EXHIBIT

Exhibit No.:	
Issue(s):	Economies of Scale
Witness/Type of Exhibit:	Meisenheimer/Surrebuttal
Sponsoring Party:	Public Counsel
Case No.:	WR-2003-0500

SURREBUTTAL TESTIMONY

OF

BARBARA A. MEISENHEIMER

Submitted on Behalf of the Office of the Public Counsel

Missouri-American Water Company

Case No. WR-2003-0500

FILED[3]

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Missouri Public Service Commission

December 5, 2003

Exhibit No. 64

Case No(s). WR-2003-0500

Date 12/11/03 Rptr SLKM

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of Missouri-American Water Company for Authority to File Tariffs Reflecting Increased Rates for Water and Sewer Service.	))))	Case No. WR-2003-0500

AFFIDAVIT OF BARBARA A. MEISENHEIMER

STATE OF MISSOURI)
) ss
COUNTY OF COLE)

Barbara A. Meisenheimer, of lawful age and being first duly sworn, deposes and states:

1. My name is Barbara A. Meisenheimer. I am Chief Utility Economist for the Office of the Public Counsel.

2. Attached hereto and made a part hereof for all purposes is my surrebuttal testimony consisting of pages 1 through 8 and Attachments 1 and 2.

3. I hereby swear and affirm that my statements contained in the attached testimony are true and correct to the best of my knowledge and belief.

Barbara A. Meisenheimer

Barbara A. Meisenheimer

Subscribed and sworn to me this 5th day of December, 2003.

KATHLEEN HARRISON
Notary Public - State of Missouri
County of Cole
My Commission Expires Jan. 31, 2006

Kathleen Harrison

Kathleen Harrison
Notary Public

My Commission expires January 31, 2006.

SURREBUTTAL TESTIMONY
OF
BARBARA MEISENHEIMER

MISSOURI-AMERICAN WATER COMPANY

CASE NO. WR-2003-0500

Q. **PLEASE STATE YOUR NAME, TITLE, AND BUSINESS ADDRESS.**

A. Barbara Meisenheimer, Chief Economist, Office of the Public Counsel, P. O. Box 2230, Jefferson City, Missouri 65102.

Q. **HAVE YOU FILED ANY PREVIOUS TESTIMONY IN THIS CASE?**

A. Yes, I filed direct testimony and rebuttal testimony on the issue of economies of scale and rate design.

Q. **WHAT IS THE PURPOSE OF YOUR SURREBUTTAL TESTIMONY?**

A. The purpose of my surrebuttal testimony is to respond to the Missouri Public Service Commission Staff (Staff) witness Randy Hubbs, Missouri Industrial Energy Consumers (MIEC) witness Michael Gorman, Missouri Energy Group (MEG) witness Billie LaConte, and Missouri American Water Company (MAWC or Company) witness Paul Herbert regarding the economies of scale adjustment and rate design proposals.

Q. WHAT IS THE MAIN CRITICISM OF YOUR DIRECT TESTIMONY?

A. The Staff, the Company and MIEC oppose OPC's modification of the Base-Extra Capacity method to reflect economies of scale in the class allocation of capacity-related costs.

Q. HAVE THESE PARTIES DENIED THE EXISTENCE OF ECONOMIES OF SCALE IN THE COMPANY'S SYSTEM?

A. No. In fact, Staff witness Mr. Hubbs agreed that "scale economies exist" in his rebuttal testimony (page 28, line 4).

Q. GIVEN THE APPARENT RECOGNITION OF ECONOMIES OF SCALE, WHAT CRITICISMS ARE RAISED BY THE OTHER PARTIES?

A. The primary points of criticism are:

1. I did not explicitly develop the economies of scale factor for use in Mr. Busch's study in this case or provide support for the use of the square root adjustment. (Gorman, page 10)

2. It is not what the AWWA manual suggested and is not traditionally done. (Herbert, pages 2-4)

3. It is a marginal or incremental cost concept. (Herbert, pages 2-4)

4. It is based on the cost of a base capacity facility that was not built or designed to be built. (Hubbs, page 28, lines 14-22)

I will respond to each below.

Q. MR. GORMAN QUESTIONS THE RELEVANCE OF PORTIONS OF YOUR TESTIMONY THAT ADDRESSES THE APPROPRIATENESS OF USING AN ECONOMIES OF SCALE FACTOR IN OPC'S COST STUDY BECAUSE YOU DID NOT PROVIDE ENGINEERING SUPPORT FOR IT IN YOUR WRITTEN TESTIMONY AND MR. BUSCH RELIED ON THE TESTIMONY OF A PREVIOUS EMPLOYEE IN A PREVIOUS RATE CASE. PLEASE RESPOND.

A. It is true that the text of my written testimony did not provide support for the economies of scale adjustment from an engineering perspective. The reason it did not is because I am not an engineer although my educational background in mathematics, statistics and other areas is similar to the theoretical training required of engineers. In preparing my testimony, I did review the previous OPC testimony including that of Barry Hall, an engineer previously employed by OPC, who developed the basis for the economies of scale adjustment. In addition, I contacted Ted Biddy, another engineer that has previously consulted for our office regarding the existence of economies of scale related to mains costs. In response to data requests in this case, I also provided papers discussing the theoretical economic basis for economies of scale adjustments in various utility areas and also provided the quantitative relationship between costs and the square root of the diameter of mains developed by Barry Hall for OPC. I am attaching one of the papers and the relationship derivation developed by Mr. Hall as Attachments 1 and Attachment 2 respectively. From an economic perspective, the existence of economies of scale is supported in my direct testimony.

Regarding the reliance on work previously performed for OPC by Ms. Hong Hu. In this case, I am presenting the theoretical foundation for the economies of scale allocator that was previously the responsibility of Ms. Hong Hu. Ms. Hu and I collaborated on developing testimony on many issues including specifically the testimony she had previously submitted in support of the methodology of utilizing an economies of scale allocator as applied to water utilities and similarly to natural gas utilities. Mr. Busch's testimony relies on that theoretical basis related only to the use of a square root function; the calculation of specific allocators based on the square root is endogenously performed in his cost study and is district and class specific to this case.

Q. MR. HERBERT CRITICIZED YOUR METHOD BECAUSE YOU HAVE NOT USED THE "TRADITIONAL BASE-EXTRA CAPACITY METHOD" THAT IS DESCRIBED IN THE AWWA MANUAL. WAS MR. HERBERT CORRECT THAT YOUR METHOD IS NOT IDENTICAL TO THE METHOD SUGGESTED IN THE AWWA MANUAL AS A TRADITIONAL OR TYPICAL METHOD?

A. Yes. Mr. Herbert was correct in pointing out that OPC has not used the traditional base-extra capacity method in developing factors for the allocation to customer classes. OPC's method does reflect a notable difference in methodology to the AWWA "B&EC" method. However, the concept is not without theoretical basis and as Mr. Busch's testimony will demonstrate it does not necessarily produce an advantage to the Residential Class over the Industrial Class.

Q. SHOULD A METHOD BE CONSIDERED TO BE WRONG OR INFERIOR TO OTHERS SIMPLY BECAUSE IT IS NOT TRADITIONAL OR SUGGESTED IN A MANUAL?

A. No. Modifying the allocation methodologies used in CCOS studies is an evolving process.

Q. PLEASE EXPLAIN WHY OPC DIDN'T USE "THE TRADITIONAL BASE-EXTRA CAPACITY METHOD AS DESCRIBED IN THE AWWA MANUAL" IN DEVELOPING FACTORS FOR YOUR ALLOCATION TO CUSTOMER CLASSES.

A. The B&EC method is inferior to utilizing an economies of scale factor because the economies of scale factor aligns cost allocation more closely to cost causation. The traditional B&EC method is equivalent to a single peak responsibility method. A single peak responsibility method is not the most appropriate method for allocating capacity-related costs to customer classes. It does not adequately recognize that utility systems are constructed for the purposes of satisfying both the base year-round need for water consumption as well as the maximum-demand. Furthermore, the method does not adequately reflect the cost causer relationship due to its inability to capture the economies of scale characteristics and thus under-allocates costs to base usage and over-allocates costs to usage in excess of base usage.

Q. MR. HERBERT'S COMMENTS ABOUT YOUR INTRODUCING "MARGINAL OR INCREMENTAL COST CONCEPTS INTO THE ALLOCATION OF EMBEDDED COSTS TO CUSTOMER CLASSES." DO YOU CONSIDER THIS TO BE A VALID CRITICISM OF YOUR METHOD?

A. No. From page 2, line 9, through page 5, line 14, Mr. Herbert has inaccurately characterized my testimony and any meaningful extension of it. Specifically his discussion is inaccurate with respect to proposing marginal cost pricing and whether base cost should also be allocated to reflect an economies of scale factor. Public Counsel's method does not allocate just the incremental cost for recovery by a class. If that were true, none of the joint and common mains cost would be targeted for recovery from any class. Instead, OPC's method is designed to address the manner in which the fully distributed embedded costs are allocated to classes.

Q. DO YOU AGREE THAT YOU HAVE INTRODUCED "MARGINAL OR INCREMENTAL COST CONCEPTS" WHICH ARE NOT CONSISTENT WITH THE EMBEDDED COST STUDY METHODOLOGY?

A. No. The AWWA manual defines extra capacity costs as "**costs** associated with meeting rate-of-use requirements in excess of average." OPC's modification to the AWWA B&EC method to reflect economies of scale aims to capture the lower costs of excess capacity that are associated with requirements in excess of average and appropriately targets it to the classes that drive that portion of costs. In addition to this component, classes also receive a cost allocation based on average use. Under volume discount pricing, it is considered justified to provide a discount for usage above some level when that greater usage produces cost savings. Public Counsel's method simply tries to identify and assign the savings in terms of cost attributable to each class.

Once again, I want to make it perfectly clear that OPC's method is fully consistent with recovering embedded costs. The extra capacity costs that are determined by use of the economies of scale adjustment in OPC's study are only incremental in the sense that they are the costs in addition to the base cost for the purpose of satisfying the additional demand by customers.

Q. ARE MR. HUBBS CRITICISMS OF THE ECONOMIES OF SCALE ADJUSTMENT VALID?

A. No. Mr. Hubbs' comments focus on the characterization that our method relies on apportioning the cost associated with a hypothetical system. OPC's method is consistent with Mr. Hubbs observation that

> Although scale economies exist, what is termed extra capacity in the Base-Extra Capacity Method of class cost-of-service allocation is essential to providing service to all customers. This extra capacity is not extra in that it is not needed; it is extra in that it is the amount of capacity over average flows. The entire system is needed to supply water service, both base and extra capacity.

I fully agree that both base capacity and extra capacity elements are needed. OPC's method differs from Mr. Hubbs in terms of the cost allocation of base versus extra capacity. OPC's method produces unit cost associated with extra peak capacity which are lower than the unit cost associated with base capacity cost. In other words, when capacity increases, the cost goes up, only at a decreasing rate.

Q. PLEASE COMMENT ON THE CONSOLIDATED BILLING PROPOSAL DESCRIBED ON PAGE 4 OF BILLIE LACONTE'S REBUTTAL TESTIMONY.

A. Public Counsel does not oppose further investigation regarding consolidated billing. However, at this time, Public Counsel does not support this proposal because of insufficient justification and the impact on small customers is unknown at this time.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

By Thomas Michael Power

Making Sense of Peak Load Cost Allocations

Usage of utility services is rarely uniform across the day, month, or year. Dramatic increases in loads often appear at particular times of the day or in particular seasons of the year. Telephone utilities may choose not to meet extreme peak demands, but electric, natural gas, sewer, and water utilities usually do not enjoy that option. Failure to meet peak demands can lead to catastrophic consequences for both the customer and the utility, and can draw the attention of regulators. For that reason, utilities adopt design criteria for their production, transmission, and distribution facilities to ensure that peak loads are met.

When it comes to cost allocation, common wisdom assigns costs in proportion to class contributions to peak loads. The justification is simple: Since the equipment had to be sized to meet peak day loads, those costs should be allocated on the same basis. Many different peak allocators have been developed on this assumption: single coincident peak contribution, sum of coincident peaks, noncoincident peak, average and excess demand, peak and average demand, base and extra capacity, and so on. Such pure peak-load allocators may not be politically acceptable, but conceptually, at least, they appear to offer the only defensible approach.

Nevertheless, where capacity can be added with significant economies of scale, making cost allocations in proportion to peak loads violates well-known relationships between economics and engineering. What is missing is any tracing of the way in which the peak-load design criteria actually influence the costs incurred.

The Logical Flaw in Peak Allocators

Simply to assert that a particular design criteria is always met does not demonstrate or quantify the resulting impact on costs. Consider an extreme example. Assume that some customers require certain stability and reliability criteria, but that the utility can meet those criteria without any additional cost under existing production and distribution technology. In that case, it would not make any cost-causal sense to use such "costless" design criteria in allocating costs, though they are important to the design of the system.

In developing cost allocations, one needs to know more than what design criteria were used in the development of the utility's system. One also needs to know how—*quantitatively*—those design criteria affected the costs the utility incurred. Were they a major or minor determinant of costs? Did the design criteria affect costs proportionally, or was the relationship more complex?

Economics and Engineering— Some Known Relationships

Public utilities tend to be capital-intensive. They incur substantial fixed costs, often with substantial economies of scale. In this environment, the costs associated with meeting peak demands tend to increase much more slowly that the peak demands themselves. That is, the costs of meeting peak do not increase in proportion to peak loads.

> Utility planners know that capacity costs do not increase in proportion to the peak. That's evident from the way they design transmission and distribution systems.

Consider the relationship between the delivery capacity of a pipe and the installed cost of the pipe. In general, the delivery capacity of a pipe bears a geometric relationship to the diameter of the pipe; the exponent lies in the range of 2 to 2.5. That is, the capacity of the pipe increases faster than the square of the diameter. The installed cost of the pipe, however, increases much more slowly than the diameter, for two reasons. First, the installation costs often are unrelated to the size of the pipe. Installation requires a right-of-way, opening and closing a ditch, and resurfacing. Most of these costs are not affected by whether the pipe diameter is 6, 8, or 10 inches. Secondly, the cost of the pipe itself often does not increase in proportion to the diameter. This certainly is true of smaller diameter pipes.

These two economic-engineering relationships compound the cost of capacity. If pipe capacity rises with

Attachment 1

the square of the diameter, and cost rises (very conservatively) only with the square root of the diameter, then the cost of delivery capacity rises only with the *fourth root* of capacity needs.

This relationship exists for electric transmission and distribution lines, too, where the peak capacity of the line increases with the square of the voltage, but the installed cost of a line increases much less than proportionally with voltage. As a result, the installed cost of electric lines can increase as slowly as the *sixth root* of the design capacity.

When economies of scale are significant, it's inappropriate to spread costs in relation to system demand.

Figure 1 contrasts the proportional assumption with a cube- or fourth-root assumption. While the proportional cost assumptions would suggest that costs rise rapidly as one seeks to meet peak loads, the fourth-root relationship suggested by actual economics-engineering relationships indicates that costs do not vary much with peak loads. Figure 2 applies these two cost-allocation approaches to the calculation of peak and offpeak costs using the base-excess approach widely favored in the water industry. For peak loads three times greater than offpeak loads, the proportional assumptions would suggest that peak costs per unit climb to five times the offpeak cost. If, on the other hand, we make use of the actual relationship, the peak costs per unit rise only 63 percent above offpeak costs—not 400 percent above.

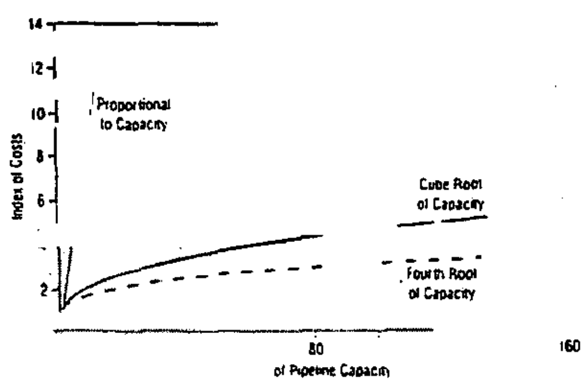

Figure 1. How costs v[illegible] with pipeline capa[illegible] the impa[illegible] differen[illegible] assumptions

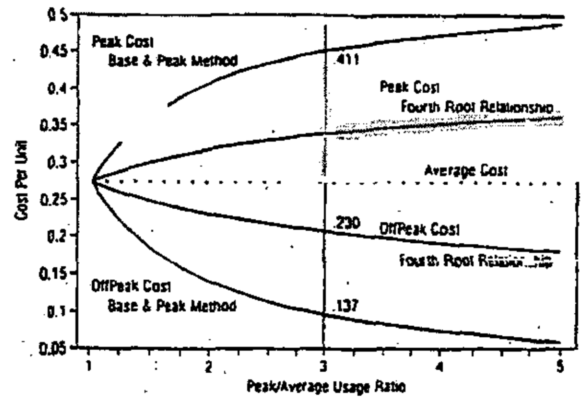

Figure 2. Peak and offpeak costs under alternative cost assumptions

Utilities Understand Their Capacity Costs

Utility planners *know* that capacity costs do not increase in proportion to the peak. This is evident, for instance, in the choices utilities make in designing transmission and distribution systems. Because additional delivery capacity can be obtained so cheaply by laying a somewhat larger line, utilities almost always install what is at the time redundant capacity in their delivery systems. The cost of removing and replacing transmission and distribution lines is so much higher than the cost of initially installing a slightly larger line that utilities as standard practice install the next larger line than projections of future demand indicate as appropriate.

If utility planners recognize the significant economies of scale associated with increasing delivery capacity, why should cost analysts not do the same? They should allocate costs on the same empirical economics-engineering relationships that are used to plan the delivery system.

Significant economies of scale are not limited to pipeline systems. One can find them in electric transmission and distribution, in natural gas storage, and in water treatment, to name just a few. Consider the water treatment plant costs in Table 1:

Table 1

Water Treatment Costs

Total Cost ($MM)	Capacity (MM gallons/day)
$14.8	8
$18.2	16

In this example, the utility testified that much of the $14.8-million cost of the initial capacity of 8 million of gallons/day (MMgd) was fixed and would have been incurred regardless of the capacity of the plant because the "laboratory, laboratory equipment, control room, control system, administrative area, chemical feed area, maintenance shop, river intake, pumping chambers, site improvements, etc. are necessary no matter what the production capacity of the plant might be." This cost information supports the basic idea that as daily demand rises, so does the cost of meeting that demand, though much less than proportionally. One can interpret this cost data either linearly—assuming a large fixed cost ($11.5 million) and a very low linear (proportional) incremental cost ($400,000 per MMgd)—or using a power function (sixth root). The proportional assumption implicitly assumes that the cost of additional capacity was $1.9 MMgd when, in fact, the cost of additional capacity was $200,000 to $400,000 MMgd. That is, using a proportional assumption could skew the result by a factor of five to 10.

Implications for Rate Design

When significant economies of scale are present, it is clearly inappropriate to allocate costs and set rates in proportion to the demand placed on the system. The less-than-proportional nature of the cost relationship has to be taken into account. One way of doing this would be to simply replace the proportional assumption with the appropriate n-th root assumption. Consider the example in Table 2:

Table 2

Water Utility Plant Alternative Allocators

Customer Group	Average Daily Use (MMgd)	Maximum Hour Consumption (MMgd)	Avg. Use Allocation	Peak-Hour Allocation (Proportional)	Peak-Hour Allocation (Fourth Root)
Residential	20	60	44%	62%	49%
Commercial	15	26	33%	25%	32%
Industrial	10	10	22%	10%	19%
Fire Service	0.	3	0.2%	3%	0.4%

Residential peak demand is three times average use, while industrial use is flat across the year. The commercial class falls in between. An allocation of costs in proportion to peak load would boost the residential cost share by 40 percent compared to an allocation based upon average or commodity use. Industrial customers, on the other hand, would see an allocation only half as large as suggested by commodity usage under a proportional peak load allocator. Traditionally, such divergent allocations would be justified on the basis that the delivery system "had to be designed to meet peak loads." But if the cost of meeting peak loads increases only with the fourth root of the capacity, an allocation much closer to the commodity allocation would be appropriate. The residential peak allocator would rise only 11 percent above the commodity allocation, not 40 percent above it. The industrial allocation would fall 14 percent below the commodity allocator, not 50 percent below it. *(Note: The fourth root allocator is calculated by taking the fourth root of the ratio of peak to average usage, then multiplying this times the average use. The sum of these class values is then used as the denominator in calculating the percentage allocator for each class.)* Clearly, the economic-engineering assumption makes a significant difference in cost allocation.

The same would be true in the design of peak-period prices. If the demands in excess of the average annual level are assigned solely to peak-period usage, as Figure 2 indicates, peak period rates dramatically exceed offpeak levels—by 200 percent where the peak load is twice the average load, as in the example above. If the fourth root relationship is used instead, the peak period rates would total only 38 percent above the offpeak rates.

Real World Examples

Testimony advocating these ideas was presented by the author in the following cases:

Electric:
Idaho Pwr. Co., Case No. IPC-E-94-5 ((Idaho P.U.C.1994).

Natural Gas:
No. Illinois Gas Corp., Dkt. No. 88-0277, June 21, 1989, 103 PUR4th 290 (Ill.C.C.).
Cascade Nat. Gas Corp., Cause No. U-86-100, May 20, 1987, 84 PUR4th 119 (Wash. U.T.C.).

Water:
Boise Water Corp., Case No. BOI-W-93-3, July 14, 1994, 153 PUR4th 320 (Idaho P.U.C.).

The Case Against Customer Charges

These results may simply confirm the logic of a "minimum system" approach to distribution cost allocation: Economies of scale flow from the high fixed costs associated with any distribution system, no matter what its design capacity. This view holds that delivery system costs are fixed and should be collected not on the basis of peak demands but through monthly fixed "access" charges that are not usage-sensitive.

The alternative view finds these costs incurred to sell profitable volumes of commodity throughout the year. Most utility line-extension policies confirm this cost-causal utility motivation, tying the investment the utility is willing to make to the revenues the utility expects to receive on sales volumes throughout the year. Advocates for this approach would point out that a competitive economy rarely enables any business to collect high fixed costs through fixed "per-customer" charges. Almost all competitive businesses must collect their "fixed overhead" costs in usage-sensitive charges. Competition tends to bid down any customer "access" fee such as entrance charges or annual service charges. Only businesses with significant monopoly power can cover their fixed costs through a fixed customer charge.

If regulation seeks to reproduce the results of a competitive economy, rate designs containing high fixed charges are inappropriate. Usage-sensitive rate design would then be appropriate for collecting delivery system costs. Because of the substantial economies of scale, even after accounting for the impact of peak loads, the cost allocation would largely resemble a volumetric or commodity allocation. This may explain the significant role that volumetric allocations have always played in utility rate design. ▼

Thomas Michael Power, PhD, is a professor and chairman of the economics department at the University of Montana in Missoula.

Courts Reject FCC's Flexible Pricing Again

The Federal Communications Commission (FCC) has been rebuffed yet again by the courts in its effort to relax tariff filing requirements for nondominant common carriers. The U.S. Court of Appeals for the District of Columbia Circuit thwarted the FCC's latest attempt, rejecting proposed rules that would permit the nondominant carriers to file a range of rates rather than fixed rates tied to a schedule of charges.

The courts had earlier overturned a series of FCC rulings. In those cases, the courts denied the FCC authority to allow the detariffing, citing the Federal Communications Act of 1934: "[e]very common carrier . . . shall . . . file" tariffs with the FCC. In its recent case, the FCC argued that the Communications Act does not precisely define the type filing required, and therefore permits a tariff containing a range of rates. As in the past, the FCC claimed that strict tariff requirements were counterproductive and inhibited price competition in the marketplace. The circuit court rejected this argument, however, finding that the Communications Act clearly requires all carriers to file "schedules showing all charges." Relying heavily on a 1994 decision by the U.S. Supreme Court concerning FCC authority to modify legislative requirements (*MCI Telecommunications Corp. v. AT&T* 114 S.Ct. 223), the circuit court ruled that the FCC must take its case to the Congress if it believes that existing legislative mandates are inadequate under current market conditions. *Southwestern Bell Corp. et al. v. Federal Communications Commission, Nos. 93-1562 et al., Jan 20, 1995 (D.C.Cir.).*

Florida Approves Decoupling Mechanism

Florida Power Corp. has won approval for a three-year experiment to remove existing disincentives to investment in conservation programs by "decoupling" residential revenues from sales for ratemaking purposes. The mechanism permits customer surcharges and refunds if revenue levels vary from targeted levels.

The new mechanism relies on a per customer revenue target figure based on the allowed revenue and average residential customer count used in the company's last rate case. The target is then adjusted to account for projected per customer revenue growth and changes in personal income. According to the utility, the adjustments assign more of the economic risk to shareholders. Customer surcharges or refunds are permitted if revenue levels vary from targeted levels, but will only be implemented to the extent that company earnings remain within a specified range.

Attachment 2

Response by Barry Hall to

Data Request No. 9C

from Stuart Conrad
representing AG Processing

in Case No. WO-98-204

9.C. Attachment

Supposing a linear relation between total installed cost of pipe and pipe diameter:

Such a relation may be expressed:

(1) $C = c\,d$; $C \doteq$ cost/ft, $c_1 \doteq$ constant
$d \doteq$ pipe diameter

For any given pressure the flow capacity of a pipe is proportional to the cross-sectional area:

(2) $$A = \pi r^2 = \pi\left(\frac{d}{2}\right)^2$$

simply:

(3) $$A = c_2 d^2$$

Flow capacity, then, is

(4) $Q = c_3 d^2$; $Q \doteq$ flow capacity
$d \doteq$ diameter
$c_3 \doteq$ constant

Performing some simple algebra on (4)

$$c_4 Q^{1/2} = d$$

Substituting (5) into the cost per foot, one obtains:

$$C = C_1 C_4 Q^{1/2} = C_5 Q^{1/2}$$

For an individual pipe the cost increases with the square root of capacity.

For the entire system it is assumed that larger size pipe will be employed whenever it is economic to do so.