Application of San Diego Gas & Electric Company (U902M) for Authority, Among Other Things, to Increase Rates and Charges for Electric and Gas Service Effective on January 1, 2012.	A.10-12-005 (Filed December 15, 2010)
Application of Southern California Gas Company (U904G) for authority to update its gas revenue requirement and base rates effective on January 1, 2012.	A.10-12-006 (Filed December 15, 2010)

Application: A.10-12-006
Exhibit No.: SCG-227

PREPARED REBUTTAL TESTIMONY OF
BOB WIECZOREK
ON BEHALF OF SOUTHERN CALIFORNIA GAS COMPANY

**BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA**

OCTOBER 2011

The Gas Company

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PREPARED REBUTTAL TESTIMONY OF

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ON BEHALF OF SOUTHERN CALIFORNIA GAS COMPANY

I. INTRODUCTION

The following rebuttal testimony regarding Depreciation for Southern California Gas Company ("SCG") addresses the intervenor testimonies dated September 2011 of:

- Division of Ratepayer Advocates ("DRA") in Exhibit DRA-36; and
- The Utility Reform Network ("TURN") in Prepared Testimony of Jacob Pous.

In summary, DRA accepts all of SCG's average service lives ("ASLs") generated from SCG's depreciation study, but takes issue with the future net salvage ("FNS") rates for one plant account (FERC account G376 – Gas Mains), and proposes a $53.573 million[1] reduction to SCG's Test Year 2012 depreciation expense. However, in reviewing DRA's calculations, SDG&E has identified some calculation errors, which if corrected, change DRA's proposed reduction to FNS to $43.943 million.[2] TURN disputes SCG's proposed ASLs and FNS rates for several plant accounts, and proposes a combined $65.1 million[3] reduction compared to SCG's 2009 authorized depreciation expense.

These recommended reductions in depreciation are overlapping when viewed in totality. To understand the cumulative impact of the reductions proposed by DRA and TURN, SCG prepared a chart (see Attachment 2) which shows that, taken independently, the reduction to 2012 depreciation expense is $122.223 million, but adjusted for overlaps shows a total net reduction of $88.930 million.

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[1] Exhibit DRA-36-Kanter, page 3, line 20.
[2] Attachment 1(calculation of DRA adjustment to FERC account G376).
[3] Attachment 2 (calculation of DRA/TURN cumulative adjustments).

My rebuttal testimony can be summarized as follows:

- DRA's acceptance of SCG's ASLs should lead to adoption of those lives.
- DRA's proposed FNS rate of 0% for FERC account G376 - Gas Mains[4] should not be adopted because it is based on a misunderstood application of industry guidance on the treatment of Contributions in Aid of Construction ("CIAC"), termed by DRA as third party reimbursements, and is furthermore arbitrarily targeted at one plant account,[5] which results in a FNS rate that is contrary to sound depreciation policies and practices.
- TURN's proposals for ASLs and FNS rate adjustments are inferior to the sound and reasoned outcomes of SCG's depreciation study, which was conducted in accordance with the Commission's longstanding and consistently upheld Standard Practice U-4 methodology. TURN's attempt to challenge the credibility of SCG's depreciation method and its study results are not persuasive and is not supported by DRA's analysis of the same study, which resulted in no adjustments to any of SCG's proposed ASLs or FNS rates (except for the arbitrary adjustment to FERC Account G376 based on DRA's third party reimbursements position).

Rebuttal to DRA's testimony is discussed in Section II. Rebuttal to TURN's testimony is discussed in Section III.

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[4] Attachment 1.
[5] Exhibit DRA-36-Kanter, page 12, line 7.

II. REBUTTAL TO DRA

A. Average Service Lives ("ASLs")

Based on its review of SCG's depreciation study, DRA does not oppose the proposed changes to SCG's ASLs as presented in its depreciation study.[6] Therefore, SCG's proposed ASLs should be adopted.

B. Future Net Salvage ("FNS") Rates

Based on its review of SCG's depreciation study, DRA does not appear to take issue with any of the proposed FNS rates produced from that study or the method in which they were derived, as 26 of the 27 FNS rates were accepted.[7] Instead, DRA contends that SCG has improperly accounted for CIAC, which it refers to as third party reimbursements ("TPRs"), and selects a large account (Gas Mains) and zeros out its FNS rate. A 0% FNS rate for this size account results in a significant reduction to depreciation expense, one which DRA represents is reasonable, if not conservative, reduction to correct for "bad recordkeeping" of TPRs.[8] DRA's adjustment should be rejected on two counts: (1) DRA's TPR analysis is incorrect, and (2) DRA's approach of selecting one plant account and zeroing out its FNS is arbitrary and inconsistent with the principles of intergenerational equity and depreciation itself, which are reflected in Standard Practice U-4. DRA has consistently upheld the validity of Standard Practice U-4, and should therefore not recommend a complete non-funding of removal costs for one of SCG's largest infrastructure assets.

Because I sponsor the depreciation study and results, my rebuttal testimony will not address DRA's TPR analysis. Instead, a separate rebuttal exhibit will specifically demonstrate

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[6] Exhibit DRA-36-Kanter, page 4, lines 4-5.
[7] Exhibit DRA-36-Kanter, Table 36-5, page 11.
[8] Exhibit DRA-36-Kanter, page 12, line 4.

why DRA's analysis of TPRs is wrong (see Exhibit SDG&E-256/SCG -246, Prepared Rebuttal Testimony of Steven Dais and Pat Moersen). My rebuttal testimony will address DRA's arbitrary adjustment to the FNS rate for Gas Mains.

DRA's own testimony begins its discussion by generally defining the term "depreciation."[9] DRA also acknowledges the appropriateness of conducting a depreciation study under the guidelines described in the Commission's Standard Practice U-4, *Determination of Straight-Line Remaining Life Depreciation Accruals*.[10] While DRA contends that SCG has collected sufficient funds in current rates for future cost of removal, DRA does not actually take issue with the FNS rates produced in the SCG depreciation study. As my prepared direct testimony stated, the FNS rates for particular assets are based on a determination of salvage and the cost of removal as a percentage of the cost of the retired property. The techniques used in deriving a FNS rate depend on the type of property, available data, and analysis of both historical and possible future factors that can impact the asset. Thus, the appropriate FNS rate for the largest plant account is not zero--given the relevant data, that is simply impossible.

An appropriate FNS rate allows the utility to accrue an amount for future cost of removal in an equitable manner. The generation of customers for whom a particular asset was used to provide service should be the generation from whom the costs of removing that asset is collected. This is the principle of intergenerational equity, and the manner in which SCG's depreciation study, under the guidelines of Standard Practice U-4, collects future removal costs through a FNS rate, adheres to intergenerational equity. DRA's proposal is contrary to that principle, and in fact has no basis in depreciation principles in general. To its credit, DRA does not attempt to mask its cost cutting motives through a lengthy discussion about depreciation concepts and

[9] Exhibit DRA-36-Kanter, page 4, lines 21-28.
[10] Exhibit DRA-36-Kanter, page 5, lines 1-2.

superior depreciation study techniques (as TURN does). DRA is upfront and transparent about its intentions to reduce depreciation expense by an amount it feels is justified, and has simply chosen one of SCG's largest plant account balances to make that adjustment. Unfortunately, DRA's method is not supported by the Commission's principles upon which FNS rates are prepared, reviewed, and where needed, adjusted.

While non-regulated industries can pass these net salvage costs along to customers at the time of their choosing, regulated industries are generally required to follow the principle of intergenerational equity. This principle dictates that customers pay only for the ultimate plant and removal costs, netted against any salvage value, for the assets that provide them with service. Any method that charges ratepayers for current-period or recent-period net salvage cost is charging for removal of assets that may have provided service for the previous 20 to 60 years. Newer customers would be paying for the removal of assets they either never used, or possibly used briefly in a diminished state of reliability or capacity at the end of the asset life.

In the same light, any attempt to offset and/or camouflage current costs to benefit the current ratepayer at the expense of the future ratepayer is contrary to that same intergenerational equity concept. Any deferral of accruals until after asset retirement is also contrary to the straight-line method. The straight-line remaining life methodology used by SDG&E, as outlined in the CPUC Standard Practice U-4, produces a depreciation rate that charges ratepayers a pro rata portion of the total front-end and back-end capital costs over the asset's useful life. The ratepayer pays this annual charge as the asset's usefulness is being consumed, and is credited for these payments in the form of a rate base reduction of an equal amount.

Therefore, because DRA does not in principle dispute the FNS rate proposed for Gas Mains, which is fully supported by SCG's depreciation study, it should be adopted as a reasonable 2012 forecasted rate for this plant account.

III. REBUTTAL TO TURN

Upon reviewing TURN's testimony, SCG finds no signs that their understanding of depreciation concepts, or its prescribed method of how it would have conducted the study or analyzed its results, produce more reliable or reasonable results than those presented by SCG. Furthermore, unlike TURN's analysis, SCG's depreciation study is supported by a witness with 35 years of utility experience, including experience physically installing some of the types of assets that are analyzed in the depreciation study. If the merits of TURN's proposals ultimately come down to which witness is more credible and exhibits the better judgment, SCG would contend that its own witness should be given the benefit of the doubt. DRA has reviewed the same case TURN has, and not only affirmed SCG's use of Standard Practice U-4 but the ASLs and 26-of-27 FNS rates produced from SCG's study (arguably all 27), TURN's criticisms about the quality of that study, or the manner in which judgment was applied, are without merit. With this, we specifically address TURN's proposed adjustments to ASLs and FNS rates.

A. ASLs

1. <u>Overview</u>

TURN opines that certain accounts in the SCG service life analysis using the SPR method fails basic statistical tests, and thus are not sufficient to support any life changes, or the changes proposed. DRA's analysis does not support TURN's conclusion, since DRA reviewed the same ASLs detail and accepted all of SCG's proposed lives. TURN relies on the Index of Variation Grading system to measure "goodness of fit" between actual and calculated balances, and proceeds to discount, challenge, and dismiss proposed changes for any recommendation of a curve and service life for accounts achieving a "poor" grade. The scale used to support the Index of Variation Grading System was developed for a presentation by Alex Bauhan[11] in April 1947. Mr. Bauhan used the experience of his company's data, performing a limited number of hand computations with a limited number of data points for the subject accounts. The calculation-intensive simulation procedure did not enter common usage until the advent of digital computers.[12] There is now much more experience on analyzing depreciation data, and advancements in this field, rendering Mr. Bauhan's "value" method used more as a resource for reference and general guidance. The National Association of Regulatory Utility Commissioners ("NARUC") published a manual entitled, "Public Utility Depreciation Practices"[13] which references the early conformance index ("CI") and the "…arbitrary scale for the CI proposed by Bauhan."

The most common reason for a high index of variation is a changing ASL within the account over time,[14] which of course, underscores SCG's proposed changes to several ASLs in its study. There is also a matter of data availability. If large amounts of the best available data for an account do not yield highly rated results, the solution is not to ignore the results, but to use them as one measure of life and Iowa curve suitability, and to closely monitor trends for the account. SCG used the same SPR Balances method in its 2004 Cost of Service filing and its 2008 GRC filing. The same test band length was consistently used but now with a longer history

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[11] Attachment 3, Life Analysis of Utility Plant….Method, Alex E. Bauhan, April 8, 1947.
[12] NARUC "Public Utility Depreciation Practices," 1996, p. 96. Perhaps the most widely used computer program for this purpose, and the one used by SCG, was developed at the Iowa State University Engineering Research Institute by Dr. Ronald E. White and Dr. Harold A. Cowles, published in 1972.
[13] Attachment 4, NARUC "Public Utility Depreciation Practices," 1996, p. 99-102.
[14] This is a bit of a paradox. We might wish for better data that shows no change of average service lives to yield all good to excellent indices of variation, but if service lives never changed, we would likely have dispensed with filings and hearings on depreciation matters.

of transactions and newer data. Therefore, SCG now has arguably better data than the older data that supported currently authorized depreciation rates. Where clear changes were indicated, the changes are being proposed in this filing.

2. Specific Adjustments to ASLs

FERC Account G367 – Transmission Mains

TURN disputes SCG's proposed life of 57 years and Iowa curve R5 for Transmission Mains, and recommends 65 years and the R3 Iowa curve.[15] TURN claims its recommendation is based on the "statistical and other information obtained from Company personnel, and my experience and judgment."[16] SDG&E contends that TURN's ASL proposal does not represent a superior result, merely its own choice of one of all possible outcomes. However, TURN has not explained any a reasoned judgment or knowledge of SCG's transmission mains underlying its proposal.

In the 2008 GRC's depreciation study, the Commission authorized a 55-year life and the R5 curve for SCG. In SCG's current depreciation study, the same Iowa curve now indicates a 57-year life, and continues to show that that same matching is even better than that authorized in 2008. Contrary to TURN's assertion that the term "superior" should be connected only to all their suggestions and statements, the truth is that there are many choices based on the SPR analysis. Relying only on the actual SPR analysis results, the choices identified by TURN and SCG both rate as "good" choices. But putting aside the Index of Variation grading method which TURN prefers, this 2-year change in life (i.e., 55 years to 57 years) is more reasonable than the 10-year life jump proposed by TURN (i.e., 55 years to 65 years). Further, TURN's

[15] TURN – Pous Testimony, September 22, 2011, page 13, line 20.
[16] TURN – Pous Testimony, September 22, 2011, page 12, lines 22-23.

judgment is not supported by PG&E's recently-authorized 45-year life for FERC account G367.[17]

From an operational perspective, SCG's proposed ASL is a more realistic representation of the status of Transmission Mains over the next few years. It's possible that gas utilities may undergo significant replacements due to efforts improving the safety and reliability of their transmission systems, rather than quick fixes, which TURN envisions. SCG still has a great deal of older service pipe in their service territory and each FERC account's ASL should be viewed knowing that current mix of the plant assets that are providing service for the current ratepayer. The ASL should be a reflection of that mix. Recorded history shows, as the mix within any account changes, the ASL will then reflect that changing environment. This Plant account is now showing an ASL of 57 years.

<u>FERC Account G376 – Distribution Mains</u>

TURN disputes SCG's proposed life of 55 years and Iowa curve R4 for Distribution Mains and recommends 66 years and the R2.5 Iowa curve.[18] TURN's rationale is the same one presented for Transmission Mains.

SCG simply notes that in the 2008 GRC, no party (including TURN) challenged SCG's proposed ASL and Iowa curves. The life was authorized at 53 years and the curve selected was R4. In the current depreciation study, the same Iowa curve now indicates a 55-year life. An increase of ASL in the 2-year range (four historical years passing) is a more reasonable and supportable change in life than a dramatic 13-year jump proposed by TURN. PG&E was

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[17] Attachment 5, CPUC Notification, PG&E, May 2011, page 18.
[18] TURN – Pous Testimony, September 22, 2011, page 16, line 12.

recently authorized a 53-year life for FERC account G376,[19] which is more in line with the SCG proposal.

From an operational perspective, TURN believes SCG's ASL proposal is too short "given that the majority of the current investment in the account is not subject to the same problems that older steel pipe and early generation plastic pipe were subject to."[20] This SCG depreciation witness has had experience replacing some of the oldest pipe in SCG's service territory and offers that very early plastic pipe and the stainless steel risers have experienced failure after only a few years. The early plastic service and distribution pipe harden and became brittle, which caused early replacement. SCG continues to monitor for leakage and safety for all its pipelines for its distribution and transmission system. Although there have been large installations of plastic main and services the last 30 years, there are still many steel mains being installed with continuing monitoring of the older existing bare steel mains, wrapped steel mains, and older plastic mains.

Knowing that SCG still has a great deal of older pipe in their service territory susceptible to corrosion, there are many other reasons for pipe retirement: such as relocations; outside party damage; changes in gas volume (customer needs) which may require pipe replaced for a larger size, installation, and removal of gas valves; and accessibility based on new construction. It's possible that gas utilities may undergo significant replacements due to efforts improving the safety and reliability of their distribution systems, rather than quick fixes, which TURN envisions. As one proposes an ASL for this account, the focus should be on the proper allocation of ratepayer costs (current and future) based on the current mix of the plant assets. The ASL

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[19] Attachment 5, CPUC Notification, PG&E, May 2011, page 19.
[20] TURN – Pous Testimony, September 22, 2011, page 18, lines 7-9.

should be a reflection of that mix. Recorded history shows, as the mix within any account changes, the ASL will then reflect that changing environment.

G380 – Distribution Services

TURN disputes SCG's proposed life of 51 years and Iowa curve L2 for Distribution Services and recommends 56 years and the S0.5 Iowa curve.[21] TURN's rationale is the same as presented for the earlier accounts.

In the 2008 GRC, no party (including TURN) challenged SCG's proposed ASL and Iowa curves. The life was authorized at 48 years and the curve selected was L2. In the current depreciation study, the same Iowa curve now indicates a 51-year life. An increase of ASL in the 3-year range (four historical years passing) is a more reasonable and supportable change in life than a dramatic 8-year jump proposed by TURN. PG&E was recently authorized a 53-year life for FERC Account G380,[22] which is more in line with SCG's proposal.

From an operational perspective, much of why TURN's proposals lack merit directly pertains to its shortcomings in analyzing Distribution Mains. While TURN suggests a change-out in FERC G376 to plastic, TURN identifies the existence of steel and copper for services FERC G380. My field experience suggests when there is a copper service the main is comprised of steel. Likewise when a steel service exists, more than likely a steel main supports that infrastructure. There are many copper, steel, and even plastic services (dependent on date of installation) that would all be replaced as plastic mains are installed, replacing any older steel main. Even the original plastic services installed years ago through insertion can be suspect as leakage surveys try to pinpoint leaks possibly traveling in the original service casing that was utilized during that installation.

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[21] TURN – Pous Testimony, September 22, 2011, page 20, line 4.
[22] Attachment 5, CPUC Notification, PG&E, May 2011, page 19.

As explained earlier, SCG still has a great deal of older service pipe in their service territory. Each FERC account's ASL should represent the current mix of the plant assets that are providing service for the current ratepayer. The ASL should be a reflection of that mix. Recorded history shows, as the mix within any account changes, the ASL will then reflect that changing environment.

G390 – Structures and Improvements

TURN disputes SCG's proposal to retain its currently-authorized ASL of 20 years and recommends a minimum of 30 years.[23]

SCG has facilities that both serve customers and support their employees. Some of these structures are leased over their lifetimes while others are owned. These properties comprise of many major units which are expected to be retired at one time as a single unit. Thus the life of a plant addition, even if the addition is made many years after the structure's original in-service date, must be the same as the structure. In cases of a leased facility which has a fixed contract term, these additions would not extend the life of the structure but instead, must be based on the structure's leased period. While these structures are occupied and used, additions, re-builds, remodels, and essential upgrades-are incurred to meet operating and/or statutory requirements. Analysis of Account 390 reveals that replacement activity of those same upgrades will often occur well within a 20-year period. Interim retirements will also have an effect on a structure's remaining life.

For leased facilities, it is imperative that costs associated with a lease be recouped during the contract term to correctly allocate cost to ratepayers receiving service. Given that SCG's largest leased facility has been 20 years (new 15-year term in 2012) , and the replacement

[23] TURN – Pous Testimony, September 22, 2011, page 22, lines 3-4.

activity for Account 390 is often less than 20 years, SCG continues to recommend a 20-year service life for this account. SCG disagrees with TURN's recommendation to extend the life of this account to 30 years. Extending the life of this account would unfairly defer costs to future ratepayers when accounting data points to an average service life substantially less than 30 years.

The Forecast Method or Life Span Method was used for determining remaining life of Account 390. This method is outlined in Standard Practice U-4. SCG's workpapers show how the remaining life and average service life are calculated.[24]

Given that replacements often occur within a 20-year period or less and leased facilities are 20 years or less, SCG' recommended average service life of 20 years is appropriate. To extend these costs beyond a 20-year life for this account will again disadvantage future ratepayers at the expense of a short-term gain to current ratepayers.

B. FNS Rates

1. Overview

In general, as infrastructure lives increase, there will also be a corresponding increase in the FNS. All the California investor-owned utilities are experiencing that the ASLs their infrastructure are increasing and the net salvage indicated by past retirement is becoming less positive and more negative. Even DRA acknowledges: "The prevailing trend in the energy industry is towards higher net salvage rates."[25] Like the other California utilities, SCG faces challenges to adhere to a systematic and completely uniform analysis of net salvage rates across all asset classes when the actual perceivable circumstances, such as constraints to removal costs and the total absence of positive salvage due to the age of the replaced asset, can vary significantly for each and every FERC account. The effect of lengthening infrastructure lives

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[24] Exhibit SCG-27-WP-R, Volume 2, BW-WP-296 thru BW-WP-307.
[25] Exhibit DRA-36-Kanter, page 6, lines 9-10.

adds additional challenges and will continue to do so going forward, as the plant accounts age and the older units are retired.

There are times when the transactions on individual projects and work orders may not be recorded in the same year.[26] Analyzing the data can help to mitigate differences between adjacent years, and there should be added scrutiny for the earliest and latest years. Typically, salvage and cost of removal analysis merely entails the calculation of salvage and cost of removal factors expressed as a percentage of the original cost of the retirements. Data explaining the past many times comes from the accounting records while the future focus would result from discussions with engineering, operating and planning personnel who are in tune with issues generating the activity. Because of technological and environmental constraints, the ability to capture positive salvage and/or reuse value from retired assets is becoming a thing of the past. Actually, the opposite occurs when disposing costs have now entered more often into the equation as an additional cost of removal consideration (i.e., wood poles, asbestos on pipe, PCBs in transformers, computer equipment environmental handling, and the rising dump costs for the miscellaneous items removed in the field).

The practice used by SCG to abandon many infrastructure assets as opposed to actual removal of the asset in certain situations has been the subject of increased scrutiny in light of the recent concerns over pipeline integrity and safety. SCG is experiencing more situations on past abandoned pipelines that require present day physical removal never envisioned. This accelerating situation requires that the FNS rates need to capture these anticipated removal costs, which may not present themselves in the recorded history used in these FNS studies. Logically,

[26] Attachment 4 (NARUC) at 159. See also Attachment 6 (response to TURN-SCG-DR-18, Q1).

these need to be part of the evaluation and judgment considerations so that intergenerational factors are addressed, and that both the value and cost are assigned to the appropriate ratepayer.

2. Specific Adjustments to FNS Rates

FERC 352 – UGS Wells

SCG proposes to reduce its currently-authorized FNS rate of -60% to -45%, whereas TURN proposes -30%. TURN claims SCG's rate is excessively negative, but fails to give proper weight to SCG's own reduction in FNS rate (i.e., less negative) when assets on whole are experiencing a trend towards more negative FNS.

During normal operations, wells have experienced the combined effect of corrosion, erosion, and the effects of temperature variation and pressure which then results in costly replacement. A 35% increase in capital well work during 2011 and 2012 has been forecast in this 2012 GRC.[27] There have been some other dramatic changes to the net salvage costs (gross salvage less removal) for wells. Gross salvage is almost negligible now for retired and removed well equipment. There has been a significant decrease of reusable materials, because reusing removed older casings, inner strings, and rebuilt valves has proven more costly and less reliable than anticipated, resulting in the disposal of those items rather than reuse due to the safety and reliability risk. Removing the previous gross salvage impact from the current 15-year picture increases the negative net salvage to -49% for the full 15-year historical period.

In the 2008 GRC, SCG was authorized a -60% FNS rate. In the current depreciation study, the full 15-year historical picture for FERC account G352 is showing a -47%.[28] There were quite a few projects undertaken in the years 1991 through 1994 which displayed high removal costs. These years are eliminated in the current 15-year historical study affecting the

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[27] Exhibit SCG-04-R, Revised Prepared Direct Testimony of James D. Mansdorfer, page JDM-21.
[28] Exhibit SCG-27-WP-R, BW-WP-333.

current FNS numbers. During the last four years, this plant account has experienced -56% in FNS. Because of an appearance of a slight downward trend, SCG's proposal of -45% reasonably factors this into the FNS rate. TURN's recommendation is unreasonably low and does not reflect superior judgment.

FERC 367 – Transmission Mains

SCG proposes to increase its currently-authorized FNS rate of -20% to -30%, whereas TURN proposes -20%. TURN attempts to weave in an "economies of scale" rationale as well as its own TPR theory to buttress its argument against SCG's proposed change in the FNS rate.[29] However, TURN's own "economies of scale" analysis, which it claims is based on "common sense" and the "NARUC Depreciation Manual," does not even support its -20% FNS rate, but instead yields a -24% rate. TURN therefore exercises its judgment to arrive at -20%.

NARUC discusses the fact that as work orders are used by utilities, one would expect that both the retirements and removal costs would be recorded in the same period/year. But NARUC states, "[i]t is cautioned, however, that this is frequently not the case, with the result being that plant retirements are recorded in one time period and the associated gross salvage and cost of removal are recorded in a different time period. The impact of this timing mismatch can be largely negated by analyzing a band of years."[30] This becomes apparent especially with the larger work order analyses as experienced first-hand by this witness in previous roles at SCG, first as a work order analyst and then as a major construction work order supervisor. SCG restates and affirms the logic of NARUC in its own definition of "time synchronization."[31]

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[29] TURN – Pous Testimony, September 22, 2011, pages 31-33.
[30] Attachment 4 (NARUC) at 158 - 159.
[31] Attachment 6.

In SCG's depreciation study, which used 15-year historical FNS analysis as a starting point, not only is there a better pattern emerging which suggests a more negative FNS rate, but there are the real world circumstances that the recent transmission pipeline integrity and safety efforts to be undertaken at SCG could accelerate more retirements with additional higher levels of removal. The pattern (or band) over just the recent six years is trending higher at -55%, as compared to the full 15-year historical study at around -48%. SCG is aware that its estimated FNS rate of -30% may not prove to be adequate for this particular account, given the possible scope of the work SCG could be required to undertake on Transmission Mains. SCG's proposed FNS rate of -30% is conservative and should be adopted.

<u>FERC 376 – Distribution Mains</u>

SCG proposes to decrease its currently-authorized FNS rate of -60% to -55%,[32] whereas TURN proposes -40%. TURN is absolutely correct that the last four (4) years were inadvertently represented as being "slightly above" the proposed rate of -55%. This should have stated "slightly below" because this downward trend was incorporated, and rightly so, in the actual analysis undertaken to arrive at the reduced proposed FNS % for the 2012 GRC. SCG apologizes for the misstatement and the time spent by TURN in having to address this specific testimony error.

With this correction noted, the current 15-year historical FNS study suggests a -65% FNS rate.[33] As stated above, SCG reviewed the test band that TURN used in its proposal (i.e., the 4-year band). For comparison, the 6-year band (same time period band as viewed in FERC

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[32] TURN's analysis reveals a typographical error in SCG's testimony, which should be corrected. On page BW-15 of its Revised Prepared Direct Testimony (Exhibit SCG-27-R), SCG indicates that the last four years were represented as being "slightly above -55% for negative net salvage."[32] That statement should have said "slightly below -55% for negative net salvage." SCG appreciates TURN's help in identifying this typographical error.

[33] Exhibit SCG-27-WP-R, BW-WP-345.

Account G367) shows a downward trend to the -52% level. Other factors to consider are the (i) one-time large gross salvage entry in 2000 that will never be reflected in the future (as there is a minimal gross salvage market for removed pipeline, older plastic, and retired valves, only disposal costs), (ii) the increase costs associated with actual removal for pipelines rather than abandonment not currently reflected within the FNS study, and (iii) the reflection in the current year of FNS % at -55%. These are presented here for a total picture, and not to suggest each be viewed as separately affecting the selected FNS rate for this account.

For both transmission and distribution pipe, retirements will consist of a physical removal and not abandonment more in line with the renewed focus at the utility and the Commission on ensuring pipeline location, integrity, and safety. This accelerating situation would suggest that the FNS rates need to capture these anticipated future removal costs on current plant assets, a fact that doesn't fully present itself in the recorded history used in these FNS studies. These factors are considered in SCG's depreciation FNS proposals, but are lacking or given little weight in TURN's analysis. Only one of the four years that show an FNS percentage less than the TURN recommended -40% reflects a rate below -30%. The three (3) remaining years average -38%. However, the more relevant analysis shows that 11 of the 15 years reflect a simple -78% average FNS rate, which is significantly greater than the -55% proposed by SCG. The actual full 15-year view of -65% likewise supports the conservative SCG proposal of -55%. Recently, PG&E was authorized a -52% FNS rate for this same FERC Account.[34] It goes against common sense to allow 4 years of history to override the other pertinent years in the full 15-year FNS study by recommending anything below the SCG proposed FNS rate.

[34] Attachment 5, CPUC Notification, PG&E, May 2011, page 19.

FERC 378 – Distribution M&R Equipment

SCG proposes to decrease its currently-authorized FNS rate of -100% to -85%, whereas TURN proposes -35%. One of TURN's main reasons for its significant adjustment is its TPR proposal, which SCG addresses in Exhibit SDG&E-256/SCG-246. Given that TURN's TPR analysis lacks credibility, its proposed FNS rate also lacks credibility, and should be rejected. Further, TURN continues to employ the "economies of scale" argument used elsewhere by basing its recommendation on a couple of specific years rather than a longer span, such as the 15-year's worth of data made available by SCG, which show that 12 of the 15 years of historical data have individual FNS rates beyond the -85% proposed by SCG. In contrast, SCG has reflected a reasonable adjustment in its FNS rate that will lower depreciation expense.

FERC 391.2 Computer Equipment

SCG proposes to keep the currently-authorized 0% FNS rate as authorized, whereas TURN proposes +2%. TURN correctly points out that SCG has adjusted its FNS 15-year historical picture to remove an error made, which now results in a +2.02% FNS rate as compared to the previous +1.72% FNS rate. Possibly considered a dramatic change by TURN, but when SCG recommends and/or proposes FNS percentages, they typically move in 5% increments up and down (one exception being situations that are dramatic like decommissioning events that must capture future costs over time for the final costly decommissioning). Even with this correction, SCG would have and still does recommend a 0% FNS rate.

Gross salvage for computer equipment is becoming a thing of the past and the majority is now disposed as an environmental hazard, not positive gross salvage. As an example, the 15-year historical data for FERC Account G391.2 shows $3.3 million in gross salvage for the year 1998, but a declining trend since then. This reflects the current trend away from re-using parts where technological advances render computer hardware obsolete and unusable. SCG's proposed FNS rate accounts for this reality, whereas TURN's proposal does not reflect this consideration. The error which TURN alludes to was addressed by SCG in a data request, which TURN cites; however, it amounts to less than one-half of one percent (+0.5%) adjustment for FERC Account 391.2.

C. Additional Reporting Requirements

TURN challenges SCG's reporting of third party reimbursements claiming that the creation of a historical database for net salvage purposes "results in artificial and excessive levels of negative net salvage." TURN then recommends a revision of SCG's historical database in the manner outlined in its testimony. As explained in the Dais/Moersen testimony, SCG properly accounts for its third party reimbursements and follows both FERC and NARUC guidelines. Therefore, TURN's recommendation lacks justification. Further, SCG evaluates exactly what TURN proposes, and finds it overly burdensome and impractical, and not likely to lead to any improvements, better results, or value.

In the last GRC, TURN, through a different depreciation witness/consultant, attacked SCG's treatment of asset retirement obligations ("AROs"), contending the need existed for additional reporting. DRA as well claimed that additional reporting of SCG's removal costs was necessary. SCG objected, explaining why that additional reporting was not warranted. However, the additional reporting requirements were made part of the GRC settlement. As part of this current GRC, SCG performed the requisite analyses and provided over 200 pages of workpapers to fulfill the additional reporting requirements. Yet, neither TURN nor DRA provides any indication that this compliance study was considered or even consulted. In the end, this burdensome, resource-intensive effort added no value to the process.[35] Thus, there is no need to continue this same compliance item as part of its GRC.

TURN's proposal to have SCG revise its historical database in the manner it prescribes has the same undertones as when it decried the inadequacies of SCG's ARO reporting, however it entails a much more burdensome, costly, and impractical effort which again will provide no value to the process. To illustrate TURN's recommendation, TURN would require that for FERC Account G380, SCG separate and individually study the recorded assets as:

- Plastic before 1975
- Plastic during 1976-1995
- Plastic after 1995
- Plastic pipe with glued fittings
- Plastic pipe with fused fittings
- Plastic pipe inserted in casing
- Different manufacturers of plastic pipe
- Bare steel before 1975
- Wrapped steel between 1976-1995
- Wrapped steel after 1995
- Copper services

[35] See D.08-07-046 (mimeo) p. 27 and Ordering Paragraph 26. SCG's compliance showing in this GRC provides the following: (1) presentation of the then-current balance of pre-funded removal costs; (2) year-by-year projection of (a) when the then-existing balance of pre-funded removal costs will be consumed, and (b) the implicit inflation rate for future asset removal costs; (3) five-year projection of the year-end balance of pre-funded removal costs, showing for each year the gross additions to the balance, gross expenditures for removal costs, and the net change in the balance of pre-funded removal costs; (4) study for presentation in the next general rate cases that will separate the accrual for cost of removal from accruals for depreciation expense; and (5) establish a regulatory liability for ratemaking purposes.

This level of detail would then be required of all plant accounts, and then used to derive individual FNS rates for each subset of assets. Undertaking this extraordinary effort for one plant account, TURN would recommend this be done for all of SCG's plant accounts, then have utilities derive FNS rates for each category instead of on a total plant basis. This massive effort would nonetheless have to yield a composite FNS rate for each plant account, which is what SCG already does, as detailed in its current depreciation study. Actuarial studies and SPR studies, which SDG&E and SCG currently use, look at the current mix of assets and determine a rate that is appropriate for those assets. As that mix changes, the rate will experience change. That is truly what we see with the life extensions proposed by SCG. No matter how you breakout a utility plant account's assets, the composite cost to the ratepayer doesn't change. The current asset base is reality and the current actuarial and SPR detail demonstrates that reality. To create a rate that doesn't reflect the current mix of assets is illogical.

Because TURN presents no compelling or convincing evidence that SCG's methods for plant accounting are inaccurate or inadequate, TURN's proposal should be rejected in total.

IV. SUMMARY AND CONCLUSION

SCG's depreciation study is fully supported by its testimony and workpapers, and reflects the longstanding principles of Standard Practice U-4. SCG has produced ASL and FNS rates that are reasonable and based on sound judgment and knowledge of SCG's plant assets. DRA's analysis and acceptance of SCG's proposed ASLs demonstrates a better understanding of this than TURN's analysis, which does not produce more reasonable or informed results. In terms of the FNS adjustments, they are all predicated on a flawed interpretation of industry guidance, as demonstrated by SCG witnesses Dais and Moersen. As this testimony further demonstrates, the arbitrary nature of targeting a few plant accounts and proposing changes to the FNS rates to reduce depreciation expense produces FNS rates that are not equitable to ratepayers and do not properly or adequately fund the future removal costs for those particular plant assets. TURN's recommendation for changes in reporting and computing FNS also lacks justification, as it is predicated on its faulty TPR analysis.

This concludes my prepared rebuttal testimony.

ATTACHMENT 1

Calculation of Annual Depreciation Accrual Rate Calculation under

DRA's Future Net Salvage Rate Proposals

SOUTHERN CALIFORNIA GAS COMPANY
ANNUAL DEPRECIATION ACCRUAL RATE CALCULATION FOR 2012
STRAIGHT LINE REMAINING LIFE METHOD
BALANCES AS OF DECEMBER 31,2009
USING PROPOSED NET SALVAGE RATES AND REMAINING LIVES
(Thousands of Dollars)

			PROPOSED SALVAGE RATE				TOTAL					
		RECORDED	ESTIMATED FUTURE NET SALVAGE		RECORDED DEPRECIATION		SERVICE LIF	AVERAGE	TOTAL ANNUAL ACCRUAL			
ASSET CLASS	DESCRIPTION	GROSS PLANT AS OF 12/31/2009	%	AMOUNT	RESERVE AS OF 12/31/20	NET BALANCE	ORG GRP (YRS)	REMAIN LIFE (YRS)	ACCRUAL AMOUNT	ACCRUAL PERCENT	SB	SA
376	MAINS	2,900,223	(55)	(1,595,123)	1,661,627	2,833,719	55	36.3	78,064	2.69%		
376	MAINS	2,900,223	0	0	1,661,627	1,238,596	55	36.3	34,121	1.18%	43,943	53,573
											43,943	53,573
											========	========

ATTACHMENT 2

Calculation of Annual Depreciation Accrual Rate Calculation under

DRA/TURN’s Combined Future Net Salvage Rate Proposals

SOUTHERN CALIFORNIA GAS COMPANY
ANNUAL DEPRECIATION ACCRUAL RATE CALCULATION FOR 2012
STRAIGHT LINE REMAINING LIFE METHOD
BALANCES AS OF DECEMBER 31,2009
USING PROPOSED NET SALVAGE RATES AND REMAINING LIVES
(Thousands of Dollars)

ASSET CLASS	DESCRIPTION	RECORDED GROSS PLANT AS OF 12/31/2009	PROPOSED SALVAGE RATE ESTIMATED FUTURE NET SALVAGE %	AMOUNT	RECORDED DEPRECIATION RESERVE AS OF 12/31/20	NET BALANCE	TOTAL SERVICE LIFE ORG GRP (YRS)	AVERAGE REMAIN LIFE (YRS)	TOTAL ANNUAL ACCRUAL ACCRUAL AMOUNT	ACCRUAL PERCENT	SB	SA
352	WELLS	208,789	(45)	(93,955)	137,947	164,797	29	20.74	7,946	3.81%		
352	WELLS	208,789	(30)	(62,637)	137,947	133,479	29	20.74	6,436	3.08%	1,510	1,510
367	MAINS	1,038,369	(30)	(311,511)	499,279	850,600	57	39.1	21,777	2.10%		
367	MAINS	1,038,369	(20)	(207,674)	499,279	746,763	65	48.2	15,499	1.49%	6,277	6,800
376	MAINS	2,900,223	(55)	(1,595,123)	1,661,627	2,833,719	55	36.3	78,064	2.69%		
376	MAINS	2,900,223	0	0	1,661,627	1,238,596	66	48.7	25,459	0.88%	52,605	85,375
378	MEASURING & REGULATING EQI	63,601	(85)	(54,061)	44,755	72,907	31	18.9	3,862	6.07%		
378	MEASURING & REGULATING EQI	63,601	(35)	(22,260)	44,755	41,106	31	18.9	2,175	6.07%	1,687	1,687
380	SERVICES	1,993,603	(95)	(1,893,923)	1,603,812	2,283,715	51	34.9	65,455	3.28%		
380	SERVICES	1,993,603	(95)	(1,893,923)	1,603,812	2,283,715	56	44.4	51,389	2.58%	14,066	14,066
390.00	STRUCTURES & IMPROVEMENTS	118,411	(25)	(29,603)	104,325	43,688	20	2.9	15,013	12.68%		
390.00	STRUCTURES & IMPROVEMENTS	118,411	(25)	(29,603)	104,325	43,688	30	12.9	3,384	2.86%	11,629	11,629
391.20	COMPUTER EQUIPMENT	108,187	0	0	54,328	53,859	5	2.6	21,039	19.45%		
391.20	COMPUTER EQUIPMENT	108,187	2	2,164	54,328	51,695	5	2.6	19,883	18.38%	1,156	1,156
											88,930	122,223
											========	========

ATTACHMENT 3

Excerpt from

Life Analysis of Utility Plant for Depreciation Accounting Purposes by the Simulated Plant Record Method

Alex E. Bauhan

Life Analysis of Utility Plant for Depreciation Accounting Purposes by the Simulated Plant Record Method

by

Alex E. Bauhan

APPENDIX

Life Analysis of Utility Plant for Depreciation Accounting Purposes by the Simulated Plant-Record Method

By Alex. E. Bauhan

Chief Plant Accountant, Public Service Electric and Gas Co.

Presented at National Conference of Electric and Gas Utility Accountants, American Gas Association—Edison Electric Institute, Buffalo, N. Y., April 8, 1947.

Foreword

This paper deals with a trial and error method of discovering the mortality characteristics exhibited by utility-plant history, and is based on experience in a current extensive study. It is an elaboration of the "indicated survivors" method described in the 1943 report of the Committee on Depreciation of the National Association of Railroad and Utilities Commissioners. In any depreciation accounting policy which gives heed to experienced plant-mortality characteristics, the method of reading the past here presented is worthy of consideration; frequently there is no alternative to its use.

Present-day requirements in the matter of depreciation accounting for utilities quite often involve estimates of the average life of various classes of utility plant, but it is frequently not recognized that if depreciation accounting for a group of utility-plant units is related to the average life, it must also be related to the "mortality dispersion" of that plant. The manner in which the retirement dates of a group of related plant units, installed in a given year, distribute themselves in the years before and after the average age of retirement, i.e., mortality dispersion, has a marked effect on the theoretically required reserve under any group-depreciation-accrual plan associated with estimated average life.

Such a reserve determination is likely to be a greater misstatement due to hitherto common errors in estimating mortality dispersion than in estimating average life. A determination made in disregard of the dispersion of retirements, if it pretends to be associated with life of plant by the ordinary straight line or sinking fund plans of accrual, is without validity. The range between an alleged theoretical reserve requirement calculated without regard for mortality dispersion and one giving proper attention to it may be as much as two to one.

If necessary estimates of mortality dispersion as well as average life are to be drawn from past plant experience, methods of life analysis which tell us how the retirements of an installation "vintage" are distributed through the years, such as the here-described plant-record simulation method, are essential. The so-called turnover methods which undertake to discover average life directly from the relative behavior of year-by-year additions, retirements, and balances, and which, at least in their present stage of development, do not divulge mortality dispersion, are therefore of limited usefulness. By the application of actuarial principles, as used for life insurance purposes, information as to mortality dispersion as well as average life is usually obtainable, and this is the method commonly used.[1] But the actuarial method, which requires a knowledge of the installation date of each item of retired and surviving plant, is frequently not available because installation dates are not obtainable or because the labor of discovering them in addition to that involved in the pursuit of the method is too great. Fortunately, in such cases, not to mention other reasons why the method might be preferred, the desired results can be generally obtained, if at all obtainable, by what has been called the "indicated survivors method," but which is here designated as the "simulated-plant-record method" with a broader implication to be explained later.

This paper undertakes to explain that method, along with various essential improvements developed in connection with its application to an actual extensive analysis of electric and gas plant. With some background mention of the phenomenon of utility-plant-mortality dispersion, the paper not only states the principles involved in the simulated plant-record method, but gives some of the details of computation procedure which have been found helpful. It further presents indices by which the trustworthiness of the results can be judged and correctly interpreted.

Mortality Dispersion

The underlying theory of the simulated plant-record methods depends on a concept of each year's additions, followed by the characteristic year-by-year retirement of those additions. Records in either monetary units or physical units may be thought of, but ordinarily only monetary records are adequately available in practice. The year-by-year retirements of the plant additions made in a particular year have been found to be distributed usually in some such manner as is illustrated by the bar diagram marked "Annual Retirements" in Figure 1.[2] A smooth curve connecting the ends of the bars would be the retirements-frequency-distribution curve. This diagram represents the phenomenon of mortality dispersion, recognition of which is so essential to any proper consideration of group-plant depreciation.

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[1] See *An Appraisal of Methods for Estimating Service Lives of Utility Properties*, prepared by cooperating committees on depreciation, American Gas Association—Edison Electric Institute, 1942.
Also, Report of Committee on Depreciation, National Association of Railroad and Utilities Commissioners, 1943.

[2] *Life Expectancy of Physical Property Based on Mortality Laws* by Edwin B. Kurtz, Ronald Press, 1930.
The Science of Valuation and Depreciation by Edwin B. Kurtz, Ronald Press, 1937.

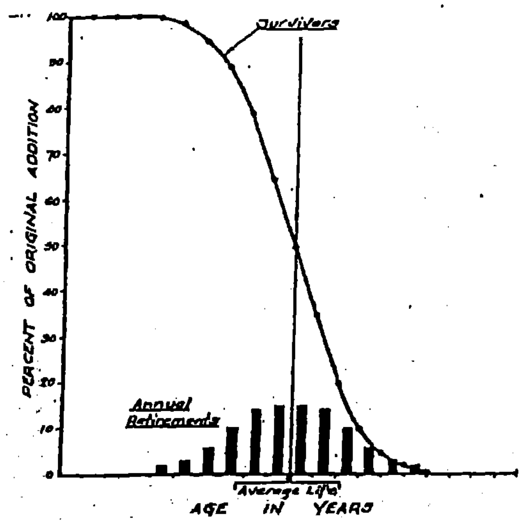

Fig. 1—Mortality Dispersion is illustrated by bar diagram marked "Annual Retirements." It shows how retirements of a single installation of a multiplicity of related plant units typically occur at ages earlier than and later than average life. If the annual retirements are successively subtracted from the original installation, the upper curve of "Survivors" is obtained

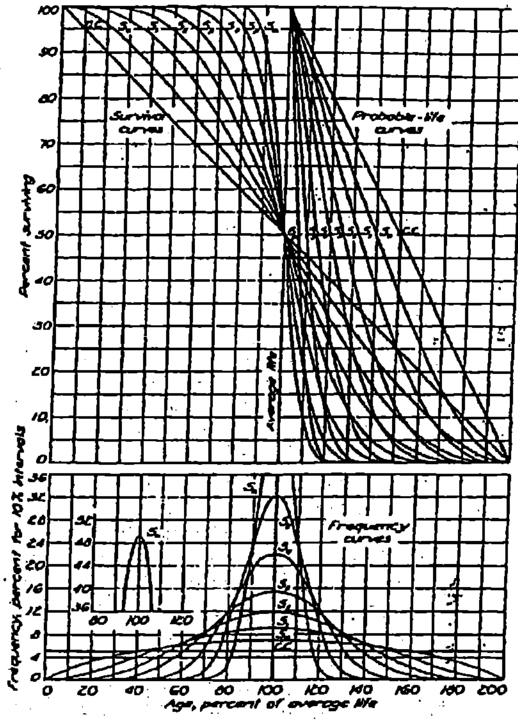

Fig. 2—Curves for Symmetrical Mortality Dispersion

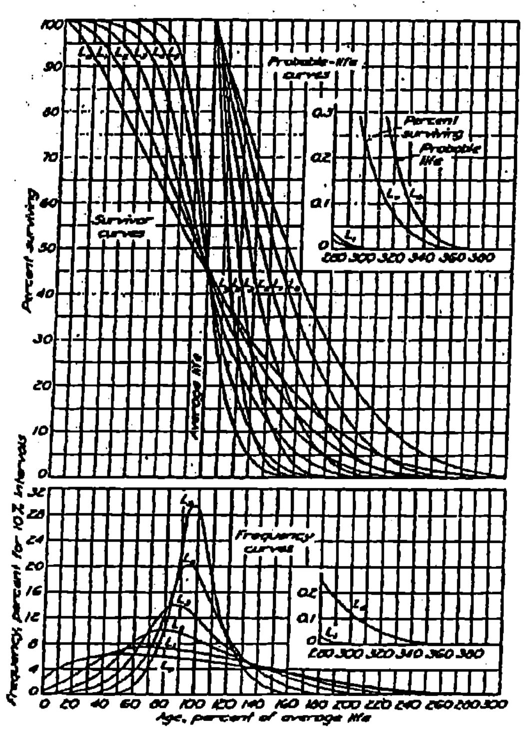

Fig. 3—Curves for Left-Moded Mortality Dispersion

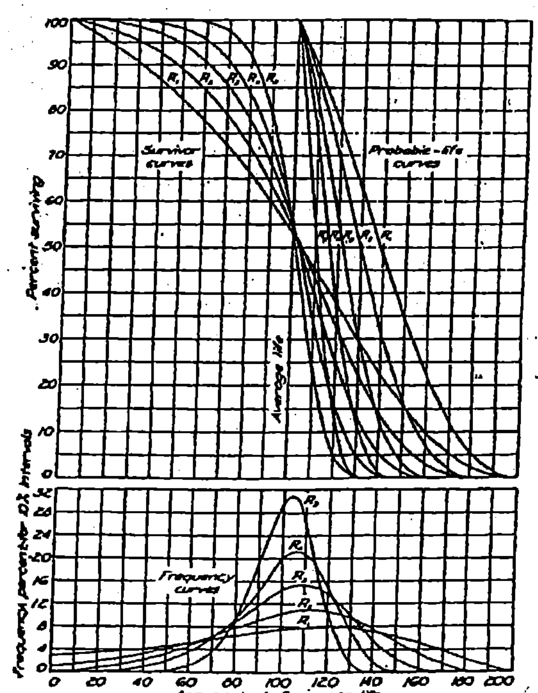

Fig. 4—Curves for Right-Moded Mortality Dispersion

The upper curve marked "Survivors" is obtained by subtracting from the original additions the accumulated annual retirements as obtained by adding the year-by-year values of the "Annual Retirements" curve. For any year, it shows how much of those original additions remain. In generalized form the annual retirements and survivors are expressed in per cent of the original additions for the various percentages of average life.

Several families of generalized mortality dispersions have been developed. The most generally known and used are those published by the Iowa Engineering Experiment Station, frequently called the Iowa type curves.[3] They are reproduced in Figures 2, 3, and 4. The standardized types developed by Lawrence S. Patterson, of the New York State Department of Public Service, have been reported in the NARUC Depreciation Committee 1943 Report. Some of these extend into a range of extremely wide dispersions not covered by the Iowa types and are therefore particularly useful in utility work. Recently a family of left-moded generalized dispersion types, based on the normal probability distribution truncated at the left and adjusted to unit area, has been introduced by C. Beverley Benson of the New York State Department of Public Service.[4] Individual companies and consultants have also developed dispersion types based on their own experience.

Recognition of mortality dispersion and use of standardized types facilitate an understanding of the methods by which average life and mortality dispersion are deduced from the records of annual plant additions, retirements, and balances. Pictures of successive years' additions with their respective retirements can be imagined as overlapped to give a composite of annual retirements which is a function of the succession of known additions of previous years and of the imagined or assumed average life and mortality dispersion. Alternatively or supplementally, the concept may be the survivors of each year's additions. (Such survivors, of course, being the original addition less the accumulated year-by-year retirements associated with that addition.) In either case, the comparison of this imagined or assumed picture with the actual history of the account is the basis of simulated plant-record method of life analysis.

Principle of the Simulated Plant-Record Method

The principle of the method as applied to balances (survivors) is described in the 1943 report of the Committee on Depreciation of the National Association of Railroad and Utilities Commissioners, in which it is called the "indicated survivors method."[5] The designation "simulated plant-record method" as here used is offered as more appropriate for the reason that the principles of the method apply equally well and quite similarly to comparisons of calculated and actual periodic retirements and of calculated and actual accumulated retirements. Henry R. Whiton of Gulf States Power Co., Beaumont, Texas, has developed the retirement approach in an important practical application. There is no indication of any significant difference in the results between the simulated balances and the simulated retirements procedure. Applied to plant records having stable life and mortality dispersion characteristics, they yield identical answers. This writing will, however, describe the method in reference to only balances, but with appropriate changes in the quantities referred to, the description of the method as to retirements would follow along the same lines.

The essence of the simulated plant-record method is that an effort is made by trial and error to duplicate the year-by-year balances of the account by a series of corresponding calcul[ated] or "simulated," balances arising f[rom] the assumption that each year's act[ual] additions were retired in accordance with a selected pattern of average life and mortality dispersion. Successive pattern selections are tried until a pattern is found which results in a series of year-by-year calculated balances simulating the progression of actual balances as closely as possible. That best fitting pattern is deemed to represent the experienced average life and mortality dispersion of the account.

The method requires that the actual annual gross additions be known or estimated quite far back. (Fortunately, it operates in such a way that if there are errors in any estimate of small early additions, the result is not materially influenced thereby.)

The assumed patterns of average life and mortality dispersion are, in practice, selected from a set of precalculated tables based on some family of standardized dispersion types, such as the Iowa types. For a given average life, and for a given type of mortality dispersion, these tables show the per cent of a year's additions which su[r]vives in each succeeding year.

By multiplying the known additi[ons] of a particular year by the successive percentages shown in the selected survivors table, the balance which would result from that particular year's additions in each succeeding year, if the selected pattern of life and dispersion had operated, is obtained. Thus, for additions made in 1901 (assuming that 1901 is the first year of recorded additions), the amount surviving in each succeeding year up to the present is calculated. Similarly, for the additions made in 1902, the survivors of each succeeding year are calculated, and so on for each year's additions. The calculations can be recorded on a columnar sheet, such as is pictured in Figure 5, in which the additions of each year are listed in a column at the left. A column is provided for the survivors in each calendar year. Thus, by the aforementioned multiplication of a given year's additions by the surviving percentage for each succeeding year, each line can be filled in across the sheet. The sum of any survivors column on the sheet will then give the total calculated survivors a[s] of the year of the column headi[ng]. That sum of survivors, or simula[ted] balance, is compared with the actual

[3] "Depreciation of Group Properties," by Robley Winfrey. Bulletin 155, Iowa Engineering Experiment Station of Iowa State College of Agriculture and Mechanic Arts, 1942.

[4] As witness for Public Service Commission of the State of New York in Case No. 8858 concerning New York Water Service Corp. The same family appears in Case No. 12455 concerning Consolidated Edison Co.

[5] The NARUC report refers to the basic idea as it appears in an article by Cyrus G. Hill, "Depreciation of Telephone Plants," *Telephony*, Mar. 18 and 25, 1922. But Hill's procedure yields only average life or dispersion type, when the other of the two is known. As a solution for both variables it is indeterminate. The reason for this is that it uses only a single time of comparison between calculated and actual balances, rather than making the comparison over an extended term. The Hill procedure was used in testimony of company witness in New York State Public Service Commission Case 8230 re New York Telephone Co. and by C. Beverley Benson as commission witness in NYPSC Case 8490 re Syracuse Lighting Co., and in NYPSC Case 8403 re Queens Borough Gas and Electric Co. In the latter case, p. 3609 of testimony, and in State of Ohio Public Service Commission Cases 11001, 11218, and 11442 re East Ohio Gas Co. v. City of Cleveland, p. 38 of written testimony, Benson mentions the comparison of calculated with actual balances at more than one point of time. This is the essential fundamental feature of the method reported in this paper.

Additions		Survivors in % and in $											
Year	Amount	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912
1901	1 000	1 000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1902	1 000		1 000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1903	1 001			1 001	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1904	2 005				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1905	4 001					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1906	5 016						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1907	10 916							[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1908	8 056								[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1909	8 005									[illegible]	[illegible]	[illegible]	[illegible]
1910	5 116										[illegible]	[illegible]	[illegible]
1911	6 191											[illegible]	[illegible]
1912	6 212												[illegible]
1913	10 984												
1914	10 810												
1915	10 890												
1916	10 999												
1917	11 117												
1918	11 502												
1919	11 706												
1920	12 041												
1921	18 446												
1922	17 141												
1923	18 401												
1924	18 960												
1925	24 475												
1926	95 260												
1927	104 864												
1928	97 010												
1929	103 131												
1930	94 177												
1931	78 966												
1932	88 716												
1933	39 718												
1934	36 816												
1935	19 366												
1936	17 406												
1937	38 402												
1938	43 742												
1939	48 135												
1940	66 634												
Calculated Balances		1 000	1 990	2 997	4 993	9 287	14 971	24 048	28 816	34 864	38 913	44 704	48 811
Actual Balances		1 000	2 000	2 000	5 000	10 000	21 000	22 000	28 000	35 000	40 000	41 000	50 000

	21 Years Iowa S_1										
Year	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940
1901	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1902	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1903	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1904	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1905	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1906	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1907	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1908	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1909	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1910	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1911	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1912	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1913	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1914	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1915	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1916	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1917	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1918	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1919	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1920	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1921	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1922	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1923	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1924	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1925	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1926	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1927	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1928	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1929	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1930	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1931		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1932			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1933				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1934					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1935						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1936							[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1937								[illegible]	[illegible]	[illegible]	[illegible]
1938									[illegible]	[illegible]	[illegible]
1939										[illegible]	[illegible]
1940											[illegible]
Calculated Balances	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Actual Balances	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Each horizontal line is completed by multiplying the addition appearing in the first column by the successive percentages of the selected survivors table, in this case that for 21 years average life and mortality-dispersion type Iowa S_1. The totals of the vertical columns are the calculated balances simulating the actual balances. The computation is repeated with various patterns of life and mortality dispersion until the simulation is as close as possible.

This form is for illustrative purposes only. In actual practice the calculation is simplified. (See Figure 1.)

Fig. 5—Illustrative Computation of Simulated Balances

balance for the corresponding year.

If the simulated balances for an extended number of years duplicate the actual balance history, we know that the actual experience of the account reflects the assumed average life and assumed type of mortality dispersion. If this calculation does not duplicate the actual balances, the calculation must be repeated with a different assumed life or a different mortality dispersion or both. If the second calculation still does not duplicate the actual experience, another trial must be made, and so on.

The usual procedure has been to make this comparison graphically; that is, the curve of the actual balance is drawn on coordinate paper and the calculated results for each trial are plotted. When the plotted points for a particular trial fall closer to the actual line than for any other trial, that trial is said to represent the average life and mortality dispersion of the plant. However, this method is rather crude in that the distinction between the best fit and several inferior fits is frequently not discernible, and, of course, the judgment of the observer enters into such a determination. Deciding between two close fits is not, as might first be supposed, a matter of choosing between two average lives which are close to each other. The average lives of two close fits may be quite far apart. The reason for this will be apparent from later discussion of Multiple Indications.

A more precise and more objective comparison is by the use of the least squares method, which is commonly used for curve-fitting purposes. By this method, the year-by-year differences between the calculated and actual balances are observed; then, to accentuate the larger discrepancies, the differences are squared. The trial which shows the smallest sum of squared differences is deemed to be the best fit and to be indicative of the average life and mortality dispersion of the account.

The result of such a trial and error determination of the best fitting average life and mortality dispersion is illustrated in Figure 6, plant data for which were taken from the 1942 Report of the Depreciation Committees of the American Gas Association and the Edison Electric Institute for the purpose of comparing the results of the turnover methods of life analysis.

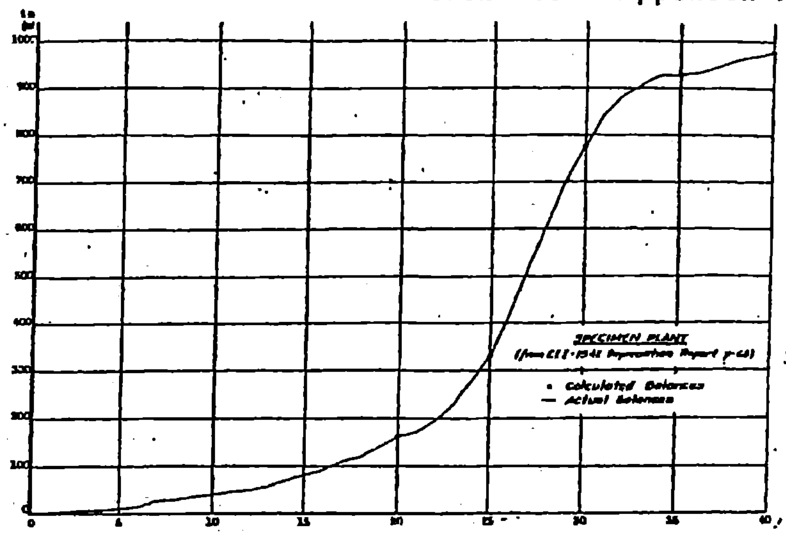

Fig. 6—Comparison of Calculated Balances and Actual Balances. Calculated values were computed from each year's additions on the assumption of a 20-year average life and mortality dispersion of type Iowa S1½. This assumption was found to give the best fit after about 50 trials of various lives and mortality-dispersion types.

In this case, after some 50 to 60 trials of various life and mortality dispersion patterns, by a calculator who was not informed as to the source or life characteristic of the data, the best fit was found to be an average life of 20 years with mortality dispersion of type Iowa S1½. Balance comparisons were made in only every fifth year of the last 20 years. Figure 6 shows that the calculated balances based on the 20-year S1½ assumption agree almost perfectly with the corresponding actual balances.

Survivors Tables

Before the simulated plant-record procedure is started there should be available not only a suitable statement of annual additions and balances for the plant under consideration but also, as stated earlier, a set of survivors tables—showing the per cent of plant installed in any year which survives at each age year — for each of the patterns of average life and mortality dispersion which are to be tested for fit with the plant record.

Figure 7 shows a page from a set of such tables based on the mortality-dispersion curves of the Iowa type. If use is to be made of the Iowa-type curves in any extensive study of utility-plant lives and dispersions, such survivors-per cent tables will be wanted for most of the 18 Iowa types of mortality dispersion for each average life in the range from approximately sev years to 60 years. The wider dispersi types will be needed up to 100 years At greater or fractional average lives tables can be drawn up as required. Several intermediate dispersion types will also be found necessary, e.g., type R1½, which may be taken as having survivors midway between R1 and R2, and L½, which lies between Lo and L1. Type GC of the Patterson family, reflecting a uniform dispersion of retirements, is likely to be required for the entire range of average lives. Type S-½, referring to a curve midway between So and Patterson GC, will be useful. As many hundreds of tables are required, the labor involved in their initial preparation is considerable. It would be helpful if suitable and generally acceptable tables for the many combinations of average life and mortality dispersion could be published.

The physical arrangement of the tables is important. In any extensive study it is out of the question, because of the labor involved, to rewrite the table on a computation form every time a computation is made. The tables should be written, photographed, o printed on stiff durable paper, or o plastic coated paper, and then cut into

EA23-PSE&GCo SURVIVORS TABLES for Iowa Dispersions in % of additions

Age Years	20 Lo	21 Lo	22 Lo	23 Lo	24 Lo	25 Lo	26 Lo	27 Lo
59.5	.3	.5	.9	1.4	2.0	2.8	3.6	4.6
58.5	.4	.6	1.0	1.6	2.3	3.1	4.0	5.1
57.5	.4	.8	1.2	1.9	2.6	3.5	4.5	5.6
56.5	.5	.9	1.5	2.2	3.0	3.9	5.0	6.2
55.5	.6	1.1	1.7	2.5	3.4	4.4	5.5	6.7
54.5	.8	1.3	2.0	2.8	3.8	4.9	6.1	7.4
53.5	1.0	1.6	2.3	3.2	4.3	5.4	6.7	8.1
52.5	1.2	1.9	2.7	3.7	4.8	6.0	7.4	8.8
51.5	1.4	2.2	3.1	4.2	5.3	6.7	8.1	9.6
50.5	1.7	2.5	3.5	4.7	6.0	7.4	8.9	10.4
49.5	2.0	3.0	4.0	5.2	6.6	8.1	9.7	11.3
48.5	2.4	3.4	4.6	5.9	7.4	8.9	10.6	12.2
47.5	2.8	3.9	5.2	6.6	8.1	9.8	11.5	13.2
46.5	3.2	4.4	5.8	7.3	9.0	10.7	12.4	14.2
45.5	3.8	5.1	6.5	8.2	9.8	11.6	13.5	15.3
44.5	4.3	5.7	7.3	9.0	10.8	12.7	14.5	16.4
43.5	5.0	6.5	8.2	10.0	11.8	13.7	15.7	17.6
42.5	5.7	7.3	9.1	11.0	12.9	14.9	16.9	18.9
41.5	6.4	8.2	10.1	12.0	14.0	16.1	18.1	20.2
40.5	7.3	9.2	11.1	13.2	15.3	17.4	19.5	21.5
39.5	8.2	10.2	12.3	14.4	16.5	18.7	20.8	22.9
38.5	9.2	11.3	13.5	15.7	17.9	20.1	22.3	24.4
37.5	10.3	12.5	14.7	17.0	19.3	21.5	23.8	25.9
36.5	11.5	13.8	16.1	18.5	20.8	23.1	25.3	27.5
35.5	12.8	15.2	17.6	20.0	22.3	24.6	26.9	29.1
34.5	14.2	16.6	19.1	21.5	23.9	26.3	28.5	30.8
33.5	15.6	18.2	20.7	23.2	25.6	28.0	30.3	32.5
32.5	17.2	19.8	22.4	24.9	27.4	29.8	32.0	34.3
31.5	18.9	21.5	24.2	26.7	29.2	31.6	33.9	36.1
30.5	20.6	23.3	26.0	28.6	31.1	33.5	35.8	38.0
29.5	22.5	25.3	28.0	30.6	33.0	35.4	37.7	39.9
28.5	24.4	27.3	30.0	32.6	35.1	37.4	39.7	41.8
27.5	26.5	29.3	32.0	34.7	37.1	39.5	41.7	43.8
26.5	28.7	31.5	34.2	36.8	39.2	41.6	43.8	45.8
25.5	30.9	33.8	36.5	39.0	41.4	43.7	45.9	47.9
24.5	33.2	36.1	38.8	41.3	43.7	45.9	48.0	50.0
23.5	35.7	38.5	41.2	43.6	46.0	48.2	50.2	52.2
22.5	38.2	41.0	43.6	46.0	48.3	50.4	52.5	54.3
21.5	40.8	43.5	46.1	48.5	50.7	52.8	54.7	56.5
20.5	43.5	46.1	48.6	50.9	53.1	55.1	57.0	58.7
19.5	46.2	48.8	51.2	53.5	55.6	57.5	59.3	61.0
18.5	49.0	51.5	53.9	56.0	58.0	59.9	61.6	63.2
17.5	51.9	54.3	56.6	58.6	60.6	62.3	64.0	65.5
16.5	54.8	57.2	59.3	61.3	63.1	64.8	66.4	67.8
15.5	57.8	60.0	62.1	63.9	65.7	67.3	68.8	70.1
14.5	60.8	62.9	64.8	66.6	68.2	69.8	71.1	72.4
13.5	63.9	65.8	67.7	69.3	70.8	72.2	73.5	74.7
12.5	67.0	68.8	70.5	72.0	73.4	74.7	75.9	77.0
11.5	70.1	71.8	73.3	74.7	76.0	77.2	78.3	79.3
10.5	73.2	74.7	76.2	77.4	78.6	79.7	80.7	81.6
9.5	76.3	77.7	79.0	80.1	81.2	82.2	83.1	83.9
8.5	79.4	80.7	81.8	82.8	83.7	84.6	85.4	86.1
7.5	82.5	83.6	84.5	85.4	86.2	86.9	87.6	88.2
6.5	85.5	86.4	87.2	87.9	88.6	89.2	89.8	90.3
5.5	88.4	89.1	89.8	90.4	90.9	91.4	91.8	92.2
4.5	91.1	91.7	92.2	92.7	93.1	93.4	93.8	94.1
3.5	93.7	94.1	94.5	94.8	95.1	95.4	95.6	95.8
2.5	96.0	96.3	96.5	96.7	96.9	97.1	97.2	97.4
1.5	98.0	98.1	98.2	98.3	98.4	98.5	98.6	98.7
0.5	99.4	99.5	99.5	99.5	99.5	99.6	99.6	99.6

Fig. 7—Specimen Survivors Tables. From sheets such as this, about 1,500 survivors-table strips are cut and used as additions multipliers to get simulated balances.

strips so that each strip will show the survivors percentages corresponding to each age-year for a particular pattern of average life and mortality dispersion. Survivors need not be shown for more than 55 or 60 years, if the dispersion extends beyond such an age, unless it is expected to work with plant histories which include a greater span of years. Assuming that the work sheets will show additions chronologically downward, and this is believed to be the best arrangement, the survivors-table strips should run upwards by ages and the line spacing should be identical with that on the work sheets. Thus, the survivors percentages can be used as multipliers of annual additions by simply laying the strip alongside of the additions column without the necessity of rewriting the survivors percentages.

The tables should show per cent survivors at mid-year intervals. This convention is desirable because, in order to facilitate calculation, it can be assumed that all the additions made at various times during a calendar year are equivalently represented by a single installation on July 1. The survivors of these additions may therefore be considered to be one-half year old at the end of the first year, 1½ years old at the end of the second year, etc. It follows that the survivors tables are properly set up at the half-year ages.

Orderly filing of the survivors table strips facilitates their use. A visible index cabinet, using a file pocket deep enough to carry the length of the strip (10 or 11 inches) and wide enough for 10 strips, with celluloid-holding strips at the top and bottom of the pocket, is one suggestion.

Term of Balance Comparisons

A decision which must be made before survivors calculations are started is the extent of and the intervals at which points of comparison between actual and calculated balances will be made. That is, shall the comparison be of annual balances throughout the entire history of the account, as may have been inferred from the previous discussion, or merely between 1940 and 1945 or between 1905 and 1945, or over some intermediate span. It is essential to the process that the analysis include comparisons over a fairly extended period. If the term of comparison is too short, the results are indeterminate. It is, for instance, theoretically impossible to make a determination from a single year by the simulated plant-record method as, by the use of intermediate lives and dispersions, an infinite number of patterns can be found which will yield a calculated balance equal exactly to the actual balance. This condition is probably not much improved by using a span of only four or five years. It appears that theoretically the comparison term should not be less than the age of the first retirements, as would be shown by the actual retirements-frequency-distribution curve of the account. Thus, for a 40-year average life and Iowa Lo dispersion, theoretically one year would suffice; but if the dispersion for that same average life were Iowa S6, a 30-year comparison term would be required. Practically, in dealing with the wider dispersions typical of utility-plant accounts, it is believed that indeterminateness will be avoided if the comparison term is made not less than 20 years.

As to extending the term of comparison beyond that required for determinateness, the choice lies in the statistical philosophy which is to be followed. If one wishes to recognize more fully the influence of earlier experience on the shape of the overall survivorship pattern, it is well to make the term quite extended. In the comparisons made in recent years is included the late history of old plant; but in the comparisons of earlier years, this same plant is included in its younger days. By the more extended comparison term, we give added weight to the experience of earlier years. Thus, in the case of short-lived accounts, is introduced life and dispersion indications of vintages which have no present-day survivors. One reason for doing this, assuming that necessary future redeterminations will be similarly made, would be to avoid the undue fluctuations of life and dispersion estimates which would result if attempt were made to follow the vicissitudes of short-time-life-and-dispersion indications. The point, however, is not as important as it may seem, for the reason that with any plant which has had the growth characteristics exhibited by most of the electric and gas accounts, the additions of recent decades so far outweigh the additions of earlier decades as to make balance comparisons of the re[illegible]cent periods controlling in the findin[illegible] of the simulated plant-record proce[illegible] as here outlined. In such accounts the result will not be materially changed by making balance comparisons prior to, say, 1915, although it may be desirable to do so if it is thought that the acceptability of the conclusions is thereby improved.

It is, however, not necessary for the observations to be made in each year in the selected comparison term. It appears that, ordinarily, balance comparisons made for every fourth or fifth year will give a result not importantly different than comparisons made on the basis of every year. This reduces the labor of the computations considerably.

Fitting Process

In practice, a computation sheet, such as appears in Figure 5 to illustrate the principle, need not be made. Since we are interested in the simulated balances of only certain years, the selected vertical columns on the illustration can be computed vertically and directly instead of horizontally filling in the whole sheet. Cross mul[illegible]plications can be accumulated in t[illegible] calculating machine without the nece[illegible]sity of writing down the individual products. A form such as illustrated in Figure 8 has been found suitable. It has been filled in with the data previously referred to as applying to Figure 6. The survivor-calculation process consists of laying the chosen survivors-table strip alongside of the column of additions which has been entered on the form, matching the bottom on the strip (age 0.5 year) with the year whose survivors are to be first calculated, say in this case 1940, and then cross-multiplying each year's additions by the adjacent percentage on the strip and accumulating the products. Thus is obtained the total of the 1940 survivors contributed by all of the previous years' additions. The result is posted opposite 1940 in the second column of the pair of columns which has been captioned with the average age and mortality dispersion type of the calculation. Using the same survivors-table strip, but shifting it and clipping it so that its bottom (age 0.5 year) is opposite and adjacent to the 1935 additions (assum[illegible]ing the comparison is to be made ever[illegible] five years), the cross-multiplicatio[illegible]

DEPRECIATION STUDY

LIFE ANALYSIS - SIMULATED PLANT-RECORD METHOD
CALCULATED BALANCES AND DIFFERENCES
ACCT SPECIAL DATA, EEI 1942 REPORT P.88

FILE J 21
MADE BY
DATE
APPROVED

DIFFERENCES SQUARED IN 000s
OTHER AMOUNTS IN $

YEAR	ADDITIONS	RETIREMENTS	ACCUMULATED ADDITIONS	ACCUMULATED RETIREMENTS	BALANCES	YEARLY AVERAGE BALANCES	AVERAGE LIFE 21, TYPE L2: DIFFERENCE SQUARED	AVERAGE LIFE 21, TYPE L2: BALANCE	21 S1: DIFFERENCE SQUARED	21 S1: BALANCE	20 L3: DIFFERENCE SQUARED	20 L3: BALANCE	19 L3: DIFFERENCE SQUARED	19 L3: BALANCE	18 S2: DIFFERENCE SQUARED	18 S2: BALANCE	18 R3: DIFFERENCE SQUARED	18 R3: BALANCE	20 S1½: DIFFERENCE SQUARED	20 S1½: BALANCE
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1890																				
91																				
92																				
93																				
94																				
95																				
96																				
97																				
98																				
99																				
1900																				
01	1 000				1000															
02	1 000				2000															
03	1 001				3000															
04	2 003				5000															
05	5 000				10000															
06	5 015				15000															
07	10 028				25000															
08	5 060				30000															
09	5 086				35000															
1910	5 135				40000															
11	5 201				45000															
12	5 282				50000															
13	10 384				60000															
14	10 516				70000															
15	10 680				80000															
16	10 880				90000															
17	21 117				110000															
18	11 392				120000															
19	21 705				140000															
1920	22 062				160000		1 392−	159 820	1 327−	158 848	3 853+	161 963	138+	160 395	67+	160 260	1 145+	161 070	137−	159 630
21	12 468				170000															
22	27 965				195000															
23	38 401				230000															
24	53 960				280000															
25	54 573				330000		2 108−	328 548	249−	325 501	6 891+	332 625	1 075−	328 964	17−	329 869	1 745+	331 321	1−	329 965
26	95 269				420000															
27	106 084				520000															
28	97 028				610000															
29	103 131				705000															
1930	84 487				780000		2 033−	778 574	31−	779 823	10 120+	786 334	551−	779 258	28−	779 832	142−	779 874	78+	780 276
31	75 960				845000															
32	52 710				885000															
33	39 715				910000															
34	36 996				930000															
35	19 565				930000		7 433−	927 270	5 820−	927 587	241616+	945 544	1 414+	931 190	83−	929 770	4 991+	932 234	747−	929 124
36	27 404				935000															
37	35 481				945000															
38	43 762				960000															
39	42 185				970000															
1940	50 654				985000		19 758−	980 556	32 047+	990 661	453434+	1006294	110397−	974 493	70 661−	976 594	98 367+	994 918	676+	985 822
41																				
42																				
43																				
44																				
TOTAL							52 744−		39 474+		745814+		113695−		70 827−		106530+		1 457−	
MEAN SQ							6 549−		7 895+		149188+		22 719−		14 165−		21 278+		332−	

For each of a number of trial mortality patterns, this form records calculated balances for comparison with actual balances in selected years, the squares of the differences, and the mean square of the differences. The trial pattern with the lowest mean square is the sought-for answer.

Fig. 8—Computation Form

and product accumulation process is repeated to give the 1935 calculated balance. This result is posted opposite 1935 in the calculated balance column on the form shown in Figure 8. The same procedure is repeated for every fifth year back as far as it is desired to make the computation.

The difference between each calculated balance and the corresponding actual balance is observed and squared. The squared difference, if a form such as in Figure 8 is used, is posted in the column immediately to the left of the calculated balance to which it pertains. The squared differences are then footed and divided by the number of years whose balances have been calculated, to give the mean square of differences. Thus, if observations are made in 1940, 1935, 1930, 1925, and 1920, as in this case, the divisor would be 5. The mean square is, of course, positive, but a plus or minus mark is associated with this figure to indicate whether the sum of the squares of plus differences (over estimates) is respectively more or less than the sum of the squares of minus differences (under estimates). Repeated trials are made with other survivors-table strips to discover the particular average life and mortality dispersion which gives the least mean square of differences.

The results of the successive trials can be conveniently posted on a form such as appears in Figure 9 entitled Mean Square of Differences. This form is designed to guide wisely the selection of, and thereby minimize the number of, successive trial calculations. This effect has been accomplished by arranging the mortality-dispersion-type columns in a suitable order for growing plant, such as is generally experienced in the electric and gas utilities.[6] Ordinarily, trials recorded on this sheet become progressively higher overages as they lie to the right of (decreased dispersion) or below (increased life) the sought-for minimum, and become progressively greater underages as they depart to the left (increased dispersion) and above (decreased life). The finally discovered least square can be circled to indicate that its corresponding average life and dispersion type are selected as representative of the account. The posted figures need be to only three significant places in some convenient power of 10.

Ordinarily, it is wise to make calculations all the way across the sheet by determining the best fitting average life for every type of mortality dispersion. This is advisable because there may be several "nodal" points, i.e., points at which the mean-square-of-differences is lower than for surrounding patterns. In fact, if experience with an account has been meagre, some of these auxiliary low points may be preferred for estimating purposes, for reasons to be explained later. It has been found that few accounts require less than 40 trials and few more than 110. The average runs about 70 trials.

The foregoing calculating procedure and the suggested forms are based on the use of calculating machines. The average elapsed time (not calculating time) required, using skilled operators on key-operated machines for a large project involving, in the main, comparisons at nine points, at intervals of five years, was slightly less than one-half man hour per trial, or about one week's work for one operator per account. Technical supervision of the work should require about one-fourth of the time required for calculating. These time estimates do not include the time required for compilation of additions and balances, preparation of survivors tables, nor the work of organizing the procedures and preparation of forms. The computing time may be shortened by the use of punched-card techniques with an automatic multiplier, but unless punched-card facilities are available on a cost basis which is incremental to some other operation, the cost is not likely to be less. It is conceivable that some of the recent developments in high-speed, large-scale digital computing devices may be very favorable to the simulation method of life analysis.

The work can be speeded considerably by using lumped additions instead of annual additions. That is, the additions of each five-year period may be taken as if made in the middle year of the period or, more accurately, in that year in which the weighted mean time of installation for the five-year period occurs. In this case, years selected for comparison of actual and simulated balances must fall on only the terminal years of the lumped periods. The lumping of additions need not be by uniform periods, but the special care required in handling such an operation is not compatible with production methods. Such rough computations, if handled understandingly, can reduce the time required to discover the area in which the desired fit falls, and can be finished off with the more refined computation using each year's additions in only that area.

Adjustments for Missing Early Additions Records

In connection with the simulated plant-record method, as may be surmised, it is theoretically necessary to have a record of plant additions going back so far that it will include all additions of which there are survivors, according to any trial mortality pattern, in the earliest year which is being used as a year of comparison between calculated and actual balances. Thus, for very short-lived accounts, the record need not go back as far as is necessary for longer-lived accounts. If the actual early additions are not available, it is advisable to make an estimate of them. If they were small in relation to later additions, accuracy of this estimate is not of great importance, as the small early additions have little influence on the selection of the best fitting mortality pattern. If the early additions are large in relation to the more recent additions, the dependability of the results will be affected by the accuracy with which the early additions are estimated.

In reconstructing early history, it is frequently easier to estimate in terms of balances than to estimate additions directly. From these balances, by the further assumption of a reasonable mortality pattern, the corresponding additions can be computed.[7]

[6] The order here used is that of the areas of the generalized survivor curves between the limits of 0 per cent and 90 per cent of average life.

[7] Some simple mortality pattern or other rough step-by-step development of the additions will probably suffice. If a more rigorous approach is desired, successive values of additions can be calculated from the balances and the selected retirements-frequency distribution by the following formula:

$$A_k = \frac{(B_k - B_{k-1}) \div \sum_{n=0}^{n=k-1} A_n f(x-k-n+1)}{1-f(x-1)}$$

Where A = additions during the chronological year indicated by subscript

B = known balance at the end of the chronological year indicated by subscript

$f(x)$ = selected retirements-frequency distribution, expressed as proportion of a given year's additions retired during each age-year x

n = a sequence of identification numbers representing chronological years, such that $n = 0$ represents the beginning of the record and $n = 1$ represents the year of first additions

k = a particular chronological year, i.e., a particular value of n

DEPRECIATION STUDY

LIFE ANALYSIS - SIMULATED PLANT-RECORD METHOD
MEAN SQUARE OF DIFFERENCES
ACCT-XCI 1942 REPORT p.56 IN 10^6

File J 31
Made by
Date
Approd

The Symbol + or − indicates whether the sum of the squares of the plus differences (over estimates) is respectively more or less than the sum of the squares of the minus differences

ASSUMED AVERAGE LIFE	GC	L0	L½	S-½	L1	S0	R1	S½	L2	S1	R2	S1½	L3	S2	R3	S3	L4	R4	S4	L5	R5	S5	S6	ASSUMED AVERAGE LIFE
15																								15
16																			−519.11	−406.52	−196.94	−113.78	−137.10	16
17																−332.58	−148.14	−68.09	+4.61	+24.20	+135.56	+201.76		17
18													−205.04	−252.56	−65.41	−23.38	+74.32	+137.90						18
19													−22.72	−14.17	+21.28									19
20									−173.68	−77.03	−49.75	−.33	+149.18	+260.45										20
21								−126.49	−6.55	+7.89	+171.03													21
22							−317.53	−24.79	+196.14															22
23						−92.09	−205.35																	23
24					−41.79	+79.23	−173.51																	24
25					+80.64		+280.95																	25
26					+274.52																			26
27																								27
28	−605.06																							28
29	−456.67				+392.49																			29
30	−385.42	−165.31																						30
31	−356.32	+219.94																						31
32	+379.01																							32
33	+434.36																							33
34	+509.20																							34
35	+616.31																							35
36																								36
37																								37
38																								38
39																								39
40																								40
41																								41
42																								42
	GC	L0	L½	S-½	L1	S0	R1	S½	L2	S1	R2	S1½	L3	S2	R3	S3	L4	R4	S4	L5	R5	S5	S6	

Posted from Figure 8 for convenient recording and expeditious guiding of the trial and error process. Trials should be pursued until the transition point between over-estimates and under-estimates of life for most types of mortality dispersion has been determined. The trial yielding the lowest mean square presumably indicates the average life and mortality dispersion of the account.

Fig. 9—Mean Square of Differences

If, because the early additions are large in comparison with later additions, this mortality-pattern assumption is deemed to be critical, then theoretically the assumed mortality pattern should, for each particular trial, be that which is to be used for simulation of the later plant record.

Another approach to the estimation of early additions is by the use of the known or estimated age distribution of the plant which survives in the first year of dependable records. By the use of an assumed survivors table the survivors of the various ages can be thrown back to their originating additions values.

It is also possible to disregard the unknown early additions and use for the simulated plant-record procedure only the additions of the years subsequent to the beginning of the dependable record, provided appropriate adjustments of later balances are made. In this case, the subsequent years' survivors of the plant balance at the beginning of the dependable record are computed. Again this requires the assumption of a reasonable survivors pattern. The resulting subsequent years' survivors would be subtracted from the corresponding actual total balances so as to give a series of values comparable with the balances calculated from the known additions; or they could be added to the calculated balances for comparison with the true total balances. This adjustment is, of course, uncalled for if there are no survivors of the first dependable year's balance in the earliest year which is used for comparison of actual and calculated balances.

Even if the early records are dependable as to balances, it is possible that a good record of gross additions may not be available. In such cases the missing data can be reconstructed or adjusted for on an estimated basis by the foregoing methods. A method which obviates any necessity for a separate adjustment in these cases has been proposed by Paul H. Jeynes of Public Service Electric and Gas Co., Newark, N. J. Instead of deriving simulated balances from the summation of cross products of annual additions by the survivors table, or of deriving simulated retirements from the summation of cross products of annual additions by the corresponding retirements table, it uses the summation of the cross products of annual increases in balance (net additions) by a table of annual "replacement" ratios, to get simulated retirements. Tables of annual replacement ratios, which represent the annual replacement required to perpetually maintain an original installation of unity, can be calculated from the retirements-frequency-distribution curve for the several mortality dispersions.[8] If the balances are sound, the use of net additions instead of gross additions eliminates any error arising from absence of good gross additions figures, provided the plant figures are correct in the years which are used for comparison between actual and simulated plant records. The method applies equally well as far as precision is concerned to simulation of balances or of periodic retirements, but is, of course, of no purpose in simulation of accumulated retirements unless the retirements of the unsatisfactory years are excluded from the accumulation. Because simulated periodic retirements are the direct result of this procedure, and simulated balances require further computation, the method is better adapted to the simulation of periodic retirements rather than simulated balances. Except for the eliminatio[n of] errors, which may be due to inac[curate] early gross addition records, the r[esults] for homogeneous plant are identical with calculations originating from additions records.

[8] Such tables for the Iowa dispersion types and for an average life of ten years appear in Bulletin 125 of Iowa Engineering Experiment Station, "Retirement Characteristics of Industrial Property Groups," by Professor Robley Winfrey, 1935.

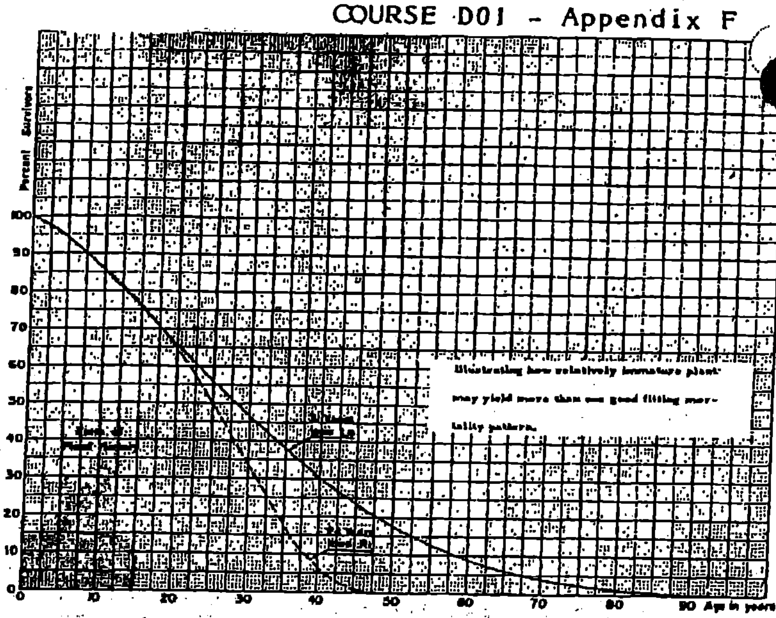

Fig. 10—Multiple Pattern Indications

Multiple Indications

One cannot pursue the plant-record-simulation methods, or for that matter the actuarial methods, in practice without running into indications of more than one good fitting pattern of life and mortality dispersion for some accounts. This arises in the case of plant which is immature in relation to the indications of the best fitting patterns. Thus, it may be found for plant, the bulk of whose additions have occurred in the last 20 years, that the actual year-by-year balances are simulated equally well by calculated balances resulting from average life of 24 years and dispersion type R1, as by the balances calculated from average life of 31 years and dispersion type Lo. The reason for this can be seen by plotting the two patterns in terms of survivors percentages on the same coordinates. The two curves are substantially the same in the range o[f a] 20-year plant history, as will be [seen] in Figure 10. The method reads past and not the future, and has no way of telling which pattern will be followed in the future. Neither the actuarial nor any other statistical process can eliminate this dilemma. Only by the exercise of reasoned judgment, or by the passage of time, can a selection be made.

Conformance Index

The best fitting pattern as found by the simulated plant-record method is not always a good fit. To indicate and register the goodness of fit in relation to the size of the account, an index has been devised and designated as the "conformance index." The criterion of goodness of fit is the mean square of the differences between the actual and calculated balances. The square root of this mean square is considered the standard error of estimate. The conformance index has been taken as the ratio of the average of the year-end balances of the account, in the years for which balance comparisons have been made, to the standard error of estimate. Thus computed, this conformance index usually ranges somewhere between 10 and 100, with a few cases so poor that they are less than 10, and a few cases so nearly perfect that they may run up to several hundred.

Arbitrarily, it has been considered that the conformance index may be graded as:

Excellent for ratios over 75
Good for ratios between 75 and 50
Fair for ratios between 50 and 25
Poor for ratios between 25 and 0

Retirements Experience Index

The merit of a result, however, is not adequately represented by the conformance index. In some cases, the conformance might be very high and yet the result could be questionable because of insufficient experience with the account. For instance, a particular account might show excellent conformance for an average life of 40 years and Iowa dispersion R3. But if the experience with the account covers only 20 years, the retirements of the first year's additions will, according to the discovered pattern, have amounted to only 6 per cent and, of course, the retirements of the later additions to a lesser percentage. Any conclusion in such a case that the discovered pattern is representative of the account would be too meagerly supported, notwithstanding the excellent conformance index. On the other hand, had the experience with the account covered 50 years, the retirements of the earliest additions would have been 82 per cent, and a conclusion that the discovered excellently fitting pattern was representative of the account would have considerable statistical warrant.

To measure and codify this matter, a complementary index has been devised to show the amount of experience with the accounts and has been designated as the "retirements-experience index." This index is the percentage of accumulated retirements of the first year's additions in the account, on the assumption that these additions have been retired in accordance with that pattern of life and mortality dispersion which was found to be the best fitting by the simulated plant-record method. This was the result of experiment and study with many other types of indices and it was concluded to be not only the simplest, but, when used in conjunction with the conformance index, the most effective. This index is obtained by observing the survivors table for the type of mortality dispersion associated with the particular pattern which has been selected as the best fitting one and noting the accumulated retirements percentage for that age which represents the age of the account. (Accumulated retirements in per cent equal 100 minus survivors in per cent.) Thus, a peaked or narrow dispersion pattern, (speaking in terms of the retirements-frequency-distribution curve) even at as late as 80 per cent of average life, might show a very low accumulated retirement percentage (taken as the complement of the survivors curve), perhaps less than 10 per cent of the original additions, whereas a completely dispersed pattern, such as Patterson type GC, would show 40 per cent accumulated retirements. Dispersions which are symmetrical would, of course, show 50 per cent accumulated retirements at 100 per cent of average life. Short-lived accounts naturally tend to show a retirements-experience index approaching 100, whereas long-lived accounts tend to show an index nearer to 0.

The simulated plant-record findings in an actual study were graded, according to this index, as follows:

Excellent — over 75 per cent
Good — from 50 per cent to 75 per cent
Fair — from 33 per cent to 50 per cent
Poor — from 17 per cent to 33 per cent
Valueless — from 0 per cent to 17 per cent

The retirements index as here described is, in effect, based on simulated accumulated retirements of the first year's additions. If the index thus obtained is poor, certainly life analysis of the account cannot be trustworthy. However, the index thus determined may be good and yet the result from the simulated plant-record method may still be questionable because of early additions being extremely light in comparison with the later growth of the account. In such extreme cases of initial dormancy, it perhaps would be better in setting the retirements-experience index to use the year of the first substantial additions rather than the first year of additions.

Interpretation of Results

In order for a life determination to be considered entirely satisfactory, it should be required that both the retirements experience index and the conformance index be "Good" or better.

A high conformance index gives assurance of relative constancy of past life and mortality dispersion. A low conformance index indicates (a) that the account has no stable life and dispersion pattern, or (b) that the actual type of mortality dispersion is so unusual as not to be within the field of generalized dispersion types which were used in the analysis. In the case of unstable life and dispersion, the actuarial procedure may be beneficial in that the prophetically valueless history of recent additions can be eliminated from the record. The remaining more revealing older plant vintages may show a more distinctive pattern of life and dispersion. Any such "band" analysis with the simulation method alone is ordinarily impracticable because the necessary number of trial computations goes up tremendously. An actual two-additions-band analysis for poles required some 500 trials, and then the indications of the most recent band were not acceptable because of immaturity. The conformance index is, however, not too important. If it is bad, there is usually not much that can be done about it, except to be forewarned in using the results. Reexamination of the account in the future may divulge a more definite characteristic. But good or bad, nothing better may be available, and therefore it might be quite reasonable to use the figure resulting from the simulated plant-record analysis, even though the conformance index is not good.

If the retirements-experience index is "Poor," or "Valueless," even though the conformance index be high, the result should not be accepted. There simply has not been enough experience with the account for it to exhibit a conclusive life characteristic. In all such cases, for estimating purposes, the result of the analysis should be discarded and a judgment figure should be substituted in place of it. In those cases where the experience index is only fair, the result should be examined critically, and if it is not supported by reasoned judgment, it should be accordingly modified.

Whenever judgment does not permit the acceptance of the best fitting pattern as an estimate of the future, it may be desirable that the second, or even the third best fit be selected as typical of the account if one of these falls close to the life and dispersion which is dictated by judgment. The selected pattern will thereby maintain some consistency with the actual, although limited, experience. If none of those subordinate fits is acceptable and judgment dictates some other average life, it may still be desirable to associate with that life, if past experience with the account is deemed to have any value at all, a dispersion type which is consistent with that past experience. This would be done by selecting that mortality dispersion which showed the least mean square of differences between actual and calculated balances for the average life determined by judgment. Inspection of the already calculated mean squares on the form in Figure 9 will probably show this pattern without the necessity of further calculation.

Summary

In summary, the simulated plant-record method of analyzing utility-plant history constitutes at this writing the only method, other than the frequently unavailable actuarial procedure, by which the necessary element of mortality dispersion as well as average life can be determined for group-depreciation-accounting purposes. This exposition of the method elaborates on the indicated survivors method as hitherto reported by:

1. Emphasis of the necessity for comparing balances calculated from assumed patterns of average life and mortality dispersion with the actual balances over an extended term of years.
2. Application of the least squares method of discovering the best fitting pattern of life and mortality dispersion, rather than the rougher and less objective graphical comparison.
3. Reference to Whiton's application of the principle to retirements comparisons.
4. Suggestion of forms and procedures which facilitate the calculations.
5. Determination of the relative stability of the past average-life and dispersion characteristics by means of the conformance index.
6. Indication of results which are of diminished value because of plant immaturity by use of the retirements-experience index.

In any application of this method it goes without saying that the first requirement is a good record of the year-by-year additions and balances classified according to the present system of accounts. Carefully planned production methods are essential. The use of conveniently set up survivors-tables strips, instead of writing and rewriting the figures, and the use of a convenient computation form, are steps to that end. The adoption of the mean-square-of-differences tally sheet, which economically guides the succession of trial and error calculations of "simulated balances" until the least mean square and thus the best fitting pattern of average life and mortality dispersion is found, is an important feature of the procedure. Time and economy considerations will recommend the use of skilled calculators with key-operated machines or automatic multiplication from punched cards.

Basically, operating on corresponding data and fitting the same family of generalized mortality dispersions, the results of the simulation method will be the same as those of the actuarial method. Where a fairly stable life and dispersion characteristic has been experienced, the plant-record-simulation method will discover it. Where the life and dispersion have been moderately fluctuating, the method will give a desirably weighted average indication. In either case, the result should be helpful in selecting a suitable average life and dispersion for the determination of accrual rate and theoretical reserve requirement for future depreciation accounting associated with life. If the life and mortality dispersion characteristics have fluctuated wildly, or if the plant is immature in relation to the best fitting pattern, neither this method nor any other statistical procedure will give an answer of any prophetic merit. The method is entirely independent of irregularities in the amount or rate of growth, and functions equally well on declining plant balances as on increasing balances. Only if the plant is perfectly static does the method become indeterminate as to dispersion type, although not as to the average life indication.

ATTACHMENT 4

Excerpt from

NARUC Public Utility Depreciation Practices (August 1996)

Public Utility

Depreciation Practices

August 1996

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Interpreting Results of SPR Balances Model

The results of the SPR model include the CI and/or IV, which measure the fit between simulated and actual balances, and the REI, which indicates the maturity of the account. A high CI, or equivalently a low IV, indicates that the simulated balances are, on the whole, "close" to the actual balances. This is not necessarily a guarantee that the pattern used to simulate the balances matches that of the underlying data.

Bauhan states that the CI should be "good" or better (i.e., at least 50) in order for a life determination to be considered entirely satisfactory. It is not uncommon, however, for the model to produce results with low CIs for all curves over several test periods. A low CI indicates either that the account has no stable life and dispersion pattern or that the actual mortality dispersion is so unusual that it is not included in the generalized patterns that were used to simulate data. In either case, Bauhan cautions that one should be forewarned in using the results.

In some cases, the CI could be high and the result could be questionable due to insufficient experience with the account. For example, if the R3-40 curve has a high CI but the oldest vintage is only 20 years old at the end of the test period, then the simulated survivors from this earliest vintage will have been calculated using a curve truncated at 94%. As with the actuarial models, one would not want to base a conclusion on such a short curve stub. Had the earliest vintage attained an age of 50 years, the survivor curve would have extended to 18% surviving and a conclusion based on the results would be warranted.

The REI is the index that is produced to indicate the maturity of the account. The REI in the above example is 6% and 82%, respectively. According to Bauhan, results with an REI less than "fair" (i.e., less than 33%) should be discarded regardless of the CI.

In cases where early vintages have little impact on the test years' simulated balances, Bauhan advised that the REI be adjusted to use the year of the first *substantial* additions rather than the first year of additions. The effect is to produce an REI which reflects the significant portion of the curve used in the simulation.

Most SPR computer programs do not consider the significance of the installations. Some programs reflect the extent of data available for analysis by truncating the curves with the highest CI in each curve family at the age of the oldest vintage as of the end of the most recent test year. The "envelope" of curves thus created is a depiction of history. Similar to the procedure followed in matching Iowa curves to survivor curves produced by actuarial models, the analyst seeks a curve which provides a suitable extension of the truncated curves in consideration of the various factors affecting property life.

This process may result in a curve being developed which is not one of those presented on the SPR output. Bauhan anticipated this result when he advised that a curve type shown on the SPR output be coupled with an average life determined by judgment if exogenous information dictates an average life different from those presented. He also stated that it may be desirable to use a curve with a CI less than the highest if judgment does not permit the acceptance of the best fitting pattern as an estimate of the future.

Some problems may arise if the IV is calculated first and then the CI imputed. That is, in some computer programs the calculated IV is truncated to an integer and then inverted to compute the CI, as shown in Table 7-9.

TABLE 7-9

SENSITIVITY OF CONFORMANCE INDEX

Curve	IV	Truncated IV	CI
R1-11.8	2.1	2	500
L0-15.1	1.9	1	1,000

The CIs which result imply a qualitative difference in results that is not warranted. In the example above, the calculated IVs of 2.1 and 1.9 are close, demonstrating that the two curves have equivalent fits. However, the CIs of 1,000 and 500 give a specious implication that there is a qualitative difference between the fits of the curves.

Another source of problems is the failure of some SPR computer programs to consider all the curve types in a family. These programs display the first curve within a family that produces better matching balances than its "neighbors", and then the programs move on to the next family without trying to locate another curve with equally good or better balances within the family. This procedure is based upon a pattern noticed by Bauhan.[14] More recent experience indicates that the best fitting curves may fall at the beginning and end of a family, so the results from all curve types should be considered in locating the best matching curves (see Table 7-10).[15]

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[14] Bauhan, 1947.

[15] Jensen, S. D., "Examining Results of the Simulated Plant Record (Balances) Model." Paper presented at the Iowa State Regulatory Conference, Iowa State University, Ames, Iowa, 1989.

TABLE 7-10

"BEST" CURVES FALLING AT BEGINNING AND END OF A FAMILY

Curve	IV	CI	REI
S0-21.2	15	66	41
S1-16.6	17	58	60
S2-14.7	17	58	78
S3-14.1	17	58	90
S4-13.7	16	62	98
S5-13.6	15	66	100
S6-13.6	15	66	100
L0-31.2	15	66	31
L1-21.2	16	62	46
L2-16.9	17	58	64
L3-15.1	17	58	77
L4-14.1	17	58	90
L5-13.7	15	66	97
R1-26.3	14	71	28
R2-17.7	15	66	51
R3-14.7	16	62	83
R4-13.8	16	62	98
R5-13.6	15	66	100

Limitations of SPR Balances Model

As Alex E. Bauhan stated when he developed the model, the SPR model will discover the life characteristics of property when they are fairly constant or only moderately fluctuating. He assured us that "[t]he method is entirely independent of irregularities in the amount or rate of growth, and functions equally well on declining plant balances as on increasing balances." He also gave us the following warning:

> If the life and mortality dispersion characteristics have fluctuated wildly, or if the plant is immature in relation to the best fitting pattern, neither this method nor any other statistical procedure will give an answer of any prophetic merit.[16]

The model is also ineffective when applied to a test period consisting of a single year. In such case, all curves are theoretically capable of producing equally excellent results. Additionally, the model is indeterminate with respect to curve type, although not as to average life, when applied to an account that is perfectly static.

[16] Bauhan, 1947.

Although the SPR model ages annual balances in an effort to discover the property's life characteristics, the aged data are not retained after the model has completed its calculations. Therefore, the data lack an age distribution of survivors for use in calculating accumulated depreciation guideline levels (i.e., theoretical reserve) and annual accruals using the ELG procedure or the remaining life technique.

The SPR model assumes that vintage additions are available from the inception of the account. As discussed herein, missing early additions may be estimated or successive data may be adjusted to compensate for their omission.

The SPR model has been faulted for not being readily responsive to trends. This lack of responsiveness may be due to the balances being the result of both additions and retirements, and additions may mask the changing retirements. One may avoid this "masking" by simulating retirements, as is done in the following two models.

SPR Retirements Models

The SPR Retirements models match retirements instead of balances. Like the SPR Balances model, the retirements models assume that all vintages' additions retire in accordance with the same retirement dispersion pattern and average life. The SPR Retirements models seek to discover this type curve and average life by comparing actual retirements to those simulated using different Iowa curves. The curves are ranked according to their ability to simulate retirements that are close to the actual retirements of the account for selected test years.

Several SPR Retirements models have been developed. Most notably are the Cumulative Retirements and Period Retirements variations. These models are discussed below.

A variation developed by J. F. Brennan of Pacific Gas and Electric Co. forms an equation for the survivor curve from a retirement frequency curve that is in the shape of a parabola.[17] The original model assumes that retirements begin at the early ages, although the model was later modified to include applications in which retirements begin at a later, specified age. Unlike the SPR methods, the Brennan model is not a trial and error procedure.

SPR Period Retirements Model

The SPR Period Retirements model was developed by William D. Garland while at New England Power Service Co. This model incorporates a two-step procedure.

First, for each type of retirement dispersion pattern (e.g., Iowa curve type) an average life is sought that succeeds in producing total retirements over a period of consecutive years equal to the actual retirements for the period. Retirements over a period may be computed by calculating the difference between the balances at the beginning and end of the period and adding the additions that occurred during the period.

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[17] NARUC Committee on Depreciation, 1968.

ATTACHMENT 5

Pacific Gas and Electric Company's 2011 Authorized Depreciation Rate Accrual Schedule

(Gas Transmission and Distribution)

Pacific Gas and Electric Company

Mail Code B11H
Pacific Gas and Electric Company
P.O. Box 770000
San Francisco, CA 94177-0001

May 1, 2011

Ms. Julie Fitch
Director, Energy Division
California Public Utilities Commission
505 Van Ness Avenue
San Francisco, CA 94102

Dear Ms. Fitch:

Enclosed is the Depreciation Accrual Rate Schedule for 2011 based on the depreciation parameters in Pacific Gas and Electric Company's ("PG&E's") Settlement Agreement for 2011 General Rate Case ("GRC"), Settlement Agreement for Gas Accord V Gas Transmission and Storage Rate Case, and Settlement Decision 06-07-027 in PG&E's Advanced Metering Infrastructure Project (AMI) Case. PG&E's 2011 GRC and Gas Accord V decision will ultimately determine the authorized accrual rates for electric and gas accounts in 2011. PG&E will file revised schedules of depreciation accrual rates shortly after receiving final decisions from Commission. PG&E will apply these authorized depreciation accrual rates to its electric, gas and common utility plant-in-service in 2011.

This information is being submitted to the California Public Utilities Commission pursuant to Commission Resolutions G-1559 and E-1332, dated August 29, 1972, which ordered Pacific Gas and Electric Company to "submit its annual depreciation studies applicable to all departments to the Commission on or before May 1 of each year."

Net salvage rate, average service life, curve type, and depreciation accrual rate for each capital account are based on the rates from the above settlement agreements and decision. Plant, net salvage amount, depreciation reserve, net balance, and average age are reported as of January 1, 2011. The average age is an estimate based on the allocation of plant across vintages within each account. The annual depreciation accrual is calculated as plant multiplied by the depreciation accrual rate. Except for those accounts for which the Commission has authorized amortization, the depreciation accrual rate is based on the straight-line remaining-life method in accordance with procedures approved by Commission Resolution No. U-988, dated August 30, 1960.

Sincerely,

Beatrix Greenwell
Manager, Capital Recovery and Analysis
415-973-6608
BxGc@pge.com

Pacific Gas and Electric Company
Depreciation Accrual Rate Schedule for Year 2011

Asset Class	FERC Acct	Description	12/31/10 Gross Plant ($000) (a)	Estimated Net Salvage Rate (%) (b)	Estimated Net Salvage Amount ($000) (c)=a*b	12/31/10 Depreciation Reserve ($000) (d)	Net Balance ($000) (e)=a-c-d	Average Service Life (Yrs) (f)	Curve Type (g)	Average Age (Yrs) (h)	Annual Accrual ($000) (i)=a*j	2010 Accrual Rate (%) (j)
Gas Department												
	Transmission (excluding Line 401 and StanPac)											
GTP36610	366.1	Compressor Station Structures	25,317	1	253	14,277	10,787	31	R1.5	23.3	696	2.75
GTP36620	366.2	Measuring & Reg Sta Structures	9,650	-5	-483	4,570	5,562	31	R1.5	18.6	317	3.29
GTP36630	366.3	Other Structures	19,794	0	-	9,300	10,494	31	R1.5	16.7	582	2.94
GTP36700	367	Mains	1,576,208	-15	-236,431	697,565	1,115,074	45	R1.5	19.8	35,307	2.24
GTP36702	367	Trans Plant: Feeder Mains	202	-15		0						2.24
GTP36800	368	Compressor Station Equipment	357,047	-15	-53,557	175,940	234,664	25	S1	12.5	13,246	3.71
GTP36900	369	Odorizing Equipment Measuring & Reg Sta Equipment	190,724	-1	-1,907	70,355	122,277	29	R0.5	16.3	6,218	3.26
GTP37100	371	Other Equipment	43,337	-5	-2,167	21,555	23,950	26	R0.5	16.7	1,517	3.50
		Non-land	2,222,280	-13	-294,292	993,562	1,522,808				57,884	2.60
GTP36511	365.11	Land & Land Rights	7,004	0	0	5,575	1,429			14.1	144	2.06
GTP36512	365.12	Rights-of-Way (ROW)	36,718	0	0	20,860	15,859			21.6	650	1.77
		Depreciable Land & Right of Way	43,722			26,435	17,287				794	1.82
		Total Transmission	2,266,002			1,019,997	1,540,095				58,678	

Pacific Gas and Electric Company
Depreciation Accrual Rate Schedule for Year 2011

Asset Class	FERC Acct	Description	12/31/10 Gross Plant ($000) (a)	Estimated Net Salvage Rate (%) (b)	Estimated Net Salvage Amount ($000) (c)=a*b	12/31/10 Depreciation Reserve ($000) (d)	Net Balance ($000) (e)=a-c-d	Average Service Life (Yrs) (f)	Curve Type (g)	Average Age (Yrs) (h)	Annual Accrual ($000) (i)=a*j	2010 Accrual Rate (%) (j)
Gas Department												
	Distribution											
GDP37500	375	Structures & Improvements	2,123	-20	-425	655	1,892	50	R2	19.9	52	2.46
GDP37601	376	Mains	2,368,309	-52	-1,231,521	1,254,463	2,345,367	53	S3	17.5	64,418	2.72
GDP37700	377	Compressor Station Equipment	866	0	-	546	319	31	R2	21.3	24	2.81
GDP37800	378	Odorizing Equipment Meas & Reg Sta Equip-General	141,652	-45	-63,743	75,659	129,736	45	R2.5	14.7	3,938	2.78
GDP38000	380	Services	2,510,397	-105	-2,635,917	2,035,655	3,110,659	53	R4	17.2	84,349	3.36
GDP38100	381	Meters	676,499	-5	-33,825	185,503	524,821	24	R4	10.3	34,501	5.10
GDP38300	383	House Regulators	160,438	0	-	93,199	67,239	25	R1.5	16.6	5,166	3.22
GDP38500	385	Meas & Reg Sta Equip-Industrial	34,457	0	-	21,551	12,906	42	R2.5	23.2	603	1.75
GDP38600	386	Other Property on Customer Premises	166	0	-	75	90	35	R2	16.0	4	2.58
GDP38700	387	Other Equipment	19,367	5	968	11,559	6,840	29	S1.5	17.8	445	2.30
		Non-land	5,914,274	-67	-3,964,462	3,678,866	6,199,870				193,502	3.27
GDP-LAND	GDP - Land	Land & Land Rights	23,426				23,426					
		Total Distribution	5,937,700				6,223,296					

ATTACHMENT 6

Response to TURN Data Request TURN-SCG-DR-18, Question 1

TURN DATA REQUEST
TURN-SCG-DR-18
SOCALGAS 2012 GRC – A.10-12-006
SOCALGAS RESPONSE
DATE RECEIVED: JULY 14, 2011
DATE RESPONDED: AUGUST 10, 2011

1. **[Net Salvage]** – Please state if the historical net salvage data (*i.e.*, gross salvage, cost of removal, and retirements) are time-synchronized. If not, please state the longest time frame between the reporting of one component versus another component of a retirement, as well as the average time period for such situations by account.

SoCalGas Response:

Time-synchronized
Generally, all three (gross salvage, cost of removal, and retirements) are recorded within the same year. There may be situations where retirements for a given year-end project could be recorded early the next year (e.g., there could be a December- January delay resulting in activity being split between adjacent years). Gross salvage for these retirement units, if applicable, occurs after these units are removed from service. Analyzing net salvage detail over the historical 15 year period captures a more thorough picture of plant information, and has the effect of smoothing out year to year fluctuations associated with timing.

Longest Time Frame
The longest time frame for any of the aforementioned activities would be the eventual recording of any gross salvage. In many instances, a specific volume of scrap needs to be captured/housed before presented for recovery. This ensures that the administrative burden and costs surrounding these activities are minimized. Scrap-valued items are not ignored, or remain at a facility for an extended length of time. Most salvage is systematically removed / recovered (avoiding any other incidental damage), regardless of volume.