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JOURNAL

OF THE

Society of Depreciation Professionals

Volume 6, Number 1
1994-1995

JOURNAL

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OF THE
SOCIETY OF DEPRECIATION PROFESSIONALS

Volume 6, Number 1, 1994-1995

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Cost: $15.00 per single issue; $10.00 each for orders of 10 or more.

Ordering information: To order additional copies contact the Society of Depreciation Professionals, 5505 Connecticut Avenue, NW #280, Washington, DC 20015; 202/362-0680.

Publisher: The Journal of the Society of Depreciation Professionals is printed by the Society, 5505 Connecticut Avenue, NW #280, Washington, DC 20015; 202/362-0680.

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The objectives of the society shall be to recognize the professional field of depreciation and those individuals contributing to this field; to promote the professional development and professional ethics of those practitioners in the field of depreciation; to collect and exchange information about depreciation engineering and analysis; to provide a national forum of programs and publications concerning depreciation.

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- Provide a forum for discussion of issues relating to depreciation policy.
- Recognize professionalism through membership and awards for service and contributions to the art of depreciation.
- Encourage papers on matters of interest to depreciation professionals.
- Sponsor regular conferences.
- Provide members with information and training that will enhance their skills as depreciation professionals.
- Sanction individually, or jointly with other organizations, educational forums on depreciation.
- Publish a regular newsletter.
- Provide electronic data sources such as bulletins boards or other electronic data services.

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SUMMARY OF ABSTRACTS

Reserve Imbalance Tracking
Vincent M. DeMatteo

Changes in the technological and economic environments require that equipment services lives be reestimated. The common practice in the telecommunications industry is to determine a reserve imbalance to quantify the financial impact of these environmental changes. Without further changes in service life, the reserve imbalance should decrease over time with the use of remaining life depreciation rates. Tracking studies could be performed to show the rate at which the reserve deficiency decreases over time. The objective of this article is to investigate a simple approach to track a reserve imbalance for multiple asset accounts. The conclusion of this investigation is that normal investment and retirement activity in multiple asset accounts makes this tracking approach of limited value and may create misleading results.

Provision for Dismantlement of Fossil-Fueled Generating Stations - PUC Acceptance
Patricia Lee

The concept of dismantlement relates to the ultimate physical demolition/removal/disposal from service of a generating unit offset by any attendant salvage from the removed assets. Historically, provision for dismantlement has been considered as part of the cost of removal component (negative net salvage) in the design of depreciation rates for production plants. The costs associated with this process have become a growing concern over the past decade due to their significant estimated levels. This paper considers the dismantlement of fossil-fueled generating stations, specifically PUC acceptance.

Adequacy of Recording and Recovery of Salvage and Cost of Removal
John S. Ferguson

The options for recording salvage and cost of removal include accrual accounting and cash accounting, and accrual accounting can be through depreciation or through amortizing a liability. Depreciation accounting recognizes the salvage expected to be received at the end of life and the cost of removal expected to be incurred as being directly related to the underlying assets. Non-regulated entities sometimes utilize cash accounting, because net salvage (salvage less cost of removal) is not material, or liability accounting rather than depreciation accounting. The Uniform Systems of Accounts (USofA) of regulators specify that regulated entities incorporate salvage and cost of removal into depreciation rates, through accrual accounting. While accrual accounting is either specified or implied by USofA's, some regulators circumvent this requirement by imposing a cash basis or some even more deferred process.

The Securities and Exchange Commission, through Staff Accounting Bulletin No. 92 (SAB 92), requires that public entities record and disclose environmental cleanup costs as a liability on a gross basis (i.e., without an offset for claims or regulatory promises of recovery). This has raised the threshold of awareness of how utility cost of removal is recorded and disclosed, and may lead to more widespread use of accrual accounting through depreciation or through liability accounting for some classes of assets. SAB 92 has particular significance to utilities, because it has led to a Financial Accounting Standards Board (FASB) project to evaluate whether the decontamination portion of decommissioning nuclear power plants should be recorded as a liability. This project could result in expanding the availability of liability accounting to utilities.

The purpose of this discussion is to evaluate the adequacy of accounting for salvage and cost of removal by electric and gas utilities by exploring its consistency with the accounting and regulatory framework for depreciation.

Benchmarking - A Case Study
Donald S. Roff

The purpose of this article is to illustrate both the potential advantages and the possible pitfalls of comparisons among companies, and stems from concerns by a depreciation client regarding differences in depreciation rates for several neighboring utilities. An understanding of the causal factors, accounting policies and practices, geographic differences and related influences are necessary for appropriate interpretation of results. Previous articles in this publication have dealt with this subject in generic terms and this discussion will quantify specific comparisons.

Relationship Between the Fisher-Pry and NX Distributions
Ronald J. Willis

The Fisher-Pry analysis effectively predicts the onset of new technology. However, in order to calculate the depreciation expense, a measure of the dispersion of retirements is required. An analysis is presented that shows the relationship between the Fisher-Pry parameter, alpha; the normal distribution parameter, sigma; and the NX distribution parameter, V. The NX distribution is a combination of normal and exponential distribution, and was developed by R. Bjerke of EdTel for accounts having both mass and integrated life characteristics.

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3. Each manuscript should include an abstract of no more than 150 words.

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5. Author(s) should use standard symbols and the English alphabet.

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7. Each table should be titled at the top, each figure should be titled at the bottom, and each table and figure should be provided on a separate sheet.

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To encourage creative interdisciplinary understanding of depreciation and its impact;

To review and discuss current issues and controversies within the field of depreciation.

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RESERVE IMBALANCE TRACKING

Vincent M. DeMatteo

ABSTRACT

This article will illustrate that for mass asset accounts the tracking of a reserve imbalance may lead to incorrect conclusions. The common practice in the telecommunications industry is to determine a reserve imbalance when it becomes clear that depreciation lives must be revised to reflect changes in technological and economic obsolescence. The issue of how fast the imbalance is being remedied has been raised and studied through the tracking of the reserve imbalance. It will be shown through example that the application of standard methods to develop reserve imbalance tracking data may create an imbalance without depreciation life changes.

INTRODUCTION

Rapid increases in the rate of technology change and the introduction of competition in the local exchange telecommunication industry have dramatically shortened equipment service lives. The regulatory process to prescribed depreciation lives has not kept pace with these changes. The financial effect of this divergence is that the depreciation reserve is understated and the book value of the firm's assets are overstated. The conventional method to quantify the financial significance of shortened lives is to determine a reserve imbalance.

The reserve imbalance is the difference between the recorded accumulated depreciation (book reserve) and an accumulated depreciation using revised depreciation lives (required reserve or theoretical reserve). A positive reserve imbalance represents a surplus and a negative imbalance a deficit. A deficit imbalance indicates that the recorded accumulated reserve has not adequately recovered investment because the depreciation lives used in the past were too long. Conversely, a surplus imbalance indicates an excess recovery of investment and is associated with past depreciation lives which were too short.

There are two common questions associated with a reserve imbalance: (1) What is the size of the imbalance at a particular point in time? and (2) How does the imbalance change over time? The answer to the first question is well documented and has been employed in the federal and most state jurisdictions. The second question has not been thoroughly addressed although it represents a reasonable issue.

The objective of this article is to investigate the tracking of a reserve imbalance for mass asset accounts. The conclusion of this investigation is that normal investment and retirement activity may produce a reserve imbalance without changes in obsolescence thus making simple tracking studies of limited value.

MODEL

The reserve imbalance will be tracked in various case situations. The cases will range from the simple one asset and one vintage to the multiple asset and multiple vintage examples.

The reserve imbalance is calculated as follows:

RESERVE IMBALANCE =
BOOK RESERVE - REQUIRED RESERVE

REQUIRED RESERVE =
$(100 - A) - ((100 - B) * (C/D))$

where:
- A = future net salvage
- B = average net salvage
- C = average remaining life
- D = average service life

In this analyses, the reserve imbalance formula will be used in its simplest form with future and average net salvage equal to zero. The depreciation reserve, required reserve and reserve imbalance are calculated at the end of the year. All investments and retirements occur at the end of the year.

To track a reserve imbalance, it is necessary to recalculate the average service life and average remaining life each year. For the single vintage cases, the average remaining and average service lives are calculated using a direct weighting procedure. In the multiple vintage cases, an accrual weighting procedure is used to develop the average service life and average remaining life.

Only technological obsolescence will be included in this analysis and it will be reflected as a decrease in the technological life span of the asset(s).

ANALYSES

Cases 1 and 2 illustrate the reserve imbalance for a single asset and single vintage example with and without technological obsolescence.

Case 1 is the single asset and single vintage example without a change in technological obsolescence. There is an initial investment of $100 in a technology which will be replaced with a new technology at the end of year 7. There are no adds over the life span. The service life is constant over the life span and the average remaining life equals the service life in year one and annually decreases by one year using a direct weighting method. Table 1 illustrates the intuitive conclusion that there is no imbalance without technological obsolescence, i.e., the technology life span (end date) remains unchanged.

Case 2 reflects a technology life span change in Case 1. At the end of year 2 due to the increasing rate of technological obsolescence, the technology life span is decreased from 7 to 5 years. Table 2 shows the creation of a reserve deficit of $11 at the end of the second year when this change is recognized. This deficit is seen to slowly decrease over time resulting from the use of a remaining life depreciation rate.

The following conclusions can be made for the single asset and single vintage cases: (1) a reserve imbalance is created from a change in the technology life span and (2) the tracking of the reserve imbalance shows the expected annual decrease resulting from applying a remaining life depreciation rate.

The following cases show that in other than the single asset and single vintage case a reserve imbalance can be generated without a change in technology life span through normal investment and retirement activity. Cases 3, 4 and 5 analyze retirement activity and Cases 6 and 7 analyze investment activity.

Case 3 reflects a single vintage and multiple assets example where the assets retire at different times. One asset retires at the end of year 3; the other at the end of the technology life span. Table 3 shows that a deficit is created the year after the first retirement when the remaining life begins decreasing at a slower rate. This deficit again decreases over the remaining life.

Case 4 addresses the significant issue of a delay in actual retirements from those used to estimate the service and remaining lives. Table 4 shows that a delay in scheduled retirement creates a surplus in the year following the year in which the retirement was originally projected. The surplus increases until the retirement occurs and then decreases over the remaining life.

Case 5 illustrates the result of decreasing the technology life span in the multiple asset and single vintage example. Table 5 shows that as expected a deficit develops with a shortened technology life span. The deficit unlike Case 2 does not decrease over its remaining life. Rather it increases in year 4 after the retirement of first asset. This result is consistent with Case 3 in that a retirement generates a deficit.

Cases 3, 4 and 5 illustrate that in tracking a reserve imbalance a retirement generates a deficit without a change in technology life span. This deficit would be in addition to that generated by a technology life span change. However, if retirements are delayed from those implicit in the development of the service and remaining lives, a surplus will occur. These counter balancing effects could create a situation in which a large deficit caused by a shortened technology life span could be quickly eliminated because of delayed retirements. Although retirements can be delayed for operational considerations, the loss in service capacity has still occurred and it is the loss in service capacity which should be reflected in the depreciation accruals not physical retirements.

Case 6 introduces an investment add of $100 at the end of year 3. The technology life span remains unchanged. The average service life and average remaining life are calculated using accrual weighting. Table 6 shows that a surplus is created in the first year. It peaks in the year the investment addition is made and it is eliminated over the remaining life.

Case 7 illustrates an example of an investment add and a technology life span decrease. Table 7 shows the surprising result that a deficit is not created as a result of a technology life span decrease.

CONCLUSION

The cases analyzed have illustrated that the calculations used to track a reserve imbalance can lead to misleading conclusions since normal retirement and investment activity can cause the creation of a reserve imbalance without a change in technological obsolescence.

ACKNOWLEDGMENT

Many thanks to Jerry Weinert, LeRoy Murphy and Patty Blatherwick for their helpful comments.

RESERVE IMBALANCE
SINGLE ASSET - SINGLE VINTAGE

	1	2	3	4	5	6	7
GROSS INVESTMENT	100	100	100	100	100	100	100
ADD	0	0	0	0	0	0	0
RETIREMENTS	0	0	0	0	0	0	100
SERVICE LIFE	7.00	7.00	7.00	7.00	7.00	7.00	7.00
REMAINING LIFE	7.00	6.00	5.00	4.00	3.00	2.00	1.00
DEPRECIATION EXP	14	14	14	14	14	14	14
BOOK RESERVE	14	29	43	57	71	86	0
REQUIRED RESERVE	14	29	43	57	71	86	0
IMBALANCE	0	0	0	0	0	0	0

TABLE 1

RESERVE IMBALANCE
SINGLE ASSET - SINGLE VINTAGE
LIFE CHANGE

	1	2	3	4	5
GROSS INVESTMENT	100	100	100	100	100
ADD	0	0	0	0	0
RETIREMENTS	0	0	0	0	100
SERVICE LIFE	7.00	7.00	5.00	5.00	5.00
REMAINING LIFE	7.00	6.00	3.00	2.00	1.00
DEPRECIATION EXP	14	14	24	24	24
BOOK RESERVE	14	29	52	76	0
REQUIRED RESERVE	14	40	60	80	0
IMBALANCE	0	-11	-8	-4	0

TABLE 2

RESERVE IMBALANCE
MULTIPLE ASSETS - SINGLE VINTAGE
RETIREMENTS

	1	2	3	4	5	6	7
GROSS INVESTMENT	100	100	100	50	50	50	50
ADD	0	0	0	0	0	0	0
RETIREMENTS	0	0	50	0	0	0	50
SERVICE LIFE	5.00	5.00	5.00	5.00	5.00	5.00	5.00
REMAINING LIFE	5.00	4.00	3.00	2.00	1.50	1.00	0.50
DEPRECIATION EXP	20	20	20	10	10	10	10
BOOK RESERVE	20	40	10	20	30	40	0
REQUIRED RESERVE	20	40	10	35	40	45	0
IMBALANCE	0	0	0	-15	-10	-5	0

TABLE 3

RESERVE IMBALANCE
MULTIPLE ASSETS - SINGLE VINTAGE
RETIREMENTS DELAYED

	1	2	3	4	5	6	7
GROSS INVESTMENT	100	100	100	100	100	50	50
ADD	0	0	0	0	0	0	0
RETIREMENTS	0	0	0	0	50	0	50
SERVICE LIFE	5.00	5.00	5.00	5.00	5.00	5.00	5.00
REMAINING LIFE	5.00	4.00	3.00	2.00	1.50	1.00	0.50
DEPRECIATION EXP	20	20	20	20	20	10	10
BOOK RESERVE	20	40	60	80	50	60	20
REQUIRED RESERVE	20	40	60	70	30	45	20
IMBALANCE	0	0	0	10	20	15	0

TABLE 4

RESERVE IMBALANCE
MULTIPLE ASSETS - SINGLE VINTAGE
LIFE CHANGE WITH RETIREMENTS

	1	2	3	4	5
GROSS INVESTMENT	100	100	100	50	50
ADD	0	0	0	0	0
RETIREMENTS	0	0	50	0	50
SERVICE LIFE	5.00	5.00	4.00	4.00	4.00
REMAINING LIFE	5.00	4.00	2.00	1.00	0.50
DEPRECIATION EXP	20	20	30	15	15
BOOK RESERVE	20	40	20	35	0
REQUIRED RESERVE	20	50	25	44	0
IMBALANCE	0	-10	-5	-9	0

TABLE 5

RESERVE IMBALANCE
MULTIPLE ASSETS - MULTIPLE VINTAGES
ADD

	1	2	3	4	5	6	7
GROSS INVESTMENT	100	100	100	200	200	200	200
ADD	0	0	100	0	0	0	0
RETIREMENTS	0	0	0	0	0	0	100
SERVICE LIFE	5.09	5.09	5.09	5.09	5.09	5.09	5.09
REMAINING LIFE	5.09	4.73	4.32	4.00	3.00	2.00	1.00
DEPRECIATION EXP	20	20	20	35	35	35	35
BOOK RESERVE	20	39	59	94	129	165	100
REQUIRED RESERVE	7	15	21	82	121	161	100
IMBALANCE	13	24	38	12	8	4	0

TABLE 6

RESERVE IMBALANCE
MULTIPLE ASSETS - MULTIPLE VINTAGES
LIFE CHANGE WITH ADD

	1	2	3	4	5
GROSS INVESTMENT	100	100	100	200	200
ADD	0	0	100	0	0
RETIREMENTS	0	0	0	0	200
SERVICE LIFE	5.09	5.09	2.86	2.86	2.86
REMAINING LIFE	5.09	4.73	2.36	2.00	1.00
DEPRECIATION EXP	20	17	27	68	68
BOOK RESERVE	20	37	63	132	0
REQUIRED RESERVE	7	17	30	130	0
IMBALANCE	13	19	33	2	0

TABLE 7

PROVISION FOR DISMANTLEMENT OF FOSSIL-FUELED GENERATING STATIONS - PUC ACCEPTANCE

Patricia Lee

The concept of dismantlement relates to the ultimate physical demolition/removal/disposal from service of a generating unit offset by any attendant salvage from the removed assets. Historically, provision for dismantlement has been considered as part of the cost of removal component (negative net salvage) in the design of depreciation rates for production plants. The costs associated with this process have become a growing concern over the past decade due to their significant estimated levels. However, a look at historical depreciation rates shows how this component has been understated: a historic estimate for Florida companies of about 5% versus current dismantling study estimates of 20 to 40%.

Some states have now begun to investigate the ratemaking and accounting treatment for the dismantlement of fossil-fueled generating stations. In Florida, an investigatory docket was opened in 1989 for the purpose of establishing or confirming the Commission's policy concerning the appropriate ratemaking and accounting treatment of dismantlement costs. The purpose of this investigation was to quantify those costs associated with future dismantlement and disposal and then to decide whether the provision for these costs should continue through depreciation, through a funded reserve or through a combination of both. Staff found three fundamental policy issues that the Commission needed to address: 1) whether the estimated costs to dismantle fossil-fueled generating stations should be funded or remain unfunded; 2) how the dismantlement accruals should be calculated; 3) whether the annual dismantlement accruals should be based on a percentage rate to be applied to plant in service, or a levelized fixed dollar amount.

As a result of the proceeding, the Commission decided that the provision for dismantlement should continue to accumulate in an unfunded reserve but be maintained in a separate dismantlement reserve account. The annual dismantlement accrual is to be a levelized fixed annual dollar amount rather than being based on a rate to be applied to the gross investment of the plant. The accrual is to be determined based on future dollars discounted to current dollars and levelized using an average for the next four-year period based on yearly accruals forecasted using inflation indices. The escalation rates used to project future dollars shall be derived from the same set of indices using the most current "DRI Review of the U.S. Economy." These indices are the Compensation Per Hour Index for labor; the Intermediate Materials, Supplies, and Components Index for materials, supplies, and salvage; and the GNP Price Deflator Index for disposal. Since the time of the decision in this proceeding, companies have justified the use of the Metal and Metal Products Index to inflate salvage rather than the Intermediate Material, Supplies, and Components Index. Any company specific adjustments to these escalation indices can be proposed with justification and support in subsequent studies. Further, the provision for dismantlement should be reviewed and revised, as necessary, but at least once every four years in connection with each company's required comprehensive depreciation review.

The subject of dismantlement and quantifying the associated costs is still in the formative stages. Through continued site specific dismantlement studies, recognition of improvements in technology and regulatory changes, and reevaluation of alternative methodologies and updated inflation rate forecasts, more accurate forecasts will be made. It is recognized that dismantlement costs can vary substantially from unit to unit due to such things as accessibility, presence of contaminants, and the physical nature of the unit.

Dismantlement cost studies submitted to the Commission staff in 1989, as well as those currently being received, are premised on the concept of ultimate physical removal, disposal, and site restoration, minus any attendant gross salvage upon final retirement of the site or unit from service. While the timing of ultimate removal certainly remains a question and is dependent on a number of factors, including major overhauls that extend the expected life of the unit, there will undoubtedly come a time this action will be necessary and site restoration will be required. These related costs are the subject of dismantlement.

Major cost activities of dismantlement that companies have identified include such items as the dismantlement of structures and boiler plant equipment, removal and disposal of asbestos and other hazardous materials, and the reclamation of ponds and site restoration. Some activities will vary by site and by company and will need to be identified and quantified in subsequent dismantlement studies.

The following dismantlement costs were estimated in 1990 by each Florida regulated company:

FPL	$134,940,992
FPC	266,273,000
TECO	87,000,000
GULF	128,320,000

Within the past year, updated dismantlement studies have been received for FPC and GULF. Cost estimates in terms of 1993 dollars for these companies are:

FPC	196,800,000
GULF	138,200,000

In reviewing the updated studies, it was identified that FPC's estimated costs for dismantlement have decreased because the previous study was not site specific. The costs estimated for the dismantlement of all FPC fossil plants, including combustion turbines, were based on a study of the estimated dismantlement costs of the Bartow steam plant. Because the asbestos abatement costs at the Bartow plant are relatively extensive, this method assumed asbestos removal costs at each of the other sites to also be costly. In fact, of the $266.3 million estimated for dismantlement, about 21% or $56.8 million was attributed to the removal and disposal of asbestos at the time of dismantlement. Subsequently, the site specific studies performed for the 1994 review showed significantly lower costs for removing and disposing of asbestos - $31.2 million. Another reason for the decrease in estimated costs has been attributed to the use of power-operated shears for the steel/metal cutting. The 1989 study assumed a much more labor intensive approach using a traditional cutting torch.

Public Health and Safety Risks

In the 1989 proceeding, the Commission found that no more public health and safety risks were associated with the dismantlement of fossil-fueled generating stations than were associated with the dismantlement of other large industrial facilities. Environmental concerns requiring consideration are removal and disposal of asbestos and coal storage areas, fuel oil facility requirements, nuclear detectors, and slag ponds. It is interesting to note, however, that there are currently no federal or state laws or regulations that require the total dismantlement of a fossil unit. With the exception of fuel oil storage tanks, the unit can be retired from service with the building structures left in place if maintenance surveillance and security are provided. Naturally, companies will be subject to local ordinances that dictate the maintenance of the appearance of the site, the public health and safety protection, and the preservation of the property value of neighboring property owners.

Funded versus Unfunded Reserve

One of the main issues concerning fossil fuel dismantlement is whether the reserve should be funded, as nuclear decommissioning costs are, or remain unfunded. Annual contributions should recover the costs of dismantlement from each generation of ratepayers that are receiving the benefit from the related assets with the result that at the time of the final plant removal and disposal, the costs of dismantlement have already been recovered from the ratepayers that have had the use of the plant. The alternative is to charge future ratepayers for the dismantlement of a plant from which they may not receive any service. The economic impact on the ratepayer favors an unfunded reserve in that this method defers external capital requirements because the utility can use the amount charged to the dismantlement reserve for other company purposes. The utility collects the funds for dismantlement from the current customers and uses them for other items thus temporarily reducing the utility's need for externally raised capital. If the revenues are invested in a funded reserve, the company loses the opportunity to reduce its external financing. The rate earned on the fund will most likely be less than the company's cost of capital; therefore, there is a cost to the ratepayer.

An unfunded reserve will cause an intergenerational inequity for the future ratepayer if the cost of external capital at the time of dismantlement is unfavorable because an unfunded approach, the utility will have to raise the funds for dismantlement during the actual dismantlement stages. If the cost of debt and equity is high at the time of dismantlement, the future ratepayer may have to pay for any incremental increases in the capital structure. However, there is just as much probability that debt and equity costs will be lower at the time of dismantlement. The unfunded approach means cash flow resulting from the dismantlement reserve, produced by the dismantlement accrual, may be invested in other rate base assets.

A pertinent question to ask is, "Will the cost at the time of dismantlement place too much financial pressure on the utility?" Currently, Florida companies maintain that dismantlement costs are relatively small when compared to the capital budgets of each company and therefore will have very little impact. If there will not be a financial strain at the time of dismantlement, then an unfunded reserve is the best option.

An alternative to consider is to fund a portion of the cost. If nuclear decommissioning is risky enough to warrant 100% funding, where would fossil fuel dismantlement be on the "riskiness" scale?

Companies could employ a risk aversion factor. The factor would take into account how much should be funded to relieve the unpredicted costs such as contingencies at the time of dismantlement.

Since it appears that the safety, health, and cash flow risks associated with dismantlement are minimal, the Commission decided that annual provisions for dismantlement should continue to be accrued in the depreciation reserve. In the future, if risks are recognized it may become appropriate to fund in Florida.

Determination of Annual Accrual

In determining the annual dismantlement accrual, an initial payment is increased by the forecasted rate of inflation and then levelized over a four-year period. Although site-specific studies should identify unique costs associated with each plant, the homogeneous nature of the labor involved and the materials used in the dismantlement process indicates that the same inflation indices should be used for all plants to determine the appropriate escalation rate. The index for labor used is the Compensation Per Hour Index which measures total compensation including benefits, divided by total hours paid. The Intermediate Materials, Supplies and Components Index is used for materials and equipment. Recognizing that disposal includes various categories encompassing burial and shipping, a general index such as the GNP Price Deflator Index is used to inflate disposal costs. The remaining component to be addressed is salvage. Since the 1989 generic proceeding, the Commission has accepted use of the Metal and Metal Products Index for inflating the salvage value (material scrap) of the plants rather than the Intermediate Materials, Supplies and Components Index. Discussions with company and DRI representatives indicate a high correlation between price movements for metals and metal products and scrap metal.

The "DRI Review of the U.S. Economy - Long Range Focus" is relied on for the forecasts of the inflation indices just described. DRI is a common source for a wide variety of forecasted statistics that is generally recognized throughout the financial community. In addition, it is the forecast service used by the Revenue and Economic Analysis Unit of the Office of Planning and Budgeting in the Florida Governor's Office. It is also the forecast service used in Florida for nuclear decommissioning.

The accrual should be calculated so that each generation of ratepayers is treated fairly, which means it should increase at the rate of inflation. Calculating an accrual based on the current dollar estimate of dismantlement and then increasing that initial accrual by the rate of inflation will account for the compounding effect of inflation on the accrual. However, the accumulation of this annual amount will not match the total future dollars needed for dismantlement because the absolute dollars of inflation on the accrual will not match the absolute dollars of inflation on the current dollar estimate of dismantlement. It is the inflation on the total cost of dismantlement, not on the accrual, that must be taken into account.

Dismantlement Accrual versus Rate

Use of an annual fixed dollar accrual amount or a dismantlement rate to be applied to the investment can achieve that same result as long as the amount to be recovered is spread over the estimated period of time the plant is expected to be serving the public. A fixed dollar amount allows for a levelized accrual which is consistent with the Commission's policy for the annual accrual amounts associated with nuclear decommissioning. Use of a percentage rate to be applied to the gross plant investment will result in expense fluctuations due to annual activity.

Periodic Reviews

Electric utilities are required by rule to file comprehensive depreciation studies at least once every four years. A review of dismantlement costs relate to costs of removal and has been naturally considered part of the depreciation study review process. It is logical, therefore, that the provision for dismantlement be reviewed in connection with each company's required depreciation study review. The dismantlement studies should be site specific and should reflect changes in estimates and inflation, changes in regulatory or environmental requirements, and account for any newly discovered public health and safety risks.

ADEQUACY OF RECORDING AND RECOVERY OF SALVAGE AND COST OF REMOVAL

John S. Ferguson
Deloitte & Touche LLP
Dallas, Texas

The options for recording salvage and cost of removal include accrual accounting and cash accounting, and accrual accounting can be through depreciation or through amortizing a liability. Depreciation accounting recognizes the salvage expected to be received at the end of life and the cost of removal expected to be incurred as being directly related to the underlying assets. Non-regulated entities sometimes utilize cash accounting, because net salvage (salvage less cost of removal) is not material, or liability accounting rather than depreciation accounting. The Uniform Systems of Accounts (USofA) of regulators specify that regulated entities incorporate salvage and cost of removal into depreciation rates, through accrual accounting. While accrual accounting is either specified or implied by USofA's, some regulators circumvent this requirement by imposing a cash basis or some even more deferred process.

The Securities and Exchange Commission (SEC), through Staff Accounting Bulletin No. 92 (SAB 92), requires that public entities record and disclose environmental cleanup costs as a liability on a gross basis (i.e., without an offset for claims or regulatory promises of recovery). This has raised the threshold of awareness of how utility cost of removal is recorded and disclosed, and may lead to more widespread use of accrual accounting through depreciation or through liability accounting for some classes of assets. SAB 92 has particular significance to utilities, because it has led to a Financial Accounting Standards Board (FASB) project to evaluate whether the decontamination portion of decommissioning nuclear power plants should be recorded as a liability. This project could result in expanding the availability of liability accounting to utilities.

The purpose of this discussion is to evaluate the adequacy of accounting for salvage and cost of removal by electric and gas utilities by exploring its consistency with the accounting and regulatory framework for depreciation.

THE ACCOUNTING AND REGULATORY FRAMEWORK

The basic accounting framework for recording salvage and cost of removal is provided by the American Institute of Certified Public Accountants (AICPA), which states that:

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

The regulatory framework is provided by the USofA's promulgated by state and federal regulatory bodies, and by the regulatory principle known as *intergenerational equity.* Regulatory definitions of depreciation list several causes of depreciation to be recognized in depreciation rates and state that depreciation is *loss in service value.* Salvage and cost of removal are incorporated through the definition of service value, which is stated to be original cost less *net salvage value.* Net salvage value is *salvage value less cost of removal,* and the gas utility USofA of the Federal Energy Regulatory Commission (FERC) defines salvage value and cost of removal as follows:

> Salvage value means the amount received for the property retired less any expenses incurred in connection with the sale or in preparing the property for sale, or, if retained. the amount at which the material recoverable is chargeable to materials and supplies, or other appropriate account.
>
> Cost of removal means the cost of demolishing, dismantling, tearing down or otherwise removing gas plant, including the cost of transportation and handling incidental thereto.

Cost of removal is a generic term, as it refers to the costs incurred to physically remove <u>or to safely abandon property in place</u>.

Of particular importance to adequate depreciation rates is the AICPA definition requirement that depreciation accounting be *systematic and rational.* To comply with this requirement, recording of depreciation should match the usage of the underlying assets, which for the Group Concept of depreciation practiced by utilities is accomplished through the pattern of depreciation rates. The usage for some types of assets is best measured by time, and for other types such as power plants is often best measured by production. No matter how life is measured, a pattern of depreciation that matches usage is the *straight-line* method. A pattern that front-end loads depreciation relative to usage is the *accelerated* method and a pattern that back-end loads is the *deferred* method. Since the straight-line method matches to asset usage, it produces intergenerational equity, whereby customers pay for asset usage as it actually occurs.

It is clear that these definitions deal with three depreciation components, *investment, salvage* and *cost of removal,* each of which with accrual accounting is recorded over the life of the asset or group of assets. For utilities it is a group of assets having some average life, and retirements are recorded with the assumption that property is fully depreciated at the time of retirement. The Group Concept of depreciation accounting that is used by utilities has two fundamental differences from the Item (or Unit) Concept commonly used by non-regulated entities, because with the Group Concept:

> Depreciation does not stop when property items reach an age equal to the service life; and,
>
> Losses are not recorded when property items are retired at an age less than the service life.

The accumulated provision for depreciation (reserve) is typically shown as a contra-asset on the asset side of the balance sheet, but there may be depreciation-like items on the liability side, such as obligations for decommissioning nuclear generating stations or for environmental clean-up. Notes to utility financial statements often disclose that salvage and cost of removal are handled through depreciation and the composite depreciation rate, but do not disclose the portions of the composite rate that are for salvage and cost of removal. However, the SEC through SAB 92 requires certain additional disclosures for nuclear decommissioning and environmental clean-up obligations.

INCORPORATION OF NET SALVAGE INTO DEPRECIATION RATES

Salvage and cost of removal are usually incorporated into depreciation rates through use of either the whole life or the remaining life calculation formula. The whole life rate formula is:

$$\text{Rate} = \frac{\text{Plant Balance - Average Net Salvage}}{\text{Average Service Life}}$$

The most commonly referred to remaining life rate formula is:

$$\text{Rate} = \frac{\text{Plant Balance -Future Net Salvage -Book Reserve Balance}}{\text{Average Remaining Life}}$$

Expressing the formula numerator terms as percent of the depreciable plant balance and the denominator term in years produces rates in percent. For example, with the plant balance representing 100%, salvage of 25% of the plant balance, cost of removal of 50% (negative 25% net salvage factor) and an average service life of 25 years, the whole life rate is 5.00% (125%/25 years).

While it is most common to utilize a single depreciation rate that incorporates all three rate components, there are several examples of segregation of the net salvage component:

> The external funding requirement of the Nuclear Regulatory Commission (NRC) has segregated the terminal net salvage component for nuclear generating units;
>
> The FERC typically requires segregation of the net salvage component for offshore facilities;
>
> Florida requires segregation of the terminal net salvage component for steam generating units;
>
> Pennsylvania requires segregation of the net salvage component for all property; and,
>
> The Federal Communications Commission has considered in the past, and decided against, segregation of the net salvage component for all property.

When segregated into three components, the above composite rate of 5.00% becomes 4.00% for investment, -1.00% for salvage and 2.00% for cost of removal.

The salvage and cost of removal factors for rate calculations are typically determined through conducting a depreciation study, whereby the salvage and cost of removal recorded in the past are related to the original cost of the retired property. When past experience is unavailable or misleading, specific removal or abandonment estimates may be required, such as is commonly done for power plants. When past experience is available, the analysis measures *past net salvage.* However, *average net salvage* is required to calculate whole life rates, and *future net salvage* is required for remaining life rates. Future net salvage is that expected when all of the surviving property is retired. Average net salvage is the average of the past and future net salvage.

When expressed as a ratio of the original cost of the retired property, salvage and cost of removal are sensitive to the age of that property, which often causes past net salvage to be different from the future net salvage. Removal or abandonment of property is labor intensive and the time required will be sensitive to the type of property and its location, but not to its age. Therefore, labor and equipment cost increases will cause today's costs expressed as a ratio of original cost to be higher for old property than for young property of the same type. Salvage is also sensitive to age, but the relationship is different because it is caused by a shift from high value reuse to low value scrap as property ages. As a result, the salvage, cost of removal and net salvage relationships shown on Figure 1 are common for electric property. For most gas property salvage is nil, causing the net salvage line and the cost of removal line to be nearly identical. When the underlying data are aged, curves such as depicted on Figure 1 will be determined by the analysis. When the data are unaged, as is most common, analyses determine individual points on the curves.

EVALUATION OF ADEQUACY

Past net salvage is rarely the same as future net salvage, so analyses of unaged data that determine points on the curves depicted on Figure 1 will often not provide net salvage factors that are suitable for depreciation rate calculations. This situation occurs because cost changes since the original installation and system growth cause the average dollar age of retired property to be young. When construction records are used to estimate the vintage of retirements, it is typical for retirements of electric distribution property to be of an age one-quarter to one-third of the average service life, and the age of gas distribution property to be one-third to one-half of the average service life. Therefore, the measured salvage and cost of removal points on the curve will be at ages less than the average service life points required for whole life rates or the probable life points (age of surviving property at retirement) required for remaining life rates.

This situation will even occur when the use of first-in-first-out aging is assumed for pricing retirements, causing the age of retirements to be about the same as average service life or probable life. The resulting cost of removal ratios will be suitable for rate calculations, but the salvage ratios will be overstated, thereby overstating the net salvage. The salvage overstatement is due to the actual age of the retired items being younger than is assumed for retirement pricing, causing the mix of high value reused items to be much higher than will occur at the age assumed for pricing.

It is not difficult to use past experience to estimate the average net salvage needed for whole life rates or the future net salvage needed for remaining life rates. However, regulators are seldom asked to approve depreciation rates based on average or future net salvage, and when asked their reaction is often negative. This reluctance commonly keeps electric and gas distribution utility depreciation rates for Transmission and Distribution Plant from reflecting the entire removal or abandonment obligation.

A somewhat similar and more severe situation sometimes occurs if regulators require handling salvage and cost of removal on a cash basis. This has occurred in Missouri and New Jersey, through a process made to look like accrual accounting. However, an Examiners Report in settled New Jersey proceeding recognized that this process violates the FERC USofA requirement that utilities practice accrual accounting, and Missouri has adopted the 1992 version of the FERC USofA. Therefore, these two states may be on the road to allowing depreciation rates that more adequately reflect removal or abandonment obligations.

For steam generating stations, demolition experience is usually for property old enough to produce average or future net salvage indications. However, two major influences other than age often keep these indications from being meaningful:

> Experience may be prior to the stringent regulations for handling insulation containing asbestos and other hazardous materials; and,
>
> Experience may be for stations having self-supporting boilers that are less costly to

demolish than are the top-hung boilers at most existing stations.

Site-specific cost estimates are useful, and perhaps necessary, when history is not meaningful. Most utilities use site-specific estimates to calculate their contributions to nuclear decommissioning trust funds. Many utilities have prepared such estimates for steam generating stations, and those in the public record indicate net removal costs (negative net salvage) of about $30/kW for gas and oil units and $40/kW for coal and lignite units at the 1993 price level. For the nearly 400 units reflected in the estimates the author has collected, the terminal net salvage is negative 40% to 50%, assuming that demolition occurs during the year the last unit at each station is retired. Estimates for engines and combustion turbines show negative 5% to 10% net salvage, and estimates are just beginning to appear for hydro plants.

The definitions of salvage value and cost of removal require that site-specific estimates be in terms of the expected price level at the time of removal or abandonment. However, with the exception of nuclear stations, regulators seldom will allow future cost escalation to be reflected in depreciation rates and sometimes utilities do not even bother to ask for it. This reluctance commonly keeps electric utility depreciation rates for steam generating stations from reflecting the entire removal obligation. Abandonment is not an option, because of building code requirements for demolition to eliminate risk to public safety.

Missouri has gone beyond denying the reflection of future cost escalation in non-nuclear terminal net salvage estimates by denying any reflection of terminal net salvage in the depreciation rates for steam generating stations. Other regulators express disbelief that generating stations will be demolished, and sometimes claims are made that the high value of a station site precludes the need to consider demolition costs in depreciation rates. This disbelief is inconsistent with the fact that stations are commonly demolished to make room for new units or to eliminate the safety hazard of an abandoned site, and the high site value claim is inconsistent with USofA requirement that gains on sale of land be recorded separately from the accumulated provision for depreciation. It is common for regulators to authorize contributions to nuclear decommissioning funds that are less than requested by the utilities. This is done by such things as adopting cost estimates that exclude the demolition of the remaining non-radioactive structures and site restoration, changing assumptions such as for work difficulty or crew size, eliminating or reducing contingencies without any compensation for the resulting changed estimate conditions, and changing assumptions about cost escalation and trust fund earnings. Situations like these commonly keep electric utility depreciation rates for generating stations from reflecting the entire removal obligation.

As a result of a court case, Pennsylvania excludes net salvage from depreciation rates and allows actual salvage and cost of removal other than the terminal net salvage for nuclear stations to be amortized over the five years after incurrence. Arkansas has had the practice of requiring zero net salvage for calculating remaining life depreciation rates for property other than power plants, which has the effect of excluding recovery of the net salvage obligation for surviving property and giving back to customers any prior accruals for salvage and cost of removal. Thus, Arkansas requires that future depreciation rates be adjusted for the costs of removing or abandoning property after such costs have been incurred, causing future customers to bear some of the costs of property never used to provide service to them.

IMPLICATIONS OF INADEQUACY

The existence and/or extent of inadequacy of recording and recovery of net salvage and the implications therefrom are utility specific, but some broad generalities are possible concerning the effect on depreciation rates:

> The average net salvage reported as being used for steam generating units is about negative 10% and the average depreciation rate is about 3.25%. If the appropriate amount is that reflected in the site-specific estimates (negative 40% -50%), the average rate excluding any catch up for reserve position would increase by about 35%; and,
>
> Experience suggests that depreciation rates reflecting terminal net salvage for electric transmission lines and electric and gas distribution lines and services could increase significantly.

As part of their recent discontinuations for financial reporting purposes of Statement of Financial Accounting Standards (SFAS) No. 71, Accounting for the Effects of Certain Types of Regulation, the regional bell operating companies have recorded asset impairments by increasing their accumulated provisions for depreciation, and have significantly decreased their depreciable lives. U. S. West was first (late 1993) and increased its accumulated provision by nearly 60%. These actions should be of more than passing interest to electric and gas utilities, because the after-tax effect of a reserve increase the percentage of U. S. West's would be more than the electric industry retained earnings (28% of the reserve at December 31, 1994) and about equal to the gas distribution industry retained earnings (41% of the reserve at December 31, 1993). The electric and gas distribution industry total equity are about equal to their accumulated provisions for depreciation.

In March 1995, the FASB issued SFAS No. 121, Accounting for the Impairment of Long-Lived Assets and for Long-Lived Assets to Be Disposed Of, which covers the identification, measurement and recording of asset impairments. Impairment exists if the future nominal cash flow of an asset or group of assets is less than the carrying amount, and the magnitude of an impairment is based on the discounted future cash flow. Deferral of recording net salvage will influence asset impairment, because:

> Carrying amounts include the accumulated provision for depreciation as a decrease and future net removal or abandonment costs as an increase; and,
>
> Future cash flows include the future net removal or abandonment costs as an expenditure.

Inadequate reflection of the typically negative utility future net salvage in past depreciation rates increases the carrying amount by decreasing the book reserve. Of course, the full amount of estimated future net salvage is to be used for determining impairment.

IMPACT OF DEFERRAL ON CUSTOMERS

Rate base regulation causes the deferral of recording and recovery of salvage and cost of removal to inflate the total costs customers are required to bear. This situation is easily demonstrated by power plants, using $40/kW for demolition, five percent inflation, and a 500MW unit having a life span of 35 years. This equates to a demolition cost of $20 million at the current price level and $110 million at the price level at retirement. Figure 2 illustrates three approaches for incorporating net salvage into depreciation rates; straight-line, sinking fund and recognizing inflation as it occurs. Figure 2A shows the annual depreciation expenses and Figure 2B shows the accumulated provision for depreciation. Figure 2B demonstrates that the differences illustrated are solely in the pattern of recording depreciation, and that the deferrals from sinking fund and recognizing inflation as it occurs are quite similar. The straight-line depreciation expense pattern in Figure 2A best matches usage, as generating units typically operate at a constant or decreasing rate over their lifetime.

The three patterns of revenue requirements produced by these depreciation patterns are shown on Figure 3, with the annual revenue requirements on Figure 3A and the cumulative revenue requirements on Figure 3B. As is evident from Figure 3B, the deferrals through sinking fund and recognizing inflation as it occurs significantly increase the costs to be borne by customers. The interest rate used for the sinking fund scenario is the rate that causes the annual revenue requirements to be constant and to be equal to the annuity portion of the annual depreciation expenses. A higher interest rate will cause the annual revenue requirements to increase each year, thereby causing the cumulative revenue requirements to curve upward and to total more than shown on Figure 3B. A lower interest rate will cause the annual revenue requirements to decrease each year, thereby causing the cumulative revenue requirements to curve downward and to total less than shown on Figure 3B. In fact, straight-line can be thought of as a special case of sinking fund using a zero interest rate.

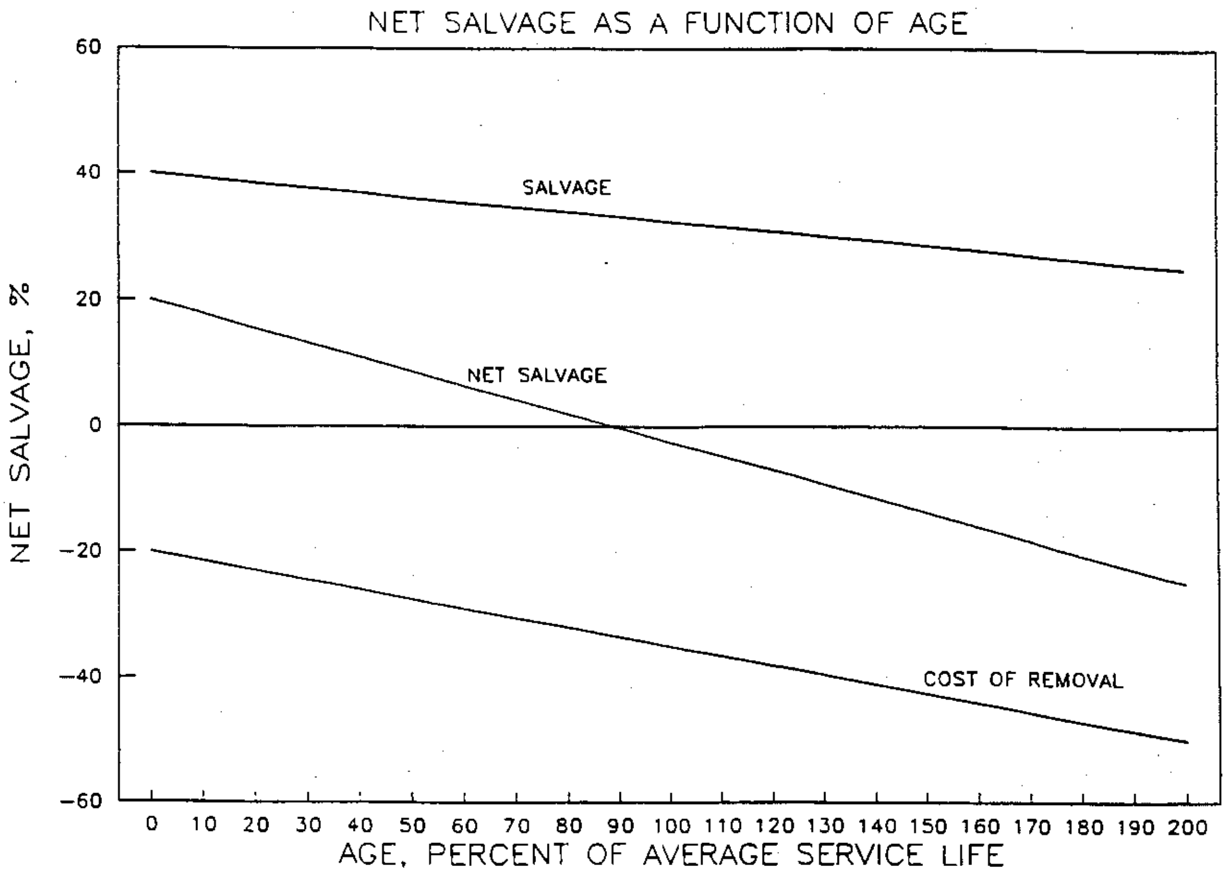
Sinking fund depreciation is not common and is not well understood. It looks like a bank account, but is not a bank account. The interest is not real, it is merely a technique to produce annual depreciation expenses that increase each year. Such a pattern does not match the typical usage pattern of generating units, so is not rational, and SFAS No. 92 states that sinking fund has the attributes of a phase-in plan. Sinking fund was sometimes used for nuclear decommissioning prior to the Nuclear Regulatory Commission requiring external funding, and is used in Florida for the terminal net salvage of steam generating units. Sinking fund can be handled two ways in regulatory proceedings. The way known as *sinking fund* is to include only the annuity component of annual depreciation expenses in revenue requirements and to not make a rate base deduction for the accumulated provision for depreciation. The other way is known as *modified sinking fund,* and includes both the annuity and interest components of depreciation expenses in revenue requirements and a rate base deduction for the accumulated provision for depreciation. Use of the after-tax cost of capital as the interest rate causes the sinking fund and modified sinking fund approaches to produce identical revenue requirements for net salvage. For any other interest rate, they will produce different revenue requirements. Which of the approaches is chosen for regulatory purposes has no effect on the recorded annual depreciation expenses.

CONCLUSION

These examples of the reactions of regulators to the salvage and cost of removal components of depreciation suggest inadequate consideration of the obligation of electric and gas utilities to remove or safely abandon their property in place. It is time for utilities and their regulators to more adequately incorporate removal or abandonment obligations into depreciation rates. The long-term benefits to customers of adequate incorporation are apparent from Figure 3B, as the utility will become a lower cost service provider.

Implementation of SFAS 121 for identifying asset impairment will require real estimates of future net salvage that will clearly illustrate the extent of past depreciation deferrals. Of course, if impairment is found past deferrals become moot, as the depreciable base will change and real future net salvage will be adopted for depreciation purposes. Further, if the current FASB project concerning liability accounting for cost of removal reaches SFAS status, there will be detailed financial statement disclosures concerning the extent and funding adequacy of removal or abandonment obligations.

Figure 1



NET SALVAGE AS A FUNCTION OF AGE
60
40
20
0
-20
-40
-60
NET SALVAGE, %
SALVAGE
NET SALVAGE
COST OF REMOVAL
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
AGE, PERCENT OF AVERAGE SERVICE LIFE

Figure 2A

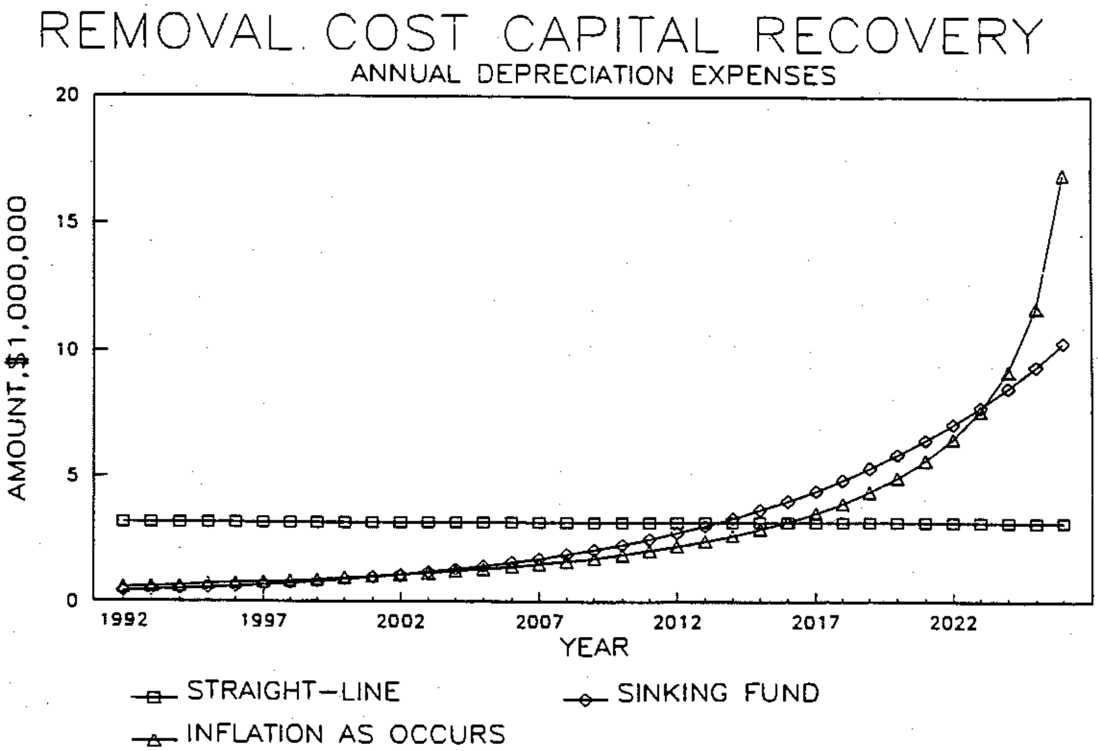


Figure 2B

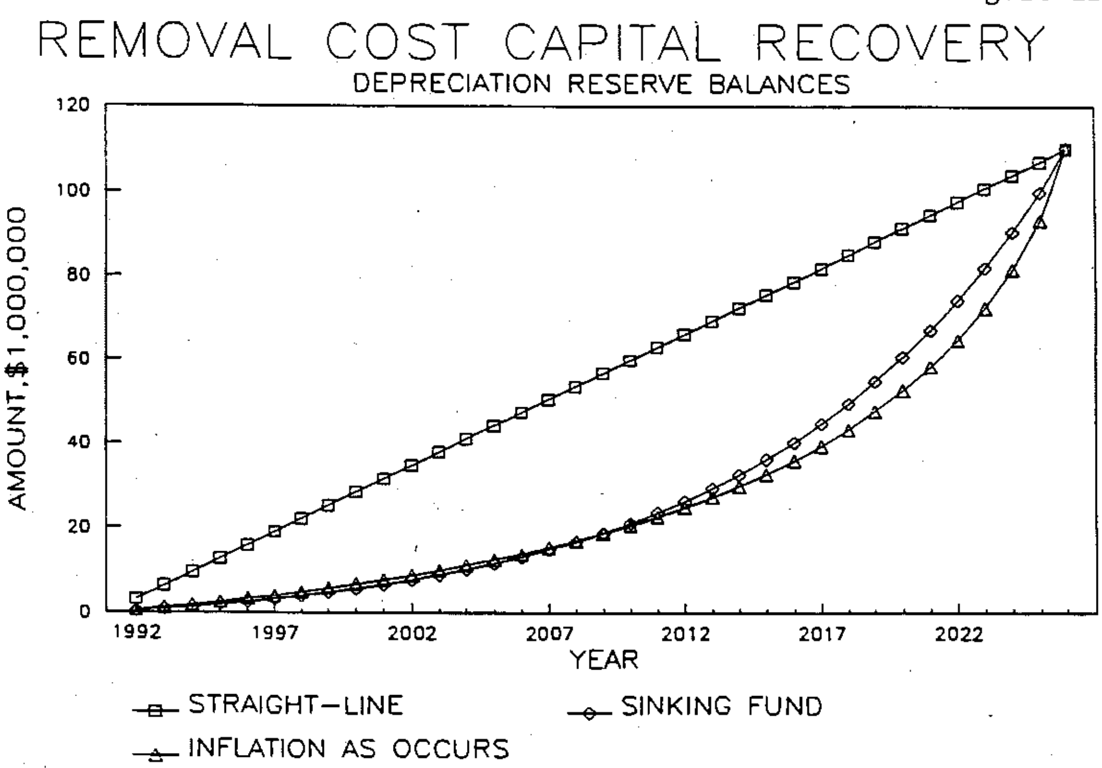


Figure 3A

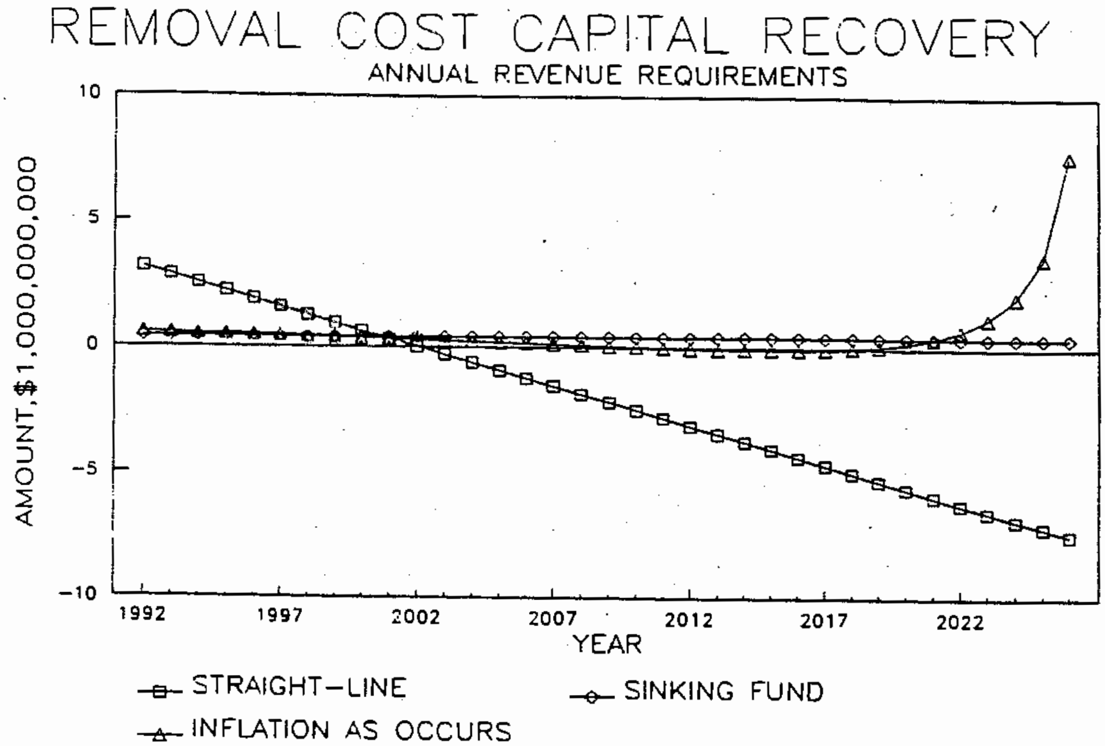
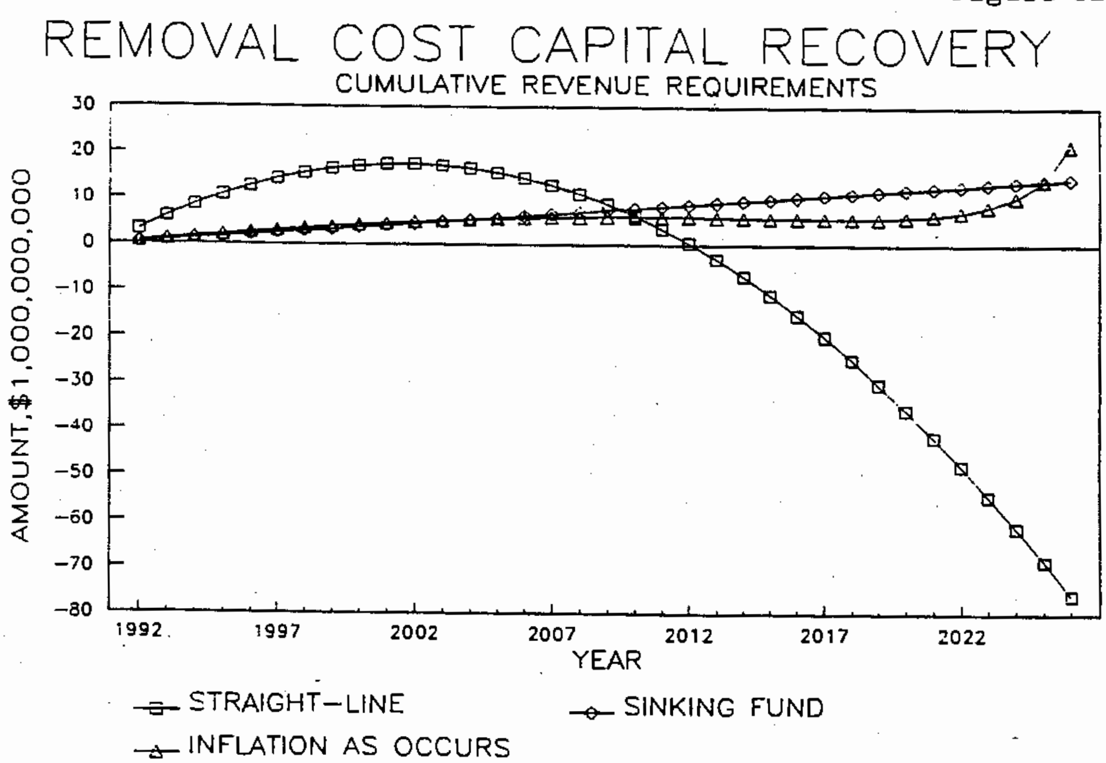


Figure 3B



COMMENTS ON USING LIVES FROM LIFE CYCLE ANALYSIS IN REMAINING LIFE RATE DEVELOPMENT

RALPH BJERKE
ED TEL
EDMONTON, ALBERTA

Gail E. Low's paper in the 1993 Journal concludes that life cycle analysis produces a remaining life which is compatible with vintage group methodology. The following comments are presented in the context of my article entitled "Product Life Cycles: A New Approach" which appeared in the same Journal.

It may be true that the calculation of average remaining life (ARL) using life cycle analysis is comparable to vintage group methodology for gross additions capitalized for one vintage but this does not hold true for subsequent additions. Vintage group is generally associated with mass properties where retirements are age dependent whereas life cycle analysis is associated with mass-integrated properties where retirements occur around the average year of final retirement. This difference in retirement profiles can have a major impact on how the depreciation expense is calculated even if the average remaining lives are the same.

The difference can be numerically illustrated by the example given by Gail Low. As he explains, the average remaining life at age 2 is 1.8 years. If another $6 investment had been capitalized at year 1, the composite ARL at year 2 would be 2.18 years as shown in figure 1. This assumes that both items have the same life expectancy and dispersion.

In the case of mass-integrated properties, however, an additional $6 capital expenditure at year 1 means that the ARL as measured from year 2 remains unchanged at 1.8 years because the average year of final retirement must remain at 3.5 years. To depreciate the second addition requires a survivor curve with an average service life of 2.5 years and a wider dispersion as shown in figure 2. This represent the demise phase of a product life cycle as commonly characterized by the Fisher-Pry model.

In essence, the fundamental difference between the two methods is the transitory nature of the survivor curve. For mass properties, it tends to move with the addition of plant whereas for mass-integrated properties, the survivor curve remains stationery.

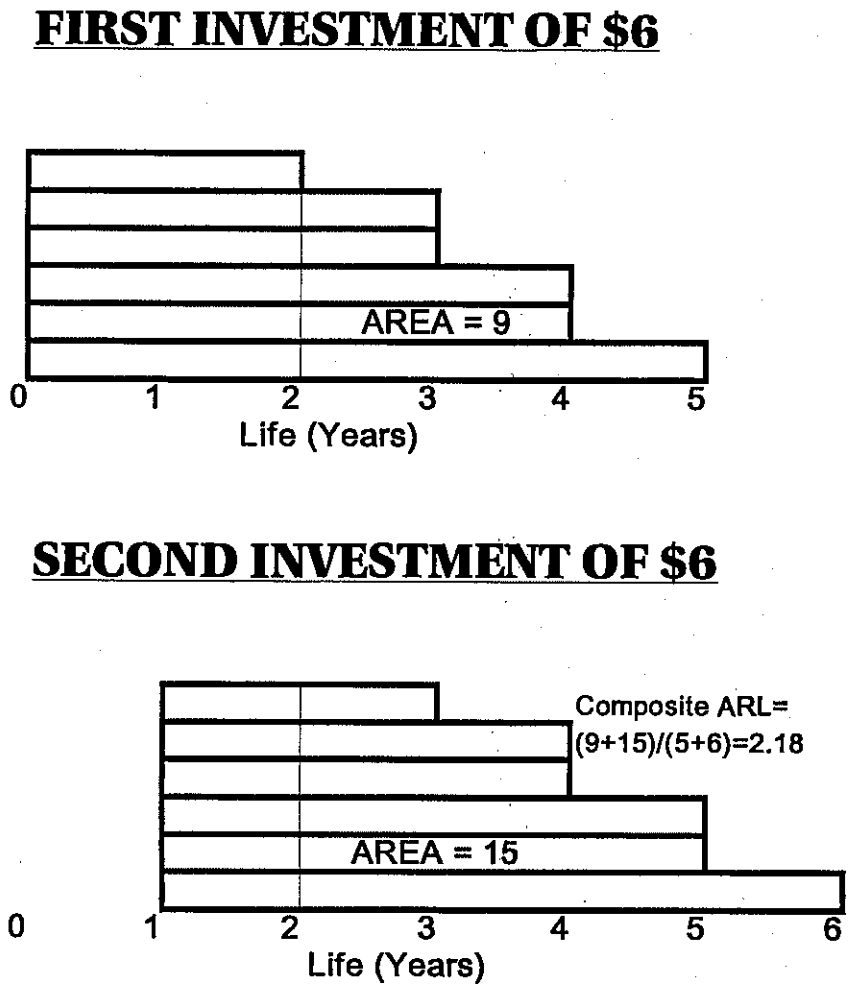


Figure 1 MASS PROPERTIES

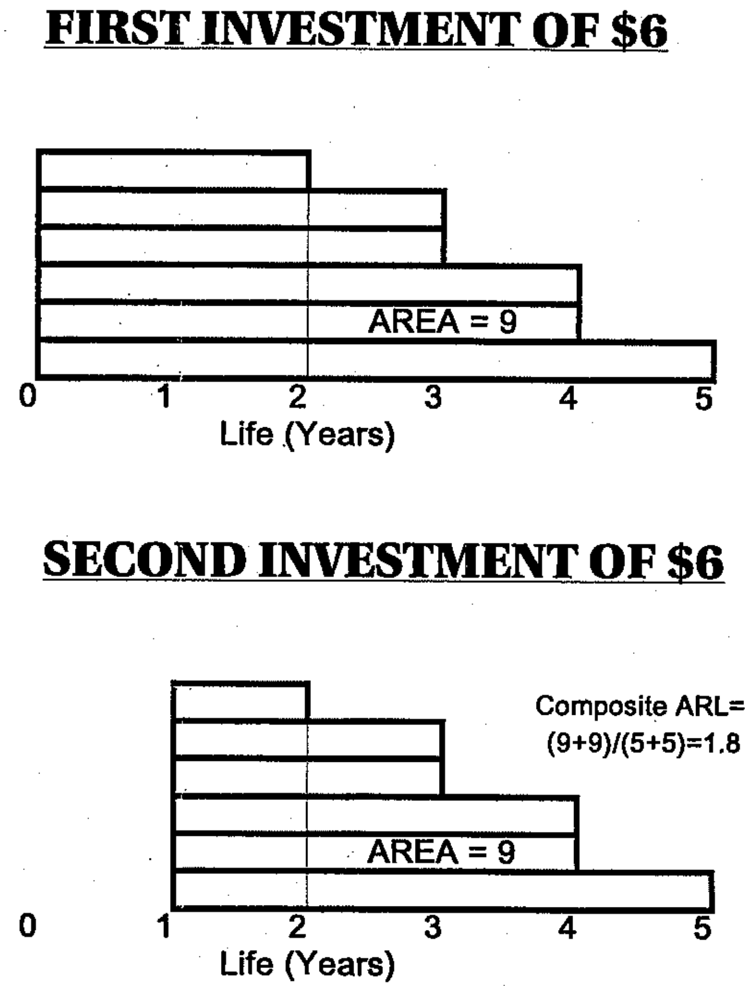


Figure 2 MASS-INTEGRATED PROPERTIES

BENCHMARKING - A CASE STUDY

Donald S. Roff
Deloitte & Touche LLP

The purpose of this article is to illustrate both the potential advantages and the possible pitfalls of comparisons among companies, and stems from concerns by a depreciation client regarding differences in depreciation rates for several neighboring utilities. An understanding of the causal factors, accounting policies and practices, geographic differences and related influences are necessary for appropriate interpretation of results. Previous articles in this publication have dealt with this subject in generic terms and this discussion will quantify specific comparisons.

The concept of best practices and the use of comparative statistics is a useful endeavor for management and strategists alike. Knowing where a company stands relative to its neighbors, its competitors or the industry as a whole is often revealing and points to areas for improvement, as well as emphasizing business segments which are performing well. The difficulty lies in determining which comparisons are meaningful, and more importantly, why the results are what they are.

The concept of benchmarking deals with quantitative comparisons, and the subsequent use of these comparisons to drive change in underlying processes. Such comparisons can be made at very global levels or at discrete functions within organizations. The critical issue is to use the results of the comparisons to produce improvement. While the goal of emulating "best practices" often results in change and improvement, the perception of what are the "best practices" is sometimes clouded.

Measuring utility performance and developing subsequent comparisons among companies, at whatever level, requires consistent financial information, physical statistics and an understanding of the reporting practices which produce these numbers. In simple terms, benchmarking refers to the use of financial and statistical information to develop common indicators for comparison.

Recent practice has been to attempt to compare individual utility statistics with other companies to identify where change could be developed. A host of statistical comparisons can be made by taking the balance sheet, the income statement and physical quantities to compute various ratios. Other sources include regulatory commission reports and financial accounting documents.

In an effort to explain the differences in depreciation rates, the author collected cost information and physical statistics from a select group of electric utilities from published sources. These data are presented in Table 1 and specific utility names have been omitted. The data were selected in an effort to understand significant differences in depreciation rates within the Distribution Plant function between neighboring utilities.

The issue recently arose for a client as to why its depreciation rates were so much different from adjacent companies. Without a lengthy dissertation regarding the components of depreciation rates and factors which influence these parameters, suffice it to say that these rates are often controlled by specific fixed asset accounting practices. (Reference is made to Journal of the Society of Depreciation Professionals, Volume 3, Number 1, 1991, and the article on "The Use and Misuse of Depreciation Statistics"). Moreover, those costs which are not capitalized for recovery are most often charged to operations currently. Thus the comparisons presented in Table 2 were prepared.

Table 2 presents a series of "metrics", some of which may not be standard, but are calculated to illustrate a point and to understand how the differences in depreciation rates may have occurred. Also shown are the composite, which is an aggregate of all the companies; the mean, or simple unweighted average; and the standard deviation, a measure of how dispersed the individual metrics are, relative to the average. Those statistics outlined in clear boxes are individual companies that exceed the average plus one standard deviation. The shaded boxes are those which are less than the average minus one standard deviation. The dilemma is twofold: which metrics to compare? and what do the comparisons mean?

It was presumed that there was a correlation between low depreciation rates and high Operations and Maintenance (O & M) expense, driven by capitalization policy differences. Specifically, large retirement units would yield long lives, but greater O & M expense. What was found was not the case. There was merely a modest correlation between depreciation rate and O & M expense, suggesting other factors were driving the results. One source that would be difficult to isolate was the impact of accounting for salvage and cost of removal, and its effect on depreciation rates. In addition, there are two primary depreciation rate procedures (Average Life Group (ALG) and Equal Life Group (ELG)) and two primary depreciation rate techniques (Whole Life and Remaining Life), each of which impacts the magnitude of depreciation rates.

Carrying this research one step further, depreciation expense and O & M expense were combined and related to the number of customers. This comparison is shown on Table 2, Column 13, and no correlation to depreciation rate was revealed. It is interesting to note the range of values shown for this "metric", as the highest figure is more than 43% greater than the lowest figure. The truth is that isolation of individual causal relationships was not possible.

Significant other comparisons were explored, which demonstrate the underlying premise of this article. Certain metrics are more common than others due to the relative availability of such data. Column 10 shows the number of customers per employee. This is a common metric and yet reveals a relatively wide range of numbers for this sample (87 - 258). Interpretation becomes difficult without an understanding of the facts and circumstances which drive the result. For example, does Company L have too many employees because a low metric is derived; or could it be that it is a very efficient utility with a very concentrated service territory? By the same token, is Company D understaffed, or just well managed?

Column 6 shows the relative Distribution Plant investment per customer. This metric has a similar wide variation ($1,066 - $2,419). The implication is that the fixed asset cost to serve a customer from Company L is more than twice that of Company C. Yet viewed a different way, Column 11 reveals that the relative cost per line mile for these two Companies is approximately equal. Which statistic is more meaningful? And perhaps more important, which comparison is more meaningful?

What about those metrics which can be developed, yet which likely have little basis for comparison. One such metric, in the author's opinion is that shown in Column 5, revenue per sales. Revenue is a function of sales and is driven by individual company cost structures and regulatory approvals. Sales are driven by weather, customer affluence, location, as well as price. The wide range of indications provided by this calculation ($41 - 103) suggests the interaction of all of these forces cannot be easily explained. Thus this metric, while simply developed, produces little useful information.

Let us take this one step further. Table 3 is an arbitrary ranking of the twelve utilities within each metric. The last Column shows the combined ranking using the unweighted average of the individual metric rankings. To the uninitiated, it would appear that Company E is the "best", yet for at least three individual metrics, it finished no higher than ninth. On the other hand, Company G appears to be the worst, yet ranked fourth on two metrics. Caution in these types of general comparisons is urged.

As mentioned earlier, the depreciation rate calculation procedure and technique influence the magnitude of the resulting depreciation rate. Whole life depreciation rates allocate total investment over useful life. Remaining life depreciation rates allocate net investment over future useful life. The ALG procedure allocates investment over average life, and the ELG procedure allocates investment over actual life. Given these differences, it is not surprising that depreciation rates vary for individual asset categories.

The focus should be on the significance of individual metrics and the causal factors which drive these results. Any number of specific metrics can be computed and compared. In the case of the depreciation analysis which produced this article, the interpretation of results led to more detailed investigation. The goal of benchmarking should be to identify which metrics have the most significance so that improvement can be made to the underlying processes. In so doing, a better understanding of the internal cost structure will result, which will lead to better decision making, or perhaps a shifting in the utilization of resources. In any event, knowledge will have been gained.

Thus, it is clear that it is nearly impossible to compare individual depreciation rates, when consideration is given to the number of variables driving the result. Comparisons of the underlying variables can be equally problematic given the array of policies and practices encountered. The examples shown here demonstrate the need for sufficient comprehension of these policies and practices to form valid judgments.

TABLE 1

Cost Data and Physical Statistics

	[1] Number of Customers	[2] Revenue $	[3] Sales MWh	[4] Distribution Balance $	[5] Distr. Plant Deprec. Expense $	[6] Depreciation Rate %	[7] O & M+Deprec Rate %	[8] Miles of Distr. Line	[9] Number of Employees
Company A	157,323	245,871,122	4,895,143	207,965,518	10,267,038	4.94	9.75	1,842	962
Company B	166,232	302,263,460	7,299,576	244,865,538	8,668,240	3.54	7.62	1,963	1,078
Company C	129,083	303,483,977	7,205,088	137,547,626	5,103,017	3.71	10.98	1,604	957
Company D	177,346	220,949,333	3,707,408	193,479,999	8,010,072	4.14	9.31	2,116	688
Company E	184,475	362,104,126	5,581,597	228,636,480	9,922,823	4.34	8.71	2,925	761
Company F	140,051	270,057,717	4,716,842	201,601,397	9,515,586	4.72	9.68	4,103	1,254
Company G	111,992	159,958,207	3,071,593	161,155,285	5,527,626	3.43	9.64	2,791	625
Company H	138,154	206,514,940	3,838,515	156,827,064	4,595,033	2.93	9.31	3,279	757
Company I	157,904	298,974,783	3,749,521	209,601,727	7,545,662	3.60	8.37	3,162	954
Company J	206,706	380,539,793	3,685,730	276,436,247	10,421,647	3.77	7.39	2,682	903
Company K	152,129	410,633,977	7,250,956	318,321,187	11,618,723	3.65	6.79	5,971	1,203
Company L	150,450	386,447,696	4,956,527	363,930,352	11,136,269	3.06	5.81	4,467	1,735
Composite	162,657	305,317,500	4,511,422	230,546,744	8,494,990	3.68	8.02	3,183	941
Std. Dev.	24,542	75,429,073	1,462,818	64,228,710	2,297,472	0.59	1.41	1,209	292

Notes: **Data are normalized relative to $10,000,000 Distribution O & M Expense.**
Composite is weighted average of all Companies.

BENCHMARK METRICS

Table 2

[1]	[2] O & M per Customer $	[3] O & M per Revenue	[4] O & M per Sales $/Mwh	[5] O & M per Distr. Plant	[6] Revenue per Sales $/Mwh	[7] Distr. Plant per Customer $	[8] O & M per Line Mile $	[9] O & M per Employee $	[10] Distr. Plant per Employee $	[11] Customers per Employee	[12] Distr. Plant per Line Mile $	[13] O&M.+Deprec. per Customer $	[14] Customers per Line Mile
Company A	63.56	0.0407	2.043	0.0481	50.23	1,321.90	5,429	10,395	216,180	164	112,902	128.82	85.4
Company B	60.16	0.0331	1.370	0.0408	41.41	1,473.03	5,094	9,276	227,148	154	124,740	112.30	84.7
Company C	77.47	0.0330	1.388	0.0727	42.12	1,065.58	6,234	10,449	143,728	135	85,753	117.00	80.5
Company D	56.39	0.0453	2.697	0.0517	59.80	1,090.97	4,726	14,535	281,221	258	91,437	101.55	83.8
Company E	54.21	0.0276	1.792	0.0437	64.87	1,239.39	3,419	13,141	300,442	242	78,166	108.00	63.1
Company F	71.40	0.0370	2.120	0.0496	57.25	1,439.49	2,437	7,974	160,767	112	49,135	139.35	34.1
Company G	89.29	0.0625	3.256	0.0621	52.08	1,436.99	3,583	16,000	257,846	179	57,741	138.65	40.1
Company H	72.38	0.0484	2.605	0.0638	53.80	1,135.16	3,050	13,210	207,169	183	47,828	105.64	42.1
Company I	63.33	0.0334	2.667	0.0477	79.74	1,327.40	3,163	10,482	219,708	166	66,288	111.12	49.9
Company J	48.38	0.0263	2.713	0.0362	103.25	1,337.34	3,729	11,074	306,131	229	103,071	98.80	77.1
Company K	65.73	0.0244	1.379	0.0314	56.63	2,092.44	1,675	8,313	264,606	126	53,311	142.11	25.5
Company L	66.47	0.0259	2.018	0.0275	77.97	2,418.95	2,239	5,764	209,758	87	81,471	140.49	33.7
Composite	61.48	0.0328	2.217	0.0434	67.68	1,417.38	3,142	10,627	245,002	173	72,431	113.71	51.1
Average	65.73	0.0365	2.171	0.0479	61.58	1,448.39	3,731	10,884	232,892	169	79,320	120.32	58.3
Std. Dev	10.54	0.0108	0.595	0.0128	16.97	389.08	1,324	2,806	48,927	50	24,433	15.80	22.1

Table 3

BENCHMARK RANKS

[1]	[2] O & M per Customer $	[3] O & M per Revenue	[4] O & M per Sales $/Mwh	[5] O & M per Distr. Plant	[6] Revenue per Sales $/Mwh	[7] Distr. Plant per Customer $	[8] O & M per Line Mile $	[9] O & M per Employee $	[10] Distr. Plant per Employee $	[11] Customers per Employee	[12] Distr. Plant per Line Mile $	[13] O&M +Deprec. per Customer $	[14] Customers per Line Mile	[15] Raw Rank	[16] Ordered Rank
Company A	6	9	6	7	3	5	11	5	5	7	11	8	1	6.46	7
Company B	4	6	1	4	1	10	10	4	7	8	12	6	2	5.77	2
Company C	11	5	3	12	2	1	12	6	1	9	8	7	4	6.23	5
Company D	3	10	10	9	8	2	9	11	10	1	9	2	3	6.69	10
Company E	2	4	4	5	9	4	6	9	11	2	6	4	6	5.54	1
Company F	9	8	7	8	7	9	3	2	2	11	2	10	10	6.77	11
Company G	12	12	12	10	4	8	7	12	8	5	4	9	9	8.62	12
Company H	10	11	8	11	5	3	4	10	3	4	1	3	8	6.23	4
Company I	5	7	9	6	11	6	5	7	6	6	5	5	7	6.54	8
Company J	1	3	11	3	12	7	8	8	12	3	10	1	5	6.46	6
Company K	7	1	2	2	6	11	1	3	9	10	3	12	12	6.08	3
Company L	8	2	5	1	10	12	2	1	4	12	7	11	11	6.62	9

Notes: All statistics ranked in ascending except Customers per Employee and Customers per Line Mile.

RELATIONSHIP BETWEEN THE FISHER-PRY AND NX DISTRIBUTIONS

Ronald J. Willis
Willis Manufacturing Ltd.

ABSTRACT

The Fisher-Pry analysis effectively predicts the onset of new technology. However, in order to calculate the depreciation expense, a measure of the dispersion of retirements is required. An analysis is presented that shows the relationship between the Fisher-Pry parameter, α; the normal distribution parameter, sigma; and the NX distribution parameter, V. The NX distribution is a combination of normal and exponential distributions, and was developed by R. Bjerke of EdTel for accounts having both mass and integrated life characteristics.

INTRODUCTION

The development of fibre optics and the increased bandwidth demands of EdTel's customers means that a great deal of the existing copper plant-in-service will be retired due to obsolescence rather than wear and tear. This is of major concern to telco's across North America because copper plant is one of their three major accounts that together represent 50-60 percent of a telco's asset base.[1] (The other two are digital switching and transmission equipment.)

EdTel's copper and fibre plant-in-service are shown in Figure 1. A key observation is that the copper plant-in-service is still growing, despite an acknowledgement that copper is becoming obsolete. This factor makes it very difficult to apply the traditional methods of depreciation analysis because the survival curve for copper plant-in-service remains near unity. We may also observe, however, that the fibre plant-in-service is increasing, as is the fraction of fibre relative to total plant-in-service (copper + fibre). The well known Fisher-Pry method exploits this fraction of new versus total technology to predict an average retirement year for the old (copper) account.[2] The results of the Fisher-Pry analysis are shown in Figure 2.

ANALYSIS

The Fisher-Pry analysis predicts the onset of new technology, and gives the depreciation engineer a means of estimating the remaining life of existing plant-in-service. However, the calculation of depreciation expense requires knowledge of the dispersion of the distribution. This analysis outlines the development of a relationship between the Fisher-Pry parameter, α; the normal distribution parameter, σ; and the NX distribution parameter, V.

The NX distribution is a combination of normal and exponential distributions, and was developed by R. Bjerke of EdTel.[3,4] The distribution is given by:[3]

$$f_{NX} = \frac{a}{DL\sqrt{2\pi}} exp\left[\frac{-1}{KD^K}\left(\frac{x}{L}-1\right)^K\right] \qquad (1)$$

where the life, L = μ; unitized standard deviation (coefficient of variation), D = σ/ L; constant K = 2 - V, where V is the unitized variance (D^2); and x is time. The parameter "a" is a scaling factor; it is equal to 1 when V = 0 and $(2\pi)^{1/2}/e$ when V = 0. This distribution is especially useful for calculating depreciation expense in accounts having life characteristics that simultaneously have the dispersion character of a mass property, and the fixed retirement date character of an integrated account. The dispersion and life for each vintage is easily derived from a single stationary survival curve at the longest life.

The Fisher-Pry cumulative distribution function (CDF) is:

$$F_{FP} = \frac{1}{2}(1 + tanh\,[\alpha(x-t_0)]) \qquad (2)$$

where α is one-half the initial annual exponential take-over rate, t_0 is the time where F_{FP} = 0.5, and x is time. The probability distribution function (PDF) is found by taking the derivative of the CDF, and for the Fisher-Pry model, this is given by:

$$f_{FP} = \frac{1}{2}\alpha\ sech^{2}[\alpha(x-t_0)] \qquad (3)$$

The distribution is symmetrical about the mean, hence it is logical to first make a comparison to the normal distribution. The normal distribution's PDF is given by:

$$f_N = \frac{1}{\sigma\sqrt{2\pi}} exp\left[-\frac{(x-\mu)^2}{2\sigma^2}\right] \quad (4)$$

Using Mathematica®, the CDF for the normal distribution is given by:[5]

$$F_N = \frac{1}{2}\left(1 + erf\left[\frac{x-\mu}{\sigma\sqrt{2}}\right]\right) \quad (5)$$

The two distributions can be compared via the standard distribution for both functions. At $x = \pm\sigma$,

$$F_N = \frac{1}{2}(1 + erf[\pm 1/\sqrt{2}]) = 0.1587\ ,\ 0.8413 \quad (6)$$

The next step is to find values of x for the Fisher-Pry distribution where F_1= 0.1587 and F_2= 0.8413. The difference, $x2 - x1 = 2\sigma$.

An alternate expression for the Fisher-Pry distribution (2) is given by:

$$F_{FP} = \frac{1}{1 + exp^{-2\alpha(x-t_0)}} \quad (7)$$

Rearranging this expression (7) gives:

$$x = t_0 + \frac{1}{2\alpha}\ln\frac{F}{1-F} \quad (8)$$

Hence, we can now write:

$$x_2 - x_1 = 2\sigma = \frac{1}{2\alpha}\left[\ln\frac{F_2}{1-F_2} - \ln\frac{F_1}{1-F_1}\right] \quad (9)$$

After recognizing that $F_2 = 1-F_1$ and $F_1 = 1-F_2$, and rearranging,

$$\sigma = \frac{1}{2\alpha}\ln\frac{F_2}{F_1} \quad (10)$$

After substituting F_1= 0.1587 and F_2= 0.8413, the following simple expression results:

$$\sigma = 0.8340\ /\alpha \quad (11)$$

The two distributions are symmetrical, so we can also write:

$$\mu = t_0 \quad (12)$$

We can now relate these parameters to the Bjerke NX distribution, and write:

$$L = t_0 \quad (13)$$

$$D = \frac{\sigma}{L} = \frac{1}{L}\left[\frac{0.8340}{\alpha}\right] \quad (14)$$

and

$$V = D^2 = \frac{0.6956}{(\alpha L)^2} \quad (15)$$

where L, D, and V are the Bjerke NX distribution's life, unitized standard deviation, and unitized variance.

In the EdTel data presented previously, the Fisher-Pry parameters were t_0 = 28.7 years and α = 0.073. Hence, the corresponding normal distribution parameters are μ = 28.7 and σ = 11.45, and the Bjerke NX parameters are L = 28.7 and V = 0.158. The effectiveness of the fits can be gauged by observation of Figure 3 which shows the CDF for the Fisher-Pry, normal, and NX distributions. Knowledge of the Bjerke NX parameters, L and V, can now be applied to the calculation of retirement dispersion and depreciation expense.[4]

Conclusions

The foregoing analysis outlined the development of a relationship between the Fisher-Pry parameter, α; the normal distribution parameter, σ; and the NX distribution parameter, V. This gives the depreciation engineer information about the dispersion of an account, needed to calculate depreciation expense.

Biography

R.J. (Ron) Willis has a B.Sc. and Ph.D. in Electrical Engineering, and a Master of Engineering (M.Eng) in Engineering Management, all from the University of Alberta, Canada. The material in this paper is based on a project done while earning the M.Eng. degree. Dr. Willis is a registered Professional Engineer in Alberta, Canada. He can be contacted at Willis Manufacturing Ltd., 18422 - 93 Avenue, Edmonton Alberta, Canada T5T 1P6.

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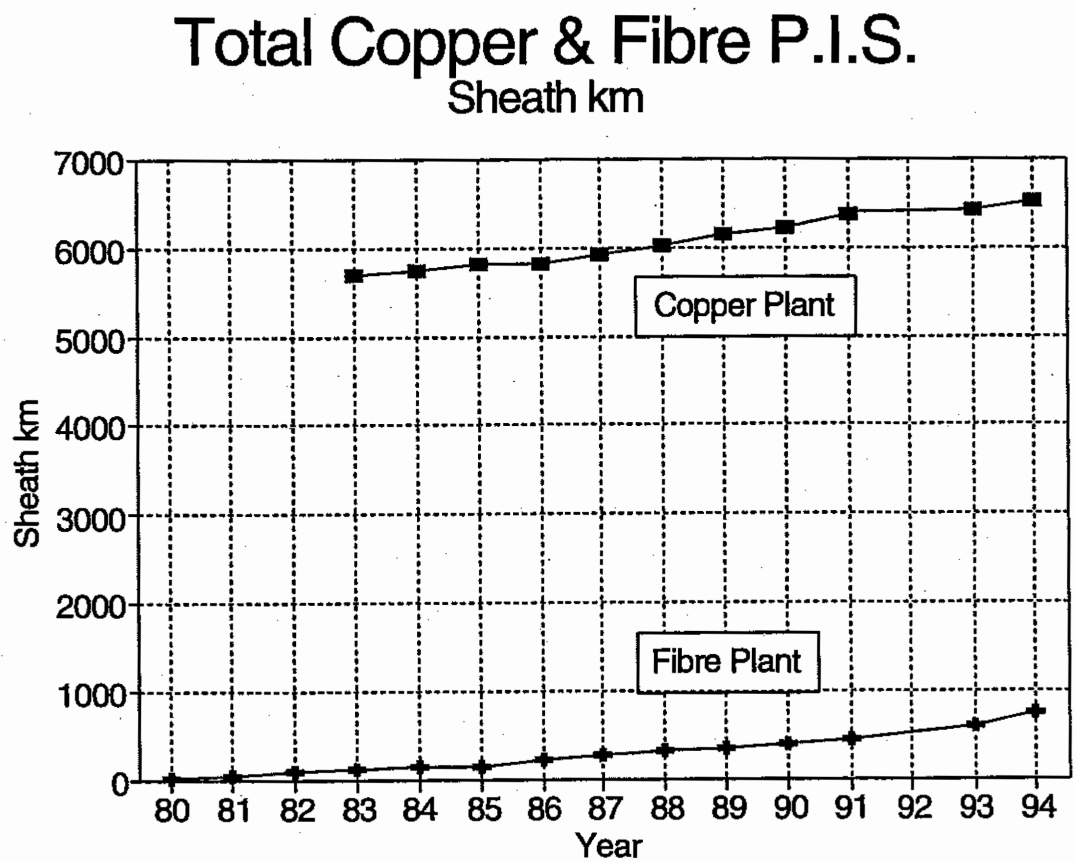

Figure 1 Copper and Fibre Plant in Service (Sheath km)

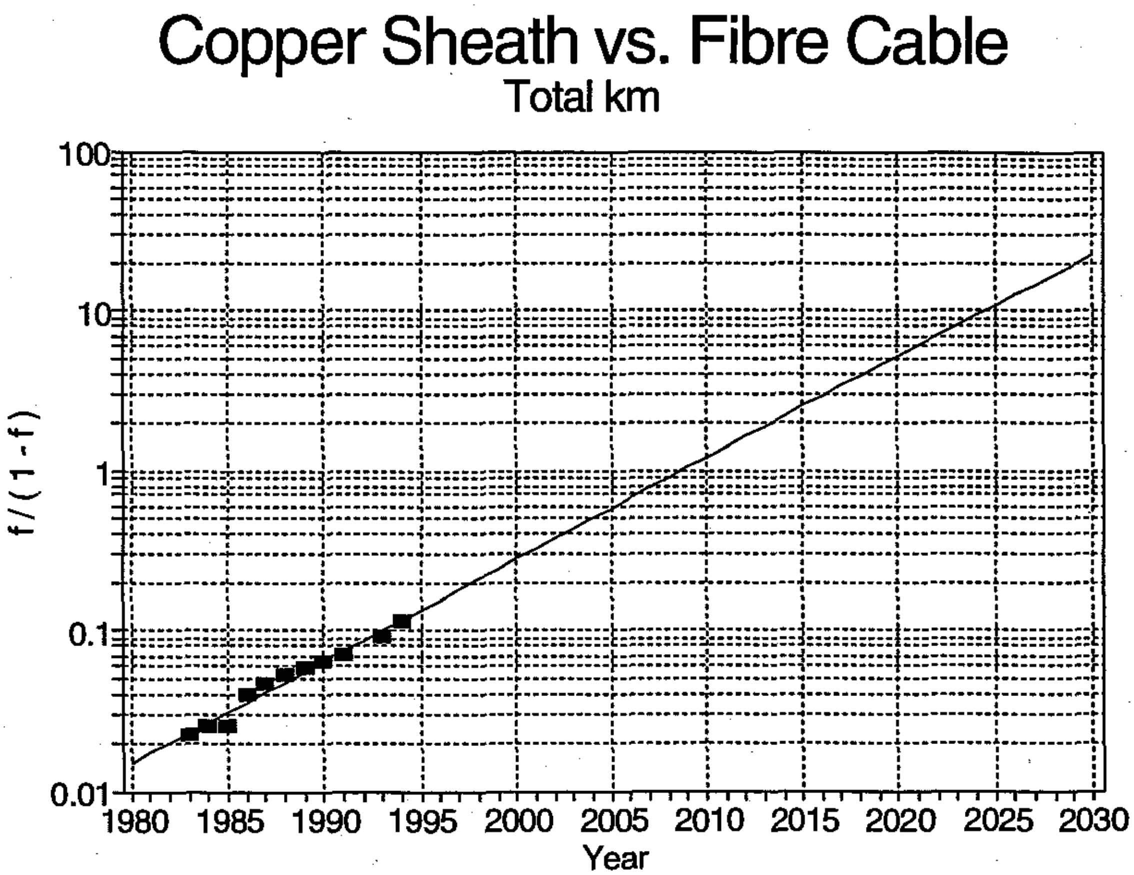

Figure 2 Fisher-Pry Analysis: EdTel's Copper and Fibre Accounts

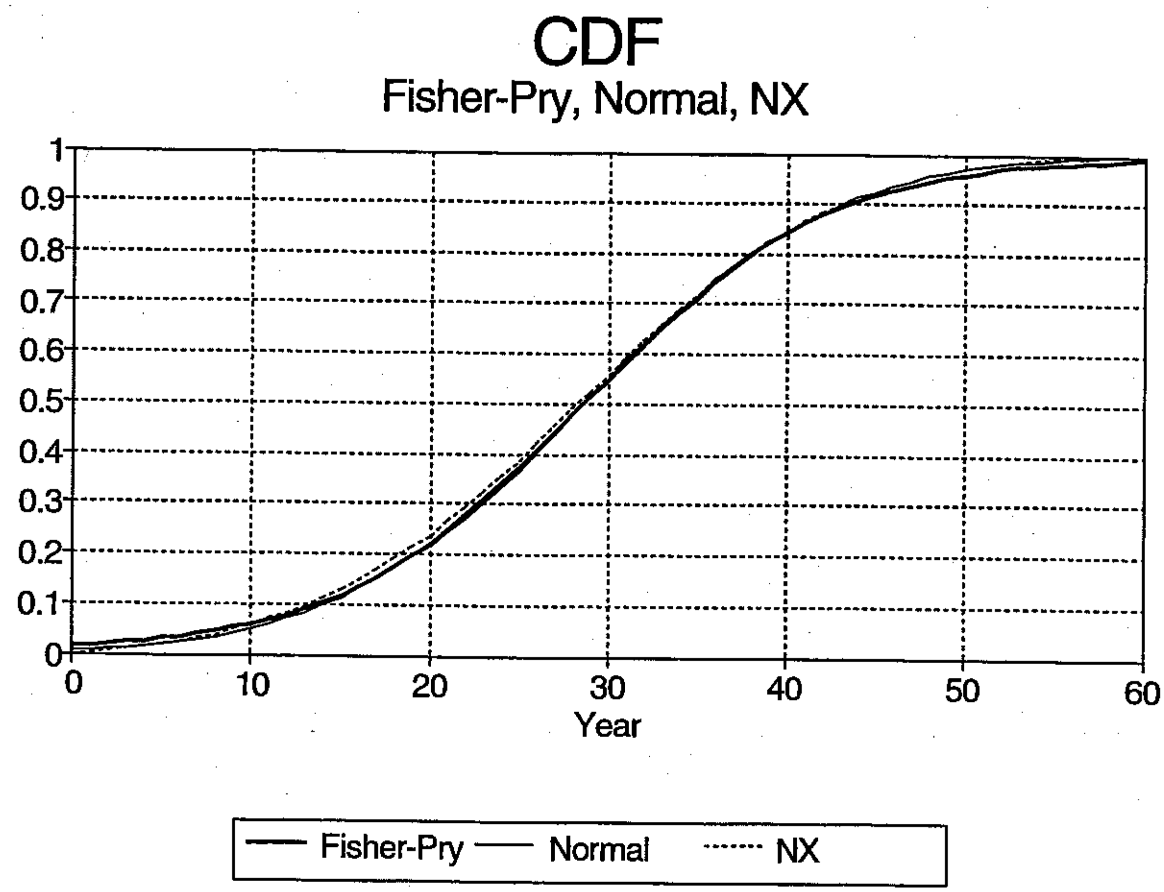

Figure 3 Fisher-Pry, Normal, and NX Cumulative Distribution Functions