 57.64% | 71.54% | 0.0537 | 0.0086 |
| 44.5 | 156,710 | 75.03% | 53.04% | 68.47% | 0.0483 | 0.0043 |
| 45.5 | 134,169 | 63.97% | 48.23% | 65.10% | 0.0248 | 0.0001 |
| 46.5 | 125,814 | 59.85% | 43.30% | 61.42% | 0.0274 | 0.0002 |
| 47.5 | 120,268 | 57.15% | 38.35% | 57.45% | 0.0353 | 0.0000 |
| 48.5 | 113,787 | 53.37% | 33.50% | 53.24% | 0.0395 | 0.0000 |
| 49.5 | 105,859 | 49.62% | 28.83% | 48.84% | 0.0432 | 0.0001 |
| 50.5 | 101,606 | 47.58% | 24.43% | 44.33% | 0.0536 | 0.0011 |
| 51.5 | 93,848 | 43.98% | 20.37% | 39.79% | 0.0557 | 0.0018 |
| 52.5 | 86,327 | 40.44% | 16.70% | 35.30% | 0.0564 | 0.0026 |
| 53.5 | 52,648 | 24.73% | 13.42% | 30.94% | 0.0128 | 0.0039 |

# Account 380.20 Detailed Curve Comparison



| [1] Age (Years) | [2] Exposures (Dollars) | [3] Observed Life Table (OLT) | [4] MDU R4-44 | [5] MCC R4-48 | [6] MDU SSD | [7] MCC SSD |
|---|---|---|---|---|---|---|
| 54.5 | 43,152 | 20.24% | 10.55% | 26.78% | 0.0094 | 0.0043 |
| 55.5 | 36,323 | 17.37% | 8.10% | 22.87% | 0.0086 | 0.0030 |
| 56.5 | 32,164 | 15.44% | 6.04% | 19.26% | 0.0088 | 0.0015 |
| 57.5 | 30,064 | 14.41% | 4.34% | 15.98% | 0.0101 | 0.0002 |
| 58.5 | 21,917 | 10.51% | 2.98% | 13.04% | 0.0057 | 0.0006 |
| 59.5 | 17,766 | 8.56% | 1.94% | 10.44% | 0.0044 | 0.0004 |
| 60.5 | 13,389 | 6.45% | 1.17% | 8.19% | 0.0028 | 0.0003 |
| 61.5 | 10,417 | 5.11% | 0.64% | 6.27% | 0.0020 | 0.0001 |
| 62.5 | 8,054 | 3.98% | 0.31% | 4.66% | 0.0013 | 0.0000 |
| 63.5 | 4,348 | 2.21% | 0.12% | 3.35% | 0.0004 | 0.0001 |
| 64.5 | 3,519 | 1.90% | 0.04% | 2.30% | 0.0003 | 0.0000 |
| 65.5 | 2,699 | 1.47% | 0.01% | 1.49% | 0.0002 | 0.0000 |
| 66.5 | 2,602 | 1.42% | 0.00% | 0.90% | 0.0002 | 0.0000 |
| 67.5 | 2,593 | 1.39% | | 0.50% | 0.0002 | 0.0001 |
| 68.5 | 622 | 0.33% | | 0.24% | 0.0000 | 0.0000 |
| 69.5 | 400 | 0.21% | | 0.10% | 0.0000 | 0.0000 |
| 70.5 | 367 | 0.20% | | 0.03% | 0.0000 | 0.0000 |
| 71.5 | 367 | 0.20% | | 0.01% | 0.0000 | 0.0000 |
| 72.5 | 227 | 0.12% | | 0.00% | 0.0000 | 0.0000 |
| 73.5 | 121 | 0.06% | | | 0.0000 | 0.0000 |
| 74.5 | 99 | 0.05% | | | 0.0000 | 0.0000 |
| 75.5 | 66 | 0.04% | | | 0.0000 | 0.0000 |
| 76.5 | 66 | 0.04% | | | 0.0000 | 0.0000 |
| 77.5 | 33 | 0.02% | | | 0.0000 | 0.0000 |
| 78.5 | 33 | 0.02% | | | 0.0000 | 0.0000 |
| 79.5 | 33 | 0.02% | | | 0.0000 | 0.0000 |
| 80.5 | 33 | 0.02% | | | 0.0000 | 0.0000 |
| 81.5 | 33 | 0.02% | | | 0.0000 | 0.0000 |
| 82.5 | 33 | 0.02% | | | 0.0000 | 0.0000 |
| 83.5 | 33 | 0.02% | | | 0.0000 | 0.0000 |
| 84.5 | 33 | 0.02% | | | 0.0000 | 0.0000 |
| 85.5 | 33 | 0.02% | | | 0.0000 | 0.0000 |
| Sum of Squared Differences | | | | [8] | 0.7075 | 0.0831 |

[1] Age in years using half-year convention
[2] Dollars exposed to retirement at the beginning of each age interval
[3] Observed life table based on the Company's property records. These numbers form the original survivor curve.
[4] The Company's selected Iowa curve to be fitted to the OLT.
[5] My selected Iowa curve to be fitted to the OLT.
[6] = ([4] - [3])^2. This is the squared difference between each point on the Company's curve and the observed survivor curve.
[7] = ([5] - [3])^2. This is the squared difference between each point on my curve and the observed survivor curve.
[8] = Sum of squared differences excluding less than 1% of beginning exposures or other statistically-relevant cut-off point when applicable
*Below the bold horizontal line represents statistically less relevant data.

# Exhibit No._(DJG-9)

## D2017.9.79

## Montana-Dakota Utilities

# Account 385.00 Detailed Curve Comparison



| [1] | [2] | [3] | [4] | [5] | [6] | [7] |
|---|---|---|---|---|---|---|
| **Age (Years)** | **Exposures (Dollars)** | **Observed Life Table (OLT)** | **MDU R4-40** | **MCC R4-44** | **MDU SSD** | **MCC SSD** |
| 0.0 | 927,997 | 100.00% | 100.00% | 100.00% | 0.0000 | 0.0000 |
| 0.5 | 652,980 | 100.00% | 100.00% | 100.00% | 0.0000 | 0.0000 |
| 1.5 | 654,953 | 99.47% | 100.00% | 100.00% | 0.0000 | 0.0000 |
| 2.5 | 481,850 | 98.98% | 99.99% | 99.99% | 0.0001 | 0.0001 |
| 3.5 | 493,529 | 98.98% | 99.99% | 99.99% | 0.0001 | 0.0001 |
| 4.5 | 511,429 | 98.98% | 99.98% | 99.98% | 0.0001 | 0.0001 |
| 5.5 | 526,578 | 98.98% | 99.97% | 99.97% | 0.0001 | 0.0001 |
| 6.5 | 526,681 | 98.98% | 99.95% | 99.96% | 0.0001 | 0.0001 |
| 7.5 | 375,805 | 98.98% | 99.93% | 99.95% | 0.0001 | 0.0001 |
| 8.5 | 392,770 | 98.98% | 99.91% | 99.93% | 0.0001 | 0.0001 |
| 9.5 | 349,133 | 98.98% | 99.87% | 99.90% | 0.0001 | 0.0001 |
| 10.5 | 361,356 | 98.98% | 99.82% | 99.87% | 0.0001 | 0.0001 |
| 11.5 | 379,874 | 98.98% | 99.77% | 99.83% | 0.0001 | 0.0001 |
| 12.5 | 325,208 | 98.98% | 99.69% | 99.77% | 0.0001 | 0.0001 |
| 13.5 | 326,900 | 98.98% | 99.59% | 99.71% | 0.0000 | 0.0001 |
| 14.5 | 312,496 | 96.59% | 99.47% | 99.62% | 0.0008 | 0.0009 |
| 15.5 | 315,855 | 96.59% | 99.31% | 99.52% | 0.0007 | 0.0009 |
| 16.5 | 306,101 | 96.59% | 99.12% | 99.39% | 0.0006 | 0.0008 |
| 17.5 | 290,165 | 96.59% | 98.88% | 99.24% | 0.0005 | 0.0007 |
| 18.5 | 276,236 | 96.59% | 98.59% | 99.05% | 0.0004 | 0.0006 |
| 19.5 | 248,123 | 96.59% | 98.24% | 98.82% | 0.0003 | 0.0005 |
| 20.5 | 236,407 | 96.59% | 97.82% | 98.55% | 0.0002 | 0.0004 |
| 21.5 | 233,350 | 96.59% | 97.31% | 98.22% | 0.0001 | 0.0003 |
| 22.5 | 224,771 | 96.59% | 96.71% | 97.84% | 0.0000 | 0.0002 |
| 23.5 | 225,435 | 96.59% | 95.99% | 97.38% | 0.0000 | 0.0001 |
| 24.5 | 216,265 | 96.59% | 95.16% | 96.85% | 0.0002 | 0.0000 |
| 25.5 | 210,755 | 95.79% | 94.19% | 96.23% | 0.0003 | 0.0000 |
| 26.5 | 225,682 | 95.79% | 93.07% | 95.52% | 0.0007 | 0.0000 |
| 27.5 | 213,724 | 95.14% | 91.78% | 94.69% | 0.0011 | 0.0000 |
| 28.5 | 199,515 | 94.37% | 90.32% | 93.75% | 0.0016 | 0.0000 |
| 29.5 | 200,468 | 94.36% | 88.66% | 92.68% | 0.0033 | 0.0003 |
| 30.5 | 132,647 | 94.36% | 86.80% | 91.46% | 0.0057 | 0.0008 |
| 31.5 | 132,717 | 93.50% | 84.72% | 90.10% | 0.0077 | 0.0012 |
| 32.5 | 136,990 | 91.24% | 82.42% | 88.58% | 0.0078 | 0.0007 |
| 33.5 | 134,994 | 90.87% | 79.90% | 86.89% | 0.0120 | 0.0016 |
| 34.5 | 142,923 | 90.85% | 77.13% | 85.02% | 0.0188 | 0.0034 |
| 35.5 | 144,379 | 90.56% | 74.07% | 82.96% | 0.0272 | 0.0058 |
| 36.5 | 148,953 | 90.56% | 70.65% | 80.73% | 0.0396 | 0.0097 |
| 37.5 | 153,513 | 90.56% | 66.82% | 78.30% | 0.0563 | 0.0150 |
| 38.5 | 159,068 | 90.26% | 62.55% | 75.64% | 0.0768 | 0.0214 |
| 39.5 | 165,665 | 90.26% | 57.86% | 72.72% | 0.1050 | 0.0308 |
| 40.5 | 154,933 | 90.26% | 52.81% | 69.49% | 0.1403 | 0.0432 |
| 41.5 | 151,496 | 88.78% | 47.50% | 65.89% | 0.1704 | 0.0524 |
| 42.5 | 147,515 | 88.78% | 42.06% | 61.93% | 0.2182 | 0.0721 |
| 43.5 | 144,556 | 88.78% | 36.64% | 57.64% | 0.2719 | 0.0970 |
| 44.5 | 141,713 | 88.78% | 31.37% | 53.04% | 0.3296 | 0.1277 |
| 45.5 | 130,296 | 88.78% | 26.37% | 48.23% | 0.3894 | 0.1644 |
| 46.5 | 116,291 | 88.78% | 21.75% | 43.30% | 0.4492 | 0.2068 |
| 47.5 | 106,380 | 88.78% | 17.58% | 38.35% | 0.5070 | 0.2543 |

# Account 385.00 Detailed Curve Comparison

| [1] Age (Years) | [2] Exposures (Dollars) | [3] Observed Life Table (OLT) | [4] MDU R4-40 | [5] MCC R4-44 | [6] MDU SSD | [7] MCC SSD |
|---|---|---|---|---|---|---|
| 48.5 | 101,513 | 88.47% | 13.88% | 33.50% | 0.5563 | 0.3022 |
| 49.5 | 96,120 | 88.47% | 10.69% | 28.83% | 0.6050 | 0.3557 |
| 50.5 | 84,947 | 88.47% | 7.99% | 24.43% | 0.6477 | 0.4101 |
| 51.5 | 67,112 | 88.47% | 5.76% | 20.37% | 0.6841 | 0.4638 |
| 52.5 | 56,529 | 88.47% | 3.97% | 16.70% | 0.7140 | 0.5152 |
| 53.5 | 54,765 | 88.47% | 2.59% | 13.42% | 0.7376 | 0.5632 |
| 54.5 | 46,569 | 88.47% | 1.56% | 10.55% | 0.7553 | 0.6071 |
| 55.5 | 34,108 | 88.47% | 0.85% | 8.10% | 0.7677 | 0.6460 |
| 56.5 | 29,534 | 88.47% | 0.41% | 6.04% | 0.7755 | 0.6795 |
| 57.5 | 25,480 | 88.47% | 0.16% | 4.34% | 0.7799 | 0.7077 |
| 58.5 | 19,419 | 88.47% | 0.04% | 2.98% | 0.7819 | 0.7308 |
| 59.5 | 12,822 | 88.47% | 0.01% | 1.94% | 0.7826 | 0.7487 |
| 60.5 | 10,459 | 88.47% | 0.00% | 1.17% | 0.7827 | 0.7621 |
| 61.5 | 9,713 | 88.47% | | 0.64% | 0.7827 | 0.7714 |
| 62.5 | 7,549 | 88.47% | | 0.31% | 0.7827 | 0.7773 |
| 63.5 | 2,681 | 88.47% | | 0.12% | 0.7827 | 0.7805 |
| Sum of Squared Differences | | | | [8] | 14.5632 | 10.9359 |

[1] Age in years using half-year convention

[2] Dollars exposed to retirement at the beginning of each age interval

[3] Observed life table based on the Company's property records. These numbers form the original survivor curve.

[4] The Company's selected Iowa curve to be fitted to the OLT.

[5] My selected Iowa curve to be fitted to the OLT.

[6] = ([4] - [3])^2. This is the squared difference between each point on the Company's curve and the observed survivor curve.

[7] = ([5] - [3])^2. This is the squared difference between each point on my curve and the observed survivor curve.

[8] = Sum of squared differences excluding less than 1% of beginning exposures or other statistically-relevant cut-off point when applicable

*Below the bold horizontal line represents statistically less relevant data.

# Exhibit No._(DJG-10)

## D2017.9.79

## Montana-Dakota Utilities

# Account 387.10 Detailed Curve Comparison



| [1]<br>Age<br>(Years) | [2]<br>Exposures<br>(Dollars) | [3]<br>Observed Life<br>Table (OLT) | [4]<br>MDU<br>R2-40 | [5]<br>MCC<br>R1.5-49 | [6]<br>"Best" Fit<br>L0.5-64 | [7]<br>MDU<br>SSD | [8]<br>MCC<br>SSD | [9]<br>L0.5-64<br>SSD |
|---|---|---|---|---|---|---|---|---|
| 0.0 | 2,334,302 | 100.00% | 100.00% | 100.00% | 100.00% | 0.0000 | 0.0000 | 0.0000 |
| 0.5 | 2,128,940 | 100.00% | 99.88% | 99.82% | 99.93% | 0.0000 | 0.0000 | 0.0000 |
| 1.5 | 2,151,349 | 100.00% | 99.63% | 99.45% | 99.73% | 0.0000 | 0.0000 | 0.0000 |
| 2.5 | 1,953,348 | 100.00% | 99.35% | 99.06% | 99.47% | 0.0000 | 0.0001 | 0.0000 |
| 3.5 | 1,838,990 | 100.00% | 99.05% | 98.66% | 99.17% | 0.0001 | 0.0002 | 0.0000 |
| 4.5 | 1,668,515 | 100.00% | 98.73% | 98.25% | 98.83% | 0.0002 | 0.0003 | 0.0000 |
| 5.5 | 1,253,721 | 99.42% | 98.38% | 97.81% | 98.45% | 0.0001 | 0.0003 | 0.0000 |
| 6.5 | 1,200,095 | 99.20% | 98.00% | 97.36% | 98.04% | 0.0001 | 0.0003 | 0.0000 |
| 7.5 | 1,152,403 | 99.20% | 97.59% | 96.90% | 97.59% | 0.0003 | 0.0005 | 0.0000 |
| 8.5 | 1,212,181 | 98.63% | 97.15% | 96.42% | 97.11% | 0.0002 | 0.0005 | 0.0000 |
| 9.5 | 1,212,370 | 98.36% | 96.67% | 95.92% | 96.61% | 0.0003 | 0.0006 | 0.0000 |
| 10.5 | 1,209,886 | 97.11% | 96.16% | 95.40% | 96.07% | 0.0001 | 0.0003 | 0.0000 |
| 11.5 | 1,155,764 | 96.71% | 95.62% | 94.86% | 95.50% | 0.0001 | 0.0003 | 0.0000 |
| 12.5 | 1,136,953 | 95.92% | 95.03% | 94.30% | 94.91% | 0.0001 | 0.0003 | 0.0000 |
| 13.5 | 1,130,578 | 94.99% | 94.40% | 93.73% | 94.28% | 0.0000 | 0.0002 | 0.0000 |
| 14.5 | 1,045,443 | 92.95% | 93.73% | 93.13% | 93.63% | 0.0001 | 0.0000 | 0.0000 |
| 15.5 | 985,205 | 92.32% | 93.01% | 92.52% | 92.95% | 0.0000 | 0.0000 | 0.0000 |
| 16.5 | 948,884 | 91.55% | 92.24% | 91.88% | 92.24% | 0.0000 | 0.0000 | 0.0000 |
| 17.5 | 896,205 | 90.64% | 91.42% | 91.22% | 91.50% | 0.0001 | 0.0000 | 0.0000 |
| 18.5 | 839,661 | 89.48% | 90.54% | 90.54% | 90.74% | 0.0001 | 0.0001 | 0.0000 |
| 19.5 | 757,784 | 88.32% | 89.61% | 89.83% | 89.95% | 0.0002 | 0.0002 | 0.0000 |
| 20.5 | 738,380 | 86.27% | 88.62% | 89.10% | 89.13% | 0.0006 | 0.0008 | 0.0000 |
| 21.5 | 702,365 | 86.18% | 87.57% | 88.34% | 88.29% | 0.0002 | 0.0005 | 0.0001 |
| 22.5 | 689,132 | 85.29% | 86.45% | 87.55% | 87.42% | 0.0001 | 0.0005 | 0.0001 |
| 23.5 | 666,250 | 84.14% | 85.27% | 86.74% | 86.54% | 0.0001 | 0.0007 | 0.0002 |
| 24.5 | 607,739 | 82.79% | 84.01% | 85.90% | 85.63% | 0.0001 | 0.0010 | 0.0003 |
| 25.5 | 611,172 | 81.47% | 82.68% | 85.02% | 84.70% | 0.0001 | 0.0013 | 0.0004 |
| 26.5 | 595,502 | 80.34% | 81.27% | 84.11% | 83.74% | 0.0001 | 0.0014 | 0.0006 |
| 27.5 | 538,129 | 79.29% | 79.78% | 83.17% | 82.78% | 0.0000 | 0.0015 | 0.0009 |
| 28.5 | 497,462 | 77.59% | 78.22% | 82.20% | 81.79% | 0.0000 | 0.0021 | 0.0013 |
| 29.5 | 428,125 | 76.94% | 76.56% | 81.19% | 80.79% | 0.0000 | 0.0018 | 0.0018 |
| 30.5 | 378,153 | 76.16% | 74.83% | 80.14% | 79.77% | 0.0002 | 0.0016 | 0.0024 |
| 31.5 | 347,293 | 75.30% | 73.00% | 79.06% | 78.75% | 0.0005 | 0.0014 | 0.0033 |
| 32.5 | 321,367 | 74.82% | 71.09% | 77.93% | 77.71% | 0.0014 | 0.0010 | 0.0044 |
| 33.5 | 305,517 | 73.92% | 69.09% | 76.77% | 76.66% | 0.0023 | 0.0008 | 0.0057 |
| 34.5 | 295,337 | 72.11% | 67.00% | 75.57% | 75.61% | 0.0026 | 0.0012 | 0.0074 |
| 35.5 | 280,080 | 71.13% | 64.82% | 74.32% | 74.55% | 0.0040 | 0.0010 | 0.0095 |
| 36.5 | 271,731 | 71.13% | 62.56% | 73.04% | 73.48% | 0.0074 | 0.0004 | 0.0119 |
| 37.5 | 244,152 | 69.04% | 60.21% | 71.71% | 72.42% | 0.0078 | 0.0007 | 0.0149 |
| 38.5 | 223,226 | 68.72% | 57.79% | 70.34% | 71.35% | 0.0119 | 0.0003 | 0.0184 |
| 39.5 | 207,224 | 68.22% | 55.30% | 68.93% | 70.28% | 0.0167 | 0.0000 | 0.0225 |
| 40.5 | 199,787 | 67.99% | 52.74% | 67.47% | 69.22% | 0.0233 | 0.0000 | 0.0272 |
| 41.5 | 180,742 | 66.21% | 50.12% | 65.97% | 68.15% | 0.0259 | 0.0000 | 0.0325 |
| 42.5 | 164,671 | 65.02% | 47.46% | 64.43% | 67.09% | 0.0308 | 0.0000 | 0.0386 |
| 43.5 | 152,647 | 64.68% | 44.75% | 62.85% | 66.03% | 0.0397 | 0.0003 | 0.0453 |
| 44.5 | 140,750 | 63.87% | 42.03% | 61.22% | 64.97% | 0.0477 | 0.0007 | 0.0526 |
| 45.5 | 137,525 | 63.22% | 39.30% | 59.56% | 63.92% | 0.0572 | 0.0013 | 0.0606 |
| 46.5 | 123,513 | 63.13% | 36.57% | 57.86% | 62.87% | 0.0706 | 0.0028 | 0.0692 |
| 47.5 | 113,350 | 62.84% | 33.86% | 56.12% | 61.82% | 0.0840 | 0.0045 | 0.0782 |
| 48.5 | 105,978 | 62.61% | 31.18% | 54.36% | 60.77% | 0.0988 | 0.0068 | 0.0876 |
| 49.5 | 104,195 | 62.61% | 28.56% | 52.56% | 59.73% | 0.1160 | 0.0101 | 0.0972 |
| 50.5 | 95,167 | 61.80% | 26.00% | 50.73% | 58.69% | 0.1282 | 0.0123 | 0.1069 |
| 51.5 | 85,440 | 61.35% | 23.52% | 48.88% | 57.66% | 0.1431 | 0.0156 | 0.1165 |
| 52.5 | 71,830 | 61.35% | 21.14% | 47.00% | 56.63% | 0.1616 | 0.0206 | 0.1259 |
| 53.5 | 62,111 | 61.35% | 18.87% | 45.11% | 55.61% | 0.1804 | 0.0264 | 0.1349 |
| 54.5 | 46,432 | 60.19% | 16.73% | 43.21% | 54.59% | 0.1889 | 0.0288 | 0.1434 |
| 55.5 | 31,719 | 60.19% | 14.71% | 41.30% | 53.58% | 0.2069 | 0.0357 | 0.1511 |
| 56.5 | 24,109 | 59.75% | 12.82% | 39.39% | 52.57% | 0.2202 | 0.0415 | 0.1580 |
| 57.5 | 20,501 | 59.75% | 11.07% | 37.48% | 51.57% | 0.2369 | 0.0496 | 0.1640 |
| 58.5 | 15,846 | 59.75% | 9.47% | 35.57% | 50.58% | 0.2528 | 0.0584 | 0.1690 |
| 59.5 | 15,052 | 59.75% | 8.01% | 33.69% | 49.59% | 0.2677 | 0.0679 | 0.1729 |
| 60.5 | 13,822 | 59.75% | 6.69% | 31.82% | 48.61% | 0.2815 | 0.0780 | 0.1757 |
| 61.5 | 13,716 | 59.75% | 5.50% | 29.97% | 47.63% | 0.2943 | 0.0887 | 0.1775 |
| 62.5 | 13,675 | 59.75% | 4.45% | 28.16% | 46.67% | 0.3058 | 0.0998 | 0.1782 |
| 63.5 | 13,038 | 59.75% | 3.53% | 26.38% | 45.71% | 0.3161 | 0.1114 | 0.1779 |
| 64.5 | 8,832 | 59.75% | 2.73% | 24.64% | 44.76% | 0.3251 | 0.1233 | 0.1766 |
| 65.5 | 7,850 | 59.75% | 2.05% | 22.95% | 43.82% | 0.3329 | 0.1355 | 0.1744 |

# Account 387.10 Detailed Curve Comparison

| [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] |
|---|---|---|---|---|---|---|---|---|
| **Age (Years)** | **Exposures (Dollars)** | **Observed Life Table (OLT)** | **MDU R2-40** | **MCC R1.5-49** | **"Best" Fit L0.5-64** | **MDU SSD** | **MCC SSD** | **L0.5-64 SSD** |
| 66.5 | 3,148 | 59.75% | 1.48% | 21.30% | 42.88% | 0.3395 | 0.1478 | 0.1714 |
| Sum of Squared Differences | | | | | [10] | 4.8344 | 1.1921 | 3.3693 |

[1] Age in years using half-year convention
[2] Dollars exposed to retirement at the beginning of each age interval
[3] Observed life table based on the Company's property records. These numbers form the original survivor curve.
[4] The Company's selected Iowa curve to be fitted to the OLT.
[5] My selected Iowa curve to be fitted to the OLT.
[6] "Best" fit of the three curves based on mathematical fitting
[7] = ([4] - [3])^2. This is the squared difference between each point on the Company's curve and the observed survivor curve.
[8] = ([5] - [3])^2. This is the squared difference between each point on my curve and the observed survivor curve.
[9] = ([6] - [3])^2. This is the squared difference between each point on the "best" mathematical curve and the observed survivor curve.
[10] = Sum of squared differences excluding less than 1% of beginning exposures or other statistically-relevant cut-off point when applicable.
*Below the bold horizontal line represents statistically less relevant data.

# Exhibit No._(DJG-11)

## D2017.9.79

## Montana-Dakota Utilities

# Account 396.20 Detailed Curve Comparison

| [1] Age (Years) | [2] Exposures (Dollars) | [3] Observed Life Table (OLT) | [4] MDU L1-3 | [5] MCC L1-7 | [6] MDU SSD | [7] MCC SSD |
|---|---|---|---|---|---|---|
| 0.0 | 38,712,079 | 100.00% | 100.00% | 100.00% | 0.0000 | 0.0000 |
| 0.5 | 35,000,850 | 97.28% | 97.83% | 99.42% | 0.0000 | 0.0005 |
| 1.5 | 15,615,655 | 42.89% | 81.71% | 96.58% | 0.1507 | 0.2882 |
| 2.5 | 9,048,581 | 24.94% | 57.23% | 90.66% | 0.1042 | 0.4318 |
| 3.5 | 6,590,202 | 21.21% | 35.09% | 81.71% | 0.0193 | 0.3661 |
| 4.5 | 5,875,376 | 20.36% | 18.16% | 71.21% | 0.0005 | 0.2585 |
| 5.5 | 5,472,697 | 19.18% | 7.44% | 60.67% | 0.0138 | 0.1721 |
| 6.5 | 5,037,267 | 17.49% | 2.15% | 50.51% | 0.0235 | 0.1090 |
| 7.5 | 4,448,783 | 15.73% | 0.34% | 40.98% | 0.0237 | 0.0637 |
| 8.5 | 3,797,834 | 14.51% | 0.00% | 32.31% | 0.0211 | 0.0317 |
| 9.5 | 3,289,730 | 13.11% | | 24.67% | 0.0172 | 0.0134 |
| 10.5 | 2,612,722 | 10.78% | | 18.16% | 0.0116 | 0.0054 |
| 11.5 | 1,969,202 | 9.32% | | 12.81% | 0.0087 | 0.0012 |
| 12.5 | 1,625,686 | 8.19% | | 8.60% | 0.0067 | 0.0000 |
| 13.5 | 1,456,173 | 7.65% | | 5.45% | 0.0059 | 0.0005 |
| 14.5 | 1,089,674 | 6.42% | | 3.21% | 0.0041 | 0.0010 |
| 15.5 | 953,093 | 5.89% | | 1.73% | 0.0035 | 0.0017 |
| 16.5 | 755,118 | 4.67% | | 0.83% | 0.0022 | 0.0015 |
| 17.5 | 669,074 | 4.36% | | 0.34% | 0.0019 | 0.0016 |
| 18.5 | 603,781 | 3.80% | | 0.11% | 0.0014 | 0.0014 |
| 19.5 | 510,345 | 3.40% | | 0.03% | 0.0012 | 0.0011 |
| 20.5 | 512,938 | 3.28% | | 0.00% | 0.0011 | 0.0011 |
| 21.5 | 479,418 | 3.01% | | | 0.0009 | 0.0009 |
| 22.5 | 368,321 | 2.40% | | | 0.0006 | 0.0006 |
| 23.5 | 318,840 | 2.04% | | | 0.0004 | 0.0004 |
| 24.5 | 292,049 | 1.57% | | | 0.0002 | 0.0002 |
| 25.5 | 230,498 | 1.14% | | | 0.0001 | 0.0001 |
| 26.5 | 118,063 | 1.01% | | | 0.0001 | 0.0001 |
| 27.5 | 88,125 | 0.71% | | | 0.0001 | 0.0001 |
| 28.5 | 84,103 | 0.57% | | | 0.0000 | 0.0000 |
| 29.5 | 90,875 | 0.46% | | | 0.0000 | 0.0000 |
| 30.5 | 99,290 | 0.45% | | | 0.0000 | 0.0000 |
| 31.5 | 83,610 | 0.38% | | | 0.0000 | 0.0000 |
| 32.5 | 99,513 | 0.38% | | | 0.0000 | 0.0000 |
| 33.5 | 99,513 | 0.38% | | | 0.0000 | 0.0000 |
| 34.5 | 107,160 | 0.38% | | | 0.0000 | 0.0000 |
| 35.5 | 86,872 | 0.31% | | | 0.0000 | 0.0000 |
| 36.5 | 75,960 | 0.27% | | | 0.0000 | 0.0000 |
| 37.5 | 77,423 | 0.26% | | | 0.0000 | 0.0000 |
| 38.5 | 58,030 | 0.20% | | | 0.0000 | 0.0000 |
| 39.5 | 51,600 | 0.14% | | | 0.0000 | 0.0000 |
| 40.5 | 51,600 | 0.14% | | | 0.0000 | 0.0000 |
| 41.5 | 61,124 | 0.12% | | | 0.0000 | 0.0000 |
| 42.5 | 40,477 | 0.08% | | | 0.0000 | 0.0000 |
| 43.5 | 22,206 | 0.04% | | | 0.0000 | 0.0000 |
| 44.5 | 19,015 | 0.04% | | | 0.0000 | 0.0000 |
| Sum of Squared Differences | | | | [8] | 0.4248 | 1.7542 |

## Account 396.20 Detailed Curve Comparison



| [1] | [2] | [3] | [4] | [5] | [6] | [7] |
|---|---|---|---|---|---|---|
| **Age (Years)** | **Exposures (Dollars)** | **Observed Life Table (OLT)** | **MDU L1-3** | **MCC L1-7** | **MDU SSD** | **MCC SSD** |

[1] Age in years using half-year convention

[2] Dollars exposed to retirement at the beginning of each age interval

[3] Observed life table based on the Company's property records. These numbers form the original survivor curve.

[4] The Company's selected Iowa curve to be fitted to the OLT.

[5] My selected Iowa curve to be fitted to the OLT.

[6] = ([4] - [3])^2. This is the squared difference between each point on the Company's curve and the observed survivor curve.

[7] = ([5] - [3])^2. This is the squared difference between each point on my curve and the observed survivor curve.

[8] = Sum of squared differences excluding less than 1% of beginning exposures or other statistically-relevant cut-off point when applicable

*Below the bold horizontal line represents statistically less relevant data.

# Exhibit No._(DJG-12)

## D2017.9.79

## Montana-Dakota Utilities

# MDU
# Gas Division
### 376.10 Distribution Mains - Steel

## Observed Life Table

**Retirement Expr. 1995 TO 2015**
**Placement Years 1916 TO 2015**

| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 0.0 - 0.5 | $17,136,681.04 | $236.09 | 0.00001 | 100.00 |
| 0.5 - 1.5 | $39,123,165.03 | $16,172.41 | 0.00041 | 100.00 |
| 1.5 - 2.5 | $17,011,502.07 | $5,143.29 | 0.00030 | 99.96 |
| 2.5 - 3.5 | $16,410,560.59 | $4,764.69 | 0.00029 | 99.93 |
| 3.5 - 4.5 | $15,122,363.36 | $6,974.61 | 0.00046 | 99.90 |
| 4.5 - 5.5 | $13,437,670.50 | $14,444.15 | 0.00107 | 99.85 |
| 5.5 - 6.5 | $13,440,886.51 | $17,304.04 | 0.00129 | 99.74 |
| 6.5 - 7.5 | $13,293,756.45 | $4,016.17 | 0.00030 | 99.62 |
| 7.5 - 8.5 | $10,435,705.52 | $28,387.63 | 0.00272 | 99.59 |
| 8.5 - 9.5 | $11,049,549.84 | $4,211.76 | 0.00038 | 99.32 |
| 9.5 - 10.5 | $11,344,187.42 | $64,477.86 | 0.00568 | 99.28 |
| 10.5 - 11.5 | $10,094,752.48 | $6,653.57 | 0.00066 | 98.71 |
| 11.5 - 12.5 | $9,684,546.83 | $85,170.12 | 0.00879 | 98.65 |
| 12.5 - 13.5 | $9,764,302.55 | $23,923.33 | 0.00245 | 97.78 |
| 13.5 - 14.5 | $9,895,705.72 | $98,659.03 | 0.00997 | 97.54 |
| 14.5 - 15.5 | $10,285,170.52 | $53,832.17 | 0.00523 | 96.57 |
| 15.5 - 16.5 | $10,596,660.45 | $33,934.88 | 0.00320 | 96.06 |
| 16.5 - 17.5 | $10,498,222.36 | $40,035.34 | 0.00381 | 95.76 |
| 17.5 - 18.5 | $10,636,842.84 | $18,649.66 | 0.00175 | 95.39 |
| 18.5 - 19.5 | $11,040,295.59 | $63,469.32 | 0.00575 | 95.22 |
| 19.5 - 20.5 | $10,851,422.92 | $29,158.55 | 0.00269 | 94.68 |
| 20.5 - 21.5 | $10,972,454.51 | $112,694.46 | 0.01027 | 94.42 |
| 21.5 - 22.5 | $10,979,056.21 | $31,352.06 | 0.00286 | 93.45 |
| 22.5 - 23.5 | $10,653,230.41 | $14,311.76 | 0.00134 | 93.18 |
| 23.5 - 24.5 | $10,825,566.24 | $76,040.17 | 0.00702 | 93.06 |
| 24.5 - 25.5 | $12,882,919.51 | $23,656.60 | 0.00184 | 92.41 |
| 25.5 - 26.5 | $13,303,337.05 | $9,143.95 | 0.00069 | 92.24 |
| 26.5 - 27.5 | $13,779,036.52 | $130,681.75 | 0.00948 | 92.17 |
| 27.5 - 28.5 | $13,989,707.95 | $23,999.35 | 0.00172 | 91.30 |
| 28.5 - 29.5 | $14,242,326.66 | $83,809.11 | 0.00588 | 91.14 |
| 29.5 - 30.5 | $14,108,968.28 | $42,978.17 | 0.00305 | 90.61 |
| 30.5 - 31.5 | $14,355,540.59 | $31,660.86 | 0.00221 | 90.33 |
| 31.5 - 32.5 | $15,032,294.44 | $120,283.26 | 0.00800 | 90.13 |
| 32.5 - 33.5 | $15,292,300.48 | $86,176.24 | 0.00564 | 89.41 |
| 33.5 - 34.5 | $15,012,053.63 | $45,915.78 | 0.00306 | 88.91 |
| 34.5 - 35.5 | $15,082,296.55 | $48,721.22 | 0.00323 | 88.63 |
| 35.5 - 36.5 | $15,115,859.43 | $64,325.07 | 0.00426 | 88.35 |

# MDU
## Gas Division
### 376.10 Distribution Mains - Steel
## Observed Life Table
**Retirement Expr. 1995 TO 2015**
**Placement Years 1916 TO 2015**

| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 36.5 - 37.5 | $15,129,716.94 | $44,024.26 | 0.00291 | 87.97 |
| 37.5 - 38.5 | $15,258,922.05 | $66,214.41 | 0.00434 | 87.72 |
| 38.5 - 39.5 | $15,665,730.89 | $70,766.28 | 0.00452 | 87.33 |
| 39.5 - 40.5 | $16,027,677.90 | $54,690.32 | 0.00341 | 86.94 |
| 40.5 - 41.5 | $16,486,938.72 | $43,714.45 | 0.00265 | 86.64 |
| 41.5 - 42.5 | $16,688,495.17 | $33,748.08 | 0.00202 | 86.41 |
| 42.5 - 43.5 | $16,617,585.41 | $38,588.37 | 0.00232 | 86.24 |
| 43.5 - 44.5 | $16,376,245.65 | $97,259.51 | 0.00594 | 86.04 |
| 44.5 - 45.5 | $16,123,048.37 | $77,384.25 | 0.00480 | 85.53 |
| 45.5 - 46.5 | $13,762,022.55 | $99,796.69 | 0.00725 | 85.12 |
| 46.5 - 47.5 | $13,094,775.78 | $32,887.09 | 0.00251 | 84.50 |
| 47.5 - 48.5 | $12,453,605.52 | $138,555.17 | 0.01113 | 84.29 |
| 48.5 - 49.5 | $11,781,900.25 | $54,592.44 | 0.00463 | 83.35 |
| 49.5 - 50.5 | $11,196,657.60 | $80,808.66 | 0.00722 | 82.96 |
| 50.5 - 51.5 | $10,342,456.19 | $79,904.26 | 0.00773 | 82.36 |
| 51.5 - 52.5 | $9,469,353.04 | $38,507.07 | 0.00407 | 81.73 |
| 52.5 - 53.5 | $8,626,186.12 | $23,034.80 | 0.00267 | 81.40 |
| 53.5 - 54.5 | $7,700,943.99 | $23,060.73 | 0.00299 | 81.18 |
| 54.5 - 55.5 | $7,158,802.16 | $69,425.89 | 0.00970 | 80.94 |
| 55.5 - 56.5 | $6,451,968.98 | $32,350.16 | 0.00501 | 80.15 |
| 56.5 - 57.5 | $5,908,220.01 | $35,889.15 | 0.00607 | 79.75 |
| 57.5 - 58.5 | $5,468,878.24 | $25,106.72 | 0.00459 | 79.26 |
| 58.5 - 59.5 | $5,140,887.24 | $27,520.14 | 0.00535 | 78.90 |
| 59.5 - 60.5 | $4,512,302.74 | $55,747.77 | 0.01235 | 78.48 |
| 60.5 - 61.5 | $3,644,816.00 | $25,553.82 | 0.00701 | 77.51 |
| 61.5 - 62.5 | $3,216,974.42 | $48,361.87 | 0.01503 | 76.97 |
| 62.5 - 63.5 | $2,816,094.99 | $25,796.77 | 0.00916 | 75.81 |
| 63.5 - 64.5 | $2,341,125.66 | $12,403.73 | 0.00530 | 75.11 |
| 64.5 - 65.5 | $2,131,548.39 | $8,553.06 | 0.00401 | 74.72 |
| 65.5 - 66.5 | $1,806,029.91 | $5,102.56 | 0.00283 | 74.42 |
| 66.5 - 67.5 | $1,774,285.32 | $31,020.14 | 0.01748 | 74.21 |
| 67.5 - 68.5 | $1,721,115.26 | $24,149.36 | 0.01403 | 72.91 |
| 68.5 - 69.5 | $1,665,160.24 | $18,520.29 | 0.01112 | 71.89 |
| 69.5 - 70.5 | $1,611,323.88 | $10,102.22 | 0.00627 | 71.09 |
| 70.5 - 71.5 | $1,680,282.09 | $4,068.52 | 0.00242 | 70.64 |
| 71.5 - 72.5 | $1,753,345.70 | $13,928.92 | 0.00794 | 70.47 |
| 72.5 - 73.5 | $1,814,708.44 | $1,874.08 | 0.00103 | 69.91 |

# MDU
## Gas Division
### 376.10 Distribution Mains - Steel

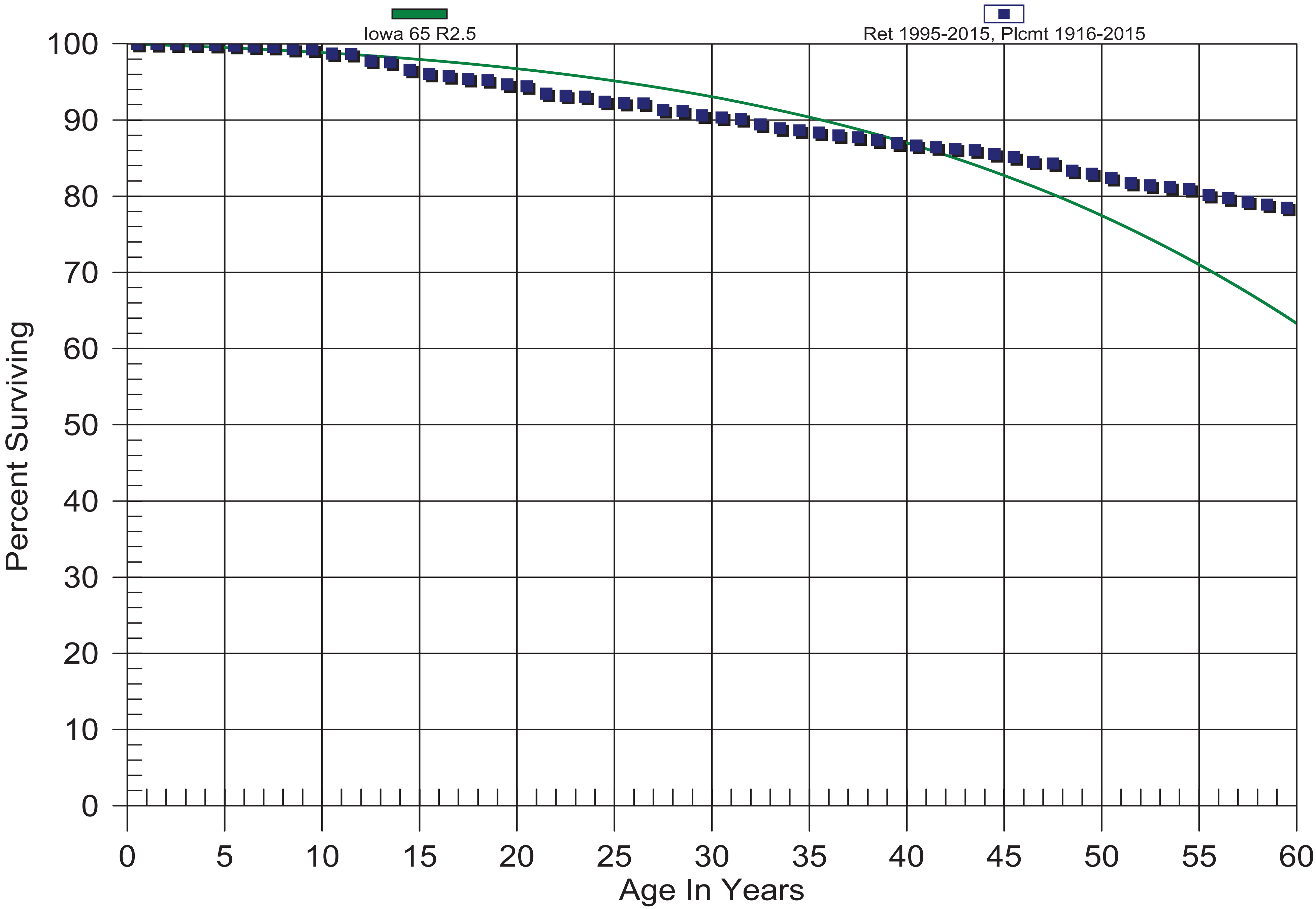
## Observed Life Table

**Retirement Expr. 1995 TO 2015**
**Placement Years 1916 TO 2015**

| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 73.5 - 74.5 | $1,886,249.83 | $944.52 | 0.00050 | 69.84 |
| 74.5 - 75.5 | $1,956,930.16 | $2,364.16 | 0.00121 | 69.80 |
| 75.5 - 76.5 | $1,908,078.53 | $4,710.88 | 0.00247 | 69.72 |
| 76.5 - 77.5 | $1,857,784.10 | $3,011.80 | 0.00162 | 69.55 |
| 77.5 - 78.5 | $1,811,600.38 | $337.84 | 0.00019 | 69.43 |
| 78.5 - 79.5 | $1,740,364.26 | $79.88 | 0.00005 | 69.42 |
| 79.5 - 80.5 | $1,634,029.97 | $868.34 | 0.00053 | 69.42 |
| 80.5 - 81.5 | $1,529,926.47 | $2,830.30 | 0.00185 | 69.38 |
| 81.5 - 82.5 | $1,425,892.13 | $0.00 | 0.00000 | 69.25 |
| 82.5 - 83.5 | $1,327,156.49 | $588.08 | 0.00044 | 69.25 |
| 83.5 - 84.5 | $1,230,693.06 | $0.00 | 0.00000 | 69.22 |
| 84.5 - 85.5 | $1,136,715.05 | $0.00 | 0.00000 | 69.22 |
| 85.5 - 86.5 | $1,045,554.72 | $546.00 | 0.00052 | 69.22 |
| 86.5 - 87.5 | $955,559.10 | $0.00 | 0.00000 | 69.18 |
| 87.5 - 88.5 | $868,291.18 | $250.32 | 0.00029 | 69.18 |
| 88.5 - 89.5 | $783,151.74 | $0.00 | 0.00000 | 69.16 |
| 89.5 - 90.5 | $700,088.87 | $0.00 | 0.00000 | 69.16 |
| 90.5 - 91.5 | $619,051.93 | $0.00 | 0.00000 | 69.16 |
| 91.5 - 92.5 | $539,991.50 | $0.00 | 0.00000 | 69.16 |
| 92.5 - 93.5 | $462,859.37 | $0.00 | 0.00000 | 69.16 |
| 93.5 - 94.5 | $387,608.51 | $0.00 | 0.00000 | 69.16 |
| 94.5 - 95.5 | $314,193.04 | $0.00 | 0.00000 | 69.16 |
| 95.5 - 96.5 | $242,568.19 | $0.00 | 0.00000 | 69.16 |
| 96.5 - 97.5 | $172,690.29 | $0.00 | 0.00000 | 69.16 |
| 97.5 - 98.5 | $104,516.72 | $0.00 | 0.00000 | 69.16 |
| 98.5 - 99.5 | $38,005.92 | $0.00 | 0.00000 | 69.16 |

# MDU

## Gas Division
## 376.10 Distribution Mains - Steel
## Original And Smooth Survivor Curves



# *MDU*
## *Gas Division*
### *376.20 Distribution Mains - Plastic*

## *Observed Life Table*

***Retirement Expr. 1995 TO 2015***
***Placement Years 1945 TO 2015***

| *Age Interval* | *$ Surviving At Beginning of Age Interval* | *$ Retired During The Age Interval* | *Retirement Ratio* | *% Surviving At Beginning of Age Interval* |
|---|---|---|---|---|
| 0.0 - 0.5 | $102,527,986.44 | $6,937.17 | 0.00007 | 100.00 |
| 0.5 - 1.5 | $93,798,516.81 | $96,088.38 | 0.00102 | 99.99 |
| 1.5 - 2.5 | $83,030,475.71 | $170,731.98 | 0.00206 | 99.89 |
| 2.5 - 3.5 | $73,856,751.16 | $54,767.65 | 0.00074 | 99.69 |
| 3.5 - 4.5 | $58,571,172.58 | $171,452.24 | 0.00293 | 99.61 |
| 4.5 - 5.5 | $53,570,270.52 | $65,148.12 | 0.00122 | 99.32 |
| 5.5 - 6.5 | $50,112,509.55 | $87,651.49 | 0.00175 | 99.20 |
| 6.5 - 7.5 | $48,394,997.15 | $49,412.21 | 0.00102 | 99.03 |
| 7.5 - 8.5 | $45,581,352.43 | $47,680.46 | 0.00105 | 98.92 |
| 8.5 - 9.5 | $43,944,747.42 | $49,889.37 | 0.00114 | 98.82 |
| 9.5 - 10.5 | $41,951,849.97 | $72,236.48 | 0.00172 | 98.71 |
| 10.5 - 11.5 | $39,797,053.90 | $48,325.19 | 0.00121 | 98.54 |
| 11.5 - 12.5 | $38,451,604.29 | $37,246.91 | 0.00097 | 98.42 |
| 12.5 - 13.5 | $37,064,902.49 | $59,220.78 | 0.00160 | 98.32 |
| 13.5 - 14.5 | $36,144,545.61 | $189,303.11 | 0.00524 | 98.17 |
| 14.5 - 15.5 | $35,817,208.72 | $78,995.69 | 0.00221 | 97.65 |
| 15.5 - 16.5 | $35,401,976.56 | $22,966.34 | 0.00065 | 97.44 |
| 16.5 - 17.5 | $34,800,341.30 | $36,431.62 | 0.00105 | 97.37 |
| 17.5 - 18.5 | $33,670,169.67 | $112,584.68 | 0.00334 | 97.27 |
| 18.5 - 19.5 | $32,610,045.20 | $67,111.93 | 0.00206 | 96.95 |
| 19.5 - 20.5 | $31,602,546.14 | $112,984.06 | 0.00358 | 96.75 |
| 20.5 - 21.5 | $30,381,156.39 | $78,481.54 | 0.00258 | 96.40 |
| 21.5 - 22.5 | $26,346,316.73 | $38,247.18 | 0.00145 | 96.15 |
| 22.5 - 23.5 | $21,037,727.15 | $21,472.28 | 0.00102 | 96.01 |
| 23.5 - 24.5 | $19,308,147.49 | $79,935.80 | 0.00414 | 95.91 |
| 24.5 - 25.5 | $18,318,460.81 | $56,495.99 | 0.00308 | 95.52 |
| 25.5 - 26.5 | $17,412,513.09 | $19,199.02 | 0.00110 | 95.22 |
| 26.5 - 27.5 | $16,785,425.07 | $23,726.34 | 0.00141 | 95.12 |
| 27.5 - 28.5 | $15,951,571.79 | $37,923.88 | 0.00238 | 94.98 |
| 28.5 - 29.5 | $14,676,043.14 | $14,109.79 | 0.00096 | 94.76 |
| 29.5 - 30.5 | $13,496,553.81 | $36,265.81 | 0.00269 | 94.67 |
| 30.5 - 31.5 | $12,234,894.51 | $71,760.78 | 0.00587 | 94.41 |
| 31.5 - 32.5 | $10,943,453.79 | $10,654.12 | 0.00097 | 93.86 |
| 32.5 - 33.5 | $9,790,524.93 | $23,401.10 | 0.00239 | 93.77 |
| 33.5 - 34.5 | $8,643,402.95 | $177,534.09 | 0.02054 | 93.54 |
| 34.5 - 35.5 | $7,333,394.43 | $3,305.88 | 0.00045 | 91.62 |
| 35.5 - 36.5 | $5,812,509.20 | $5,420.24 | 0.00093 | 91.58 |

# MDU
## Gas Division
### 376.20 Distribution Mains - Plastic

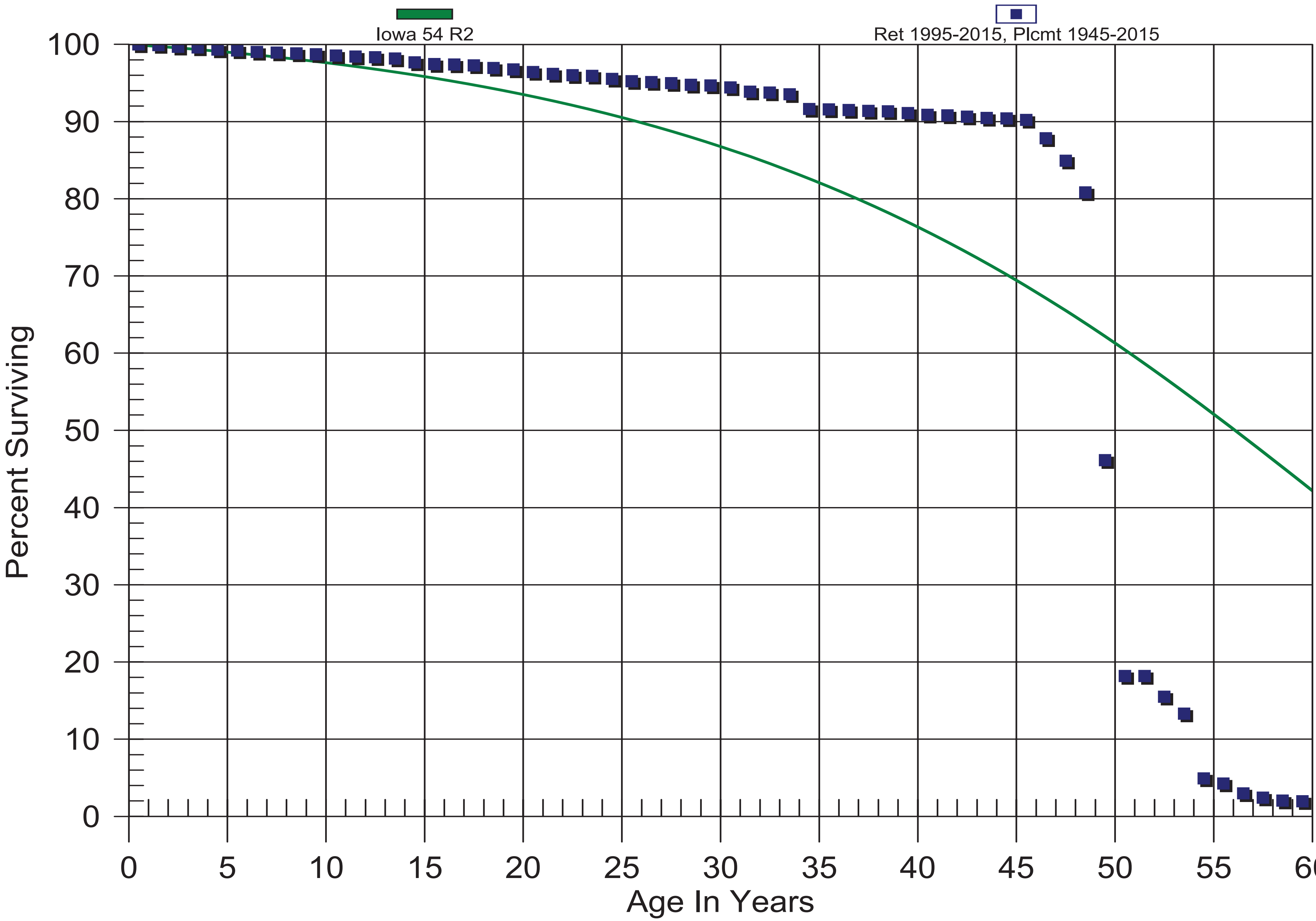
## Observed Life Table

**Retirement Expr. 1995 TO 2015**
**Placement Years 1945 TO 2015**

| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 36.5 - 37.5 | $4,717,184.40 | $6,678.88 | 0.00142 | 91.50 |
| 37.5 - 38.5 | $4,203,174.36 | $2,337.13 | 0.00056 | 91.37 |
| 38.5 - 39.5 | $3,883,688.77 | $8,800.48 | 0.00227 | 91.31 |
| 39.5 - 40.5 | $3,231,073.75 | $8,248.89 | 0.00255 | 91.11 |
| 40.5 - 41.5 | $2,359,070.38 | $1,741.35 | 0.00074 | 90.88 |
| 41.5 - 42.5 | $2,116,116.47 | $3,897.07 | 0.00184 | 90.81 |
| 42.5 - 43.5 | $1,810,720.77 | $3,794.63 | 0.00210 | 90.64 |
| 43.5 - 44.5 | $548,800.22 | $202.88 | 0.00037 | 90.45 |
| 44.5 - 45.5 | $408,293.51 | $923.00 | 0.00226 | 90.42 |
| 45.5 - 46.5 | $47,291.56 | $1,246.19 | 0.02635 | 90.21 |
| 46.5 - 47.5 | $46,045.37 | $1,528.80 | 0.03320 | 87.84 |
| 47.5 - 48.5 | $44,639.48 | $2,148.39 | 0.04813 | 84.92 |
| 48.5 - 49.5 | $42,491.09 | $18,232.25 | 0.42908 | 80.83 |
| 49.5 - 50.5 | $24,297.02 | $14,723.58 | 0.60598 | 46.15 |
| 50.5 - 51.5 | $9,573.44 | $0.00 | 0.00000 | 18.18 |
| 51.5 - 52.5 | $9,573.44 | $1,411.48 | 0.14744 | 18.18 |
| 52.5 - 53.5 | $8,161.96 | $1,163.98 | 0.14261 | 15.50 |
| 53.5 - 54.5 | $6,997.98 | $4,403.87 | 0.62931 | 13.29 |
| 54.5 - 55.5 | $2,594.11 | $349.74 | 0.13482 | 4.93 |
| 55.5 - 56.5 | $2,244.37 | $672.94 | 0.29983 | 4.26 |
| 56.5 - 57.5 | $1,571.43 | $289.49 | 0.18422 | 2.98 |
| 57.5 - 58.5 | $1,281.94 | $214.20 | 0.16709 | 2.43 |
| 58.5 - 59.5 | $1,067.74 | $43.85 | 0.04107 | 2.03 |
| 59.5 - 60.5 | $1,023.89 | $0.00 | 0.00000 | 1.94 |
| 60.5 - 61.5 | $1,023.89 | $94.36 | 0.09216 | 1.94 |
| 61.5 - 62.5 | $929.53 | $0.00 | 0.00000 | 1.77 |
| 62.5 - 63.5 | $929.53 | $47.63 | 0.05124 | 1.77 |

# MDU

Gas Division
376.20 Distribution Mains - Plastic
Original And Smooth Survivor Curves



# MDU
## Gas Division
### 380.10 Services - Steel

## Observed Life Table
**Retirement Expr. 1995 TO 2015**
**Placement Years 1920 TO 2015**

| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 0.0 - 0.5 | $363,913.72 | $0.00 | 0.00000 | 100.00 |
| 0.5 - 1.5 | $348,124.83 | $771.08 | 0.00221 | 100.00 |
| 1.5 - 2.5 | $473,602.06 | $3,502.04 | 0.00739 | 99.78 |
| 2.5 - 3.5 | $510,038.81 | $4,572.16 | 0.00896 | 99.04 |
| 3.5 - 4.5 | $531,142.23 | $7,068.62 | 0.01331 | 98.15 |
| 4.5 - 5.5 | $563,933.28 | $5,411.08 | 0.00960 | 96.85 |
| 5.5 - 6.5 | $607,722.10 | $3,843.82 | 0.00632 | 95.92 |
| 6.5 - 7.5 | $653,781.60 | $6,011.07 | 0.00919 | 95.31 |
| 7.5 - 8.5 | $733,665.20 | $7,145.19 | 0.00974 | 94.43 |
| 8.5 - 9.5 | $805,750.60 | $4,810.33 | 0.00597 | 93.51 |
| 9.5 - 10.5 | $877,039.69 | $9,478.09 | 0.01081 | 92.96 |
| 10.5 - 11.5 | $948,734.73 | $13,198.72 | 0.01391 | 91.95 |
| 11.5 - 12.5 | $1,037,215.62 | $10,806.43 | 0.01042 | 90.67 |
| 12.5 - 13.5 | $1,170,079.51 | $64,201.29 | 0.05487 | 89.73 |
| 13.5 - 14.5 | $1,244,480.68 | $90,552.36 | 0.07276 | 84.80 |
| 14.5 - 15.5 | $1,285,923.33 | $49,577.16 | 0.03855 | 78.63 |
| 15.5 - 16.5 | $1,336,957.16 | $15,654.37 | 0.01171 | 75.60 |
| 16.5 - 17.5 | $1,429,696.06 | $28,309.70 | 0.01980 | 74.72 |
| 17.5 - 18.5 | $1,509,377.55 | $23,441.05 | 0.01553 | 73.24 |
| 18.5 - 19.5 | $1,613,902.86 | $32,045.69 | 0.01986 | 72.10 |
| 19.5 - 20.5 | $1,743,636.54 | $25,377.14 | 0.01455 | 70.67 |
| 20.5 - 21.5 | $1,826,685.10 | $17,161.04 | 0.00939 | 69.64 |
| 21.5 - 22.5 | $2,054,064.31 | $19,371.72 | 0.00943 | 68.99 |
| 22.5 - 23.5 | $2,354,689.02 | $19,053.57 | 0.00809 | 68.34 |
| 23.5 - 24.5 | $2,607,135.37 | $23,101.02 | 0.00886 | 67.78 |
| 24.5 - 25.5 | $3,404,357.81 | $31,841.36 | 0.00935 | 67.18 |
| 25.5 - 26.5 | $3,547,603.81 | $28,710.13 | 0.00809 | 66.55 |
| 26.5 - 27.5 | $3,664,775.39 | $28,119.23 | 0.00767 | 66.01 |
| 27.5 - 28.5 | $3,801,747.99 | $27,210.41 | 0.00716 | 65.51 |
| 28.5 - 29.5 | $3,908,036.46 | $23,126.05 | 0.00592 | 65.04 |
| 29.5 - 30.5 | $4,039,100.89 | $19,230.91 | 0.00476 | 64.65 |
| 30.5 - 31.5 | $4,200,187.85 | $26,720.50 | 0.00636 | 64.35 |
| 31.5 - 32.5 | $4,333,264.25 | $22,958.88 | 0.00530 | 63.94 |
| 32.5 - 33.5 | $4,473,273.54 | $28,596.11 | 0.00639 | 63.60 |
| 33.5 - 34.5 | $4,506,686.28 | $25,570.11 | 0.00567 | 63.19 |
| 34.5 - 35.5 | $4,526,131.41 | $20,185.06 | 0.00446 | 62.83 |
| 35.5 - 36.5 | $4,569,489.70 | $30,246.50 | 0.00662 | 62.55 |

# MDU
## Gas Division
### 380.10 Services - Steel

## Observed Life Table
**Retirement Expr. 1995 TO 2015**
**Placement Years 1920 TO 2015**

| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 36.5 - 37.5 | $4,583,884.70 | $18,755.55 | 0.00409 | 62.14 |
| 37.5 - 38.5 | $4,603,106.85 | $27,331.61 | 0.00594 | 61.88 |
| 38.5 - 39.5 | $4,679,136.99 | $27,826.74 | 0.00595 | 61.52 |
| 39.5 - 40.5 | $4,642,840.41 | $22,770.75 | 0.00490 | 61.15 |
| 40.5 - 41.5 | $4,588,599.12 | $16,650.16 | 0.00363 | 60.85 |
| 41.5 - 42.5 | $4,598,390.01 | $19,952.82 | 0.00434 | 60.63 |
| 42.5 - 43.5 | $4,449,885.86 | $18,545.72 | 0.00417 | 60.37 |
| 43.5 - 44.5 | $4,225,396.22 | $22,997.53 | 0.00544 | 60.12 |
| 44.5 - 45.5 | $4,011,322.50 | $30,754.20 | 0.00767 | 59.79 |
| 45.5 - 46.5 | $3,234,490.17 | $24,246.56 | 0.00750 | 59.33 |
| 46.5 - 47.5 | $3,072,162.90 | $23,231.30 | 0.00756 | 58.89 |
| 47.5 - 48.5 | $2,931,544.32 | $22,319.77 | 0.00761 | 58.44 |
| 48.5 - 49.5 | $2,779,968.89 | $19,666.58 | 0.00707 | 58.00 |
| 49.5 - 50.5 | $2,612,520.54 | $23,043.20 | 0.00882 | 57.59 |
| 50.5 - 51.5 | $2,404,345.34 | $17,436.06 | 0.00725 | 57.08 |
| 51.5 - 52.5 | $2,186,029.84 | $18,960.63 | 0.00867 | 56.66 |
| 52.5 - 53.5 | $1,978,892.63 | $15,286.94 | 0.00772 | 56.17 |
| 53.5 - 54.5 | $1,754,046.97 | $12,575.57 | 0.00717 | 55.74 |
| 54.5 - 55.5 | $1,629,777.99 | $16,920.39 | 0.01038 | 55.34 |
| 55.5 - 56.5 | $1,529,662.00 | $15,588.10 | 0.01019 | 54.76 |
| 56.5 - 57.5 | $1,396,288.83 | $12,925.22 | 0.00926 | 54.21 |
| 57.5 - 58.5 | $1,287,239.89 | $16,872.18 | 0.01311 | 53.70 |
| 58.5 - 59.5 | $1,170,406.22 | $14,273.92 | 0.01220 | 53.00 |
| 59.5 - 60.5 | $997,617.84 | $13,243.07 | 0.01327 | 52.35 |
| 60.5 - 61.5 | $914,084.76 | $9,337.87 | 0.01022 | 51.66 |
| 61.5 - 62.5 | $808,448.01 | $8,106.70 | 0.01003 | 51.13 |
| 62.5 - 63.5 | $724,566.40 | $5,466.16 | 0.00754 | 50.62 |
| 63.5 - 64.5 | $629,263.18 | $3,766.53 | 0.00599 | 50.24 |
| 64.5 - 65.5 | $561,185.06 | $4,550.78 | 0.00811 | 49.94 |
| 65.5 - 66.5 | $518,744.58 | $2,378.30 | 0.00458 | 49.53 |
| 66.5 - 67.5 | $507,652.88 | $1,652.90 | 0.00326 | 49.30 |
| 67.5 - 68.5 | $497,247.39 | $1,130.15 | 0.00227 | 49.14 |
| 68.5 - 69.5 | $486,610.12 | $1,682.10 | 0.00346 | 49.03 |
| 69.5 - 70.5 | $474,603.38 | $998.20 | 0.00210 | 48.86 |
| 70.5 - 71.5 | $497,312.51 | $308.05 | 0.00062 | 48.76 |
| 71.5 - 72.5 | $520,217.13 | $2,688.98 | 0.00517 | 48.73 |
| 72.5 - 73.5 | $540,093.12 | $168.80 | 0.00031 | 48.48 |

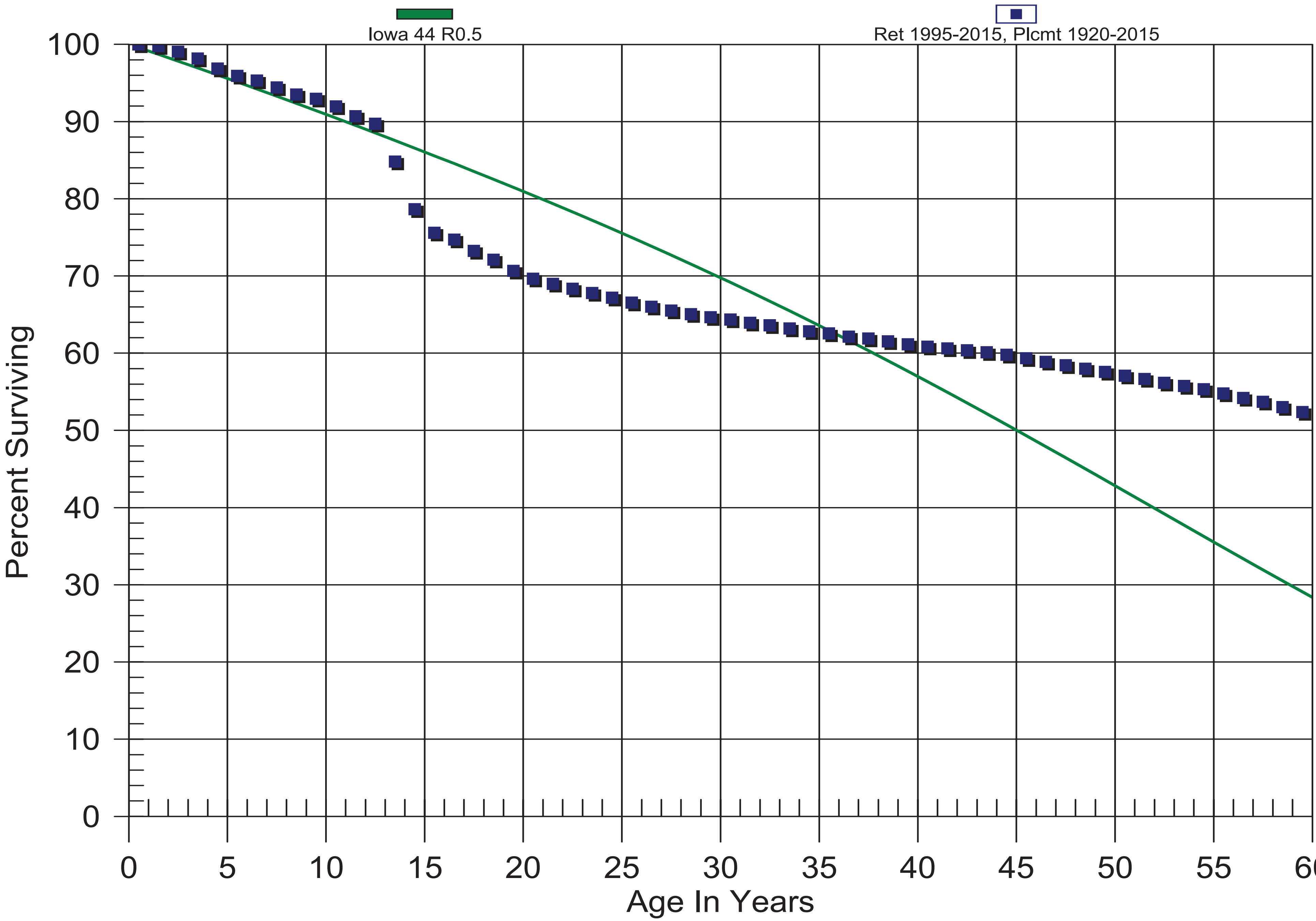
# MDU
## Gas Division
### 380.10 Services - Steel

## Observed Life Table
**Retirement Expr. 1995 TO 2015**
**Placement Years 1920 TO 2015**

| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 73.5 - 74.5 | $561,938.93 | $326.56 | 0.00058 | 48.46 |
| 74.5 - 75.5 | $583,090.04 | $175.10 | 0.00030 | 48.43 |
| 75.5 - 76.5 | $548,306.17 | $108.90 | 0.00020 | 48.42 |
| 76.5 - 77.5 | $514,072.90 | $109.28 | 0.00021 | 48.41 |
| 77.5 - 78.5 | $480,465.80 | $21.35 | 0.00004 | 48.40 |
| 78.5 - 79.5 | $447,763.64 | $97.15 | 0.00022 | 48.40 |
| 79.5 - 80.5 | $415,782.78 | $54.45 | 0.00013 | 48.39 |
| 80.5 - 81.5 | $384,655.37 | $0.00 | 0.00000 | 48.38 |
| 81.5 - 82.5 | $354,307.99 | $0.00 | 0.00000 | 48.38 |
| 82.5 - 83.5 | $324,753.52 | $0.00 | 0.00000 | 48.38 |
| 83.5 - 84.5 | $295,868.45 | $0.00 | 0.00000 | 48.38 |
| 84.5 - 85.5 | $267,687.89 | $33.10 | 0.00012 | 48.38 |
| 85.5 - 86.5 | $240,706.08 | $0.00 | 0.00000 | 48.37 |
| 86.5 - 87.5 | $213,883.42 | $62.22 | 0.00029 | 48.37 |
| 87.5 - 88.5 | $187,652.75 | $21.35 | 0.00011 | 48.36 |
| 88.5 - 89.5 | $162,101.20 | $0.00 | 0.00000 | 48.35 |
| 89.5 - 90.5 | $137,193.69 | $0.00 | 0.00000 | 48.35 |
| 90.5 - 91.5 | $112,893.68 | $0.00 | 0.00000 | 48.35 |
| 91.5 - 92.5 | $89,186.35 | $0.00 | 0.00000 | 48.35 |
| 92.5 - 93.5 | $66,057.25 | $0.00 | 0.00000 | 48.35 |
| 93.5 - 94.5 | $43,492.28 | $0.00 | 0.00000 | 48.35 |
| 94.5 - 95.5 | $21,477.67 | $0.00 | 0.00000 | 48.35 |

# MDU

## Gas Division
## 380.10 Services - Steel
## Original And Smooth Survivor Curves



# MDU
## Gas Division
### 380.20 Services - Plastic

## Observed Life Table
**Retirement Expr. 1995 TO 2015**
**Placement Years 1927 TO 2015**

| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 0.0 - 0.5 | $72,285,488.89 | $12,749.45 | 0.00018 | 100.00 |
| 0.5 - 1.5 | $66,773,885.74 | $107,209.59 | 0.00161 | 99.98 |
| 1.5 - 2.5 | $59,573,486.09 | $98,485.44 | 0.00165 | 99.82 |
| 2.5 - 3.5 | $52,127,305.36 | $70,390.49 | 0.00135 | 99.66 |
| 3.5 - 4.5 | $44,781,716.39 | $70,730.46 | 0.00158 | 99.52 |
| 4.5 - 5.5 | $39,951,324.51 | $63,582.60 | 0.00159 | 99.37 |
| 5.5 - 6.5 | $36,567,389.51 | $59,017.46 | 0.00161 | 99.21 |
| 6.5 - 7.5 | $33,790,030.77 | $70,211.95 | 0.00208 | 99.05 |
| 7.5 - 8.5 | $30,589,664.23 | $62,289.14 | 0.00204 | 98.84 |
| 8.5 - 9.5 | $28,230,204.94 | $61,016.06 | 0.00216 | 98.64 |
| 9.5 - 10.5 | $26,082,733.33 | $63,329.48 | 0.00243 | 98.43 |
| 10.5 - 11.5 | $24,005,939.09 | $51,597.29 | 0.00215 | 98.19 |
| 11.5 - 12.5 | $22,257,404.67 | $64,840.24 | 0.00291 | 97.98 |
| 12.5 - 13.5 | $20,819,103.82 | $35,083.26 | 0.00169 | 97.69 |
| 13.5 - 14.5 | $20,071,317.48 | $72,167.76 | 0.00360 | 97.53 |
| 14.5 - 15.5 | $19,579,660.04 | $49,581.74 | 0.00253 | 97.18 |
| 15.5 - 16.5 | $19,128,658.50 | $43,720.29 | 0.00229 | 96.93 |
| 16.5 - 17.5 | $18,517,551.57 | $40,889.54 | 0.00221 | 96.71 |
| 17.5 - 18.5 | $17,689,605.60 | $66,575.66 | 0.00376 | 96.49 |
| 18.5 - 19.5 | $16,797,355.84 | $39,591.49 | 0.00236 | 96.13 |
| 19.5 - 20.5 | $15,576,017.46 | $43,856.39 | 0.00282 | 95.90 |
| 20.5 - 21.5 | $15,064,056.39 | $37,504.77 | 0.00249 | 95.63 |
| 21.5 - 22.5 | $13,290,576.81 | $36,064.37 | 0.00271 | 95.40 |
| 22.5 - 23.5 | $12,547,022.31 | $37,708.61 | 0.00301 | 95.14 |
| 23.5 - 24.5 | $11,700,544.92 | $30,752.74 | 0.00263 | 94.85 |
| 24.5 - 25.5 | $11,011,276.39 | $28,777.98 | 0.00261 | 94.60 |
| 25.5 - 26.5 | $10,493,663.45 | $29,094.08 | 0.00277 | 94.36 |
| 26.5 - 27.5 | $10,012,626.99 | $32,825.25 | 0.00328 | 94.09 |
| 27.5 - 28.5 | $9,427,329.87 | $30,481.25 | 0.00323 | 93.79 |
| 28.5 - 29.5 | $8,837,431.89 | $35,338.41 | 0.00400 | 93.48 |
| 29.5 - 30.5 | $8,155,960.97 | $48,780.93 | 0.00598 | 93.11 |
| 30.5 - 31.5 | $7,263,645.15 | $23,800.68 | 0.00328 | 92.55 |
| 31.5 - 32.5 | $6,488,156.31 | $28,733.72 | 0.00443 | 92.25 |
| 32.5 - 33.5 | $5,602,111.06 | $19,340.29 | 0.00345 | 91.84 |
| 33.5 - 34.5 | $4,885,068.92 | $35,468.89 | 0.00726 | 91.52 |
| 34.5 - 35.5 | $4,265,900.79 | $13,863.21 | 0.00325 | 90.86 |
| 35.5 - 36.5 | $3,532,006.46 | $18,773.11 | 0.00532 | 90.56 |

# MDU
## Gas Division
### 380.20 Services - Plastic

## Observed Life Table
**Retirement Expr. 1995 TO 2015**
**Placement Years 1927 TO 2015**

| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 36.5 - 37.5 | $2,881,842.17 | $18,338.30 | 0.00636 | 90.08 |
| 37.5 - 38.5 | $2,458,614.68 | $15,221.19 | 0.00619 | 89.51 |
| 38.5 - 39.5 | $2,056,244.32 | $16,445.45 | 0.00800 | 88.95 |
| 39.5 - 40.5 | $1,476,203.11 | $23,617.49 | 0.01600 | 88.24 |
| 40.5 - 41.5 | $1,164,221.31 | $15,983.59 | 0.01373 | 86.83 |
| 41.5 - 42.5 | $645,841.93 | $16,765.00 | 0.02596 | 85.64 |
| 42.5 - 43.5 | $418,543.34 | $13,005.38 | 0.03107 | 83.42 |
| 43.5 - 44.5 | $174,587.77 | $12,505.33 | 0.07163 | 80.82 |
| 44.5 - 45.5 | $156,710.11 | $23,102.67 | 0.14742 | 75.03 |
| 45.5 - 46.5 | $134,169.12 | $8,641.20 | 0.06441 | 63.97 |
| 46.5 - 47.5 | $125,814.41 | $5,679.08 | 0.04514 | 59.85 |
| 47.5 - 48.5 | $120,268.16 | $7,958.85 | 0.06618 | 57.15 |
| 48.5 - 49.5 | $113,786.68 | $7,982.86 | 0.07016 | 53.37 |
| 49.5 - 50.5 | $105,858.95 | $4,368.11 | 0.04126 | 49.62 |
| 50.5 - 51.5 | $101,605.69 | $7,687.19 | 0.07566 | 47.58 |
| 51.5 - 52.5 | $93,847.79 | $7,552.47 | 0.08048 | 43.98 |
| 52.5 - 53.5 | $86,326.75 | $33,534.87 | 0.38846 | 40.44 |
| 53.5 - 54.5 | $52,648.32 | $9,560.63 | 0.18159 | 24.73 |
| 54.5 - 55.5 | $43,151.59 | $6,123.84 | 0.14191 | 20.24 |
| 55.5 - 56.5 | $36,322.67 | $4,025.00 | 0.11081 | 17.37 |
| 56.5 - 57.5 | $32,163.66 | $2,143.09 | 0.06663 | 15.44 |
| 57.5 - 58.5 | $30,064.04 | $8,147.18 | 0.27099 | 14.41 |
| 58.5 - 59.5 | $21,916.86 | $4,053.69 | 0.18496 | 10.51 |
| 59.5 - 60.5 | $17,765.64 | $4,376.93 | 0.24637 | 8.56 |
| 60.5 - 61.5 | $13,388.71 | $2,786.55 | 0.20813 | 6.45 |
| 61.5 - 62.5 | $10,417.08 | $2,296.92 | 0.22050 | 5.11 |
| 62.5 - 63.5 | $8,053.58 | $3,592.44 | 0.44607 | 3.98 |
| 63.5 - 64.5 | $4,348.48 | $603.98 | 0.13889 | 2.21 |
| 64.5 - 65.5 | $3,519.18 | $798.66 | 0.22694 | 1.90 |
| 65.5 - 66.5 | $2,699.32 | $97.15 | 0.03599 | 1.47 |
| 66.5 - 67.5 | $2,602.17 | $42.70 | 0.01641 | 1.42 |
| 67.5 - 68.5 | $2,592.57 | $1,971.07 | 0.76028 | 1.39 |
| 68.5 - 69.5 | $621.50 | $221.45 | 0.35632 | 0.33 |
| 69.5 - 70.5 | $400.05 | $33.10 | 0.08274 | 0.21 |
| 70.5 - 71.5 | $366.95 | $0.00 | 0.00000 | 0.20 |
| 71.5 - 72.5 | $366.95 | $139.55 | 0.38030 | 0.20 |
| 72.5 - 73.5 | $227.40 | $106.75 | 0.46944 | 0.12 |

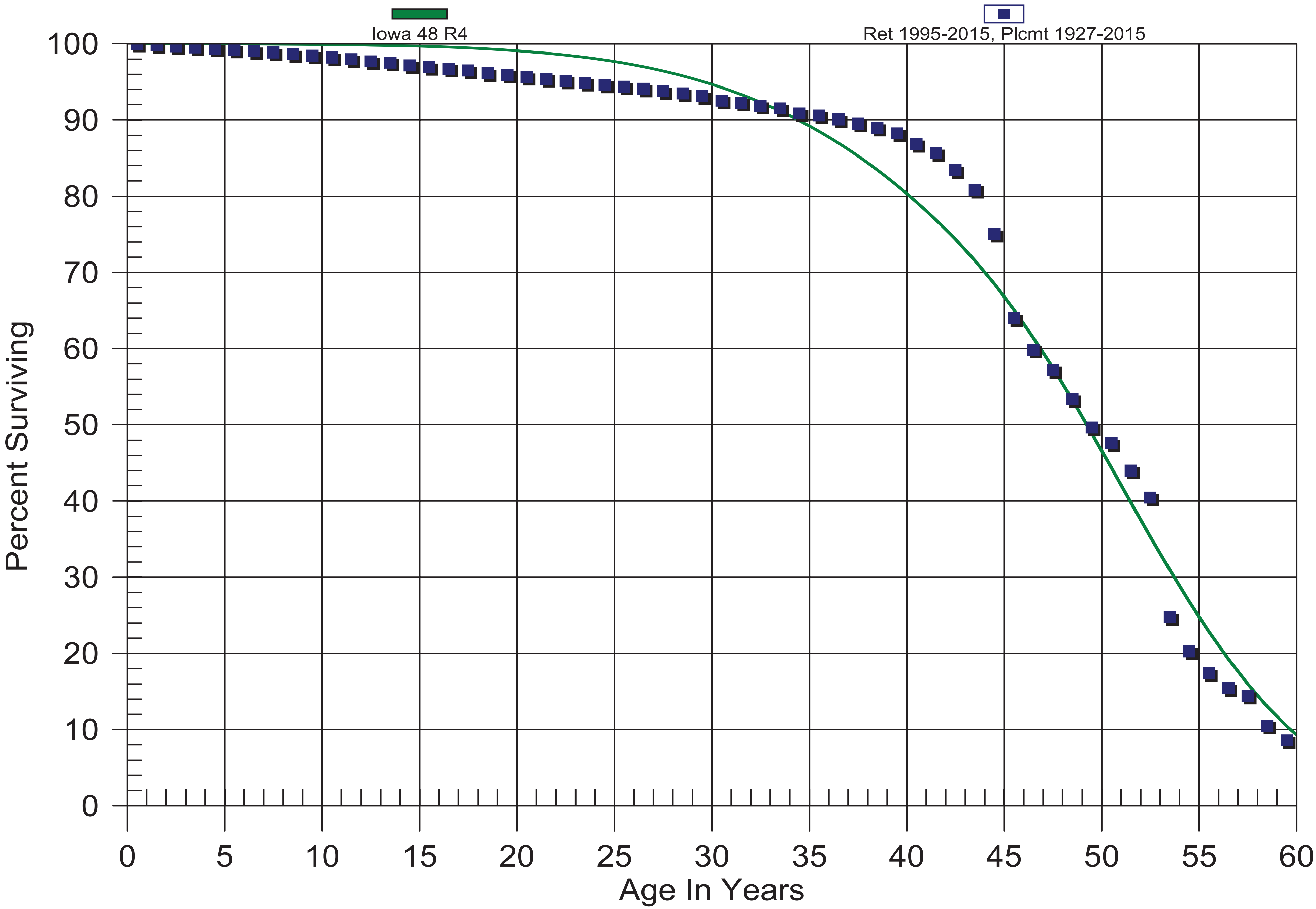
# MDU
## Gas Division
### 380.20 Services - Plastic

## Observed Life Table
**Retirement Expr. 1995 TO 2015**
**Placement Years 1927 TO 2015**

| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 73.5 - 74.5 | $120.65 | $21.35 | 0.17696 | 0.06 |
| 74.5 - 75.5 | $99.30 | $33.10 | 0.33333 | 0.05 |
| 75.5 - 76.5 | $66.20 | $0.00 | 0.00000 | 0.04 |
| 76.5 - 77.5 | $66.20 | $33.10 | 0.50000 | 0.04 |
| 77.5 - 78.5 | $33.10 | $0.00 | 0.00000 | 0.02 |
| 78.5 - 79.5 | $33.10 | $0.00 | 0.00000 | 0.02 |
| 79.5 - 80.5 | $33.10 | $0.00 | 0.00000 | 0.02 |
| 80.5 - 81.5 | $33.10 | $0.00 | 0.00000 | 0.02 |
| 81.5 - 82.5 | $33.10 | $0.00 | 0.00000 | 0.02 |
| 82.5 - 83.5 | $33.10 | $0.00 | 0.00000 | 0.02 |
| 83.5 - 84.5 | $33.10 | $0.00 | 0.00000 | 0.02 |
| 84.5 - 85.5 | $33.10 | $0.00 | 0.00000 | 0.02 |
| 85.5 - 86.5 | $33.10 | $0.00 | 0.00000 | 0.02 |

# MDU

## Gas Division
## 380.20 Services - Plastic
## Original And Smooth Survivor Curves



# MDU
## Gas Division
### 385.00 Ind. Meas. & Reg. Sta. Equip

## Observed Life Table

**Retirement Expr. 1996 TO 2015**
**Placement Years 1951 TO 2015**

| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 0.0 - 0.5 | $927,997.36 | $0.00 | 0.00000 | 100.00 |
| 0.5 - 1.5 | $652,980.22 | $3,439.95 | 0.00527 | 100.00 |
| 1.5 - 2.5 | $654,953.34 | $3,255.75 | 0.00497 | 99.47 |
| 2.5 - 3.5 | $481,850.34 | $0.00 | 0.00000 | 98.98 |
| 3.5 - 4.5 | $493,528.85 | $0.00 | 0.00000 | 98.98 |
| 4.5 - 5.5 | $511,428.91 | $0.00 | 0.00000 | 98.98 |
| 5.5 - 6.5 | $526,577.82 | $0.00 | 0.00000 | 98.98 |
| 6.5 - 7.5 | $526,681.41 | $0.00 | 0.00000 | 98.98 |
| 7.5 - 8.5 | $375,804.79 | $0.00 | 0.00000 | 98.98 |
| 8.5 - 9.5 | $392,770.06 | $0.00 | 0.00000 | 98.98 |
| 9.5 - 10.5 | $349,133.39 | $0.00 | 0.00000 | 98.98 |
| 10.5 - 11.5 | $361,355.77 | $0.00 | 0.00000 | 98.98 |
| 11.5 - 12.5 | $379,873.50 | $0.00 | 0.00000 | 98.98 |
| 12.5 - 13.5 | $325,207.60 | $0.00 | 0.00000 | 98.98 |
| 13.5 - 14.5 | $326,900.09 | $7,894.41 | 0.02415 | 98.98 |
| 14.5 - 15.5 | $312,496.35 | $0.00 | 0.00000 | 96.59 |
| 15.5 - 16.5 | $315,855.33 | $0.00 | 0.00000 | 96.59 |
| 16.5 - 17.5 | $306,101.17 | $0.00 | 0.00000 | 96.59 |
| 17.5 - 18.5 | $290,164.70 | $0.00 | 0.00000 | 96.59 |
| 18.5 - 19.5 | $276,235.68 | $0.00 | 0.00000 | 96.59 |
| 19.5 - 20.5 | $248,122.78 | $0.00 | 0.00000 | 96.59 |
| 20.5 - 21.5 | $236,407.38 | $0.00 | 0.00000 | 96.59 |
| 21.5 - 22.5 | $233,350.35 | $0.00 | 0.00000 | 96.59 |
| 22.5 - 23.5 | $224,770.78 | $0.00 | 0.00000 | 96.59 |
| 23.5 - 24.5 | $225,435.00 | $0.00 | 0.00000 | 96.59 |
| 24.5 - 25.5 | $216,264.86 | $1,778.43 | 0.00822 | 96.59 |
| 25.5 - 26.5 | $210,755.09 | $0.00 | 0.00000 | 95.79 |
| 26.5 - 27.5 | $225,681.65 | $1,530.15 | 0.00678 | 95.79 |
| 27.5 - 28.5 | $213,724.02 | $1,750.38 | 0.00819 | 95.14 |
| 28.5 - 29.5 | $199,514.76 | $14.96 | 0.00007 | 94.37 |
| 29.5 - 30.5 | $200,467.87 | $0.00 | 0.00000 | 94.36 |
| 30.5 - 31.5 | $132,646.86 | $1,207.13 | 0.00910 | 94.36 |
| 31.5 - 32.5 | $132,717.20 | $3,206.04 | 0.02416 | 93.50 |
| 32.5 - 33.5 | $136,989.97 | $561.38 | 0.00410 | 91.24 |
| 33.5 - 34.5 | $134,993.74 | $24.58 | 0.00018 | 90.87 |
| 34.5 - 35.5 | $142,922.74 | $464.54 | 0.00325 | 90.85 |
| 35.5 - 36.5 | $144,378.84 | $0.00 | 0.00000 | 90.56 |

# MDU
## Gas Division
### 385.00 Ind. Meas. & Reg. Sta. Equip

## Observed Life Table
### Retirement Expr. 1996 TO 2015
### Placement Years 1951 TO 2015

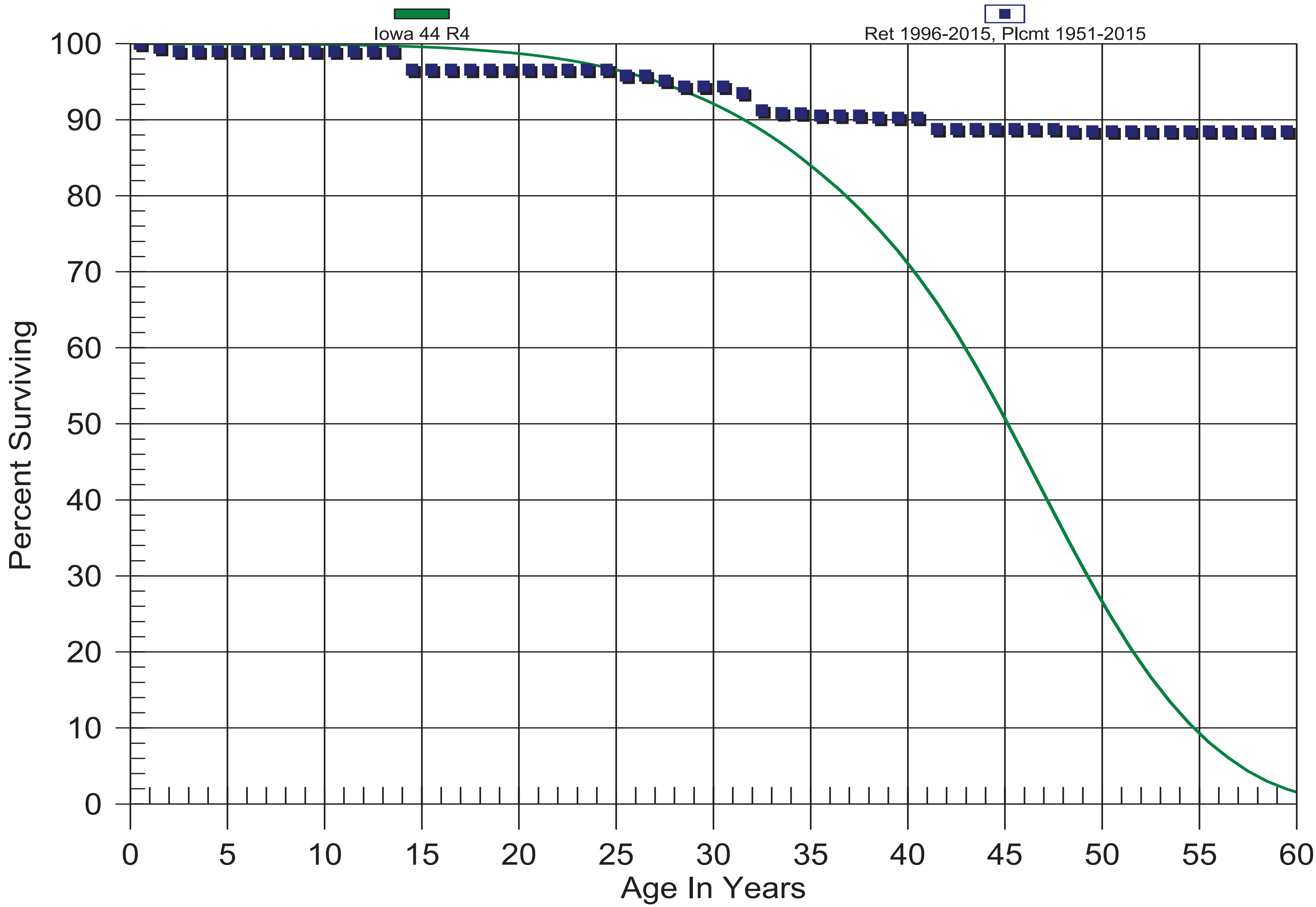
| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 36.5 - 37.5 | $148,952.62 | $0.00 | 0.00000 | 90.56 |
| 37.5 - 38.5 | $153,512.85 | $506.05 | 0.00330 | 90.56 |
| 38.5 - 39.5 | $159,068.21 | $0.00 | 0.00000 | 90.26 |
| 39.5 - 40.5 | $165,665.24 | $0.00 | 0.00000 | 90.26 |
| 40.5 - 41.5 | $154,933.21 | $2,526.60 | 0.01631 | 90.26 |
| 41.5 - 42.5 | $151,495.94 | $0.00 | 0.00000 | 88.78 |
| 42.5 - 43.5 | $147,514.74 | $0.00 | 0.00000 | 88.78 |
| 43.5 - 44.5 | $144,556.24 | $0.00 | 0.00000 | 88.78 |
| 44.5 - 45.5 | $141,713.24 | $0.00 | 0.00000 | 88.78 |
| 45.5 - 46.5 | $130,295.67 | $0.00 | 0.00000 | 88.78 |
| 46.5 - 47.5 | $116,291.44 | $0.00 | 0.00000 | 88.78 |
| 47.5 - 48.5 | $106,379.80 | $375.00 | 0.00353 | 88.78 |
| 48.5 - 49.5 | $101,513.37 | $0.00 | 0.00000 | 88.47 |
| 49.5 - 50.5 | $96,120.30 | $0.00 | 0.00000 | 88.47 |
| 50.5 - 51.5 | $84,946.96 | $0.00 | 0.00000 | 88.47 |
| 51.5 - 52.5 | $67,111.86 | $0.00 | 0.00000 | 88.47 |
| 52.5 - 53.5 | $56,528.66 | $0.00 | 0.00000 | 88.47 |
| 53.5 - 54.5 | $54,765.30 | $0.00 | 0.00000 | 88.47 |
| 54.5 - 55.5 | $46,569.08 | $0.00 | 0.00000 | 88.47 |
| 55.5 - 56.5 | $34,107.97 | $0.00 | 0.00000 | 88.47 |
| 56.5 - 57.5 | $29,534.19 | $0.00 | 0.00000 | 88.47 |
| 57.5 - 58.5 | $25,480.01 | $0.00 | 0.00000 | 88.47 |
| 58.5 - 59.5 | $19,418.60 | $0.00 | 0.00000 | 88.47 |
| 59.5 - 60.5 | $12,821.57 | $0.00 | 0.00000 | 88.47 |
| 60.5 - 61.5 | $10,458.62 | $0.00 | 0.00000 | 88.47 |
| 61.5 - 62.5 | $9,713.25 | $0.00 | 0.00000 | 88.47 |
| 62.5 - 63.5 | $7,549.40 | $0.00 | 0.00000 | 88.47 |
| 63.5 - 64.5 | $2,680.88 | $0.00 | 0.00000 | 88.47 |

# MDU

## Gas Division

## 385.00 Ind. Meas. & Reg. Sta. Equip

## Original And Smooth Survivor Curves



# MDU
## Gas Division
### 387.10 Cathodic Protection Equipment

## Observed Life Table

**Retirement Expr. 1995 TO 2015**
**Placement Years 1948 TO 2015**

| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 0.0 - 0.5 | $2,334,302.30 | $0.00 | 0.00000 | 100.00 |
| 0.5 - 1.5 | $2,128,939.96 | $0.00 | 0.00000 | 100.00 |
| 1.5 - 2.5 | $2,151,348.95 | $0.00 | 0.00000 | 100.00 |
| 2.5 - 3.5 | $1,953,347.98 | $0.00 | 0.00000 | 100.00 |
| 3.5 - 4.5 | $1,838,990.22 | $0.00 | 0.00000 | 100.00 |
| 4.5 - 5.5 | $1,668,515.23 | $9,721.97 | 0.00583 | 100.00 |
| 5.5 - 6.5 | $1,253,721.18 | $2,719.89 | 0.00217 | 99.42 |
| 6.5 - 7.5 | $1,200,094.52 | $0.00 | 0.00000 | 99.20 |
| 7.5 - 8.5 | $1,152,403.40 | $6,662.18 | 0.00578 | 99.20 |
| 8.5 - 9.5 | $1,212,181.10 | $3,265.55 | 0.00269 | 98.63 |
| 9.5 - 10.5 | $1,212,370.33 | $15,377.78 | 0.01268 | 98.36 |
| 10.5 - 11.5 | $1,209,885.96 | $5,037.65 | 0.00416 | 97.11 |
| 11.5 - 12.5 | $1,155,764.18 | $9,464.13 | 0.00819 | 96.71 |
| 12.5 - 13.5 | $1,136,953.27 | $10,955.16 | 0.00964 | 95.92 |
| 13.5 - 14.5 | $1,130,578.22 | $24,331.06 | 0.02152 | 94.99 |
| 14.5 - 15.5 | $1,045,443.47 | $7,088.53 | 0.00678 | 92.95 |
| 15.5 - 16.5 | $985,204.71 | $8,243.26 | 0.00837 | 92.32 |
| 16.5 - 17.5 | $948,884.31 | $9,364.20 | 0.00987 | 91.55 |
| 17.5 - 18.5 | $896,205.33 | $11,526.21 | 0.01286 | 90.64 |
| 18.5 - 19.5 | $839,660.97 | $10,863.97 | 0.01294 | 89.48 |
| 19.5 - 20.5 | $757,784.03 | $17,618.36 | 0.02325 | 88.32 |
| 20.5 - 21.5 | $738,380.00 | $771.03 | 0.00104 | 86.27 |
| 21.5 - 22.5 | $702,364.99 | $7,219.86 | 0.01028 | 86.18 |
| 22.5 - 23.5 | $689,132.19 | $9,262.84 | 0.01344 | 85.29 |
| 23.5 - 24.5 | $666,250.08 | $10,728.37 | 0.01610 | 84.14 |
| 24.5 - 25.5 | $607,739.43 | $9,699.26 | 0.01596 | 82.79 |
| 25.5 - 26.5 | $611,171.54 | $8,470.78 | 0.01386 | 81.47 |
| 26.5 - 27.5 | $595,502.30 | $7,765.02 | 0.01304 | 80.34 |
| 27.5 - 28.5 | $538,128.81 | $11,547.79 | 0.02146 | 79.29 |
| 28.5 - 29.5 | $497,461.93 | $4,145.20 | 0.00833 | 77.59 |
| 29.5 - 30.5 | $428,125.42 | $4,353.26 | 0.01017 | 76.94 |
| 30.5 - 31.5 | $378,153.37 | $4,261.74 | 0.01127 | 76.16 |
| 31.5 - 32.5 | $347,293.37 | $2,216.61 | 0.00638 | 75.30 |
| 32.5 - 33.5 | $321,366.91 | $3,859.58 | 0.01201 | 74.82 |
| 33.5 - 34.5 | $305,517.36 | $7,515.06 | 0.02460 | 73.92 |
| 34.5 - 35.5 | $295,336.67 | $3,979.03 | 0.01347 | 72.11 |
| 35.5 - 36.5 | $280,079.90 | $0.00 | 0.00000 | 71.13 |

# MDU
## Gas Division
### 387.10 Cathodic Protection Equipment

## Observed Life Table

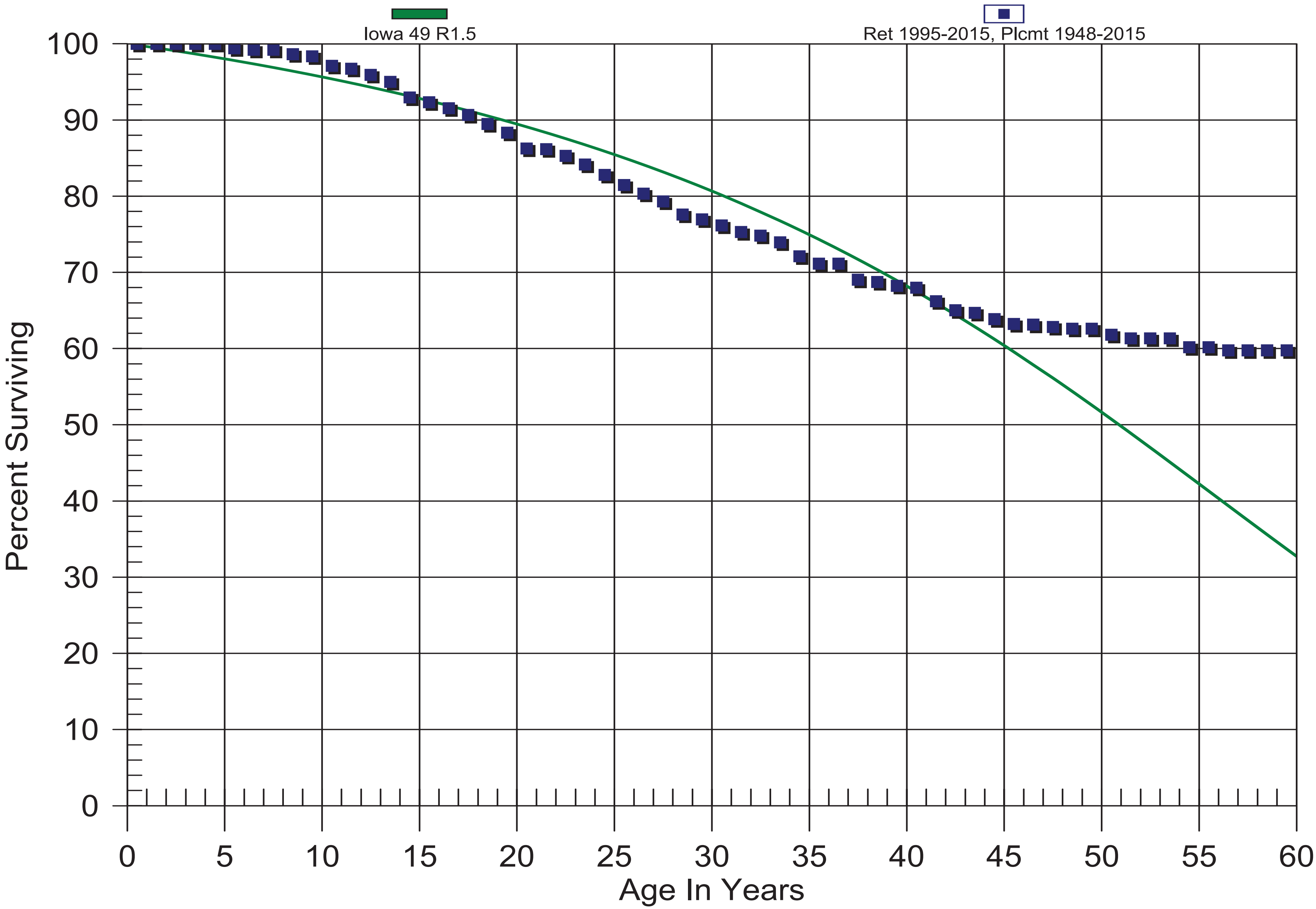
**Retirement Expr. 1995 TO 2015**
**Placement Years 1948 TO 2015**

| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 36.5 - 37.5 | $271,730.82 | $8,006.44 | 0.02946 | 71.13 |
| 37.5 - 38.5 | $244,152.07 | $1,118.73 | 0.00458 | 69.04 |
| 38.5 - 39.5 | $223,226.28 | $1,622.73 | 0.00727 | 68.72 |
| 39.5 - 40.5 | $207,224.46 | $702.65 | 0.00339 | 68.22 |
| 40.5 - 41.5 | $199,787.09 | $5,239.81 | 0.02623 | 67.99 |
| 41.5 - 42.5 | $180,741.55 | $3,252.46 | 0.01800 | 66.21 |
| 42.5 - 43.5 | $164,670.50 | $851.99 | 0.00517 | 65.02 |
| 43.5 - 44.5 | $152,647.11 | $1,913.52 | 0.01254 | 64.68 |
| 44.5 - 45.5 | $140,750.15 | $1,434.27 | 0.01019 | 63.87 |
| 45.5 - 46.5 | $137,524.50 | $197.58 | 0.00144 | 63.22 |
| 46.5 - 47.5 | $123,513.03 | $569.93 | 0.00461 | 63.13 |
| 47.5 - 48.5 | $113,350.31 | $401.75 | 0.00354 | 62.84 |
| 48.5 - 49.5 | $105,977.95 | $0.00 | 0.00000 | 62.61 |
| 49.5 - 50.5 | $104,195.33 | $1,359.39 | 0.01305 | 62.61 |
| 50.5 - 51.5 | $95,166.63 | $686.04 | 0.00721 | 61.80 |
| 51.5 - 52.5 | $85,439.81 | $0.00 | 0.00000 | 61.35 |
| 52.5 - 53.5 | $71,830.37 | $0.00 | 0.00000 | 61.35 |
| 53.5 - 54.5 | $62,111.14 | $1,177.94 | 0.01897 | 61.35 |
| 54.5 - 55.5 | $46,431.98 | $0.00 | 0.00000 | 60.19 |
| 55.5 - 56.5 | $31,719.29 | $231.98 | 0.00731 | 60.19 |
| 56.5 - 57.5 | $24,108.64 | $0.00 | 0.00000 | 59.75 |
| 57.5 - 58.5 | $20,500.56 | $0.00 | 0.00000 | 59.75 |
| 58.5 - 59.5 | $15,845.76 | $0.00 | 0.00000 | 59.75 |
| 59.5 - 60.5 | $15,052.24 | $0.00 | 0.00000 | 59.75 |
| 60.5 - 61.5 | $13,822.47 | $0.00 | 0.00000 | 59.75 |
| 61.5 - 62.5 | $13,716.48 | $0.00 | 0.00000 | 59.75 |
| 62.5 - 63.5 | $13,674.76 | $0.00 | 0.00000 | 59.75 |
| 63.5 - 64.5 | $13,037.64 | $0.00 | 0.00000 | 59.75 |
| 64.5 - 65.5 | $8,832.21 | $0.00 | 0.00000 | 59.75 |
| 65.5 - 66.5 | $7,850.18 | $0.00 | 0.00000 | 59.75 |
| 66.5 - 67.5 | $3,147.50 | $0.00 | 0.00000 | 59.75 |

# MDU

## Gas Division

## 387.10 Cathodic Protection Equipment
## Original And Smooth Survivor Curves



# MDU
## Gas Division
### 396.20 Power Operated Equipment
## Observed Life Table
### Retirement Expr. 1995 TO 2015
### Placement Years 1953 TO 2015

| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 0.0 - 0.5 | $38,712,079.44 | $1,053,881.37 | 0.02722 | 100.00 |
| 0.5 - 1.5 | $35,000,850.15 | $19,567,500.77 | 0.55906 | 97.28 |
| 1.5 - 2.5 | $15,615,655.04 | $6,537,402.88 | 0.41864 | 42.89 |
| 2.5 - 3.5 | $9,048,580.60 | $1,352,359.00 | 0.14946 | 24.94 |
| 3.5 - 4.5 | $6,590,201.90 | $262,801.22 | 0.03988 | 21.21 |
| 4.5 - 5.5 | $5,875,376.40 | $341,349.88 | 0.05810 | 20.36 |
| 5.5 - 6.5 | $5,472,697.03 | $482,863.25 | 0.08823 | 19.18 |
| 6.5 - 7.5 | $5,037,267.44 | $507,073.86 | 0.10066 | 17.49 |
| 7.5 - 8.5 | $4,448,783.05 | $344,272.78 | 0.07739 | 15.73 |
| 8.5 - 9.5 | $3,797,833.60 | $365,934.32 | 0.09635 | 14.51 |
| 9.5 - 10.5 | $3,289,730.44 | $585,253.89 | 0.17790 | 13.11 |
| 10.5 - 11.5 | $2,612,722.12 | $353,197.01 | 0.13518 | 10.78 |
| 11.5 - 12.5 | $1,969,202.48 | $239,207.02 | 0.12147 | 9.32 |
| 12.5 - 13.5 | $1,625,686.15 | $106,919.69 | 0.06577 | 8.19 |
| 13.5 - 14.5 | $1,456,173.43 | $234,233.53 | 0.16086 | 7.65 |
| 14.5 - 15.5 | $1,089,674.30 | $89,292.53 | 0.08194 | 6.42 |
| 15.5 - 16.5 | $953,092.87 | $197,221.06 | 0.20693 | 5.89 |
| 16.5 - 17.5 | $755,118.22 | $51,266.93 | 0.06789 | 4.67 |
| 17.5 - 18.5 | $669,074.03 | $85,967.13 | 0.12849 | 4.36 |
| 18.5 - 19.5 | $603,780.70 | $62,849.07 | 0.10409 | 3.80 |
| 19.5 - 20.5 | $510,345.33 | $18,569.28 | 0.03639 | 3.40 |
| 20.5 - 21.5 | $512,938.33 | $42,263.85 | 0.08240 | 3.28 |
| 21.5 - 22.5 | $479,417.69 | $96,946.52 | 0.20222 | 3.01 |
| 22.5 - 23.5 | $368,320.80 | $55,251.26 | 0.15001 | 2.40 |
| 23.5 - 24.5 | $318,839.92 | $73,032.10 | 0.22906 | 2.04 |
| 24.5 - 25.5 | $292,049.39 | $80,486.08 | 0.27559 | 1.57 |
| 25.5 - 26.5 | $230,497.92 | $26,767.85 | 0.11613 | 1.14 |
| 26.5 - 27.5 | $118,063.19 | $34,709.83 | 0.29399 | 1.01 |
| 27.5 - 28.5 | $88,124.93 | $17,163.54 | 0.19476 | 0.71 |
| 28.5 - 29.5 | $84,102.87 | $15,844.15 | 0.18839 | 0.57 |
| 29.5 - 30.5 | $90,875.49 | $2,497.72 | 0.02749 | 0.46 |
| 30.5 - 31.5 | $99,290.38 | $15,680.00 | 0.15792 | 0.45 |
| 31.5 - 32.5 | $83,610.38 | $0.00 | 0.00000 | 0.38 |
| 32.5 - 33.5 | $99,513.48 | $0.00 | 0.00000 | 0.38 |
| 33.5 - 34.5 | $99,513.48 | $0.00 | 0.00000 | 0.38 |
| 34.5 - 35.5 | $107,160.37 | $20,288.16 | 0.18933 | 0.38 |
| 35.5 - 36.5 | $86,872.21 | $10,912.61 | 0.12562 | 0.31 |

# MDU
## Gas Division
### 396.20 Power Operated Equipment

## Observed Life Table
### Retirement Expr. 1995 TO 2015
### Placement Years 1953 TO 2015

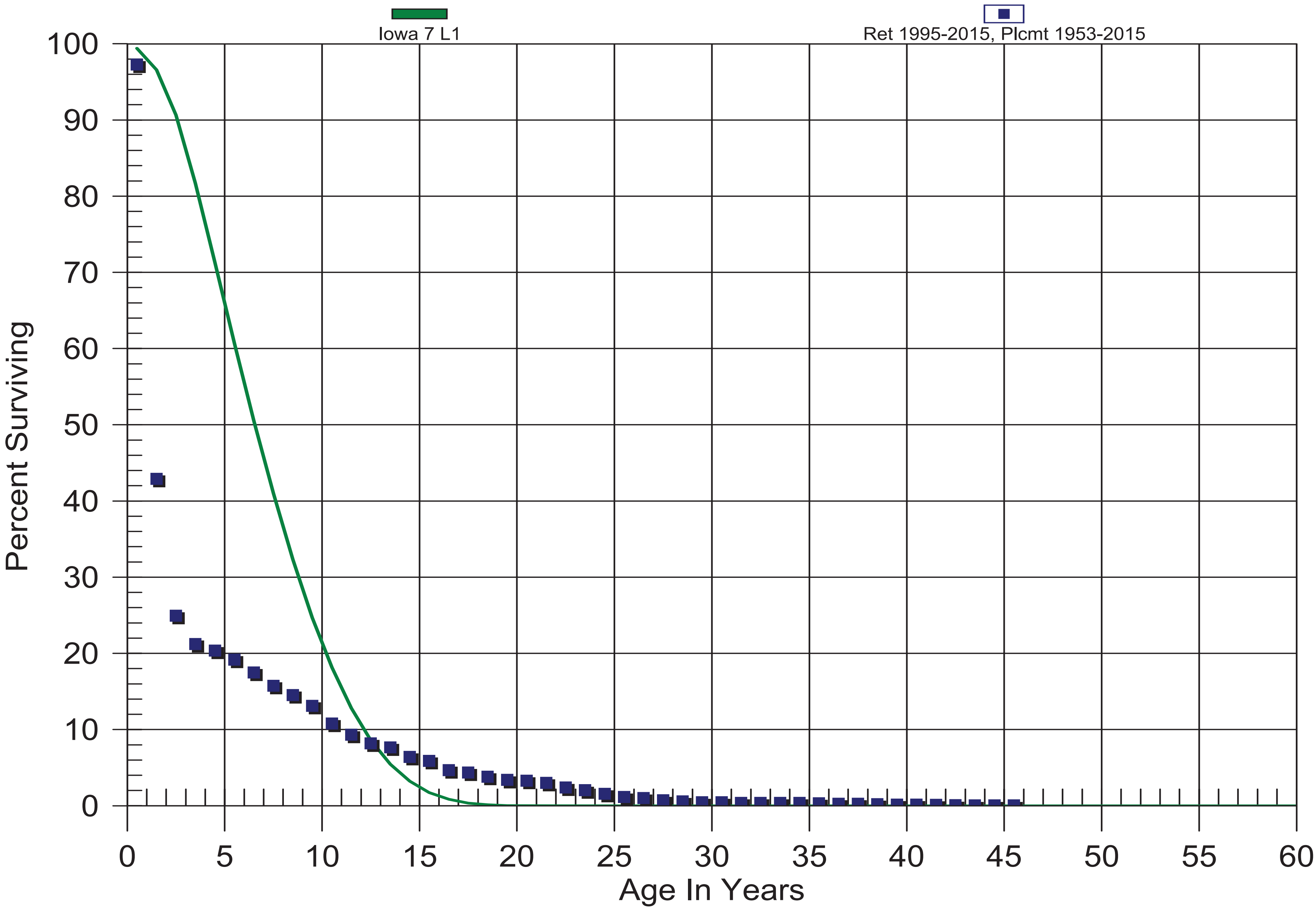
| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 36.5 - 37.5 | $75,959.60 | $1,727.02 | 0.02274 | 0.27 |
| 37.5 - 38.5 | $77,423.47 | $19,393.45 | 0.25049 | 0.26 |
| 38.5 - 39.5 | $58,030.02 | $15,903.10 | 0.27405 | 0.20 |
| 39.5 - 40.5 | $51,599.71 | $0.00 | 0.00000 | 0.14 |
| 40.5 - 41.5 | $51,599.71 | $8,672.37 | 0.16807 | 0.14 |
| 41.5 - 42.5 | $61,124.41 | $20,647.61 | 0.33780 | 0.12 |
| 42.5 - 43.5 | $40,476.80 | $18,270.81 | 0.45139 | 0.08 |
| 43.5 - 44.5 | $22,205.99 | $3,190.89 | 0.14370 | 0.04 |
| 44.5 - 45.5 | $19,015.10 | $0.00 | 0.00000 | 0.04 |

# MDU

## Gas Division

## 396.20 Power Operated Equipment

## Original And Smooth Survivor Curves



# Exhibit No._(DJG-13)

## D2017.9.79

## Montana-Dakota Utilities

# MDU
# Gas Division
### 376.10 Distribution Mains - Steel

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2015
### Based Upon Broad Group/Remaining Life Procedure and Technique

**Average Service Life:** 65 **Survivor Curve:** R2.5

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 1916 | 38,005.92 | 65.00 | 584.71 | 5.40 | 3,155.16 |
| 1917 | 66,510.80 | 65.00 | 1,023.24 | 5.63 | 5,755.75 |
| 1918 | 68,173.57 | 65.00 | 1,048.82 | 5.83 | 6,115.72 |
| 1919 | 69,877.90 | 65.00 | 1,075.04 | 6.05 | 6,500.31 |
| 1920 | 71,624.85 | 65.00 | 1,101.92 | 6.27 | 6,911.24 |
| 1921 | 73,415.47 | 65.00 | 1,129.47 | 6.49 | 7,330.30 |
| 1922 | 75,250.86 | 65.00 | 1,157.70 | 6.72 | 7,779.67 |
| 1923 | 77,132.13 | 65.00 | 1,186.65 | 6.94 | 8,237.36 |
| 1924 | 79,060.43 | 65.00 | 1,216.31 | 7.18 | 8,729.01 |
| 1925 | 81,036.94 | 65.00 | 1,246.72 | 7.40 | 9,229.33 |
| 1926 | 83,062.87 | 65.00 | 1,277.89 | 7.64 | 9,767.21 |
| 1927 | 84,889.12 | 65.00 | 1,305.98 | 7.87 | 10,284.36 |
| 1928 | 87,267.92 | 65.00 | 1,342.58 | 8.12 | 10,903.52 |
| 1929 | 89,449.62 | 65.00 | 1,376.15 | 8.36 | 11,503.77 |
| 1930 | 91,160.33 | 65.00 | 1,402.46 | 8.61 | 12,079.87 |
| 1931 | 93,978.01 | 65.00 | 1,445.81 | 8.86 | 12,809.68 |
| 1932 | 95,875.35 | 65.00 | 1,475.00 | 9.12 | 13,445.63 |
| 1933 | 98,735.64 | 65.00 | 1,519.01 | 9.38 | 14,249.94 |
| 1934 | 101,204.04 | 65.00 | 1,556.98 | 9.65 | 15,022.67 |
| 1935 | 103,235.16 | 65.00 | 1,588.23 | 9.93 | 15,766.69 |
| 1936 | 106,254.41 | 65.00 | 1,634.68 | 10.21 | 16,688.84 |
| 1937 | 108,904.20 | 65.00 | 1,675.45 | 10.50 | 17,598.17 |
| 1938 | 109,682.72 | 65.00 | 1,687.42 | 10.80 | 18,229.31 |
| 1939 | 113,757.12 | 65.00 | 1,750.11 | 11.12 | 19,453.41 |
| 1940 | 116,365.37 | 65.00 | 1,790.23 | 11.44 | 20,471.61 |
| 1946 | 116,353.01 | 65.00 | 1,790.04 | 13.60 | 24,351.55 |
| 1947 | 117,026.33 | 65.00 | 1,800.40 | 14.01 | 25,222.91 |

# MDU
## Gas Division
### 376.10 Distribution Mains - Steel

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2015
### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* 65 *Survivor Curve:* R2.5

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 1948 | 116,885.73 | 65.00 | 1,798.24 | 14.43 | 25,944.34 |
| 1949 | 117,272.09 | 65.00 | 1,804.18 | 14.86 | 26,810.59 |
| 1950 | 408,129.69 | 65.00 | 6,278.91 | 15.30 | 96,096.63 |
| 1951 | 339,367.90 | 65.00 | 5,221.04 | 15.76 | 82,307.27 |
| 1952 | 549,289.51 | 65.00 | 8,450.60 | 16.24 | 137,199.50 |
| 1953 | 456,970.46 | 65.00 | 7,030.31 | 16.72 | 117,564.86 |
| 1954 | 502,195.96 | 65.00 | 7,726.08 | 17.22 | 133,041.65 |
| 1955 | 915,425.79 | 65.00 | 14,083.45 | 17.73 | 249,752.32 |
| 1956 | 714,299.46 | 65.00 | 10,989.21 | 18.26 | 200,627.05 |
| 1957 | 416,003.97 | 65.00 | 6,400.05 | 18.80 | 120,300.56 |
| 1958 | 522,541.80 | 65.00 | 8,039.09 | 19.35 | 155,541.33 |
| 1959 | 633,684.76 | 65.00 | 9,748.98 | 19.91 | 194,101.60 |
| 1960 | 797,327.52 | 65.00 | 12,266.56 | 20.49 | 251,291.22 |
| 1961 | 655,072.90 | 65.00 | 10,078.03 | 21.07 | 212,356.92 |
| 1962 | 945,630.68 | 65.00 | 14,548.14 | 21.67 | 315,269.09 |
| 1963 | 814,602.38 | 65.00 | 12,532.33 | 22.28 | 279,202.84 |
| 1964 | 795,937.06 | 65.00 | 12,245.17 | 22.90 | 280,419.84 |
| 1965 | 774,536.91 | 65.00 | 11,915.94 | 23.53 | 280,377.99 |
| 1966 | 552,063.05 | 65.00 | 8,493.27 | 24.17 | 205,305.11 |
| 1967 | 660,200.41 | 65.00 | 10,156.92 | 24.82 | 252,116.53 |
| 1968 | 766,962.21 | 65.00 | 11,799.40 | 25.49 | 300,710.75 |
| 1969 | 698,975.14 | 65.00 | 10,753.45 | 26.15 | 281,244.86 |
| 1970 | 2,419,008.95 | 65.00 | 37,215.47 | 26.84 | 998,716.27 |
| 1971 | 593,554.63 | 65.00 | 9,131.60 | 27.53 | 251,355.69 |
| 1972 | 578,798.24 | 65.00 | 8,904.58 | 28.22 | 251,314.40 |
| 1973 | 636,258.26 | 65.00 | 9,788.58 | 28.93 | 283,189.65 |
| 1974 | 260,227.66 | 65.00 | 4,003.50 | 29.64 | 118,682.42 |

# MDU
## Gas Division
### 376.10 Distribution Mains - Steel

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2015
### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* 65 *Survivor Curve:* R2.5

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 1975 | 45,589.52 | 65.00 | 701.38 | 30.37 | 21,300.21 |
| 1976 | 539,324.52 | 65.00 | 8,297.29 | 31.10 | 258,041.07 |
| 1977 | 287,429.31 | 65.00 | 4,421.98 | 31.84 | 140,796.46 |
| 1978 | 292,720.32 | 65.00 | 4,503.38 | 32.59 | 146,747.19 |
| 1979 | 498,570.33 | 65.00 | 7,670.30 | 33.34 | 255,745.09 |
| 1980 | 593,962.02 | 65.00 | 9,137.87 | 34.10 | 311,629.96 |
| 1981 | 744,558.96 | 65.00 | 11,454.74 | 34.87 | 399,477.35 |
| 1982 | 905,914.76 | 65.00 | 13,937.13 | 35.65 | 496,856.44 |
| 1983 | 617,652.89 | 65.00 | 9,502.34 | 36.44 | 346,223.63 |
| 1984 | 228,227.17 | 65.00 | 3,511.18 | 37.23 | 130,712.14 |
| 1985 | 615,538.35 | 65.00 | 9,469.81 | 38.02 | 360,087.54 |
| 1986 | 946,687.73 | 65.00 | 14,564.41 | 38.83 | 565,541.03 |
| 1987 | 345,330.48 | 65.00 | 5,312.77 | 39.64 | 210,603.76 |
| 1988 | 402,701.80 | 65.00 | 6,195.40 | 40.46 | 250,665.42 |
| 1989 | 358,494.00 | 65.00 | 5,515.28 | 41.28 | 227,689.82 |
| 1990 | 328,332.25 | 65.00 | 5,051.26 | 42.12 | 212,734.09 |
| 1991 | 364,550.57 | 65.00 | 5,608.46 | 42.95 | 240,888.68 |
| 1992 | 463,955.93 | 65.00 | 7,137.77 | 43.79 | 312,597.74 |
| 1993 | 934,445.38 | 65.00 | 14,376.06 | 44.64 | 641,784.00 |
| 1994 | 552,732.28 | 65.00 | 8,503.56 | 45.50 | 386,896.87 |
| 1995 | 131,681.46 | 65.00 | 2,025.87 | 46.36 | 93,913.55 |
| 1996 | 205,661.80 | 65.00 | 3,164.02 | 47.22 | 149,418.11 |
| 1997 | 150,722.72 | 65.00 | 2,318.81 | 48.10 | 111,524.32 |
| 1998 | 127,248.71 | 65.00 | 1,957.67 | 48.97 | 95,869.70 |
| 1999 | 433,279.69 | 65.00 | 6,665.83 | 49.85 | 332,312.78 |
| 2000 | 270,576.53 | 65.00 | 4,162.71 | 50.74 | 211,211.18 |
| 2001 | 167,896.27 | 65.00 | 2,583.02 | 51.63 | 133,362.30 |

# MDU
## Gas Division
### 376.10 Distribution Mains - Steel

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2015
### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* 65 *Survivor Curve:* R2.5

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 2002 | 628,199.23 | 65.00 | 9,664.59 | 52.53 | 507,637.52 |
| 2003 | 795,186.47 | 65.00 | 12,233.62 | 53.43 | 653,597.09 |
| 2004 | 1,085,420.10 | 65.00 | 16,698.75 | 54.33 | 907,245.50 |
| 2005 | 1,414,268.75 | 65.00 | 21,757.95 | 55.24 | 1,201,899.05 |
| 2006 | 387,013.55 | 65.00 | 5,954.05 | 56.15 | 334,329.25 |
| 2007 | 420,802.44 | 65.00 | 6,473.88 | 57.07 | 369,457.56 |
| 2008 | 3,238,658.24 | 65.00 | 49,825.45 | 57.99 | 2,889,314.95 |
| 2009 | 557,130.58 | 65.00 | 8,571.23 | 58.91 | 504,961.80 |
| 2010 | 422,807.66 | 65.00 | 6,504.72 | 59.84 | 389,252.22 |
| 2011 | 2,034,286.58 | 65.00 | 31,296.68 | 60.77 | 1,901,967.01 |
| 2012 | 1,741,341.86 | 65.00 | 26,789.84 | 61.71 | 1,653,112.77 |
| 2013 | 1,066,117.46 | 65.00 | 16,401.79 | 62.64 | 1,027,468.91 |
| 2014 | 23,135,748.72 | 65.00 | 355,934.12 | 63.58 | 22,631,855.13 |
| 2015 | 927,020.36 | 65.00 | 14,261.83 | 64.53 | 920,276.60 |
| ***Total*** | 69,466,300.96 | 65.00 | 1,068,710.90 | 46.20 | 49,375,440.01 |

***Composite Average Remaining Life ... 46.20 Years***

# MDU
## Gas Division
### 376.20 Distribution Mains - Plastic

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2015
### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* 54 *Survivor Curve:* R2

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 1970 | 360,960.85 | 54.00 | 6,684.44 | 19.38 | 129,546.03 |
| 1971 | 140,497.51 | 54.00 | 2,601.80 | 19.95 | 51,916.46 |
| 1972 | 1,258,125.92 | 54.00 | 23,298.55 | 20.54 | 478,471.84 |
| 1973 | 301,498.63 | 54.00 | 5,583.29 | 21.13 | 117,984.63 |
| 1974 | 241,844.34 | 54.00 | 4,478.58 | 21.74 | 97,351.24 |
| 1975 | 864,405.51 | 54.00 | 16,007.46 | 22.35 | 357,804.54 |
| 1976 | 645,293.23 | 54.00 | 11,949.84 | 22.98 | 274,577.50 |
| 1977 | 317,566.24 | 54.00 | 5,880.84 | 23.61 | 138,860.39 |
| 1978 | 508,859.96 | 54.00 | 9,423.30 | 24.26 | 228,578.56 |
| 1979 | 1,090,019.71 | 54.00 | 20,185.49 | 24.91 | 502,798.64 |
| 1980 | 1,517,876.74 | 54.00 | 28,108.74 | 25.57 | 718,813.47 |
| 1981 | 1,137,597.86 | 54.00 | 21,066.56 | 26.25 | 552,898.91 |
| 1982 | 1,129,925.56 | 54.00 | 20,924.48 | 26.93 | 563,432.85 |
| 1983 | 1,143,095.56 | 54.00 | 21,168.37 | 27.62 | 584,614.35 |
| 1984 | 1,219,729.54 | 54.00 | 22,587.51 | 28.32 | 639,595.75 |
| 1985 | 1,240,062.47 | 54.00 | 22,964.05 | 29.02 | 666,503.77 |
| 1986 | 1,178,380.35 | 54.00 | 21,821.79 | 29.74 | 648,941.46 |
| 1987 | 1,238,990.07 | 54.00 | 22,944.19 | 30.46 | 698,943.08 |
| 1988 | 810,156.97 | 54.00 | 15,002.86 | 31.20 | 468,018.23 |
| 1989 | 608,006.39 | 54.00 | 11,259.34 | 31.94 | 359,574.27 |
| 1990 | 895,566.07 | 54.00 | 16,584.50 | 32.68 | 542,043.53 |
| 1991 | 1,277,869.62 | 54.00 | 23,664.18 | 33.44 | 791,316.44 |
| 1992 | 1,852,379.26 | 54.00 | 34,303.21 | 34.20 | 1,173,205.16 |
| 1993 | 6,544,178.31 | 54.00 | 121,188.10 | 34.97 | 4,238,198.85 |
| 1994 | 4,279,204.10 | 54.00 | 79,244.27 | 35.75 | 2,833,005.23 |
| 1995 | 1,538,675.90 | 54.00 | 28,493.91 | 36.54 | 1,041,040.59 |
| 1996 | 1,815,024.44 | 54.00 | 33,611.46 | 37.33 | 1,254,640.40 |

# MDU
## Gas Division
### 376.20 Distribution Mains - Plastic

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2015
### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* 54 *Survivor Curve:* R2

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 1997 | 1,607,913.66 | 54.00 | 29,776.08 | 38.13 | 1,135,266.36 |
| 1998 | 1,420,802.71 | 54.00 | 26,311.08 | 38.93 | 1,024,356.44 |
| 1999 | 1,091,957.49 | 54.00 | 20,221.37 | 39.74 | 803,670.19 |
| 2000 | 1,457,290.07 | 54.00 | 26,986.77 | 40.56 | 1,094,660.30 |
| 2001 | 1,746,497.87 | 54.00 | 32,342.45 | 41.39 | 1,338,603.02 |
| 2002 | 2,118,850.53 | 54.00 | 39,237.85 | 42.22 | 1,656,629.87 |
| 2003 | 2,528,207.24 | 54.00 | 46,818.50 | 43.06 | 2,015,914.76 |
| 2004 | 2,451,269.33 | 54.00 | 45,393.73 | 43.90 | 1,992,872.76 |
| 2005 | 3,340,294.31 | 54.00 | 61,857.11 | 44.75 | 2,768,208.01 |
| 2006 | 3,207,448.33 | 54.00 | 59,397.00 | 45.61 | 2,708,871.81 |
| 2007 | 2,815,945.48 | 54.00 | 52,146.97 | 46.47 | 2,423,149.19 |
| 2008 | 4,058,737.52 | 54.00 | 75,161.57 | 47.33 | 3,557,748.42 |
| 2009 | 2,482,145.50 | 54.00 | 45,965.51 | 48.21 | 2,215,860.98 |
| 2010 | 4,016,719.00 | 54.00 | 74,383.45 | 49.08 | 3,651,085.40 |
| 2011 | 5,757,252.71 | 54.00 | 106,615.45 | 49.97 | 5,327,296.75 |
| 2012 | 16,644,424.51 | 54.00 | 308,229.11 | 50.86 | 15,675,043.68 |
| 2013 | 10,902,116.54 | 54.00 | 201,890.41 | 51.75 | 10,447,253.17 |
| 2014 | 17,464,150.79 | 54.00 | 323,409.18 | 52.64 | 17,025,844.29 |
| 2015 | 13,364,350.72 | 54.00 | 247,487.19 | 53.55 | 13,252,267.05 |
| **Total** | 133,632,165.42 | 54.00 | 2,474,661.90 | 44.56 | 110,267,278.60 |

*Composite Average Remaining Life ...* 44.56 Years

# MDU
## Gas Division
### 380.10 Services - Steel

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2015
### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* 44 *Survivor Curve:* R0.5

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 1920 | 21,477.67 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1921 | 22,014.61 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1922 | 22,564.97 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1923 | 23,129.10 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1924 | 23,707.33 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1925 | 24,300.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1926 | 24,907.51 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1927 | 25,530.20 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1928 | 26,168.45 | 44.00 | 594.72 | 0.50 | 297.36 |
| 1929 | 26,822.66 | 44.00 | 609.59 | 0.83 | 504.25 |
| 1930 | 26,948.71 | 44.00 | 612.45 | 1.28 | 782.60 |
| 1931 | 28,180.56 | 44.00 | 640.45 | 1.74 | 1,116.75 |
| 1932 | 28,885.07 | 44.00 | 656.46 | 2.21 | 1,450.88 |
| 1933 | 29,554.47 | 44.00 | 671.67 | 2.67 | 1,795.39 |
| 1934 | 30,347.38 | 44.00 | 689.69 | 3.13 | 2,160.47 |
| 1935 | 31,072.96 | 44.00 | 706.18 | 3.58 | 2,531.55 |
| 1936 | 31,883.71 | 44.00 | 724.61 | 4.03 | 2,919.62 |
| 1937 | 32,680.81 | 44.00 | 742.72 | 4.46 | 3,314.98 |
| 1938 | 33,497.82 | 44.00 | 761.29 | 4.89 | 3,724.14 |
| 1939 | 34,124.37 | 44.00 | 775.53 | 5.31 | 4,121.14 |
| 1940 | 34,608.77 | 44.00 | 786.54 | 5.73 | 4,507.10 |
| 1946 | 34,624.65 | 44.00 | 786.90 | 8.14 | 6,407.29 |
| 1947 | 34,547.03 | 44.00 | 785.14 | 8.54 | 6,704.02 |
| 1948 | 34,524.09 | 44.00 | 784.62 | 8.93 | 7,009.13 |
| 1949 | 35,096.50 | 44.00 | 797.62 | 9.33 | 7,441.18 |
| 1950 | 64,866.11 | 44.00 | 1,474.19 | 9.73 | 14,337.98 |
| 1951 | 93,134.50 | 44.00 | 2,116.63 | 10.12 | 21,429.04 |

# MDU

## Gas Division

### 380.10 Services - Steel

## Original Cost Of Utility Plant In Service

### And Development Of Composite Remaining Life as of December 31, 2015

### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* 44 *Survivor Curve:* R0.5

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 1952 | 118,526.97 | 44.00 | 2,693.72 | 10.52 | 28,344.92 |
| 1953 | 107,874.33 | 44.00 | 2,451.62 | 10.92 | 26,781.56 |
| 1954 | 126,407.13 | 44.00 | 2,872.81 | 11.33 | 32,542.58 |
| 1955 | 101,451.84 | 44.00 | 2,305.66 | 11.73 | 27,053.58 |
| 1956 | 194,466.67 | 44.00 | 4,419.57 | 12.14 | 53,665.27 |
| 1957 | 133,247.15 | 44.00 | 3,028.26 | 12.55 | 38,019.51 |
| 1958 | 130,523.48 | 44.00 | 2,966.36 | 12.97 | 38,475.36 |
| 1959 | 154,481.36 | 44.00 | 3,510.84 | 13.39 | 47,008.26 |
| 1960 | 123,969.42 | 44.00 | 2,817.41 | 13.81 | 38,915.30 |
| 1961 | 152,185.76 | 44.00 | 3,458.67 | 14.24 | 49,249.52 |
| 1962 | 213,524.34 | 44.00 | 4,852.69 | 14.67 | 71,191.77 |
| 1963 | 189,894.23 | 44.00 | 4,315.65 | 15.11 | 65,192.13 |
| 1964 | 201,727.39 | 44.00 | 4,584.58 | 15.55 | 71,271.43 |
| 1965 | 185,907.55 | 44.00 | 4,225.05 | 15.99 | 67,560.25 |
| 1966 | 151,026.22 | 44.00 | 3,432.32 | 16.44 | 56,425.85 |
| 1967 | 170,868.19 | 44.00 | 3,883.26 | 16.89 | 65,603.09 |
| 1968 | 158,025.08 | 44.00 | 3,591.38 | 17.35 | 62,320.53 |
| 1969 | 181,408.00 | 44.00 | 4,122.79 | 17.82 | 73,454.90 |
| 1970 | 788,949.96 | 44.00 | 17,930.17 | 18.29 | 327,873.79 |
| 1971 | 275,880.61 | 44.00 | 6,269.83 | 18.76 | 117,624.83 |
| 1972 | 315,189.69 | 44.00 | 7,163.20 | 19.24 | 137,818.89 |
| 1973 | 270,508.82 | 44.00 | 6,147.75 | 19.72 | 121,261.04 |
| 1974 | 105,598.63 | 44.00 | 2,399.90 | 20.21 | 48,513.64 |
| 1975 | 187,967.96 | 44.00 | 4,271.88 | 20.71 | 88,471.04 |
| 1976 | 132,972.56 | 44.00 | 3,022.02 | 21.21 | 64,098.71 |
| 1977 | 119,565.31 | 44.00 | 2,717.32 | 21.72 | 59,011.26 |
| 1978 | 114,254.61 | 44.00 | 2,596.62 | 22.23 | 57,717.32 |

# MDU
## Gas Division
### 380.10 Services - Steel

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2015
### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* 44 *Survivor Curve:* R0.5

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 1979 | 101,666.33 | 44.00 | 2,310.53 | 22.74 | 52,550.95 |
| 1980 | 111,261.68 | 44.00 | 2,528.60 | 23.27 | 58,828.94 |
| 1981 | 130,919.16 | 44.00 | 2,975.35 | 23.79 | 70,790.74 |
| 1982 | 113,741.35 | 44.00 | 2,584.96 | 24.32 | 62,876.38 |
| 1983 | 84,952.87 | 44.00 | 1,930.69 | 24.86 | 47,997.67 |
| 1984 | 61,720.44 | 44.00 | 1,402.70 | 25.40 | 35,630.56 |
| 1985 | 57,764.87 | 44.00 | 1,312.80 | 25.95 | 34,064.55 |
| 1986 | 57,400.14 | 44.00 | 1,304.51 | 26.50 | 34,567.61 |
| 1987 | 52,819.55 | 44.00 | 1,200.41 | 27.05 | 32,475.09 |
| 1988 | 31,831.29 | 44.00 | 723.42 | 27.61 | 19,975.25 |
| 1989 | 37,760.51 | 44.00 | 858.17 | 28.18 | 24,179.94 |
| 1990 | 27,318.28 | 44.00 | 620.85 | 28.74 | 17,845.33 |
| 1991 | 16,870.74 | 44.00 | 383.41 | 29.31 | 11,239.42 |
| 1992 | 25,256.70 | 44.00 | 574.00 | 29.89 | 17,156.10 |
| 1993 | 25,730.67 | 44.00 | 584.77 | 30.47 | 17,815.80 |
| 1994 | 48,519.47 | 44.00 | 1,102.68 | 31.05 | 34,234.81 |
| 1995 | 19,889.92 | 44.00 | 452.03 | 31.63 | 14,297.79 |
| 1996 | 47,463.51 | 44.00 | 1,078.69 | 32.22 | 34,751.57 |
| 1997 | 25,981.16 | 44.00 | 590.46 | 32.80 | 19,370.17 |
| 1998 | 30,947.92 | 44.00 | 703.34 | 33.40 | 23,488.46 |
| 1999 | 25,142.27 | 44.00 | 571.40 | 33.99 | 19,420.91 |
| 2000 | 26,994.94 | 44.00 | 613.50 | 34.58 | 21,216.63 |
| 2001 | 14,363.69 | 44.00 | 326.44 | 35.18 | 11,483.66 |
| 2002 | 14,668.63 | 44.00 | 333.37 | 35.78 | 11,926.61 |
| 2003 | 1,760.33 | 44.00 | 40.01 | 36.38 | 1,455.24 |
| 2015 | 136,963.82 | 44.00 | 3,112.73 | 43.69 | 135,996.94 |

# MDU
## Gas Division
### 380.10 Services - Steel

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2015
### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* 44 *Survivor Curve:* R0.5

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| Total | 7,315,313.52 | 39.60 | 161,988.15 | 17.86 | 2,893,658.30 |

*Composite Average Remaining Life ...* 17.86 Years

# MDU
## Gas Division
### 380.20 Services - Plastic

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2015
### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* 48 *Survivor Curve:* R4

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 1950 | 21.20 | 48.00 | 0.44 | 1.66 | 0.73 |
| 1951 | 225.32 | 48.00 | 4.69 | 1.90 | 8.93 |
| 1952 | 112.66 | 48.00 | 2.35 | 2.15 | 5.05 |
| 1953 | 151.98 | 48.00 | 3.17 | 2.40 | 7.61 |
| 1954 | 185.08 | 48.00 | 3.86 | 2.66 | 10.25 |
| 1956 | 130.63 | 48.00 | 2.72 | 3.18 | 8.66 |
| 1958 | 140.93 | 48.00 | 2.94 | 3.72 | 10.94 |
| 1959 | 134.01 | 48.00 | 2.79 | 4.00 | 11.18 |
| 1960 | 738.18 | 48.00 | 15.38 | 4.29 | 66.03 |
| 1962 | 228.96 | 48.00 | 4.77 | 4.90 | 23.39 |
| 1963 | 56.12 | 48.00 | 1.17 | 5.24 | 6.12 |
| 1964 | 70.71 | 48.00 | 1.47 | 5.59 | 8.23 |
| 1966 | 72.97 | 48.00 | 1.52 | 6.37 | 9.68 |
| 1967 | 546.40 | 48.00 | 11.38 | 6.80 | 77.42 |
| 1968 | 72.97 | 48.00 | 1.52 | 7.27 | 11.05 |
| 1969 | 187.00 | 48.00 | 3.90 | 7.76 | 30.25 |
| 1970 | 690.88 | 48.00 | 14.39 | 8.30 | 119.41 |
| 1971 | 8,474.43 | 48.00 | 176.55 | 8.86 | 1,564.60 |
| 1972 | 235,188.97 | 48.00 | 4,899.74 | 9.46 | 46,349.66 |
| 1973 | 213,829.79 | 48.00 | 4,454.76 | 10.09 | 44,927.07 |
| 1974 | 506,159.33 | 48.00 | 10,544.92 | 10.74 | 113,229.67 |
| 1975 | 295,691.91 | 48.00 | 6,160.21 | 11.41 | 70,259.62 |
| 1976 | 575,270.36 | 48.00 | 11,984.72 | 12.09 | 144,874.02 |
| 1977 | 391,241.29 | 48.00 | 8,150.81 | 12.79 | 104,208.65 |
| 1978 | 407,346.70 | 48.00 | 8,486.34 | 13.50 | 114,534.51 |
| 1979 | 635,186.83 | 48.00 | 13,232.98 | 14.22 | 188,208.00 |
| 1980 | 727,404.56 | 48.00 | 15,154.17 | 14.96 | 226,773.21 |

# MDU
# Gas Division
### 380.20 Services - Plastic

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2015
### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* 48 *Survivor Curve:* R4

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 1981 | 620,527.57 | 48.00 | 12,927.58 | 15.72 | 203,245.73 |
| 1982 | 708,478.64 | 48.00 | 14,759.88 | 16.50 | 243,466.09 |
| 1983 | 864,693.53 | 48.00 | 18,014.33 | 17.28 | 311,362.12 |
| 1984 | 755,451.72 | 48.00 | 15,738.48 | 18.09 | 284,688.62 |
| 1985 | 850,884.99 | 48.00 | 17,726.66 | 18.91 | 335,185.30 |
| 1986 | 654,106.19 | 48.00 | 13,627.13 | 19.75 | 269,077.67 |
| 1987 | 564,260.95 | 48.00 | 11,755.36 | 20.59 | 242,101.34 |
| 1988 | 562,206.86 | 48.00 | 11,712.57 | 21.46 | 251,328.01 |
| 1989 | 458,861.72 | 48.00 | 9,559.56 | 22.33 | 213,504.28 |
| 1990 | 515,891.30 | 48.00 | 10,747.67 | 23.22 | 249,589.97 |
| 1991 | 703,498.43 | 48.00 | 14,656.12 | 24.12 | 353,550.10 |
| 1992 | 833,072.65 | 48.00 | 17,355.57 | 25.03 | 434,484.66 |
| 1993 | 972,990.39 | 48.00 | 20,270.50 | 25.96 | 526,136.64 |
| 1994 | 1,976,689.97 | 48.00 | 41,180.78 | 26.89 | 1,107,213.27 |
| 1995 | 1,009,865.80 | 48.00 | 21,038.74 | 27.83 | 585,427.04 |
| 1996 | 1,503,303.85 | 48.00 | 31,318.63 | 28.77 | 901,146.58 |
| 1997 | 1,434,793.50 | 48.00 | 29,891.34 | 29.73 | 888,608.49 |
| 1998 | 1,199,606.28 | 48.00 | 24,991.64 | 30.69 | 766,985.09 |
| 1999 | 999,370.69 | 48.00 | 20,820.09 | 31.66 | 659,085.05 |
| 2000 | 1,084,182.19 | 48.00 | 22,586.99 | 32.63 | 736,962.88 |
| 2001 | 1,208,228.51 | 48.00 | 25,171.27 | 33.60 | 845,849.40 |
| 2002 | 1,406,586.89 | 48.00 | 29,303.71 | 34.58 | 1,013,428.62 |
| 2003 | 2,180,642.87 | 48.00 | 45,429.77 | 35.57 | 1,615,794.30 |
| 2004 | 2,600,383.29 | 48.00 | 54,174.31 | 36.55 | 1,980,232.60 |
| 2005 | 2,805,488.73 | 48.00 | 58,447.31 | 37.54 | 2,194,204.62 |
| 2006 | 2,996,536.28 | 48.00 | 62,427.44 | 38.53 | 2,405,472.18 |
| 2007 | 3,020,408.35 | 48.00 | 62,924.77 | 39.52 | 2,487,087.05 |

# MDU
## Gas Division
### 380.20 Services - Plastic

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2015
### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* 48 *Survivor Curve:* R4

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 2008 | 3,739,082.45 | 48.00 | 77,897.06 | 40.52 | 3,156,289.64 |
| 2009 | 3,313,233.85 | 48.00 | 69,025.27 | 41.51 | 2,865,508.96 |
| 2010 | 3,810,304.58 | 48.00 | 79,380.84 | 42.51 | 3,374,497.44 |
| 2011 | 5,312,168.05 | 48.00 | 110,669.47 | 43.51 | 4,814,922.61 |
| 2012 | 8,021,313.88 | 48.00 | 167,109.65 | 44.50 | 7,437,200.55 |
| 2013 | 8,211,108.95 | 48.00 | 171,063.68 | 45.50 | 7,783,932.10 |
| 2014 | 8,155,486.56 | 48.00 | 169,904.89 | 46.50 | 7,900,875.58 |
| 2015 | 7,549,289.96 | 48.00 | 157,275.88 | 47.50 | 7,470,717.28 |
| *Total* | 86,602,560.59 | 48.00 | 1,804,208.57 | 37.67 | 67,964,505.81 |

*Composite Average Remaining Life ... 37.67 Years*

# MDU
## Gas Division
### 385.00 Ind. Meas. & Reg. Sta. Equip

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2015
### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* 44 *Survivor Curve:* R4

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 1951 | 2,680.88 | 44.00 | 60.93 | 0.67 | 40.72 |
| 1952 | 4,868.52 | 44.00 | 110.65 | 0.80 | 88.92 |
| 1953 | 2,163.85 | 44.00 | 49.18 | 1.02 | 50.13 |
| 1954 | 745.37 | 44.00 | 16.94 | 1.23 | 20.90 |
| 1955 | 2,362.95 | 44.00 | 53.70 | 1.44 | 77.17 |
| 1956 | 6,597.03 | 44.00 | 149.93 | 1.67 | 250.72 |
| 1957 | 6,061.41 | 44.00 | 137.76 | 1.92 | 263.84 |
| 1958 | 4,054.18 | 44.00 | 92.14 | 2.16 | 199.47 |
| 1959 | 4,573.78 | 44.00 | 103.95 | 2.41 | 250.18 |
| 1960 | 12,461.11 | 44.00 | 283.21 | 2.67 | 755.46 |
| 1961 | 8,196.22 | 44.00 | 186.28 | 2.93 | 546.38 |
| 1962 | 1,763.36 | 44.00 | 40.08 | 3.20 | 128.39 |
| 1963 | 10,583.20 | 44.00 | 240.53 | 3.47 | 834.65 |
| 1964 | 17,835.10 | 44.00 | 405.34 | 3.75 | 1,521.68 |
| 1965 | 11,173.34 | 44.00 | 253.94 | 4.05 | 1,028.06 |
| 1966 | 5,393.07 | 44.00 | 122.57 | 4.36 | 533.90 |
| 1967 | 4,491.43 | 44.00 | 102.08 | 4.68 | 477.27 |
| 1968 | 9,911.64 | 44.00 | 225.26 | 5.02 | 1,130.94 |
| 1969 | 14,004.23 | 44.00 | 318.28 | 5.39 | 1,715.41 |
| 1970 | 11,417.57 | 44.00 | 259.49 | 5.79 | 1,501.83 |
| 1971 | 5,523.88 | 44.00 | 125.54 | 6.22 | 780.53 |
| 1972 | 7,827.02 | 44.00 | 177.89 | 6.68 | 1,188.48 |
| 1973 | 6,520.05 | 44.00 | 148.18 | 7.18 | 1,064.11 |
| 1974 | 1,656.04 | 44.00 | 37.64 | 7.72 | 290.67 |
| 1975 | 13,094.98 | 44.00 | 297.61 | 8.30 | 2,469.41 |
| 1980 | 6,543.69 | 44.00 | 148.72 | 11.57 | 1,720.97 |
| 1981 | 242.64 | 44.00 | 5.51 | 12.28 | 67.73 |

# MDU
## Gas Division
### 385.00 Ind. Meas. & Reg. Sta. Equip

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2015
### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* 44 *Survivor Curve:* R4

| Year<br>(1) | Original Cost<br>(2) | Avg. Service Life<br>(3) | Avg. Annual Accrual<br>(4) | Avg. Remaining Life<br>(5) | Future Annual Accruals<br>(6) |
|---|---|---|---|---|---|
| 1982 | 3,198.21 | 44.00 | 72.69 | 13.01 | 945.44 |
| 1983 | 3,104.39 | 44.00 | 70.55 | 13.75 | 970.01 |
| 1984 | 19,084.23 | 44.00 | 433.73 | 14.51 | 6,291.93 |
| 1985 | 78,994.35 | 44.00 | 1,795.32 | 15.28 | 27,441.31 |
| 1986 | 4,425.00 | 44.00 | 100.57 | 16.08 | 1,616.93 |
| 1987 | 16,965.27 | 44.00 | 385.57 | 16.89 | 6,511.42 |
| 1988 | 20,339.12 | 44.00 | 462.25 | 17.71 | 8,188.12 |
| 1989 | 103.59 | 44.00 | 2.35 | 18.56 | 43.69 |
| 1990 | 15,148.91 | 44.00 | 344.29 | 19.42 | 6,684.83 |
| 1991 | 17,900.06 | 44.00 | 406.82 | 20.29 | 8,253.62 |
| 1992 | 11,678.51 | 44.00 | 265.42 | 21.18 | 5,620.50 |
| 1993 | 15,099.62 | 44.00 | 343.17 | 22.08 | 7,575.55 |
| 1994 | 8,709.85 | 44.00 | 197.95 | 22.99 | 4,550.11 |
| 1995 | 26,585.34 | 44.00 | 604.21 | 23.91 | 14,445.49 |
| 1996 | 28,112.90 | 44.00 | 638.93 | 24.84 | 15,872.00 |
| 1997 | 13,929.02 | 44.00 | 316.57 | 25.78 | 8,162.13 |
| 1998 | 15,936.47 | 44.00 | 362.19 | 26.73 | 9,682.47 |
| 1999 | 9,754.16 | 44.00 | 221.68 | 27.69 | 6,138.66 |
| 2000 | 3,184.71 | 44.00 | 72.38 | 28.65 | 2,074.03 |
| 2001 | 6,751.97 | 44.00 | 153.45 | 29.62 | 4,546.00 |
| 2002 | 1,505.72 | 44.00 | 34.22 | 30.60 | 1,047.13 |
| 2003 | 55,438.44 | 44.00 | 1,259.96 | 31.58 | 39,788.17 |
| 2004 | 8,460.91 | 44.00 | 192.29 | 32.56 | 6,261.40 |
| 2006 | 48,061.67 | 44.00 | 1,092.31 | 34.54 | 37,724.58 |
| 2008 | 171,215.74 | 44.00 | 3,891.26 | 36.52 | 142,111.50 |
| 2013 | 184,946.87 | 44.00 | 4,203.33 | 41.50 | 174,450.69 |
| 2014 | 3,296.78 | 44.00 | 74.93 | 42.50 | 3,184.50 |

# MDU
## Gas Division
### 385.00 Ind. Meas. & Reg. Sta. Equip

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2015
### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* 44 *Survivor Curve:* R4

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 2015 | 301,602.48 | 44.00 | 6,854.59 | 43.50 | 298,178.07 |
| Total | 1,276,280.83 | 44.00 | 29,006.31 | 29.90 | 867,358.21 |

*Composite Average Remaining Life ... 29.90 Years*

# MDU
## Gas Division
### 387.10 Cathodic Protection Equipment

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2015
### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* 49 *Survivor Curve:* R1.5

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 1948 | 3,147.50 | 49.00 | 64.23 | 8.73 | 560.59 |
| 1949 | 4,702.68 | 49.00 | 95.97 | 9.04 | 867.42 |
| 1950 | 982.03 | 49.00 | 20.04 | 9.35 | 187.48 |
| 1951 | 4,205.43 | 49.00 | 85.82 | 9.68 | 830.55 |
| 1952 | 637.12 | 49.00 | 13.00 | 10.01 | 130.11 |
| 1953 | 41.72 | 49.00 | 0.85 | 10.34 | 8.81 |
| 1954 | 105.99 | 49.00 | 2.16 | 10.69 | 23.11 |
| 1955 | 1,229.77 | 49.00 | 25.10 | 11.04 | 276.97 |
| 1956 | 793.52 | 49.00 | 16.19 | 11.40 | 184.54 |
| 1957 | 4,654.80 | 49.00 | 94.99 | 11.76 | 1,117.54 |
| 1958 | 3,608.08 | 49.00 | 73.63 | 12.14 | 894.04 |
| 1959 | 7,378.67 | 49.00 | 150.58 | 12.53 | 1,886.62 |
| 1960 | 14,712.69 | 49.00 | 300.26 | 12.93 | 3,880.92 |
| 1961 | 14,501.22 | 49.00 | 295.94 | 13.33 | 3,945.45 |
| 1962 | 9,719.23 | 49.00 | 198.35 | 13.75 | 2,727.03 |
| 1963 | 14,543.95 | 49.00 | 296.81 | 14.18 | 4,207.51 |
| 1964 | 9,040.78 | 49.00 | 184.50 | 14.61 | 2,696.18 |
| 1965 | 7,669.31 | 49.00 | 156.51 | 15.06 | 2,357.31 |
| 1966 | 2,468.66 | 49.00 | 50.38 | 15.52 | 781.90 |
| 1967 | 6,970.61 | 49.00 | 142.26 | 15.99 | 2,274.59 |
| 1968 | 9,592.79 | 49.00 | 195.77 | 16.47 | 3,224.23 |
| 1969 | 16,961.39 | 49.00 | 346.15 | 16.96 | 5,870.81 |
| 1970 | 6,494.06 | 49.00 | 132.53 | 17.46 | 2,314.25 |
| 1971 | 10,965.47 | 49.00 | 223.78 | 17.97 | 4,022.32 |
| 1972 | 15,376.83 | 49.00 | 313.81 | 18.50 | 5,804.54 |
| 1973 | 13,455.71 | 49.00 | 274.60 | 19.03 | 5,225.78 |
| 1974 | 14,059.27 | 49.00 | 286.92 | 19.57 | 5,616.17 |

# MDU
## Gas Division
### 387.10 Cathodic Protection Equipment

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2015
### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* 49 *Survivor Curve:* R1.5

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 1975 | 6,840.71 | 49.00 | 139.60 | 20.13 | 2,809.94 |
| 1976 | 15,608.86 | 49.00 | 318.54 | 20.69 | 6,591.28 |
| 1977 | 22,013.30 | 49.00 | 449.25 | 21.27 | 9,553.59 |
| 1978 | 24,227.11 | 49.00 | 494.42 | 21.85 | 10,803.02 |
| 1979 | 11,957.16 | 49.00 | 244.02 | 22.44 | 5,476.97 |
| 1980 | 22,791.29 | 49.00 | 465.12 | 23.05 | 10,719.99 |
| 1981 | 19,568.17 | 49.00 | 399.35 | 23.66 | 9,448.49 |
| 1982 | 25,800.11 | 49.00 | 526.53 | 24.28 | 12,784.75 |
| 1983 | 36,179.08 | 49.00 | 738.34 | 24.91 | 18,393.21 |
| 1984 | 45,090.09 | 49.00 | 920.19 | 25.55 | 23,511.50 |
| 1985 | 54,534.99 | 49.00 | 1,112.94 | 26.20 | 29,156.99 |
| 1986 | 75,159.11 | 49.00 | 1,533.84 | 26.85 | 41,189.44 |
| 1987 | 31,587.75 | 49.00 | 644.64 | 27.52 | 17,738.96 |
| 1988 | 59,999.30 | 49.00 | 1,224.46 | 28.19 | 34,516.66 |
| 1989 | 17,043.41 | 49.00 | 347.82 | 28.87 | 10,041.08 |
| 1990 | 10,960.58 | 49.00 | 223.68 | 29.56 | 6,610.99 |
| 1991 | 56,488.37 | 49.00 | 1,152.81 | 30.25 | 34,871.46 |
| 1992 | 25,897.42 | 49.00 | 528.51 | 30.95 | 16,357.40 |
| 1993 | 35,241.27 | 49.00 | 719.20 | 31.66 | 22,768.01 |
| 1994 | 54,037.17 | 49.00 | 1,102.79 | 32.37 | 35,698.67 |
| 1995 | 22,834.58 | 49.00 | 466.01 | 33.09 | 15,420.87 |
| 1996 | 82,667.19 | 49.00 | 1,687.06 | 33.82 | 57,052.82 |
| 1997 | 66,569.72 | 49.00 | 1,358.55 | 34.55 | 46,937.65 |
| 1998 | 61,929.35 | 49.00 | 1,263.85 | 35.29 | 44,598.02 |
| 1999 | 59,869.64 | 49.00 | 1,221.81 | 36.03 | 44,022.58 |
| 2000 | 68,394.11 | 49.00 | 1,395.78 | 36.78 | 51,335.09 |
| 2001 | 98,382.49 | 49.00 | 2,007.78 | 37.53 | 75,356.22 |

# MDU
## Gas Division
### 387.10 Cathodic Protection Equipment

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2015
### Based Upon Broad Group/Remaining Life Procedure and Technique

**Average Service Life:** 49 **Survivor Curve:** R1.5

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 2002 | 20,383.69 | 49.00 | 415.99 | 38.29 | 15,928.36 |
| 2003 | 44,807.00 | 49.00 | 914.42 | 39.05 | 35,711.26 |
| 2004 | 103,470.45 | 49.00 | 2,111.62 | 39.82 | 84,090.15 |
| 2005 | 39,770.35 | 49.00 | 811.63 | 40.60 | 32,948.62 |
| 2006 | 81,317.58 | 49.00 | 1,659.52 | 41.37 | 68,660.14 |
| 2007 | 22,130.31 | 49.00 | 451.63 | 42.16 | 19,039.09 |
| 2008 | 90,598.99 | 49.00 | 1,848.94 | 42.94 | 79,399.83 |
| 2009 | 125,385.94 | 49.00 | 2,558.86 | 43.74 | 111,913.87 |
| 2010 | 422,115.49 | 49.00 | 8,614.49 | 44.53 | 383,627.11 |
| 2011 | 186,524.39 | 49.00 | 3,806.57 | 45.33 | 172,569.04 |
| 2012 | 192,773.41 | 49.00 | 3,934.10 | 46.14 | 181,523.28 |
| 2013 | 225,972.92 | 49.00 | 4,611.63 | 46.95 | 216,526.17 |
| 2014 | 36,730.68 | 49.00 | 749.60 | 47.77 | 35,806.74 |
| 2015 | 256,142.63 | 49.00 | 5,227.33 | 48.59 | 253,988.86 |
| **Total** | 3,157,815.44 | 49.00 | 64,444.40 | 37.98 | 2,447,414.96 |

**Composite Average Remaining Life ... 37.98 Years**

# MDU
## Gas Division
### 396.20 Power Operated Equipment

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2015
### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* 7 *Survivor Curve:* L1

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 1987 | 11,210.89 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1988 | 6,980.43 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1989 | 83,751.23 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1992 | 28,376.16 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1993 | 14,150.37 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1994 | 21,151.49 | 7.00 | 3,020.96 | 0.50 | 1,510.48 |
| 1995 | 3,202.81 | 7.00 | 457.44 | 0.53 | 244.07 |
| 1996 | 32,573.93 | 7.00 | 4,652.38 | 0.63 | 2,950.52 |
| 1999 | 753.59 | 7.00 | 107.63 | 1.08 | 116.70 |
| 2000 | 129,701.57 | 7.00 | 18,524.64 | 1.26 | 23,356.22 |
| 2001 | 132,265.60 | 7.00 | 18,890.85 | 1.45 | 27,380.89 |
| 2002 | 104,953.05 | 7.00 | 14,989.93 | 1.65 | 24,722.73 |
| 2003 | 194,405.82 | 7.00 | 27,766.03 | 1.86 | 51,674.42 |
| 2004 | 397,288.15 | 7.00 | 56,742.73 | 2.09 | 118,321.65 |
| 2005 | 285,303.54 | 7.00 | 40,748.51 | 2.32 | 94,705.59 |
| 2006 | 324,792.12 | 7.00 | 46,388.47 | 2.58 | 119,621.89 |
| 2007 | 471,763.22 | 7.00 | 67,379.64 | 2.85 | 192,060.43 |
| 2008 | 127,949.71 | 7.00 | 18,274.43 | 3.14 | 57,414.85 |
| 2009 | 22,284.52 | 7.00 | 3,182.79 | 3.45 | 10,996.41 |
| 2010 | 275,815.92 | 7.00 | 39,393.44 | 3.79 | 149,398.19 |
| 2011 | 559,319.24 | 7.00 | 79,884.84 | 4.16 | 332,097.44 |
| 2012 | 1,089,408.48 | 7.00 | 155,594.90 | 4.56 | 709,270.80 |
| 2013 | 218,973.07 | 7.00 | 31,274.85 | 5.06 | 158,231.34 |
| 2014 | 532,633.64 | 7.00 | 76,073.46 | 5.72 | 435,054.42 |
| 2015 | 3,339,358.95 | 7.00 | 476,944.34 | 6.54 | 3,119,764.25 |

# MDU
## Gas Division
### 396.20 Power Operated Equipment

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2015
### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* 7 *Survivor Curve:* L1

| Year | Original Cost | Avg. Service Life | Avg. Annual Accrual | Avg. Remaining Life | Future Annual Accruals |
|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) |
| Total | 8,408,367.50 | 5.60 | 1,180,292.27 | 4.77 | 5,628,893.30 |

*Composite Average Remaining Life ...* 4.77 Years