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THESIS

Electric light companies - Rates

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RATE DETERMINATION
FOR
ELECTRIC PUBLIC UTILITIES.

A Thesis Submitted to the
Faculty of the
Michigan State College,
East Lansing, Michigan.

by

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Electrical Engineer
June, 1933.

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General Principles Affecting Rate Determination

The determination of rates to be charged for furnishing electric energy and service is a very complex problem. The general theory in the mathematical calculations is that each customer should pay for all costs which are created by him. The exact application of this theoretical principle is seldom attained. The mathematical determination should be used as a primary basis for the rate schedule, adjustments being made because of economic factors. Psychology of the rate payer and competition with other forms of service have a very definite effect necessitating, at times, modification of parts of the mathematical result of a rate determination.

The utility rendering a service is entitled to compensation to cover all costs plus a reasonable profit for its efforts. This statement applies to the complete property and operations of the utility. Each class of service need not contribute its proportional amount over and above costs to make up the profit necessary to attract capital into the business. The industrial customers will use from 60 to 65 percent of the plant output. The rates charged these customers must be low enough so there will be no economic justification for them to install separate plants. After this item is fixed the other groups of customers must make up the difference between the total cost of service and that portion contributed by the industrial customers.

There are many customers in all electric utilities who are served at less than actual costs. The reason for this condition is that it has been found impracticable to devise and apply any system of cost computation which could carry out the theoretical principle literally. The application of any system of cost accounting which considers all the factors entering into costs would result in such elaborate and complicated rate schedules that the rate payers could not understand them and few could apply them.

It has been said of Economics that it is yet a long way from a true scientific status and when one contemplates the vast range of facts which must be subjected to scientific description and inductive treatment, the doubt arises if we will ever have an economic science comparable to physics and chemistry. The same situation exists for any mathematical determination of rates and particularly for electric utilities.

The operation of an electric utility is essentially a monopoly. If it were not, duplicate system of distribution lines would be necessary, duplicate stations, offices and similar items, were another company entered into competition with the existing utility. Investment costs per customer would necessarily be increased, operation costs per unit would be higher, and higher rates would be necessary to yield the same return on the investment. Electric utilities render a quasi-public service and the detrimental effects of competition does not balance the evils of monopoly;

assuming however that the utility is regulated by a State Regulatory Commission.

The rule used in drafting freight rates for railroads, of charging what the traffic will bear, applies to a certain degree in drafting rates for electric service. Where power is one of the principal items entering into the manufacture of a product, the industrial customer must obtain the power at a low price. If he does not, then competition may force him out of business or to make other arrangements for power; either will affect the revenue of the electric utility. As a general rule, a price differential in favor of the industrial user, is a direct benefit to the other customers. Having the large industries using the bulk of the output, decreases not only the investment costs per unit but also the operating costs per unit.

The principal subjects on which various rate experts and engineers disagree in any rate determination for any one utility are:

1. The value of the property under consideration including used and useful equipment plus the intangible items.
2. The amount of depreciation of the properties. This item includes both the accrued, and the amount necessary for future depreciation.
3. The reasonableness and the propriety of the inclusion of certain charges set up in the costs of operation.

4. The amount and the treatment of losses sustained in the early period of operation of the utility. This item, if it exists, is sometimes called "Cost of Establishing the Business". "Going Value" is another similar term which not only includes the cost of establishing the business but also the efforts to bring the business to the present state of success.

The controversial phases of the above items will be treated later.

Any rate determination should be made so the rates fixed can stay in effect for from three to five years, excepting, however, revisions downward. The primary necessity for this stability is for a reasonable permanent business relationship between the customers and the utility. The principal items which should be considered when a rate schedule is determined are:

1. The growth in population in the territory served which can reasonably be expected.
2. The increase or decrease in the amount of energy which will be demanded per customer or per capita.
3. The increase in plant production facilities, transmission and distribution systems which will be required to properly serve the demand expected.
4. The operating costs averaged over the period for which the rates are to apply.

The rates will, in a large measure, be dependent upon the kind of service rendered by the utility. A utility which maintains close voltage regulation, spare capacity, few interruptions and good service for trouble calls should be entitled to a higher rate of return than a utility which supplies a less satisfactory service.

One fundamental principle of rate making is that the rates shall apply to all customers having similar requirements for service. Rates should be published and strictly adhered to. This will eliminate all special and discriminatory contracts. These contracts have frequently caused trouble for utilities. Regulatory commissions have repeatedly ordered their elimination where they are at variance with filed tariffs. The question of special contracts usually arises when the utility makes some use of equipment on the customers property. This situation can best be dealt with by billing the customer at the regular rate for the service rendered and the utility paying to the consumer a fair and reasonable compensation for the equipment and facilities used.

Many states have statutes that make it mandatory for a utility to charge the same rate throughout contiguous territory. The object of this legislation is to eliminate discrimination. Special cases arise, however, where, due to competition with municipal plants private utilities have been allowed to make exceptions in order to hold business and commissions have ruled and been supported by the United States Supreme Court that this does not create an unjust or

unlawful discrimination as against other localities served by it and accordingly does not offend the statutes against locality discrimination. These rulings have permitted the utilities to reduce the rates in special cases only to the extent of meeting the rates in force and have not permitted schedules that would result in lower rates than charged by the competing utility.

For an equitable rate determination some position should be assumed. Neither a socialistic nor a capitalistic attitude must be followed. Conscionable conduct toward both the utility and the consumers must be continually kept in mind. If this last principle is used, then the result will be of a judicial character and fair to both the utility and the consumers.

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Rate Base

The first step in making a rate determination is to fix the rate base. The rate base is the amount of capital upon which a utility is permitted to earn the return. The rate of return will be discussed in detail in the caption "Rate of Return". This rate of return usually varies from six to eight percent. Rate of return should not be confused with dividends on stocks. The dividends earned or paid by a utility is in no way a measure of the reasonableness of rates and does not enter, even remotely, into a rate determination.

The electric consumers should pay for the capital that is necessary to render the service that they require or demand. It should make no difference to the consumer whether this capital is money that the stockholders have put into the business or is money that has been borrowed by issuing mortgage bonds against the property, debentures or preferred stock.

There has been and still is considerable contention as to the proper method of determining the rate base. The two principle methods are generally known as:

1. Historical cost base.
2. Reproduction cost base.

The "historical cost base" is the total amount of capital which has been prudently put into the business less accrued depreciation. The advantage of this base

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lies in its stability. Fluctuating commodity prices have no effect on this base. The disadvantage of this base is that the utility does not realize on the appreciation of the property due to advancing commodity prices.

The "reproduction cost base" is the total amount of capital which would be required to replace all of the property in like condition at the time the rate base is determined. This is determined principally from appraisal and applying land, material and equipment prices as of the appraisal date. Theoretically this base would be the historical cost multiplied by the weighted average of the ratios of the present commodity costs to the commodity costs at the time any particular item was added to the properties. The advantage of this method is that the present value of the property is used as a basis for the rate of return. Court decisions have generally favored the "reproduction cost" method. The term "present value" is synonymous with "reproduction cost". The greatest inherent practical difficulty with this basis for a rate determination is that it is a shifting base; theoretically the base fluctuates from day to day, as commodity prices which enter into the construction of the properties go up or down; practically, a substantial variation occurs periodically, as the cycle of prosperity and depression takes its course. The use of this method requires considerable judgment for prophecy and a careful study of the past before any degree of stability can be assured. Reproduction cost or present value cannot be determined by accurate measurement or calculation.

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It must be obtained or deducted from known facts which enter into the value as items of varying weights or have evidential value of varying weight which indicates what is the present fair value of the properties.

Regulatory commissions and experts retained by consumers advocate the adoption of the method of fixing a rate base that will result in the lowest rates to consumers. This procedure may result in rates which in effect confiscates the utilities' property. On the other hand, public utilities usually advocate the adoption of the method of fixing a rate base that will result in the highest rate that the traffic will bear. This procedure usually would result in rates that bring excessive returns.

The first influential advocate of reproduction cost was William Jennings Bryan representing the consumers. This was in the period of 1893 to 1898. At that time this method resulted in the lowest rates. The utilities at that time advocated the historical cost. This method was referred to as stock and bond base or prudent investment. The latter term is sometimes used now instead of historical cost, but the stock and bond base was dropped some time ago, and is seldom even mentioned. At that time, historical cost would have resulted in the highest rates. Now the position of the parties is completely reversed.

The first case in regard to the proper determination of the rate base to reach the United States

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Supreme Court was *Smyth versus Ames*, 169 U.S. 466. This case dealt with railroad rates but the principles laid down by the Supreme Court were general and apply to all utilities, including electric, telephone, gas and water in addition to the railroads. The principles originally announced in this decision have been termed the "fair value" rule. They require that consideration be given to:

1. Original cost of construction.
2. Amount expended in permanent improvements.
3. Amount and market value of bonds and stocks.
4. Present cost of construction.
5. Probable earning capacity under rates prescribed.
6. Operating expenses.

The decision also stated that the above factors are not intended to be all-inclusive or to exclude other relevant evidence as to fair value. Since this decision in 1898, later decisions as to fair value have brought other factors into prominence.

These are:

7. Accrued depreciation, 1909. (*Knoxville v Knoxville Water Co.* 212 U.S. 1).
8. Market value of land, 1913. (*Minnesota Rate Cases*, 230 U.S. 352).
9. Working capital.
10. Future costs of construction, 1922. (*Galveston Electric Company v Galveston*, 258 U.S. 388).
11. Going concern value, 1926. (*McCardle v Indianapolis Water Company*, 272 U.S. 400).

The United States Supreme Court has consistently adhered to the principles laid down in the *Smyth v Ames* case. The court has not, however, stated any definite ruling as to how much weight each of the items should be given in arriving at the fair value. The only stipulation is that all items must be given such weight as may be "just and right" in each case. This requires that all competent evidence must be received and considered in the determination of fair value.

Although court decisions definitely prescribe the elements of value which must be considered and given effect in the determination of the rate base, the rate of return on the rate base has not been so definitely stipulated. The only limitation prescribed by the courts is that it shall not be so low as to be confiscatory. As a general rule, a rate of return below six percent would be considered confiscatory unless there are extenuating circumstances. Effect can be given to the different elements of value stipulated by the United States Supreme Court by using a rate of return between 8 and $8\frac{1}{2}$ percent on the historical cost. Should 10 to 15 percent be added to the historical rate base, the resulting amount will approximate the reproduction cost base and will be the fair value including going value as stipulated by court rulings. Should, also, 10 to 15 percent be deducted from the rate of return of 8 or $8\frac{1}{2}$ percent on a historical cost rate base and the resulting percentage of 7 to $7\frac{3}{4}$ percent be applied upon the reproduction cost, or fair value base, the

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actual return to the electric utility would be the same.

Electric utilities prefer the method of determining the rate base which results in the higher valuation, even if the rate of return is reduced and the resulting amount of return is identical for either method. The main reason for making a persistent effort to have the higher valuation accepted as the rate base is the relative cost of issuing bonds for financing large extensions. The lower the ratio of outstanding bonds to the valuation, the lower will be the interest rate necessary on the bonds and the less will be the cost of selling the bonds. For the same amount of outstanding bonds, the higher the valuation of the properties of the electric utility, the lower will be the ratio of outstanding bonds to the valuation. The payment of interest on bonds cannot be charged to the customers as an operating expense like coal, maintenance and labor, but must be paid for out of the money obtained from the rate of return. The lower the interest rate, the more will be the remainder available for dividends on the common stock.

The laws resulting from precedence in reference to the determination of the rate base requires that consideration and weight must be given to the reproduction cost as an element. It is impracticable to state any definite rule as to the weight that should be given to this element or any of the other elements. The rate history of the particular electric utility for which a rate determination is being made must be studied for the fifteen to twenty years immediately

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preceding. If the reproduction cost had been given the controlling weight in the rate base and the utility had the benefit of increased earnings during a period of rising prices, then the utility should not complain, if, during falling prices, the same weight was given reproduction cost; conversely, if historical cost was given controlling weight during the period of rising prices, and the customers benefited by lower rates, then the customers should not complain if, during falling prices, the same base was given the same weight.

The purchase price paid by an electric utility for a completed enterprise should not be given any weight in the determination of the rate base. Purchase price is usually based on the dividend earning capacity of a property and does not reflect the "fair value" upon which customers should be charged a rate of return.

The amount of money collected from customers of an electric utility for the construction of transmission or distribution lines should be deducted from the total value of the property involved in ascertaining the base for rate making purposes.

Should an electric utility acquire duplicate equipment from a former competitor which is unnecessary after the consolidation, it should not be permitted to earn a return upon its investment. This duplicate property should not be included in the rate base because it is not used nor useful. Nor should the utility be permitted to amortize the loss in such abandoned property over a period of years against

operating expenses. Unused property may in some cases be included in a valuation for security issues but not for rate-making. Property that is unused and superseded and no longer required for future use can be amortized against operating expenses over a period of years after deducting salvage and the balance in the retirement reserve applicable to the abandoned property.

The cost of maintaining and operating an overbuilt system which was caused by the demands of a particular group of customers should not be charged against the customers generally, but should to a greater degree be assessed against the group of customers for whose benefit the additional capital expenditures were originally incurred. This is the equitable disposition of such expense but managerial policies may be otherwise.

Property in excess of that used and useful is usually very difficult to ascertain. Some amount of spare capacity must be provided in order that facilities may be available when needed. As a general rule it is uneconomical to construct a property to meet only the immediate present requirements or even one having spare capacity for only a very limited period. That spare capacity must be provided does not eliminate the question as to whether or not at any given time more than a reasonable amount of property is provided. Additions not prudently made should be excluded from the rate base.

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Land purchased by a utility for future use if not actually used on the date of a rate determination should be excluded from the rate base.

Bond discount can not be included in the capital structure or the rate base. Bond discount is deferred interest which is payable from the rate of return and is not capital. Should such capitalization be made, the effect would be the capitalization of future earnings.

The policy used by most electric utilities in regard to retirement reserve is to invest this fund in additions and betterments. The primary purpose of this reserve is to provide for retirements and renewals. This account must be thoroughly studied to determine its relation to the capital structure. Unless the money can be definitely traced and is on hand as a fund, the assumption must be made that this money has been used for additions and betterments. The amount of the retirement reserve that has been added to fixed capital accounts must be deducted from these accounts if the book accounts are correct as to historical costs. When an appraisal is made by inventory, the amount of depreciation is determined by inspection and the amount of the retirement reserve which has been added as new capital is also deducted. The reason for this procedure is that retirement reserve money is being contributed by the customers as a fund for accrued depreciation to replace equipment when necessary.

The rate base upon which the electric utility is allowed to earn a return should include, in

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addition to the fixed capital, an amount representing the working cash capital necessary to conduct the business. The necessary working cash capital is determined by calculation from the operating expense accounts. Revenue from service usually lags actual expenditures by 60 days. This necessitates cash to the extent of one-sixth of the annual operating costs less the annual retirement reserve. Retirement reserve does not require cash outlay but is only an accounting transfer. One-sixth of the taxes and bond interest may also be added but this procedure is controversial. The value of the material carried for repairs and supplies should be included in the working cash capital. Prepayments for insurance and other similar items should also be included. Coal in storage should be sufficient for a three months supply. The amount to be included in the working cash capital for this item should be twenty-five percent of the annual fuel cost based on a three months supply.

Going value or going concern value as it is sometimes called is another controversial item which enters into nearly all rate determinations. Expert opinion has not been crystallized on this point. Going value should, as a matter of law, be included as a property right in the rate base of the property upon which an electric utility is entitled to earn a return. Whether or not this item should be set up as a specific item in the rate base must be determined from an analysis of the past policy of the electric utility in regard to the charges for building up the business. Where new business costs had been allowed as operating expenses and where the

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allowance for increased land values, fair value of overbuilt property, costs of surveys and investigations of abandoned projects were included in the fixed capital costs, then no separate allowance should be made for going value in a rate base. The character of the service rendered by an electric utility has considerable bearing upon the going value. Where the service is not as satisfactory and efficient as it should be, this fact would impair the going value of the electric utility as an element in the rate base.

The United States Supreme Court has approved an allowance of going value in several decisions as indicated in the following cases:

Parties	Cost of Reproduction	Going Value	Percent
Knoxville v Knoxville Water Co. 1909, 212 U.S. 1.	\$538,000	\$60,000	11.1
Omaha v Omaha Water Co. 1910, 218 U.S. 180	\$5,700,583	562,712	9.9
Denver v Denver Union Co. 1918, 246 U.S. 178	10,617,732	800,000	7.5
Georgia Power Co. v Ga. Comm. 1923, 262 U.S. 625	5,250,000	441,629	8.4
Bluefield Imp. Co. v West Virginia Public Service Comm. 1923, 262 U.S. 679	324,428	32,442	10.0
McCardle v Indianapolis Water Co. 1926, 272 U.S. 400	14,904,000	1,366,000	9.17

The use of a percentage of the entire property to calculate the going value is not particularly scientific or illuminating but has been sanctioned by engineering usage and court decisions. Where practical the percentage method should not be resorted to, but a complete

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detailed analysis should be made of this item.

An actual typical example of a rate base determination is found in the case of the Black River Telephone Company which was recently heard before the New York Public Service Commission. The reproduction cost claimed by the company is compared with the historical cost and also the reproduction cost as determined by the Commission upon which the rate of return was allowed.

	Reproduction Cost Claimed by Company	Book Cost less Depre- ciation.	Reproduction Cost as Deter- mined by Comm- ission.
Plant and Equipment	\$1,455,962	\$950,212	\$1,324,187
Retirement Reserve	322,388	322,388	368,683
Plant and Equipment less Retirement	1,133,574	627,824	955,504
Preliminary Organ- ization	77,508	5,008	5,008
Working Capital	40,803	30,000	30,000
Going Value	30,270	0	0
Rate Base	\$1,282,155	\$662,832	\$990,512

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Rate of Return.

The rate of return is the ratio of the difference between the total operating revenue and the total operating expense to the fair value of the used and useful property of an electric utility. The rate of return is expressed as a percentage. The average rate of return of electric utilities usually lies between 7 and 8 percent. It is from the money that the rate of return yields that the interest on bonds and preferred stock is paid. The surplus after this interest is paid is then available for dividends on the common stock. The amount of the rate of return can also be defined as the amount that all consumers pay over and above the total operating costs.

The Smyth versus Ames case previously referred to sets forth a doctrine which has become axiomatic in public utility law: that "what the company is entitled to ask is a fair return upon the value of that which it employs for the public convenience" or "a fair return upon the fair value of the property".

From this and other rulings of the United States Supreme Court certain principles in regard to the rate of return can be set up:

1. A fair return is a flexible concept, not a static, unchangeable rule.
2. What return is "fair" calls for the exercise of judgment in the light of the particular circumstances of each case.

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4. General conditions affecting all business should be given consideration in the application of each of the measures of "fairness".
5. To be fair, the return should equal the returns earned at the time of the rate determination by other business enterprises with comparable risks, in the same part of the country.
6. The utility's need for new capital should be considered, since the return should be such as, under present day conditions, will enable it to raise whatever capital it requires.
7. The return should be such as will maintain the credit of the utility, in the light of present existing business conditions and opportunities for capital in other enterprises.

Other factors which must be given consideration when determining the rate of return are:

1. The cost of service.
2. The history of the present rates.
3. Comparison with rate structures of other utilities.
4. The equities as between classes and groups of consumers.
5. The effect of rate levels and spreads on future earnings.
6. The ability of consumers to pay.
7. The availability and cost of power from other sources.

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rate base, rather than on the basis of years reflecting abnormal operating conditions, whether good or bad from the electric utility's standpoint.

The relative price at which a given utility can sell its service in comparison with other utilities doing a similar business should be given considerable weight in determining the rate of return. The utility that is able to extend to its customers the lowest price is entitled to a higher rate of return.

The utility's right to earn a fair return is subordinate to the right of the customers to be charged no more than the value of the service rendered to him. This principle has been affirmed repeatedly by the United States Supreme Court. It is stated in 10 Corpus Juris 418, as follows: "The public is entitled to demand that no more shall be exacted from it than the services rendered are reasonable worth and this right takes precedence even over the right of the carrier (utility) to a fair return on its investment when the two rights cannot stand together. In consequence, the value of the service to the public is an important factor in determining the reasonableness of the rates charged therefor". Sometimes the factors that enter into the reasonableness of the rates are very complex and it is difficult to measure such "value of the service" to the consumer.

Some consideration should be given, when determining the rate of return, to the general economic conditions obtaining throughout the country when such conditions

seriously affect the districts served by a utility.

The weight to be given the present economic depression when considering the rate of return has divergent opinions of regulatory commissions. The attitude of the Wisconsin Commission in the Wisconsin Telephone Company case can best be stated by a quotation from the order in which the telephone rates were temporarily reduced 12 $\frac{1}{2}$ percent. "A business enterprise such as a telephone company enjoying a complete monopoly and rendering service which has become an absolute necessity has no statutory or constitutional right to a return in a time of general business depression such as it enjoys when the business community from which it derives its revenues is operating successfully.

"The increase in the purchasing power of money supports our findings relating to the value of service and to fair return, but is considered of such importance that it is discussed as a separate topic.

"Since 1929 the dollar has increased markedly in purchasing power. A dollar today, according to the facts produced by Dr. F.C.Mills in this record, will buy 49.9 percent more in wholesale markets than it would in 1929, 53.1 percent more in retail food markets, 33.5 percent more when tested by a very large number of commodities gathered by the statistician of the Federal Reserve Bank of New York.

"In other words, when a subscriber pays \$5 a month to the Wisconsin Telephone Company in April 1932 he is paying very substantially more than he paid for the same service

in 1928, let us say, when the rate may have been fixed by the Commission as a reasonable one. In wholesale markets of today that \$5 is now worth \$7.50.

"In 1929 the Wisconsin Telephone Company paid to its parent, the American Telephone and Telegraph Company, the sum of \$2,052,000 in dividends on common stock, at the rate of \$8 a share. Dividends at the same rate are being accrued in 1932. The dividends payable in 1932 will buy much more than the dividends of 1929. In wholesale markets, expressed in terms of purchasing power the rate of 8 percent of 1929 becomes 12 percent in 1932, and \$2,052,000 in 1929 becomes \$3,078,000 in 1932.

"The Supreme Court of the United States has held that such a change in purchasing power shall under appropriate circumstances be taken into consideration in rate proceedings. In *Banton v Belt Line Railroad Corporation* (1925) 268 U.S. 413, a rate fixed in 1912 was challenged in 1920 on the ground that it was confiscatory. The court stated 'It is well known and the court will take judicial notice of the fact, that the purchasing power of money has been less since 1917 than it was in 1912, when the order was made, and that the cost of labor, materials, and supplies necessary for the proper operation and maintenance of street railways had greatly increased.' "

While on the other hand the contention of the North Carolina Corporation Commission is that "The public should remember that when individuals and corporations were

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making fabulous profits during the period of the war and as late as 1929, the public utilities were limited to their same fair return on the invested capital; we were not permitted by law to give them rates that would produce any more. The growth in public utility revenue in this state (North Carolina) after the World War resulted from growth in business by expansion into new territory and building by industry and not from increase in rates". The same thought is expressed by the Alabama Public Service Commission, "Declining commodity prices are not of themselves a sufficient basis for a reduction in public utility rates, in view of the fact that utility business is controlled by a Commission and restrained during prosperous times from realizing higher profits which they might earn if their businesses were not so regulated".

These two outstanding and divergent opinions (the Wisconsin and the Alabama) were written in 1932 and have not been before the United States Supreme Court. Equity may dictate that the latter opinion should prevail.

Courts have repeatedly held that it is impossible to fix a definite percentage for return on the rate base as "reasonable". Investigation of all the cases published in Public Utility Reports since 1915 (which are all the cases in which regulatory commissions determined a rate of return) shows the following schedule of allowances.

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	5 to 6%	6 to 7%	7%	7 to 8%	8 to 9%	9% and above
Electric Utilities	3	16	43	31	86	12
Gas Utilities	5	14	45	43	57	13
Telephone Utilities	6	24	73	38	66	16

A computation from these figures yields an average rate of return of 7.50 per cent for electric utilities, 7.41 per cent for gas utilities and 7.22 per cent for telephone utilities; a composite rate of 7.38 per cent for all three utilities.

There are two recognized methods of providing the protection against the early losses which investors in electric utilities require to induce them to enter this industry rather than some other field. One method involves the amortization of these early losses during a limited period of years. The other method considers these losses as a permanent item of cost to be included in the rate base and subject to the same continuing rate of return as investment in physical property. The treatment of early losses was the subject of an opinion by the Supreme Court of Oklahoma 29 Okla. 429 which stated: "During the time of development, there is a loss of money actually expended, and of dividends upon the property invested. How shall this be taken care of? Must it be borne by the owner of the plant? Or shall it be treated as part of the investment or value of the plant, constituting the basis upon which charges shall be made to all customers who receive the benefits from the increased service

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rendering power of the plant by reason of these expenditures? It seems that the last solution is the logical, just and correct one. If rates were to be charged from the beginning, so as to cover these expenditures and earn a dividend from the time a plant is first operated, the rate to the first customers would be in many instances, if not in all, so exorbitant as to be prohibitive, and would be so at the time when the plant could be of least service to them. On the other hand, the public can not expect as a business proposition, or demand as a legal right, that this loss shall be borne by him who furnishes the service, for investors in public service property make such investments for the return they will yield; and, if the law required that a portion of the investments shall never yield any return, but shall be a total loss to the investor, capital would unwillingly be placed into such class of investments; but the law, in our opinion, does not so require.

Private property can no more be taken in this method for public use without compensation than by any other method. When the use of the property and the expenditures made during the non-expense-paying and nondividend-paying period of the plant are treated as an element of the value of the property upon which fair returns shall be allowed, then the burden is distributed among those who receive the benefits of the expenditures and the use of the property in its enhanced value. The above is controlling where equity is considered."

The importance of the rate of return to both the electric utility and the consumer can best be

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illustrated by a numerical example. The following assumptions represent a typical electric utility:

Rate Base	\$10,000,000
Common Stock	\$ 4,000,000
Bonds and Preferred Stock	\$ 6,000,000
Average Interest on Bonds and Preferred Stock	6%
Total Operating Expenses	\$ 1,800,000

If the rate of return was determined as 6% on the rate base, the total revenue paid by all consumers would be \$1,800,000 plus \$600,000 which is equal to \$2,400,000. Out of the \$600,000 return must be paid the interest on the bonds and preferred stock which amounts to \$360,000. This leaves a balance of \$240,000 available for dividends. This amount is equal to a dividend rate of 6% on the \$4,000,000 of common stock.

If instead of 6% a rate of return of 7.6% was determined as fair, the total revenue paid by all consumers would be \$1,800,000 plus \$760,000 which is equal to \$2,560,000. Out of the \$760,000 return must be paid the interest on the bonds and preferred stock which amounts to \$360,000. This leaves a balance of \$400,000 available for dividends. This amount is equal to a dividend rate of 10% on the \$4,000,000 of common stock.

The return necessary to an electric utility amounts to 25 to 30 per cent of the total revenue paid by the consumers and represents a large item of the

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cost of service. It will also be noted that an increase in the total revenue of 6.7% increased the dividends by 66.7% which is indicative of the importance of the rate of return to the electric utility.

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Depreciation

Depreciation is the lessening in value of any property or equipment due to usage (wear or tear) and age. The measure of depreciation is the ratio of the expired life of the property to its total life as determined by physical inspection. The term "depreciation" has a very definite meaning and should not be confused with or used in accounting practice. This term should be used only in valuations or appraisals to represent the subnormal condition of physical property. Land has no depreciation. Courts have consistently held that, depreciation, if it exists, must be found and deducted from the total value for rate-making purposes. When the term "depreciation" is used in accounting practice the general usage refers to the amount which should be added to the operating costs each fiscal period to cover the loss of service life in that period so as to provide for the retirement of equipment units when they come to the end of their service lives. A better term to use for this procedure is "retirement accounting". The purpose of this form of accounting is to spread the cost of long-term equipment units over the revenue they assist in producing.

There are two principal methods of maintaining a retirement account. One is the "straight line" theory which sets aside sufficient funds annually which, without interest accruals, will replace the depreciable property at the end of its useful life. The amount of the funds is

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determined by dividing the depreciable amount (original cost plus estimated cost of removal less estimated salvage value) by the estimated number of years that the equipment will be used and useful. The other method can be termed "retirement reserve" for which no specific amount is set aside for depreciation, but funds are assigned annually to the "retirement reserve" based on judgment and requirements. The cost of current replacements or retirals are then taken care of as they occur.

The advantage of the "straight line" method is that it tends to maintain a uniform ratio of expenses to earnings. The disadvantage is that each year must carry the same amount of depreciation. Depreciation is not so rapid in lean years as in prosperous years. The "straight line" method takes no cognizance of this fact. Reserves set up by this method instead of being beneficial may constitute a burden in lean years, tending to destroy credit instead of preserving property. The advantage of the "retirement reserve" method is that it will permit the electric utility to lay aside in prosperous years sufficient reserves to permit full and adequate maintenance of the reserve by lower appropriations in lean years when depreciation is not so rapid and revenues are lower. The disadvantage of this method lies in the possibility of manipulation to the detriment of either the consumers or stockholders.

The retirement reserve may amount to 5 to 20 per cent of the total investment.

Another controversial item in regard to depreciation is the basis upon which it should be determined; whether the basis should be the original cost or the replacement cost. The following quotation from a pamphlet prepared by the Department of Manufacture of the Chamber of Commerce of the United States fully discusses this point.

"When the cost of an asset, less any salvage value, has been recovered, the process of depreciation stops - the consumer has paid for that particular item of service. There are those who maintain that the obligation of the consumer is one rather of replacement, - building for building, machine for machine. According to this view, depreciation should be based on replacement cost rather than actual cost. The replacement theory substitutes for something certain and definite, the actual cost, a cost of reproduction which is highly speculative and conjectural and requiring frequent revision. It, moreover, seeks to establish for one expense a basis of computation fundamentally different from that used for the other expenses of doing business. Insurance is charged on a basis of actual premiums paid, not on the basis of probable premiums three years hence; rent on the amount actually paid, not on the problematical rate of the next lease; salaries, light, heat, power, supplies are all charged at actual, not upon a future contingent cost."

The rate of depreciation for a typical well operated and maintained electric utility will usually

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lie between 2 and 4 per cent of the book cost of the depreciable property, excluding intangible elements and working capital. Depreciation is a substantial item in the total cost of service. A depreciation rate of 4 per cent amounts to 15 per cent of the revenue received from all customers.

Rate Structures

All types of rates can be classified under one or more of six different forms. These forms are known as:

1. Straight line rate
2. Step rate
3. Block rate
4. Wright demand rate
5. Hopkinson demand rate
6. Three charge demand rate.

The straight line rate is the simplest of all rates. The price per kilowatt-hour is constant; does not vary because of increased or decreased use. Figure 1 illustrates the variation of the total bill with variation of kilowatt-hour consumption. The general form of the rate in a schedule would be:

5.0 cents per kilowatt-hour used per month

Less 10 per cent discount for prompt payment

The method of figuring the monthly statement would be:

Assume a monthly consumption of 160 kw-hr.

$160 \text{ kw-hr.} \times .05 = \$8.00 \text{ gross, less } 10\% =$

$\$7.20 \text{ net statement.}$

The straight line rate was the first rate form used. As the electric business developed, the inequity of this form was soon apparent. The larger users should be given a lower price due to the fact that the costs

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are less. The step rate was the next development. In this form the price per unit is charged for the entire consumption, depending on the particular step within which the total consumption falls. Figure 2 illustrates the variation of the total bill and the unit prices with variations of kilowatt-hour consumption. The term "step" is associated with this form because of the resemblance of the plotted unit price to a flight of steps. The general form of the rate in a schedule would be:

8.0	cents	per	kw-hr.	for	from	1	to	25	kw-hr.	used	per	month
6.4	"	"	"	"	"	26	to	50	"	"	"	"
5.0	"	"	"	"	"	51	to	100	"	"	"	"
4.0	"	"	"	"	"	101	to	200	"	"	"	"
3.0	"	"	"	"	"	201	to	500	"	"	"	"
2.4	"	"	"	"	"	501	or	more	kw-hr.	used	per	month.

Less 10 per cent discount for prompt payment.

The method of figuring the monthly statement would be:

Assume a monthly consumption of 100 kw-hr. This falls within the step 101 to 200 kw-hr. charged for at 4 cents.
 $160 \text{ kw-hr.} \times .04 = \6.40 gross, less 10% =
 $\$5.76$ net statement.

It will be noted that where a step occurs there is a point where a smaller number of units result in a higher statement than a larger number of units. Thus a customer using 100 kw-hr. would receive a statement for \$4.50 whereas the customer using 101 kw-hr. would receive a statement for \$3.60. This inconsistency was soon found to be

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objectionable not only to customers but also regulatory commissions. This inconsistency led to the development and the introduction of the "block" form. In this rate form a definite price per unit charged for all or any part of a block of such units and reduced prices per unit for all or any part of succeeding blocks, each reduced price per unit applying only to a particular block or portion thereof. Figure 3 illustrates the variation of average prices per kilowatt hour for various consumptions per month. The general form of the rate in a schedule would be:

8.0	cents	per	kw-hr.	for	the	first	25	kw-hr.	used	per	month
4.7	"	"	"	"	"	next	25	"	"	"	"
3.0	"	"	"	"	"	next	150	"	"	"	"
1.8	"	"	"	"	"	excess	over	200	kw-hr.	used	per month.

Less 10% discount for prompt payment.

The method of figuring the monthly statement would be:

Assume a monthly consumption of 160 kw-hr.

25	kw-hr.	@	.030	=	\$2.00
25	"	@	.047	=	1.18
<u>110</u>	"	@	.030	=	<u>3.30</u>

160 kw-hr. \$6.48 gross less 10% =

\$5.83 net statement.

The above three rate forms consider only the measured quantity of kilowatt hours used by the customer. In 1896 Arthur Wright in England was the first to propose that the demand or load factor be taken into

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consideration when billing a customer. The "Wright demand" rate is illustrated in Figure 4. The general form of the rate in a schedule would be:

8.0 cents per kw-hr. for the first 30 hours use per month of the maximum demand.

6.0 cents per kw-hr. for the next 30 hours use per month of the maximum demand.

1.8 cents per kw-hr. for all over 60 hours use per month of the maximum demand.

Less 10 per cent discount for prompt payment.

The method of figuring the monthly statement would be:

Assume a monthly consumption of 160 kw-hr. 0.6 kw+ dem.	
30 x 0.6 = 18 kw-hr. in first block @ .08 =	\$1.44
30 x .06 = 18 kw-hr. in next block @ .06 =	1.08
160 - 36 = 124 kw-hr. in last block @ .018 =	<u>2.23</u>
Total	\$4.75

\$4.75 gross less 10 per cent = \$4.28 net statement.

The demand is usually estimated for small customers, such as residences and small stores and measured for larger users. When the estimated demand is used, it is based on the connected load and a percentage applied on the load as inventoried. A variation of this rate is that of using the number of active rooms in a residence or floor area to determine the size of the blocks. The weakness of this particular form lies in the possibility that the customer may not make use of the facilities provided and reserved by the electric utility.

Another rate form, first suggested by Dr. John Hopkinson of England 1892, does not have the above objection. In the "Hopkinson demand" rate the total charge

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to a customer is the sum of a demand charge plus an energy charge. This rate form is illustrated in Figure 5. The general form of the rate in a schedule would be:

Demand charge

\$2.00 per month per kilowatt for the first 25 kw. of the maximum demand per month.

\$1.50 per month per kilowatt for the excess of the maximum demand over 25 kw.

Plus energy charge of

4 cents per kw-hr. for the first 50 kw-hr. used per month

3 " " " " " next 150 " " "

1 " " " " " excess over 200 kw-hr. used per month.

Less 10 per cent discount for prompt payment.

The method of figuring the monthly statement would be:

Assume a monthly consumption of 160 kw-hr. 0.6 kw. dem.

Demand charge 0.6 kw. @ \$2.00 = \$1.20

Plus energy charge 50 kw. @ .04 = 2.00

110 kw. @ .03 = 3.30

Total \$6.50

\$6.50 gross, less 10 per cent = \$5.85 net statement.

The particular advantage of this form is that all the fixed costs of operating an electric utility can be collected as demand charges, (readiness to serve) and the variable costs (operating costs) can be collected in the energy charges.

In 1900 Mr. Henry L. Doherty proposed the "three charge demand" rate. The only difference between this form and the "Hopkinson demand" rates is that a customer charge was introduced, the theory being that each customer

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should pay his particular costs of meter reading, service calls, billing and collections. The "three charge demand" rate consists of a charge per customer or per meter, plus a demand charge, plus an energy charge. This rate form is illustrated in Figure 6. The general form of the rate in a schedule would be:

Customer charge

50 cents per month per meter (no discount)

Demand charge

\$2.00 per kilowatt for the first 25 kw. of maximum demand in the month.

\$1.50 per kilowatt for the excess of the maximum demand over 25 kw.

Energy charge

3 cents per kw-hr. for the first 200 kw-hr. used per month.

1 " " " " " excess over 200 kw-hr. used per month.

Less 10 per cent discount for prompt payment.

The method of figuring the monthly statement would be:

Assume a monthly consumption of 160 kw-hr. 0.6 kw. dem.

Demand charge 0.6 kw. @ \$2.00 = \$1.20

Energy charge 160 kw-hr @ .03 = 4.80

\$6.00

Less 10 per cent

.60

\$5.40

Plus customer charge

.50

Total

\$5.90 net charge.

This last rate form causes considerable dissatisfaction among the smaller customers, the residential class particularly. The fact that a customer charge must be

paid each month and causes the customer complaining to feel that he has received no benefit for this part of the statement; this psychological fact, which is real and should not be dismissed because the basis of the mathematical rate determination is right, can best be dealt with by substituting a minimum charge which nearly accomplishes the same purpose. The minimum charge is determined in the same way as the customer charge. In its application the customer is not confronted with this charge unless the calculated amount of his statement falls below the minimum in which case the statement is presented for the minimum charge. Complaints received on this procedure are very few and it is relatively simple to explain to the complaining customer what items of cost are represented by the minimum charge. Some rates have a service charge which is identical with a customer charge, the only difference being in the terminology. The same objections obtain for this designation as do for the customer charge.

The item of power factor is given consideration in nearly all of the modern rate schedules for industrial customers. The standard rating on generating equipment is 80 per cent power factor. This point is usually taken as the base from which power factor penalties, bonuses, or both are determined. Low power factor increases the cost of energy, transmission and distribution investment and decreases the generating capacity. High power factor has the opposite effect.

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• **Prevalence** = the proportion of a population that has a disease at a particular point in time

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The tendency of modern industrial rate schedules is to also include a fuel clause. For small users the fuel cost may be only 10 per cent of the total charge while for industrial users the fuel cost may be 50 per cent. The industrial rate has a very small differential between costs and price, depending on quantity for the profit. A moderate change in fuel cost may change a profitable business into a loss. The form that a coal clause usually takes is that for a 5 or 10 cent increase or decrease in the price of coal the energy rate is increased or decreased a specified amount.

To insure prompt payment of statements rendered customers, most rate schedules contain a discount for prompt payment. This discount is usually 10 per cent. The tendency is to lower this to 5 per cent because 10 per cent is more than it costs to collect the statement after the due date, and also that 10 per cent is too much a penalty for non-payment within the ten days usually specified. Some electric utilities prefer to use a 5 per cent penalty for delinquent payment. The particular advantage of this method is that the electric utility has the benefits, if any, of a lower published rate schedule. The discounts on industrial users is rarely over 5 per cent, usually less.

Due to its simplicity the block form of rate is usually chosen for residential and suburban customers while the Hopkinson demand rate is most popular for use in billing commercial and industrial customers.

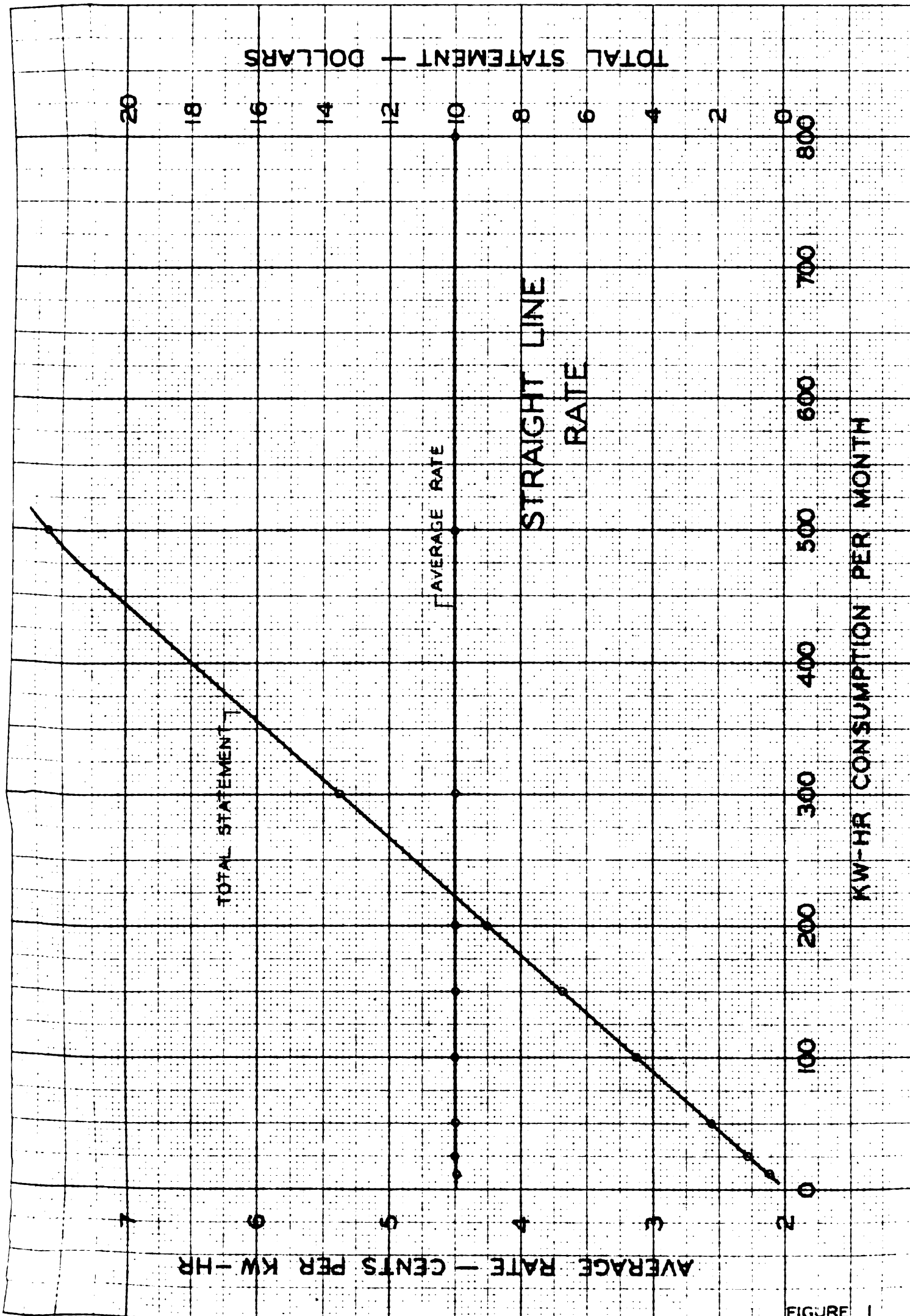


FIGURE 1

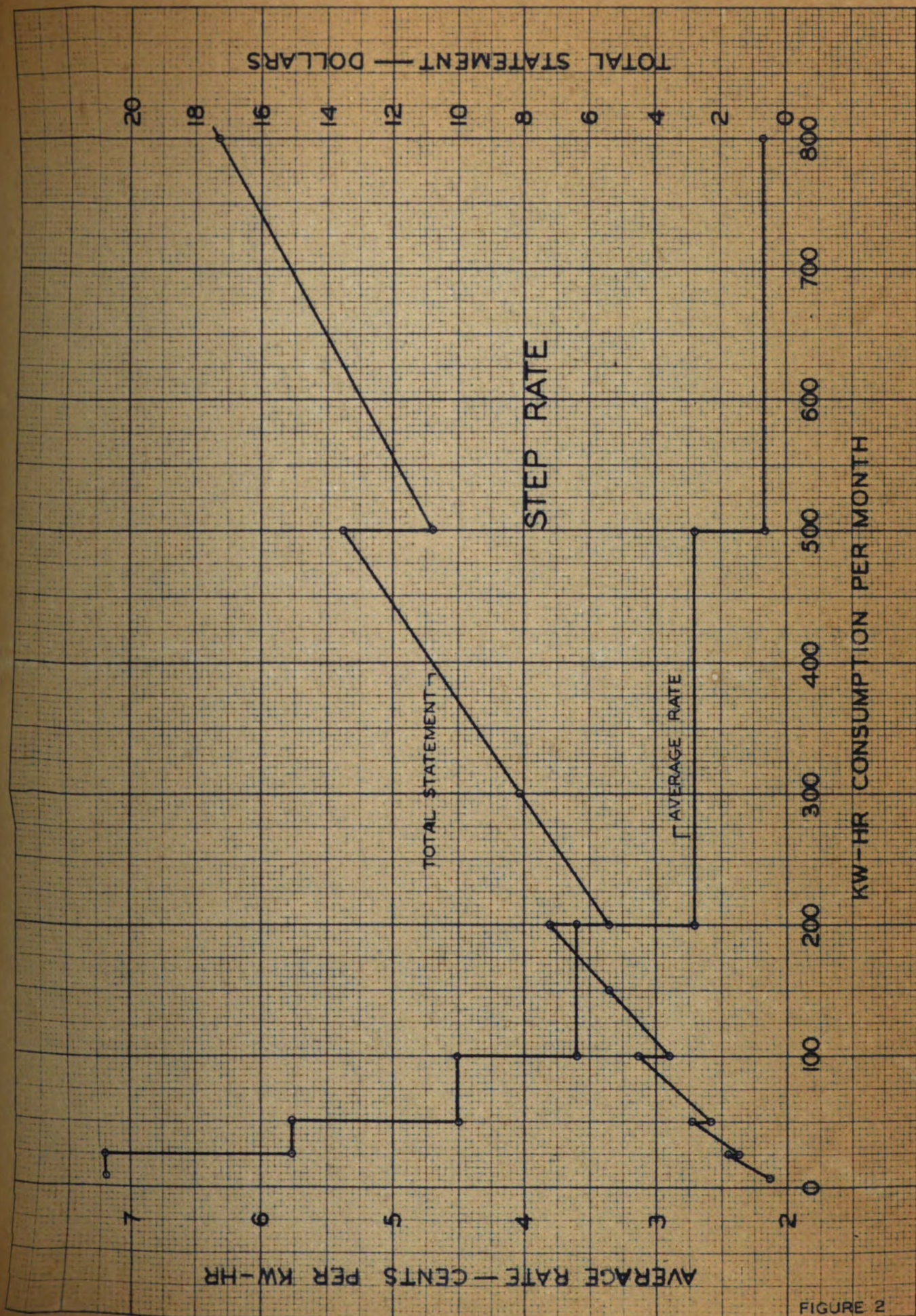


FIGURE 2

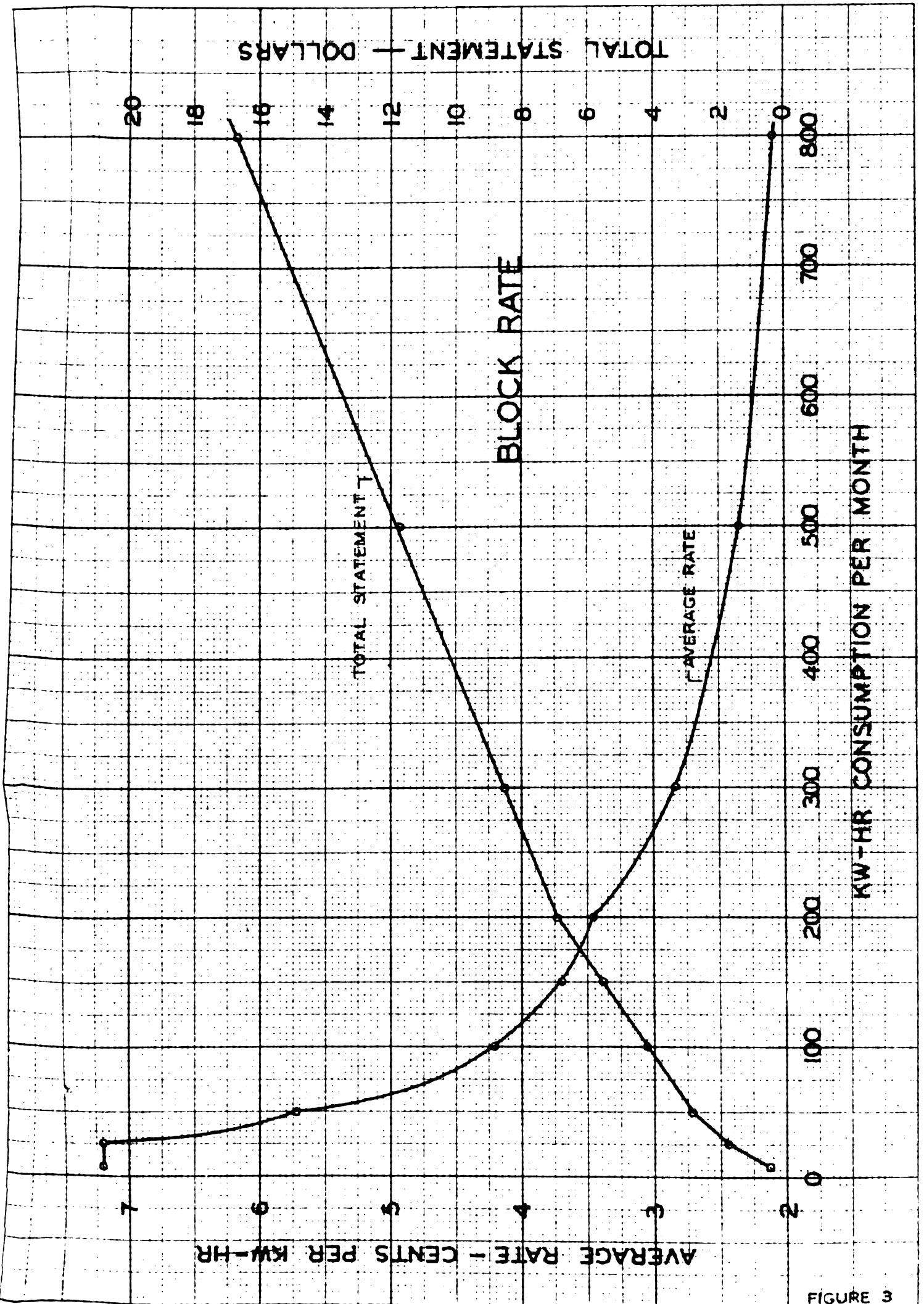


FIGURE 3

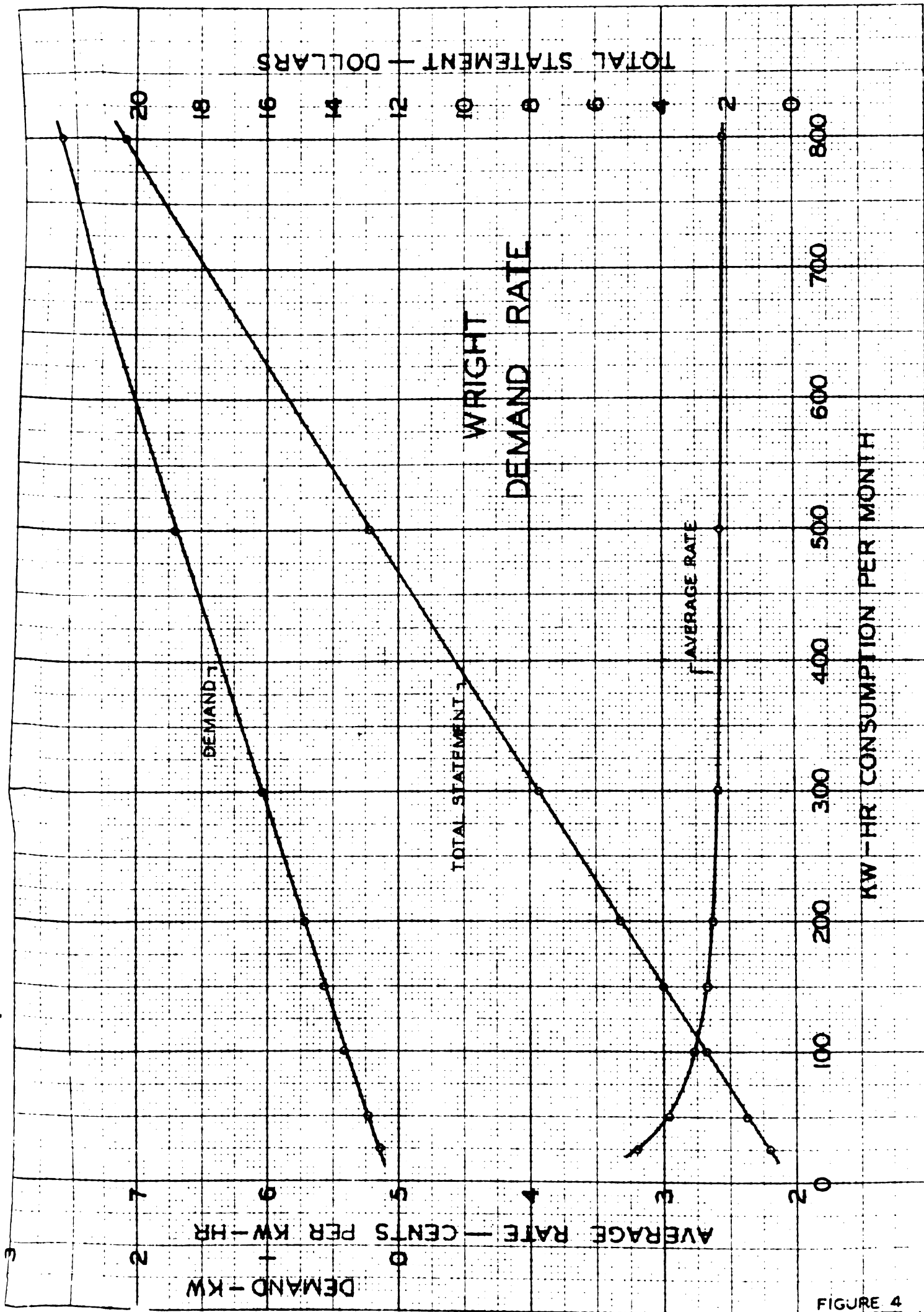
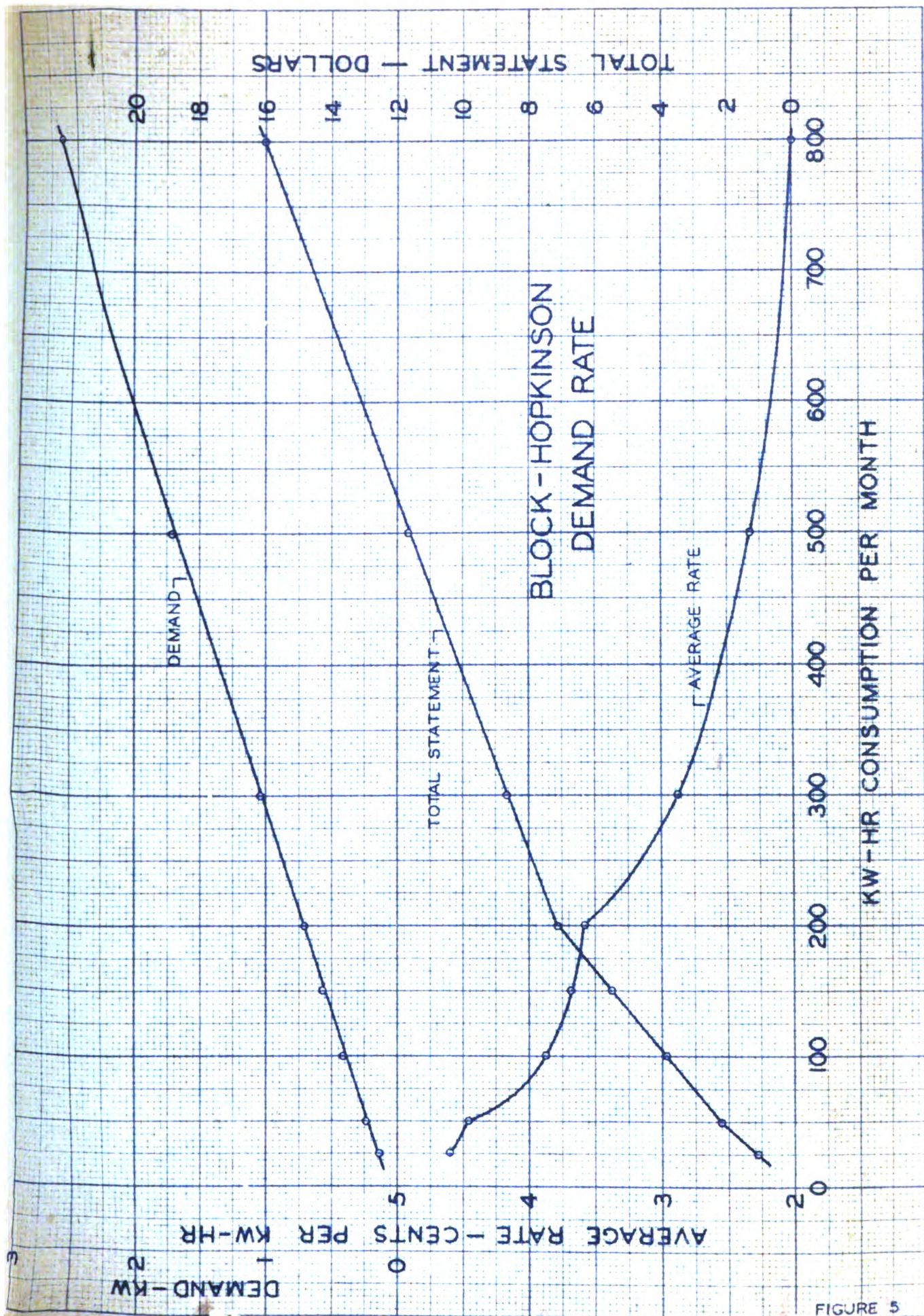


FIGURE 4



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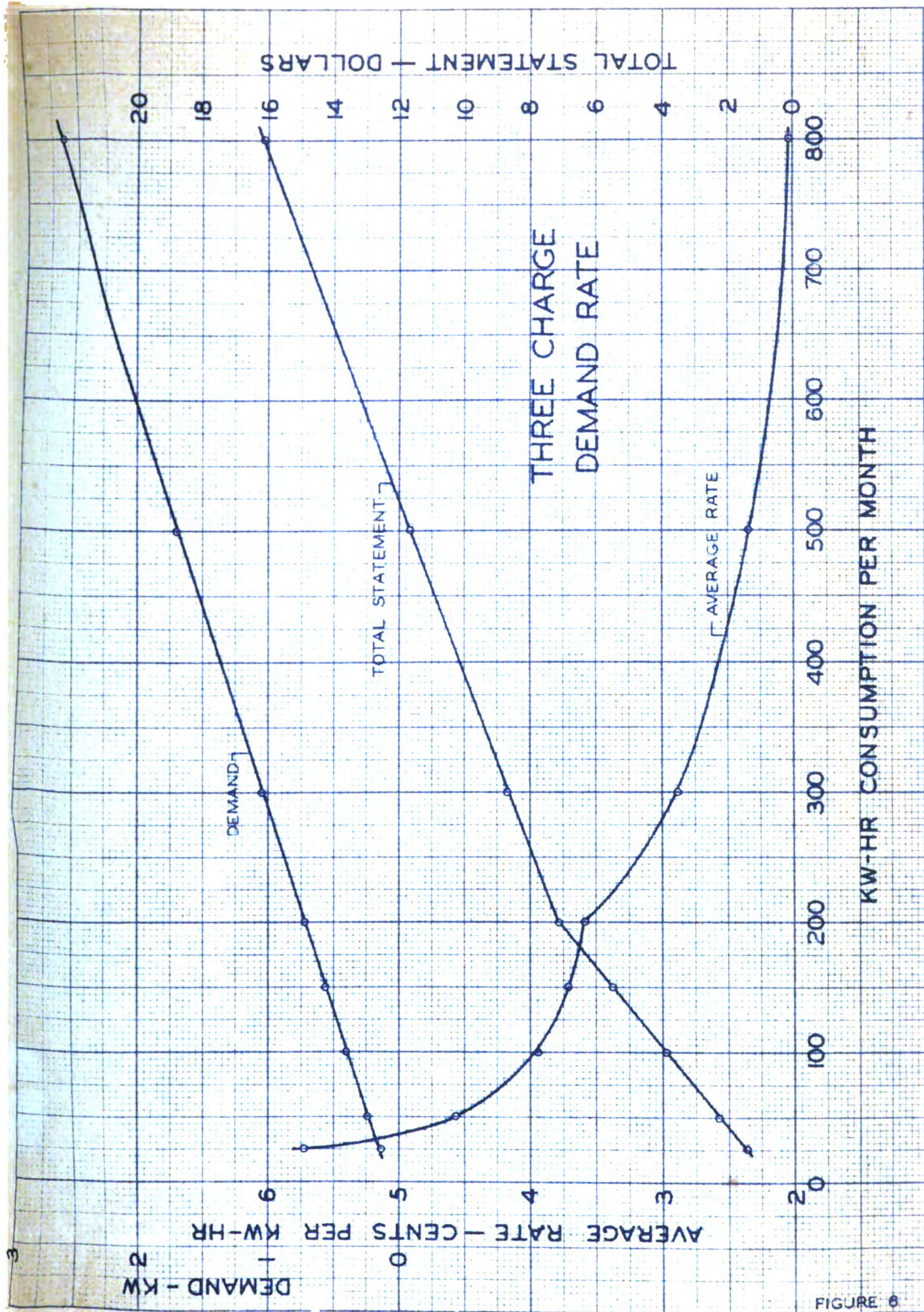


FIGURE 8

Classification of Customers

There are three fundamental objectives that must be kept in mind in a rate determination, viz:

1. The rates should provide the electric utility with adequate revenue..
2. The burden of providing this adequate revenue should be spread over all classes of customers without discrimination.
3. The rates should be such that they will encourage the maximum economic consumption of energy.

To insure successful operation and the best possible public relations, all of the three above objectives must be met.

Due to the public service rendered by an electric utility they must accept all customers that comply with their rules and regulations, regardless of the kind of load they impose on the utility. Each customer uses the service to meet his individual requirements. The cost of rendering this service varies with the type of load, hours of use, demand and quantity required.

The tendency is toward the minimum number of rates possible for any electric utility and still satisfy the requirement that each class of service should bear its just share of the costs.

The customary classification of customers is:

- | | |
|----------------|------------------------------|
| 1. Residential | 4. Suburban |
| 2. Commercial | 5. Municipal Street Lighting |
| 3. Industrial | 6. Electric Railways |

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The service required by any particular customer in any of the above classifications usually is typical of the group. Sometimes the residential and the suburban are combined to make for better public relations, although the cost of serving the suburban customer is slightly higher than the urban residential. Occasionally, special rates, which are termed promotional, are put into effect for some particular type of customer such as ice making, off-peak service and grist mills.

Uniform Classification of Accounts

The first states to prescribe a uniform system of accounting for the electric utilities under their regulation were New York and Wisconsin. This first attempt for the classification of accounts was made in 1907. Variation in the method of bookkeeping of the different electric utilities made comparison between them difficult if not impossible in most cases. There is no Federal authority over electric utilities, each state prescribing its own system for comparison. Electric utilities operating in two or more states found it mandatory to keep separate methods of accounting. To obtain accurate comparisons these utilities found it necessary to reclassify their accounts. To eliminate this difficulty the National Association of Railway and Utilities Commissioners adopted a "Uniform Classification of Accounts for Electric Utilities" in 1922. Practically all regulatory commissions have adopted this system.

The uniform classification of accounts for electric utilities specifies the following standard forms:

Standard Form of Balance Sheet
Assets and other debits
Liabilities and other credits.

Fixed Capital Accounts

Standard Form of Income Account

Standard Form of Profit and Loss Account

Operating Revenue Accounts

Operating Expense Accounts

Each of the several forms contains detailed accounts which pertain to the general caption. Pages 47 and 48 show the standard form of Balance Sheet. All accounts under "Assets and Other Debits" have been assigned a number between 100 and 199. Each of these accounts is defined in detail in the uniform classification, for example, account number 101 "Fixed Capital" is defined as follows: "This account shall include the cost of property having an expectation of life in service of more than one year which is devoted to the operations conducted by the accounting company, less deductions for property abandoned, sold or otherwise retired. Separate subdivisions shall be used for each distinct class of operations conducted by the accounting company, as, for example, "Fixed Capital--electric," "Fixed Capital--gas." If, however, the accounting company conducts two or more separate and distinct classes of operations, as in the case of a company having both an electric and gas department, expenditures chargeable to such fixed capital accounts as "Land," "Organization," "General Structures," "Engineering and Superintendence," etc., which are not assignable to a particular department or kind of operations, may be shown in a subdivision having the title "Fixed Capital--general" The foregoing shall not be construed to prohibit the apportionment of such expenditures between departments on a more or less arbitrary basis provided this basis is clearly stated in the accounting company's public reports."

All accounts under "Liabilities and Other Credits" have been assigned a number between 200 and 299.

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Pages 49, 50 and 51 show the detailed subdivision of "Fixed Capital Accounts". These have numbers between 300 and 399.

Pages 52 and 53 show the make-up of the "Income Account". The purpose of these accounts is to show the sources and disposition of income during any given period. These accounts are numbered between 400 and 499.

Page 54 shows the standard form of the "Profit and Loss Account". The purpose of this account is to form the connecting link between the income account and the balance sheet. These account numbers are between 500 and 599.

Page 55 shows the items that make up the operating revenue accounts. These accounts record the amounts that are received for services rendered, for products or merchandise sold, as a return on property used in the utility's own operations and as interest on current funds, such as daily bank balances. These accounts have been assigned the 600 series.

Pages 56 to 61 show the detail items of the operating expense account. The accounts are in the 700 series. They can be grouped in subheads of:

1. Production
 - Operation
 - Maintenance
 - Miscellaneous Production
2. Transmission Expenses
3. Distribution Expenses
4. Utilization
5. Commercial Expenses

17

6. New Business Expenses

7. General Miscellaneous Expenses

Expenses under the classification of Operation include those that are necessary to the maintenance of the corporate organization, the rendering of service required or authorized by law, the sale of merchandise, the produce (including herein the cost of capital consumed) and disposition of commodities produced, and the collection of revenues therefor. This group of accounts are divided into four classes as follows:

Class A - Utilities having average annual operating revenues exceeding \$250,000.

Class B - Utilities having average annual operating revenues exceeding \$50,000 but not over \$250,000.

Class C - Utilities having average annual operating revenues exceeding \$10,000 but not over \$50,000.

Class D - Utilities having average annual operating revenues of \$10,000 or less.

In the standard form the letter "D" preceding the title denotes that at least the accounts so indicated must be kept by utilities in Class D so far as they are applicable to its business. The letter "C" indicates the accounts that must be kept by Class C utilities, and so on. The utility may keep a more extended number of accounts than those indicated for its class.

STANDARD FORM OF BALANCE SHEET

Assets and Other Debits

101. Fixed Capital

CURRENT ASSETS:

- 111. Cash
- 112. Notes receivable
- 113. Accounts receivable
- 114. Interest and dividends receivable
- 115. Marketable securities
- 116. Materials and supplies
- 117. Prepayments
- 118. Subscribers to capital stock
- 119. Miscellaneous current assets

MISCELLANEOUS ASSETS:

- 121. Investments in affiliated companies
- 122. Miscellaneous investments
- 123. Sinking funds
- 124. Replacement fund
- 125. Miscellaneous special funds
- 126. Special deposits

SUSPENSE:

- 131. Unamortized debt discount and expense
- 132. Property abandoned
- 133. Jobbing accounts
- 134. Clearing or apportionment accounts
- 135. Work in progress
- 136. Miscellaneous suspense

ADJUSTMENT ACCOUNTS:

- 141. Discount on capital stock
- 142. Reacquired securities
- 143. Treasury securities
- 150. Profit and loss - deficit

STANDARD FORM OF BALANCE SHEET

Liabilities and Other Credits

- 201. Capital stock
- 202. Premium ~~and~~ capital stock
- 203. Capital stock subscribed

- 211. Long term debt.
- 212. Receiver's certificates

CURRENT LIABILITIES:

- 221. Notes payable
- 222. Accounts payable
- 223. Consumers' deposits
- 224. Matured interest unpaid
- 225. Dividends declared
- 226. Matured long term debt unpaid
- 227. Miscellaneous current liabilities

ACCRUED LIABILITIES:

- 231. Taxes accrued
- 232. Interest accrued
- 233. Miscellaneous accrued liabilities
- 241. Advances from affiliated companies

RESERVES:

- 251. Retirement reserve
- 252. Casualty and insurance reserve
- 253. Unamortized premium on debt
- 254. Sinking fund reserves
- 255. Contributions for extensions
- 256. Contingency reserve
- 257. Miscellaneous reserves
- 261. Miscellaneous unadjusted credits
- 270. Profit and loss - surplus

TABLE

301.
302.
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TABLE

304.

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FIXED CAPITAL ACCOUNTS

INTANGIBLE FIXED CAPITAL:

- 301. Organization
- 302. Franchises
- 303. Miscellaneous intangible capital

TANGIBLE FIXED CAPITAL:

SPECIFIC ACCOUNTS:

- 311. Land
 - (a) Steam power plant land
 - (b) Hydro-electric power plant land
 - (c) Gas power plant land
 - (d) Transmission system land
 - (e) Distribution system land
 - (f) General office land
 - (g) Miscellaneous land devoted to electric operations
 - (g-1) Stores department land
 - (g-2) General shops land
 - (g-3) Transportation department land
 - (g-4) Communication system land
 - (g-5) Miscellaneous land
- 312. Structures
 - (a) Steam power plant structures
 - (b) Hydro-electric power plant structures
 - (c) Gas power plant structures
 - (d) Transmission system structures
 - (e) Distribution system structures
 - (f) General office structures
 - (g) Miscellaneous structures devoted to electric operations
 - (g-1) Stores department structures
 - (g-2) General shop structures
 - (g-3) Transportation department structures
 - (g-4) Communication system structures
 - (g-5) Miscellaneous structures
- Generating Plant - Steam
- 313. Boiler plant equipment
- 314. Prime movers and auxiliaries - steam
- 315. Turbo-generator units - steam
- 316. Electric plant - steam
- 317. Miscellaneous power plant equipment - steam

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FIXED CAPITAL ACCOUNTS

Generating Plant - Hydro-Electric

- 318. Reservoirs, dams and waterways
 - (a) Reservoirs, dams and intakes
 - (b) Navigation facilities
 - (c) Waterways
 - (d) Forebays, penstocks and tailraces
- 319. Roads, trails, and bridges
- 320. Water turbines and water-wheels
- 321. Turbo-generator units - hydro
- 322. Electric plant - hydro
- 323. Miscellaneous power plant equipment - hydro

Generating Plant - Gas

- 324. Fuel holders, producers and accessories
- 325. Internal combustion engines
- 326. Electric plant - gas
- 327. Miscellaneous power plant equipment - gas

Transmission and Distribution

- 328. Sub-station equipment
- 329. Storage battery equipment
- 330. Underground conduits
- 331. Poles, towers, and fixtures
- 332. Overhead conductors
- 333. Underground conductors
- 334. Transmission roads and trails
- 335. Services
- 336. Line transformers and devices
- 337. Line transformer installation
- 338. Consumers' meters
- 339. Meter installation

Consumers' Installations

- 340. Installations on consumers' premises
- 341. Commercial lamps
- 342. Street lighting equipment
- 343. Electric appliances

GENERAL EQUIPMENT:

- 344. General equipment
 - (a) Office equipment
 - (b) Stores equipment
 - (c) Shop equipment
 - (d) Transportation equipment
 - (e) Telephone, telegraph and wireless system
 - (f) Laboratory equipment
 - (g) Miscellaneous equipment
- 345. Miscellaneous tangible capital

FIXED CAPITAL ACCOUNTS

OVERHEAD COSTS AND OTHER UNDISTRIBUTED ITEMS:

- 351. Engineering and superintendence
- 352. Law expenditures during construction
- 353. Injuries and damages during construction
- 354. Taxes during construction
- 355. Interest during construction
- 356. Miscellaneous construction expenditures
- 357. Fixed capital not classified by prescribed accounts
- 358. Cost of plant and equipment purchased
- 359. Unfinished construction

STANDARD FORM OF INCOME ACCOUNT

Item Ac-
count

INCOME FROM OPERATING PROPERTIES

1	401	Operating revenues	***	\$
2	402	Operating expenses	\$	***
3	403	Uncollectible bills		***
4	404	Taxes		***
5		Total revenue deductions	***	
6		Operating income applicable to corporate and leased properties	***	\$
7	411	Rent for lease of other electric plant..	\$	***
8	412	Amortization of limited term land rights		***
9		Total (items 7 and 8)	\$	***
10	413	Rent accrued from lease of electric plant - Cr.		***
11		Net rent deduction (credit balance in red).....	***	
12		Balance of income applicable to corp- orate property	***	\$

INCOME FROM NON-OPERATING PROPERTIES

13	421	Miscellaneous rent revenues	\$	***
14	422	Interest on long term debt owned		***
15	423	Miscellaneous interest revenues		***
16	424	Dividend revenues		***
17	425	Income from special funds		***
18	426	Miscellaneous non-operating revenues ...		***
19		Total (items 13 to 18 inclusive)	\$	***
20	427	Non-operating revenue deductions		***
21		Total miscellaneous income	***	
22		Gross corporate income (items 12 and 21)	***	\$

STANDARD

Ac
count

DEDUCTION

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434	Amorti
435	Miscel
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443	Misc
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STANDARD FORM OF INCOME ACCOUNT

Item Ac
 count

DEDUCTIONS FROM GROSS CORPORATE INCOME

23	431	Interest on long term debt	\$	***
24	432	Miscellaneous interest deductions		***
25	433	Amortization of debt discount and expense		***
26	434	Amortization of premium on debt - Cr.		***
27	435	Miscellaneous amortization chargeable to income		***
28	436	Miscellaneous deductions from gross corpor- ate income		***
29		Total deductions from gross corporate income	---	***
30		Net income (loss in red)	***	---

DISPOSITION OF NET INCOME

31	441	Sinking fund appropriations	\$	***
32	442	Dividend appropriations of income		***
33	443	Miscellaneous appropriations of net income		***
34		Total appropriations of net income	---	***
35		Balance transferred to surplus	***	---

STANDARD FORM OF PROFIT AND LOSS ACCOUNT

	Dr.	Gr.
Balance at the beginning of the fiscal period		
Balance transferred from income account		
501. Dividend appropriations of surplus		***
502. Appropriations to reserves		***
503. Miscellaneous credits to Profit and Loss	***	
504. Miscellaneous debits to Profit and Loss		***
Balance at the end of the fiscal period		

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OPERATING REVENUE ACCOUNTS

SALES OF CURRENT:

- 601. Metered sales to general consumers
- 602. Flat-rate sales to general consumers
- 603. Railroad corporations
- 604. Other electrical corporations
- 605. Municipal street lighting
- 606. Miscellaneous municipal sales

MISCELLANEOUS REVENUE:

- 611. Commission on others' electric energy
- 612. Rent from electric appliances
- 613. Rent from property used in operation
- 614. Merchandise and jobbing
- 615. Miscellaneous operating revenues.

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OPERATING EXPENSE ACCOUNTS

700

Production Expenses
Steam Power Generation

OPERATION:

D C B	701	Superintendence and labor
	A 701.1	Superintendence
	A 701.2	Boiler labor
	A 701.3	Engine labor
	A 701.4	Electrical labor
	A 701.5	Miscellaneous labor
D	702	Power plant supplies and expenses
C B A	702.1	Fuel
C B A	702.2	Water
C B	702.3	Miscellaneous supplies and expenses
	A 702.31	Lubricants
	A 702.32	Production supplies
	A 702.33	Station expense

MAINTENANCE:

D	703	Maintenance of power plant
C B A	703.1	Maintenance of station buildings
C B	703.2	Maintenance of steam equipment
	A 703.21	Maintenance of furnaces and boilers
	A 703.22	Maintenance of boiler apparatus
	A 703.23	Maintenance of steam accessories
	A 703.24	Maintenance of steam engines
	A 703.25	Maintenance of turbo-generator units
C B	703.3	Maintenance of electrical equipment
	A 703.31	Maintenance of main generators
	A 703.32	Maintenance of exciting apparatus
	A 703.33	Maintenance of control and protective equipment
	A 703.34	Maintenance of transformers and converting apparatus.
C B A	703.4	Maintenance of miscellaneous power plant equipment
D C B A	704	Steam generated - Apportionment account
D C B A	705	Steam from other sources

OPERATION:

HYDRO-ELECTRIC GENERATION

D C B	706	Superintendence and labor
	A 706.1	Superintendence
	A 706.2	Hydro-electric labor
	A 706.3	Station labor
	A 706.4	Miscellaneous labor

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OPERATING EXPENSE ACCOUNTS

Hydro-Electric Generation (cont'd)

D	707	Power plant supplies and expenses
C B A	707.1	Water for power
C B	707.2	Miscellaneous supplies and expenses
	A 707.21	Lubricants
	A 707.22	Production supplies
	A 707.23	Station expense

MAINTENANCE:

D	708	Maintenance of power plant
C B A	708.1	Maintenance of station buildings
C B	708.2	Maintenance of reservoirs, dams and waterways
	A 708.21	Maintenance of reservoirs, dams and intakes
	A 708.22	Maintenance of navigation facilities
	A 708.23	Maintenance of waterways
	A 708.24	Maintenance of forebays, penstocks and tailraces
	A 708.25	Maintenance of way and cars
	A 708.26	Maintenance of telephone system
	A 708.27	Maintenance of production roads and trails
C B	708.3	Maintenance of hydro-electric equipment
	A 708.31	Maintenance of water turbines and water wheels
	A 708.32	Maintenance of turbo-generator units
	A 708.33	Maintenance of main generators
	A 708.34	Maintenance of exciting apparatus
	A 708.35	Maintenance of control and protective equipment
	A 708.36	Maintenance of transformers and converting apparatus
C B A	708.4	Maintenance of miscellaneous power plant equipment

GAS GENERATION

OPERATION:

D C B	709	Superintendence and labor
	A 709.1	Superintendence
	A 709.2	Fuel labor
	A 709.3	Engine labor
	A 709.4	Electrical labor
	A 709.5	Miscellaneous labor
D	710	Power plant supplies and expenses
C B A	710.1	Engine fuel
C B	710.2	Miscellaneous supplies and expenses
	A 710.21	Water
	A 710.22	Lubricants
	A 710.23	Production supplies
	A 710.24	Station expense

OPERATING EXPENSE ACCOUNTS

MAINTENANCE:

D	711	Maintenance of power plant
C B A	711.1	Maintenance of station buildings
C B	711.2	Maintenance of gas equipment
A	711.21	Maintenance of fuel holders, producers and accessories
A	711.22	Maintenance of engines and turbines
C B	711.3	Maintenance of electric equipment
A	711.31	Maintenance of main generators
A	711.32	Maintenance of exciting apparatus
A	711.33	Maintenance of control and protective apparatus
A	711.34	Maintenance of transformers and converting apparatus
C B A	711.4	Maintenance of miscellaneous power plant equipment
D C B A	712	Power gas from other sources

MISCELLANEOUS PRODUCTION ACCOUNTS

D C B A	713	Electric energy from other sources
D C B A	714	Duplicate production charges - Cr.
D C B A	715	Production expenses transferred - Cr.

720

TRANSMISSION EXPENSES

D	721	Transmission operation and maintenance
O B A	721.1	Superintendence
O B A	721.2	Substation labor
C B A	721.3	Substation supplies and expenses
C B	721.4	Operating of transmission lines
A	721.41	Labor and expense - underground conduits
A	721.42	Labor and expense - poles, towers and fixtures
A	721.43	Labor and expense - overhead conductors
A	721.44	Labor and expense - underground conductors
A	721.45	Miscellaneous supplies and expenses
C B A	721.5	Maintenance of structures
C B A	721.6	Maintenance of substation equipment
C B A	721.7	Maintenance of underground conduits
O B	721.8	Maintenance of transmission lines
A	721.81	Maintenance of poles, towers and fixtures
A	721.82	Maintenance of overhead conductors
A	721.83	Maintenance of underground conductors
C B A	721.9	Maintenance of roads and trails

730

DISTRIBUTION EXPENSES

D	731	Distribution operation and maintenance
C B A	731.1	Superintendence
C B	731.2	Substation expenses
A	731.21	Substation labor
A	731.22	Substation supplies and expenses

OPERATING EXPENSE ACCOUNTS

DISTRIBUTION EXPENSES (cont'd)

C B	731.3	Storage battery expenses
A	731.31	Storage battery labor
A	731.32	Storage battery supplies and expenses
C B	731.4	Operation of distribution lines
A	731.41	Labor and expense - underground conduits
A	731.42	Labor and expense - poles, towers and fixtures
A	731.43	Labor and expense - overhead conductors
A	731.44	Labor and expense - underground conductors
A	731.45	Miscellaneous supplies and expenses
C B	731.5	Meter and transformer operation
A	731.51	Salaries and expenses - meter department
A	731.52	Testing meters
A	731.53	Miscellaneous expenses - meter department
A	731.54	Removing and resetting meters
A	731.55	Removing and resetting transformers
C B A	732.1	Maintenance of structures
CCB A	732.2	Maintenance of substation equipment
C B A	732.3	Maintenance of storage battery equipment
C B A	732.4	Maintenance of underground conduits
C B	732.5	Maintenance of distribution lines
A	732.51	Maintenance of poles, towers and fixtures
A	732.52	Maintenance of overhead conductors
A	732.53	Maintenance of underground conductors
C B A	732.6	Maintenance of services
C B	732.7	Maintenance of transformers and meters
A	732.71	Maintenance of line transformers
A	732.72	Maintenance of consumers' meters

750

UTILIZATION

D	751	Utilization operation and maintenance
C B	751.1	Commercial lamps - operation
A	751.11	Commercial arc lamps
A	751.12	Incandescent lamps - installation
A	751.13	Incandescent lamps - renewals
C B	751.2	Consumers' installation and inspection work
A	751.21	Inspection - consumers' premises
A	751.22	Consumers' installations
C B	751.3	Municipal street lamps - operation
A	751.31	Municipal street arc lamps
A	751.32	Municipal street incandescent installation
A	751.33	Municipal street incandescent renewals
C B A	751.4	Maintenance of commercial lamps
C B	751.5	Maintenance of municipal street light equipment
A	751.51	Maintenance of municipal street arc lamps
A	751.52	Maintenance of municipal street incandescent lamps

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OPERATING EXPENSE ACCOUNTS

		760	COMMERCIAL EXPENSES
D C		761	Commercial administration
	B A	761.1	Commercial general labor
	B	761.2	Commercial books and contracts
	A	761.21	Commercial bookkeeping
	A	761.22	Commercial contracts
	B	761.3	Commercial meter reading and collecting
	A	761.31	Commercial collecting
	A	761.32	Meter reading
	B A	761.4	Commercial supplies and expenses
D C B A		762	Agents' commissions
		770	NEW BUSINESS EXPENSES
D C		771	New business expenses
	B	771.1	New business salaries
	A	771.11	New business management salaries
	A	771.12	New business advertising salaries
	B	771.2	New business supplies and expenses
	A	771.21	Demonstrations
	A	771.22	Wiring and appliances
	A	771.23	Advertising supplies and expenses
	A	771.24	Canvassing and soliciting
	A	771.25	Miscellaneous new business supplies and expenses
		780	GENERAL MISCELLANEOUS EXPENSES
D		781	Undistributed general expenses
	C B	781.1	General office salaries
	A	781.11	Administrative salaries
	A	781.12	Other general office salaries
	C	781.2	Miscellaneous general expenses
	B A	781.21	General office supplies and expenses
	B A	781.22	General stationery and printing
	B A	781.23	Maintenance of general structures
	B A	781.24	Operation of communication system
	B A	781.25	Maintenance of communication system
	B A	781.26	Law expenses
	B A	781.27	Insurance
	B A	781.28	Store expenses
	B A	781.29	Transportation expenses
	B A	781.30	Undistributed adjustments
	B A	781.31	Rentals
	B A	781.32	Other miscellaneous general expenses
D C B		782	Retirement expense

OPERATING EXPENSE ACCOUNTS

GENERAL MISCELLANEOUS EXPENSES (cont'd)

D C B	783	Injuries and damages
A	783.1	Claim department expenses
A	783.2	Medical expenses
A	783.3	Injuries to employees
A	783.4	Other personal injuries and property damage
A	783.5	Miscellaneous accident expenses
D C B A	784	Regulatory commission expenses
D C B	785	Relief and welfare work
A	785.1	Employees' welfare department
A	785.2	Pensions
D C B A	786	Franchise requirements
D C B A	787	Amortization of franchises
D C B A	788	Electric expenses transferred - Cr.
D C B A	789	Joint operating expenses - Cr.
D C B A	790	Duplicate miscellaneous charges - Cr.

Rate Determination

The process of rendering electric service to customers can be divided into four groups:

1. Generation of electric energy.
2. Transmission on high voltage lines from generating station to substation.
3. Distribution on low voltage lines from substation secondary to customer's meter.
4. Administration of the utilities affairs.

For any rate determination the costs of rendering service may be divided into two main divisions:

1. Fixed (or capacity) costs which include all the necessary and unavoidable interest, insurance, depreciation (or retirement reserve) and taxes. These costs are practically constant whether customers consume energy or not.
2. Operating (or variable) costs which include all the necessary costs for production, transmission, distribution, maintenance, meter reading, billing, collection and supervision.

The application of the mathematical determination of a rate schedule can best be illustrated and discussed by the use of a hypothetical electric utility. All figures for the hypothetical utility as to common and preferred stock, bonds, fixed capital, operating costs and service conditions have been assumed so they will represent average or typical operation in the electric utility field. All financial statements are presented in conformity with the uniform classification of accounts and the whole rate determination is based on the proper analysis and grouping of these accounts as they enter into the cost of service.

For simplicity the fixed capital is assumed at \$10,000,000. All other items can then be compared relative to this figure as a percentage. The customers on a system with this amount of fixed capital will in normal times require a generation of 100,000,000 kilowatt-hours per year, population of territory served will be 100,000.

The hypothetical electric utility will have the following physical characteristics:

Installed generating capacity consists of three 10,000 kw. and one 7,500 kw. steam turbo generators. Small hydro electric plant has two 1,000 kw. generators. Generation at a voltage of 13,200, 60 cycles and three phase. Generating stations located ten miles from substation which is near the center of load. Transmission voltage 66,000. The distribution system consists of lighting and power circuits, 4400 volts, phase to phase. The thirty lighting circuits have single phase voltage regulators on each of the three phases. Each three phase lighting circuit goes near the center of load for the various districts and then covers that particular district as single phase with a ground, 2400 volts phase to ground wire. The secondary voltage would be 120-240. The twenty power circuits are not regulated. Primary metering for industrial customers at 4400 volts. Small power customers metered at 440 volts, three phase. The population of the area served is 100,000.

SEASONAL VARIATION OF GENERATION

AVERAGE DAILY GENERATION - THOUSAND KW-HR

320
300
280
260
240
220

JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.

MONTH

FIGURE 7

COMPOSITE LOAD CURVE INDICATING TIME OF OCCURANCE OF MAXIMUM DEMAND OF DIFFER- ENT CLASSES OF SERVICE

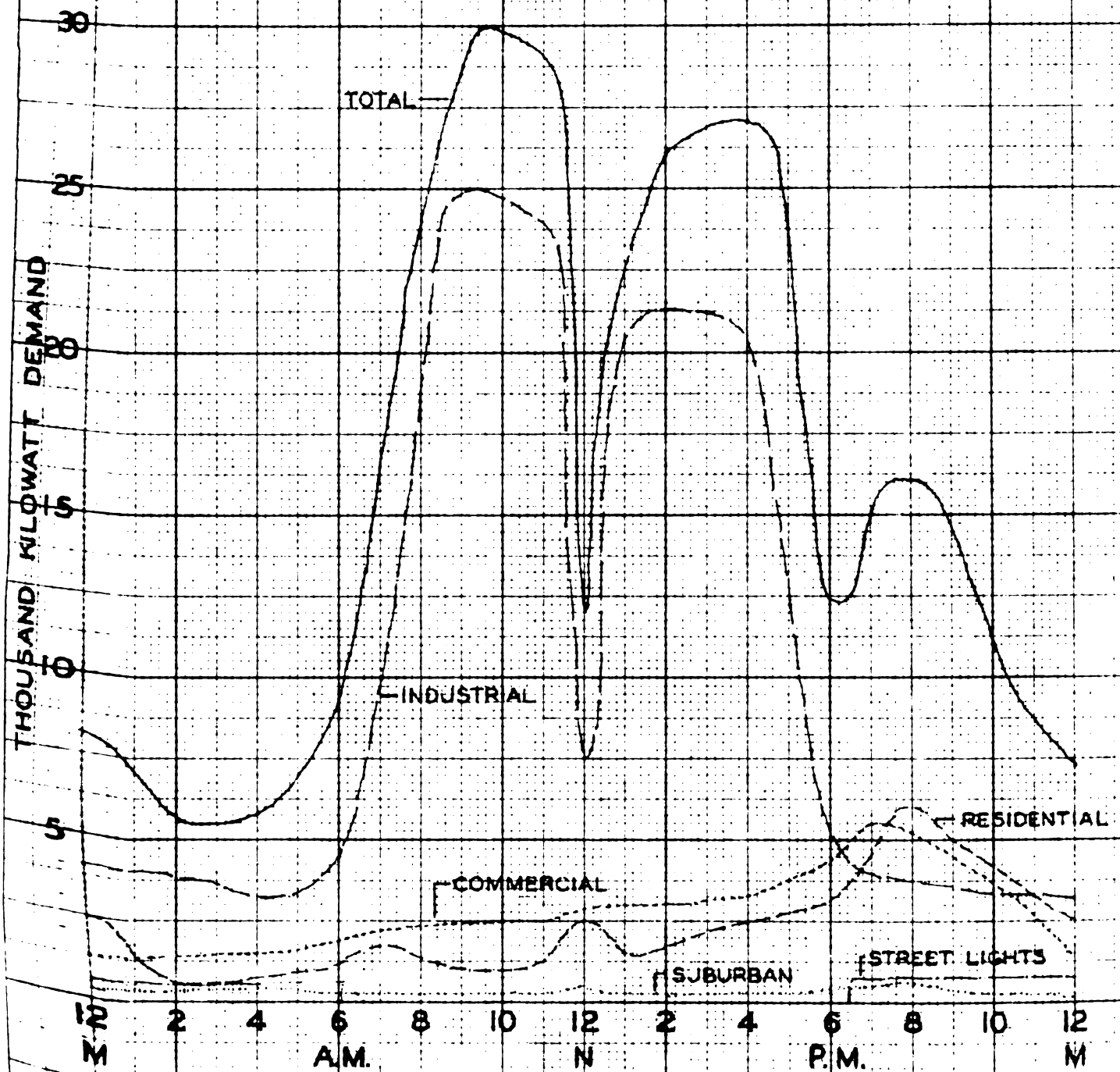
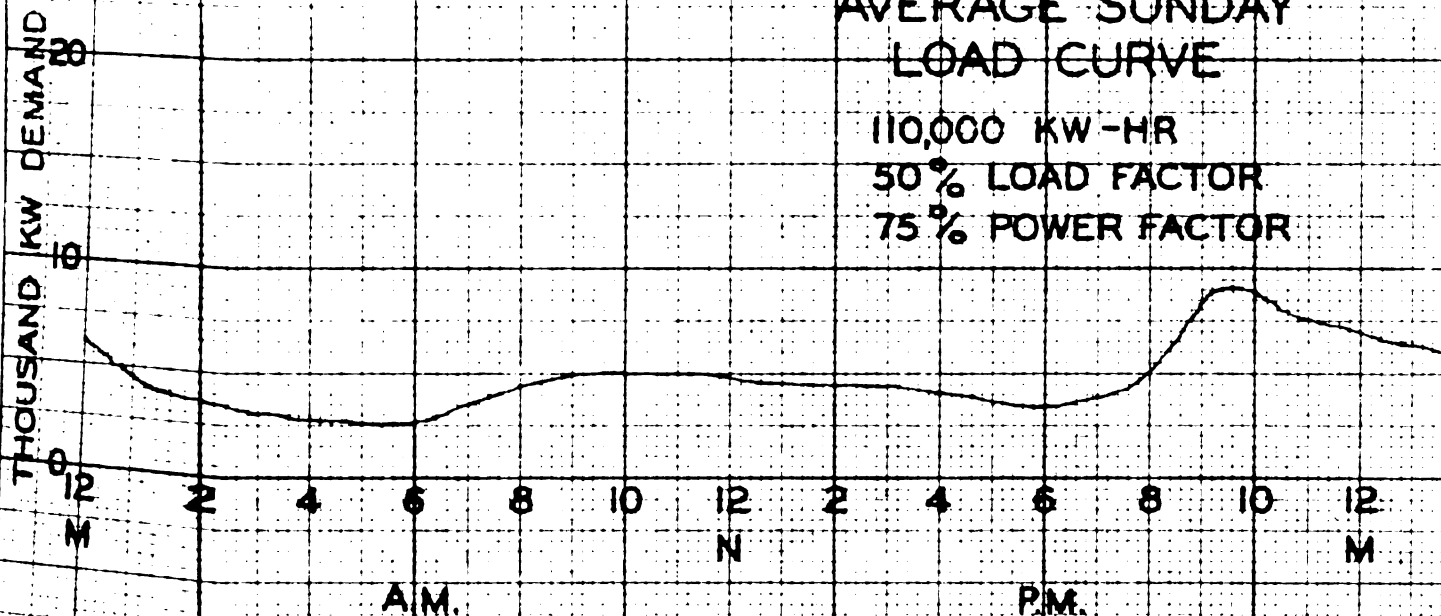


FIGURE 8

AVERAGE SUNDAY LOAD CURVE

110,000 KW-HR
50% LOAD FACTOR
75% POWER FACTOR



AVERAGE SATURDAY LOAD CURVE

220,000 KW-HR
55% LOAD FACTOR
78% POWER FACTOR

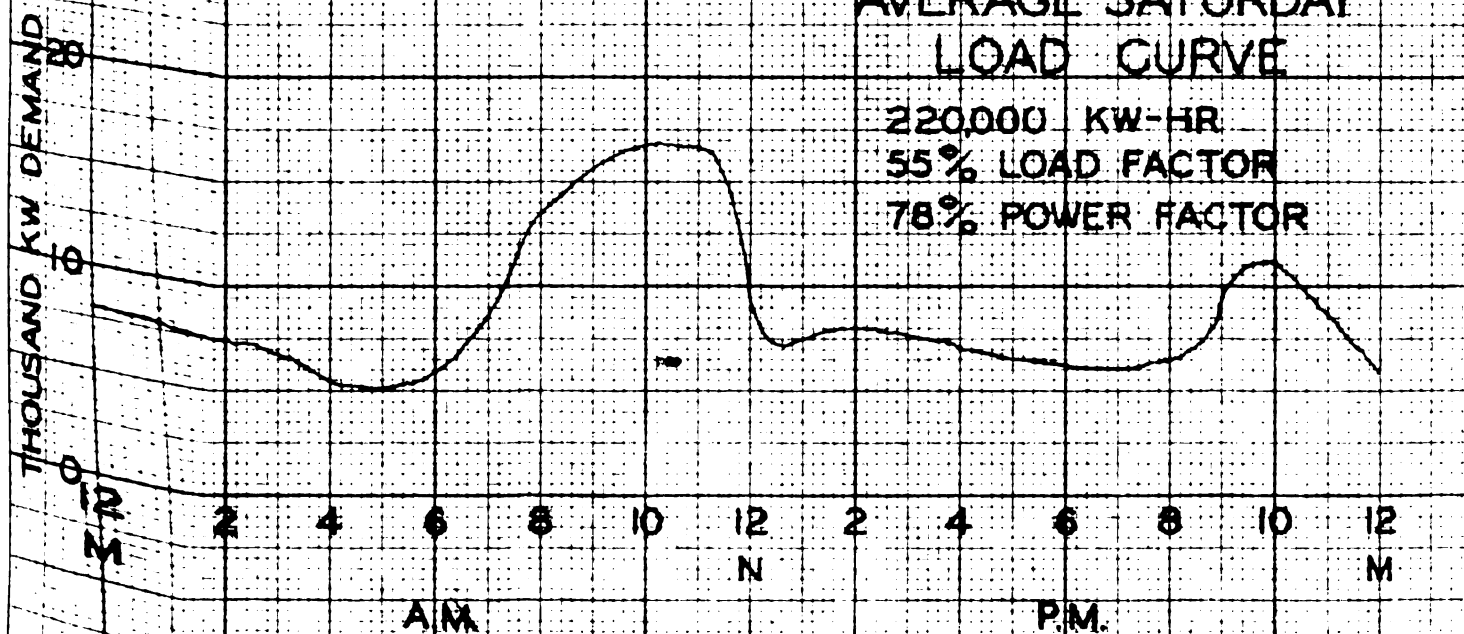
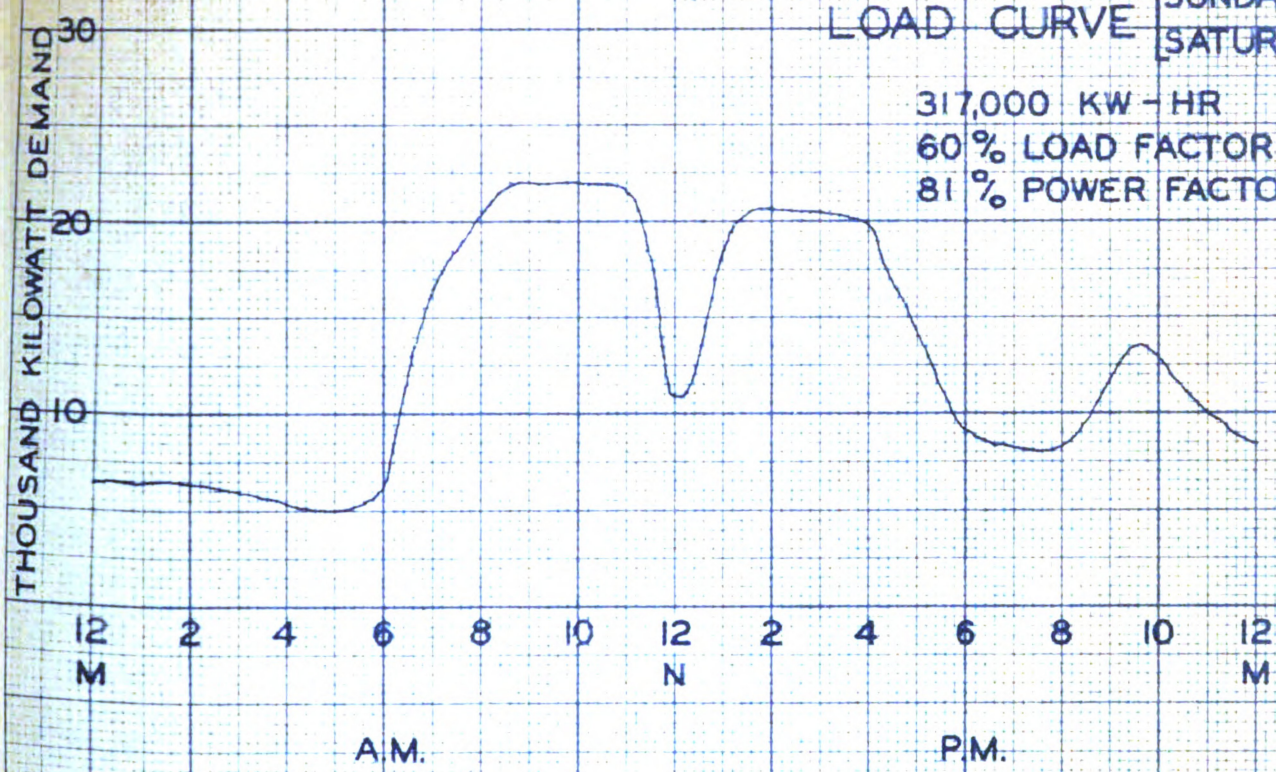


FIGURE 9

AVERAGE DAILY LOAD CURVE {EXCEPT SUNDAY & SATURDAY

317,000 KW-HR
60% LOAD FACTOR
81% POWER FACTOR



MAXIMUM LOAD CURVE

446,000 KW-HR
62% LOAD FACTOR
82% POWER FACTOR

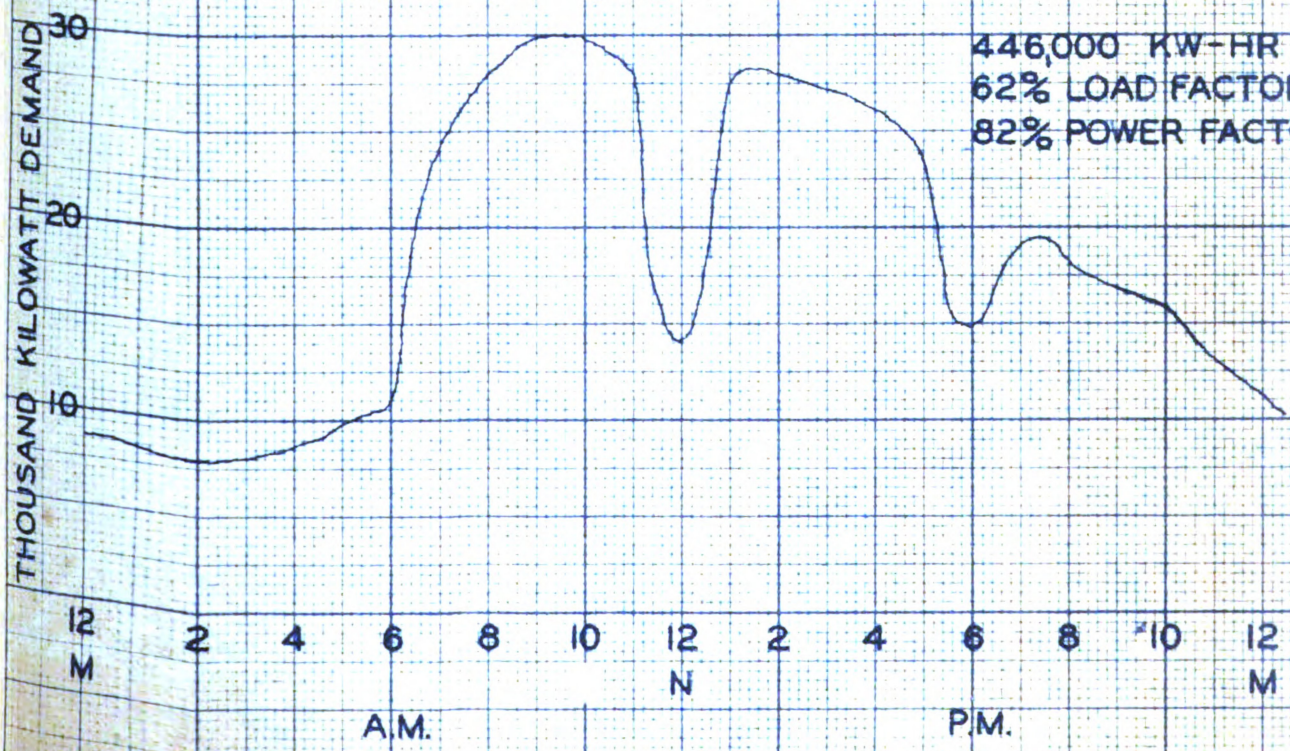


FIGURE 10

Page 65 shows the balance sheet for the assumed electric utility.

Pages 66 and 67 show the detail of the fixed capital account. The items that make up the total of the fixed capital can be classified either as specific or joint. A specific item is one which is wholly allocated to some particular part of the process of rendering service while a joint item is one which is necessary for one or more parts of the process and requires an allocation to those particular parts. These joint items have various bases for allocation depending on the joint use made of them. After each item in the fixed capital account, a notation is made showing the proper allocation of that particular item. The summary of these allocations is made after the presentation of the other financial and operating factors. All transmission items are allocated under the caption "Substation".

The income account is shown in page 68.

The profit and loss account is shown on page 69..

The operating revenue is shown on page 70 .

After each item of operating expense, notations are made showing the allocation and the basis of the allocation of that particular item.

The data presented so far (pages 65 to 73) is that obtained by the uniform classification of accounts and is a complete financial history of the utility for an annual period. This data is compiled by the accounting division of the electric utility.

Exhibit A
BALANCE SHEET

HYPOTHETICAL POWER CORPORATION

Assets and other Debits

Fixed Capital		\$10,000,000	
Current assets			
Cash	\$420,000		
Notes Receivable	2,500		
Accounts Receivable	200,000		
Interest & Dividends Receivable	5,000		
Marketable Securities	60,000		
Materials and Supplies	125,000		
Prepayments	35,000		
Misc. Current Assets	25,500	873,000	
Miscellaneous Assets			
Investment in Affiliated Companies	250,000		
Misc. Investments	65,000		
Sinking Funds	320,000		
Replacement Fund	50,000		
Misc. Special Funds	20,000		
Special Deposits	20,000	725,000	
Suspense			
Unamortized Debt Discount & Expense	105,000		
Property Abandoned	25,000		
Jobbing Accounts	10,000		
Clearing or Apportionment Accounts	6,000		
Work in Progress	30,000		
Misc. Suspense	8,000	184,000	
Adjustment Accounts			
Discount on Capital Stock	15,000		
Reacquired Securities	35,000		
Increased Securities	55,000	105,000	
Profit and Loss - deficit	0		
			\$11,887,000

Liabilities and other Credits

Capital Stock		\$3,500,000	
Premium on Capital Stock		25,000	
Preferred Stock		1,000,000	
Long Term Debt		3,500,000	
Current Liabilities			
Notes Payable	5,000		
Accounts Payable	120,000		
Consumers Deposits	7,000		
Dividends Declared	225,000		
Misc. Current Liabilities	8,000	365,000	
Accrued Liabilities			
Taxes accrued	150,000		
Interest accrued	100,000		
Misc. accrued liabilities	25,000		
Advance from Affiliated Companies	55,000	330,000	
Reserves			
Retirement Reserve	850,000		
Casualty & Insurance Reserve	400,000		
Unamortized Premium on debt	40,000		
Sinking Fund Reserve	300,000		
Contributions for extensions	400,000		
Contingency Reserve	250,000		
Misc. Reserves	250,000	2,490,000	
Misc. Unadjusted Credits		127,000	
Profit and Loss - surplus		550,000	\$11,887,000

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Exhibit B
Fixed Capital Accounts

	Total	Allocated to
INTANGIBLE FIXED CAPITAL		
Organization	\$50,000	Generation
Franchises	15,000	"
Misc. intangible capital	20,000	"
	\$85,000	
TANGIBLE FIXED CAPITAL		
Land		
Steam power plant land	20,000	Generation
Hydro-electric power plant land	150,000	"
Transmission system land	3,000	Substation
Distribution system land	5,000	Distribution
General office land	40,000	25% - Generation & Substation on basis of fixed capital, 75% - Distribution.
Misc. land devoted to elec. operation	12,000	Ditto
	\$230,000	
Structures		
Steam power plant structures	850,000	Generation
Hydro-electric power plant structure	10,000	"
Transmission system structures	2,000	Substation
Distribution system structures	3,000	Distribution
General office structures	240,000	Same as General Office Land
Misc. structures devoted to electric operation	40,000	Ditto
	\$1,145,000	
Generating Plant - Steam		
Boiler plant equipment	1,500,000	Generation
Prime movers of auxiliaries - steam	400,000	"
Turbo-generator units - steam	950,000	"
Electric plant - steam	650,000	"
Misc. power plant - steam	3,000	"
	\$3,503,000	
Generating Plant - Hydro-electric		
Reservoirs, dams and waterways	70,000	Generation
Roads, trails and bridges	2,500	"
Water turbines and water-wheels	50,000	"
Turbo-generator units - hydro	30,000	"
Electric plant - hydro	12,000	"
Misc. power plant equipment - hydro	1,500	"
	\$ 166,000	
Transmission and Distribution		
Substation equipment	300,000	Substation
Storage battery equipment	3,000	"
Underground conduits	122,000	10%-Substation & 90%-Distribution
Poles, towers and fixtures	380,000	Ditto
Overhead conductors	850,000	Ditto
Underground conductors	375,000	Ditto
Transmission roads and trails	6,000	Substation
Services	750,000	Distribution
Line transformers and devices	400,000	10%-Substation & 90%-Distribution
Line transformer installation	125,000	Ditto
Consumers' meters	350,000	Distribution
Meter installation	75,000	"
	\$3,736,000	
Consumers' Installation		
Installation on consumers' premises	50,000	Distribution
Commercial lamps	15,000	"
Street lighting equipment	200,000	Distribution (Mun. Street Lights)
Electric appliances	5,000	Distribution
	\$ 270,000	
General Equipment		
Office equipment	40,000	25%-Generation & Substation on basis of fixed capital and 75% to Distribution
Stores equipment	8,000	
Shop equipment	9,000	Ditto
Transportation equipment	50,000	"
Telephone system	5,000	"
Laboratory equipment	10,000	"
Misc. equipment	15,000	"
Misc. tangible capital	35,000	"
	\$ 172,000	
Overhead Costs & Other Undistributed Items		
Engineering and superintendence	300,000	Generation, Substation on basis of fixed capital
Law expenditures during construction	6,000	Ditto
Injuries & damages "	2,000	"
Taxes during construction	40,000	"
Interest during construction	150,000	"
Misc. construction expenditures	30,000	"
Fixed capital not classified by prescribed accounts	35,000	"
Cost of plant & equipment purchased	55,000	"
Unfinished construction	75,000	"
	\$ 693,000	
	\$10,000,000	

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ТАКЖЕ ВНЕШНЕГО ЗАВИСИМОСТИ
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SUMMARY OF FIXED CAPITAL ACCOUNTS

Intangible Fixed Capital	\$ 85,000	
Land	230,000	
Structures	1,145,000	
Generating Plant - Steam	3,503,000	
Generating Plant - Hydro	166,000	
Transmission & Distribution	3,736,000	
Consumers' Installation	270,000	
General Equipment	172,000	
Overhead Costs and Other Undistributed Items	693,000	\$10,000,000

Exhibit C
INCOME ACCOUNT

Income from operating properties		
Operating revenues		\$2,257,000
Operating expense	\$1,300,000	
Uncollectible bills	12,000	
Taxes	290,000	
Operating income applicable to corporate properties		655,000
Income from non-operating properties		25,000
Gross corporate income		680,000
Deductions from gross corporate income		
Interest on long term debt	210,000	
Interest on preferred stock	65,000	
Miscellaneous deductions	30,000	305,000
Net income		375,000
Disposition of net income		
Sinking fund appropriation	100,000	
Dividend appropriation of income	200,000	
Miscellaneous appropriation of net income	50,000	350,000
Balance transferred to surplus		\$25,000

Exhibit D

PROFIT AND LOSS ACCOUNT

	Debit	Credit
Balance at the beginning of the fiscal year		\$629,000
Balance transferred from income account		25,000
Dividend appropriation of surplus	\$80,000	
Appropriations to reserves	25,000	
Misc. credits to Profit & Loss		5,000
Misc. debits to Profit & Loss	4,000	
Balance at the end of the fiscal year		\$550,000

Exhibit E

OPERATING REVENUE ACCOUNT

Metered sales to general consumers

Residential	\$ 611,500
Commercial	460,300
Industrial	1,002,400
Suburban	73,300
Municipal street lighting	102,500
Sub-total	\$2,250,000

Miscellaneous Revenue

Rent from electric appliances	\$ 2,000
Merchandise and jobbing	4,000
Miscellaneous operating revenues	1,000

Total	\$2,257,000
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OPERATING EXPENSE

	Total	Allocation	Basis of Allocation to customer class- ification
PRODUCTION EXPENSE - STEAM POWER GENERATION			
Operation		Generation	Kw-hr. Utilized
Superintendence	\$14,000	"	"
Boiler labor	19,000	"	"
Engine labor	18,000	"	"
Electrical labor	17,000	"	"
Miscellaneous labor	9,000	"	"
Fuel	320,000	"	"
Water	6,000	"	"
Lubricants	5,000	"	"
Production supplies	8,000	"	"
Station expense	6,000	"	"
	\$422,000		
Maintenance			
Station buildings	8,000	"	"
Furnaces and boilers	17,000	"	"
Boiler apparatus	21,000	"	"
Steam accessories	8,000	"	"
Turbo-generator units	8,000	"	"
Main generators	9,000	"	"
Exciting apparatus	4,000	"	"
Control and protective equip.	17,000	"	"
Transformer and convertor	7,000	"	"
Misc. plant equipment	4,500		
	\$103,500		
PRODUCTION EXPENSE - HYDRO ELECTRIC GENERATION			
Superintendence and labor	7,000	"	"
Power plant supplies and expenses	1,300	"	"
Maintenance of power plant	4,500	"	"
	\$ 12,800		
MISCELLANEOUS PRODUCTION ACCOUNT			
Electric energy from other sources	00	"	"
TRANSMISSION EXPENSE			
Superintendence	6,500	Substation	Kw-hr. Utilized
Substation labor	4,000	"	"
Substation supplies & expenses	1,500	"	"
Transmission labor & expense - underground conduits	2,000	"	"
Ditto - poles, towers & fixtures	2,000	"	"
" - overhead conductors	2,000	"	"
" - underground conductors	1,500	"	"
Misc. supplies and expenses	1,000	"	"
Maintenance of structures	1,500	"	"
" " substation equip.	4,500	"	"
" " underground conduits	1,500	"	"
" " poles, towers & fixt.	8,000	"	"
" " overhead conductors	3,000	"	"
" " underground "	2,000	"	"
" " roads and trails	500	"	"
	\$ 41,500		
DISTRIBUTION EXPENSES			
Superintendence	10,500	Distribution	Total Distribution
Substation labor	8,000	Substation	fixed capital
Substation supplies and expenses	1,500	"	"
Storage battery labor	500	"	"
Storage battery supplies and expenses	500	"	"
Distribution labor & expense - underground conduits	3,000	Distribution	"
Ditto - poles, towers and fixtures	3,500	"	"
Ditto - overhead conductors	3,500	"	"
Ditto - underground conductors	1,500	"	"
Miscellaneous supplies & expenses	2,000	"	"
Salaries & expenses - meter dept.	5,000	"	No. of customers
Testing meters	3,500	"	"
Misc. expenses - meter dept.	3,500	"	"
Removing and resetting meters	6,500	"	"
Removing and resetting transformers	3,500	"	"
Maintenance of structures	1,500	"	Total structures
" " substation equip.	8,000	Substation	fixed capital
" " storage battery equip.	1,000	"	"
" " underground conduits	6,000	Distribution	Basis of fixed
" " poles, towers & fixt.	10,500	"	capital
" " overhead conductors	8,000	"	"
" " underground "	4,000	"	"
" " services	8,000	"	No. of services
" " line transformers	8,500	"	Fixed capital
" " customers' meters	6,500	"	No. of customers
	\$118,500		
UTILIZATION			
Commercial arc lamps	1,000	Distribution	Commercial
Incandescent lamps - installation	2,000	"	No. of customers
" " - renewals	5,500	"	"
Inspection - consumers' premises	10,000	"	"
Consumers' installations	8,500	"	"
Municipal street arc lamps	2,500	"	Street lights
Municipal street incandescent installation	5,000	"	"
Municipal street incandescent renewals	5,000	"	"
Maintenance of commercial lamps	1,500	"	"
Maintenance of municipal street arc lamps	5,000	"	"
Maintenance of municipal street incandescent lamps	30,000	"	"
	\$ 76,000		

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OPERATING EXPENSE

	Total	- Allocation	Basis of Allocation to customer classification
Amt. brought forward	\$774,300		
COMMERCIAL			
Commercial general labor	\$2,000	Distribution	No. of customers
Commercial bookkeeping	3,000	"	"
Commercial contracts	1,500	"	"
Commercial collecting	3,000	"	"
Meter reading	14,000	"	"
Commercial supplies and expenses	1,000	"	"
Agents' commission	3,000	"	"
	\$ 27,500		
NEW BUSINESS EXPENSES			
New business management salaries	2,400	"	"
" " advertising salaries	1,500	"	"
Demonstrations	3,000	"	"
Wiring and appliances	1,200	"	"
Advertising supplies and expenses	3,000	"	"
Canvassing and soliciting	1,200	"	"
Misc. new business supplies & expenses	500	"	"
	\$ 12,800		
GENERAL MISCELLANEOUS EXPENSES			
Administrative salaries	71,000	Gen.station, sub- sta. & dist. on basis of payroll	Distribution to number of customers
Other general office salaries	30,000	"	"
General office supplies and expenses	6,500	25% Gen; 10% Sub- sta; 65% Distr.	No. of customers
General stationery and printing	5,000	"	"
Maintenance of general structures	4,500	"	"
Operation of communication system	6,500	"	"
Maintenance of " "	3,500	"	"
Law expenses of	5,000	Fixed capital	
Insurance	10,000	Fixed capital, Gen.Sta. and Substation only	
Store expenses	3,500	Fixed capital	
Transportation expenses	10,000	25% Gen; 10% Sub- sta; 65% Distr.	No. of customers
Undistributed adjustments	5,000	"	No. of customers
Rentals		"	"
Other misc. general expenses	2,500	"	"
Retirement expense	300,000	Fixed capital	
Claim department expenses	1,400	25% Gen; 10% Sub- sta; 65% Distr.	No. of customers
Medical expenses	1,000	"	"
Injuries to employess	1,500	"	"
Other personal injuries & property damage	1,500	"	"
Misc. accident expenses	500	"	"
Regulatory commission expenses	3,000	Generation	
Employees welfare department	3,000	Gen, Sub-sta. and Dist. on basis of payroll	No. of customers
Pensions	6,000	"	
Franchise requirements	2,000	Fixed capital	
Amortization of franchises	1,500		
	\$485,400		
Total Operating Expenses	\$1,300,000		

CONDENSED OPERATING EXPENSES

Production Expenses	\$538,300
Transmission Expenses	41,500
Distribution Expenses	118,500
Utilization Expenses	76,000
Commercial Expenses	27,500
New Business Expenses	12,800
General Misc. Expenses	<u>485,400</u>
	\$1,300,000

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With the financial data complete, the next step in the rate determination is that of determining the proper rate base. The following is the detailed calculation of the rate base. All figures used originate either in the balance sheet or the operating expense accounts.

RATE BASE CALCULATION

Fixed capital as of Dec. 31, 1932	\$10,000,000	
Fixed capital as of Dec. 31, 1931	9,500,000	
Average fixed capital		\$9,750,000
Less retirement reserve	\$50,000	
Plus replacement fund	50,000	\$00,000
Sub-total		\$9,950,000
Less contributions for extensions		400,000
Sub-total		\$,550,000
Working cash capital		
Annual operating costs	\$1,300,000	
Less annual retirement res.	<u>300,000</u>	
Plus taxes	1,000,000	
Plus bond interest	<u>290,000</u>	
	210,000	
	<u>\$1,500,000</u>	
One-sixth of above	250,000	
Stores, materials & supplies	48,500	
General office materials and supplies	6,500	
Coal in storage, 3 mo. supply	80,000	
Prepayments	35,000	
	420,000	
Plus total working cash capital		\$,970,000
Plus going concern value 5% on \$8,550,000		427,500
Rate Base		\$9,397,500
Permissible return @ 7 per cent		\$ 657,800

Before any further progress can be made in the rate determination, operating data as to kilowatt hours utilized by each group of customers, kilowatt demands, generation, load factor, number of customers, losses and similar data must be obtained. This information can usually be obtained from either a statistical or engineering department.

The kilowatt hours utilized per year by the different groups of customers and the number of customers are:

Table I

Group	Kw-hr Utilized (sold)	No. of Customers	Kw-hr. per Customer	Avg. revenue per kw-hr. Utilized
Residential	13,500,000	20,000	675	4.53 cents
Commercial	16,500,000	2,100	7,850	2.79 "
Industrial	56,000,000	100	560,000	1.79 "
Suburban	1,500,000	2,500	600	4.89 "
Municipal Street Light.	2,500,000	1	2,500,000	4.10 "
Total	90,000,000	24,701	3,640	2.50 cents

Fixed costs that are jointly used by all customers is the most difficult item of expense to allocate between the different groups of customers; the principal expense being that due to the investment in the generating station. The allocation should be on the basis of the demands of the various customers because it is this factor that determines the installed capacity of the generating station. There is a diversity in the demands of the groups of customers as there is between customers in the group. The following data shows the size of the group demands, time of occurrence and a history showing the growth of the demand.

Table II

Group demands at maximum demand on generation station

Time of occurrence January 15, 1932 9:00 a.m.

	Kilowatt Demand	Per cent of Peak
Residential	3,000	10.0%
Commercial	3,600	12.0
Industrial	23,100	77.0
Suburban	300	1.0
Municipal Street Lighting	<u>0</u>	<u>0</u>
	30,000	100.0%

Table III

Time of occurrence of maximum demand of each group.

	Kilowatt Demand	Per cent of sum	Time of Occurrence
Residential	6,000	15.9	7:30 p.m. Dec. 24, 1932
Commercial	5,500	14.5	7:00 p.m. Dec. 23, 1930
Industrial	25,000	66.0	9:00 a.m. Apr. 15, 1929
Suburban	650	1.7	7:30 p.m. Dec. 24, 1932
Municipal Street Lighting	<u>700</u>	<u>1.9</u>	7:30 p.m. Dec. 21, 1931
	37,850	100.0	

There are several theories in regard to the proper method of allocating these joint costs. One method would be to make the allocation on the basis of the use that customers made of the generating station; ratio of kilowatt-hours consumed by each group of customers to total consumption. Generating stations are designed on the basis of demands imposed on them which is not a function of the use except for customers having the same load factor.

Another old theory can be termed the

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"Peak Responsibility" method. This means that the fixed charge was allocated on the basis of the maximum instantaneous demand of all customers. The percent of peak calculations in Table II would be the percentage applied to the total fixed cost to determine the allocation. This method is theoretically correct from the station design viewpoint, but results in inequitable rates. The municipal street lighting would carry no share of the burden of fixed costs. This method is practically obsolete.

Greene's theory of joint costs allocation is described in the Electrical World of November 7, 1925, page 947. He considers both the individual maximum demands (Table III) and the kilowatt-hour consumption (Table I).

He develops two equations:

$$KX - DY = C$$

$$8760X - Y = C + P$$

in which

- X = cost per kilowatt-hour of that portion of the capacity costs that functions with the kilowatt-hours supplied the customer.
- Y = demand cost per kilowatt of that portion of the capacity costs that function with consumer's maximum demand.
- D = sum of consumer's maximum demand.
- P = maximum coincident demand of all consumers
- K = kilowatt-hours used by all consumers in year.
- C = total annual fixed charges.

8760 = number of hours in one year.

This theory assumes that the use the customers make of the installed plant should be given consideration. The fixed costs are not necessarily a function

of the use. The capacity must be installed to meet the demands required by the customers and the short hour user should pay his share the same as the long hour user.

Another theory has been advanced by H.E. Eisenmenger in his book "Central-Station Rates in Theory and Practice". This theory is similar to the Greene theory but takes into account another factor, that of the length of time that the capacity is used. This theory then considers three elements; individual maximum demand, amount of consumption and the length of time the capacity is used. In practice this theory is difficult to apply for estimates must be made; the results therefrom are as accurate as the estimates.

Another recent theory has been proposed by H. W. Hills and is described in the Electrical World, January 29, 1927, page 249. This theory proposes to assume a "phantom customer" who would make up the difference between the actual load factor and 100 per cent. This phantom customer would then have a demand equal to the highest demand on the station less the actual load. The costs that would be charged this phantom customer are then allocated to the different groups. To apply this theory, it is necessary to start with some actual load curve or build up an average. This calculation of a load curve or the analysis of several load curves will result in approximations and averages. The difficulty lies in the determination of the proper load curve and being able to allocate the demand every hour during the

day. Practically this is very difficult if not impossible.

Another method of allocating these costs is that of taking the maximum demand of each group regardless of time of occurrence and calculating what percentage each is of the sum of all. This is the method that will be used in the allocation of the joint fixed costs for the hypothetical electric utility. The disadvantage of this method is that the demand of off peak load is weighted the same as that on the peak. Off peak load is a very small percentage of the total and separate allowance can be made if a detailed study is desired for this small quantity. Practically, this method is easy to apply; all factors can be determined with reasonable accuracy. Table III shows the time of occurrence of the demands and the method of determining the percentage to be allocated to each group of customers. The justification of this method of allocation is that each group of customers share in proper proportion of the total joint fixed costs. Should the load consist entirely of residential customers, the installed capacity of the generating station would be the 6000 kilowatts actual demand plus 20 per cent for reserve. Also should a station be designed for the industrial customers exclusively, the size would be 25,000 kilowatts plus 20 per cent reserve. If each group in the classification of customers had an individual generating station the total installed capacity of all five stations would be 37,350 kilowatts plus 20 per cent for reserve or 45,420 kilowatts. Due to the

diversity of the demands of the various groups the generating station for the combined load need only be 30,000 kilowatts (peak demand) plus 20 per cent for reserve or 36,000 kilowatts. The saving in generating station investment would be more than 20 per cent for the combined plant because the larger plant can be installed for a smaller unit cost per kilowatt than the lower capacity plant. When consideration is given to the individual requirements of each group and each group receives the benefits of the saving due to the combined station, the results obtained therefrom must be equitable.

Figures 7, 8, 9 and 10 show the operating load conditions imposed on the generating station. These curves do not enter into the calculations but are presented only to show the load characteristics.

The next step in the cost analysis is to determine and allocate the losses of electric energy between the generating station and the customer's meter. The overall loss in a well designed and operated transmission and distribution system is on the order of 10 per cent. If the cost analysis is made on the basis of kilowatt hours utilized by each group of customers the losses would be included in the unit cost determined but they would also then be allocated in the proportion that the group utilization is to the total utilization. This would be unfair to the industrial customers particularly, most of whom own their transformer installations and pay for the energy as measured

on the primary side of the transformers. As a general rule the transformer losses are more than the line losses.

The loss due to the transmission of energy from the generating station to the substation is determined by taking the difference between the watt-meter readings of the total energy leaving the generating station and the total energy entering the substation.

Table IV

Net generation at generating station	100,000,000 kw-hr/yr.		
Energy received at substation	97,500,000	"	"
Loss due to transmission	2,500,000	"	"

This loss must be shared by all customers in proportion to their utilization.

Table V

Installed Transformer Capacity on
Distribution Systems.

Residential customers	-	12,000 kva.	installed transf. capacity		
Commercial	"	- 13,000	"	"	"
Industrial	"	- 9,000	"	"	"
Suburban	"	- 1,800	"	"	"

Municipal street lighting is metered at substation before regulation.

The total loss in the distribution system is made up principally by the transformers core loss, transformer copper loss and the I^2R loss in the conductors. There are other minor losses but they have negligible effect on the total and should be neglected because the additional complication does not warrant their consideration.

The various sizes of transformers that make up the total of 12,000 kva. installed for the residential customers must be itemized and the core loss calculated for each size. The total of these losses are those occasioned by core loss. The weighted average core loss per kva. is 9 watts per hour. This loss is constant and does not vary with the transformer loading. The same calculations are made for the other groups of customers. Due to the larger average size of installed transformers for the commercial customers, the weighted average loss will be 8 watts per kva installed; the industrial installation will average 6 watts per kva; and the suburban 10 watts.

The copper losses vary with the load factor on each transformer and must be calculated for the various sizes. This loss will be 2.7 watts per kva per hour for residential; 2.5 watts for the commercial; 2.1 watts for the industrial and 2.9 watts for the suburban. Table VI shows these losses in tabular form.

Table VI

Transformer Losses

	Installed Capacity	Core Loss per kva. per hour	Copper Loss per kva. per hour
Residential	12,000 kva	9 watts	2.7 watts
Commercial	13,000 "	8 "	2.5 "
Industrial	9,000 "	6 "	2.1 "
Suburban	1,800 "	10 "	2.9 "

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It is very difficult to obtain the I^2R loss in the various distribution systems by any direct method due to the customary net work installations. The most practical method is to test typical circuits. We can assume that such tests will show a loss of 3 per cent from the substation to the distribution transformer and 1.5 per cent in the services for residential, commercial and industrial customers, and a total of 5.0 per cent for the suburban customers. These percentages are based on substation output and must be adjusted if applied to the utilization quantity.

The following table shows the calculation of the losses:

Table VII

Distribution Losses

Residential						
Core loss	12,000 kva. x 9 x 8,760 =	946,000 kw-hr.				
Copper loss	12,000 " x 2.7 x 8,760 =	234,000 "				
Line loss	13,500,000 kw-hr. x .048 =	655,000 "				1,885,000 kw-hr.
Total loss						
Commercial						
Core loss	13,000 kva. x 8 x 8,760 =	910,000 kw-hr.				
Copper loss	13,000 " x 2.5 x 8,760 =	285,000 "				
Line loss	16,500,000 x .048 =	797,000 "				1,992,000 kw-hr.
Total loss						
Industrial						
Core loss	9,000 kva. x 6 x 8,760 =	473,000 kw-hr.				
Copper loss	9,000 " x 2.1 x 8,760 =	167,000 "				
Line loss	56,000,000 kw-hr. x .048 =	2,700,000 "				3,340,000 kw-hr.
Total loss						
Suburban						
Core loss	1,800 kva. x 10 x 8,760 =	158,000 kw-hr.				
Copper loss	1,800 " x 2.9 x 8,760 =	46,000 "				
Line loss	1,500,000 kw-hr. x .053 =	79,000 "				283,000 kw-hr.
Total loss						
Municipal Street Lighting	No loss metered at substation					
Total losses outside substation						7,500,000 kw-hr.
Transmission loss						2,500,000 "
Utilization						90,000,000 "
Total Net Generation						100,000,000 kw-hr.

To determine the number of kilowatt hours that must be sent out from the generating station for each group of customers per year, the losses which have been allocated to each group must be added to the utilization of that group. Table VIII shows the detailed calculations to arrive at the net generation for each group.

Table VIII

NET GENERATION REQUIRED FOR EACH GROUP OF CUSTOMERS

	Kw-hr. Utilized per yr.	Kw.-hr. Loss Substation to Customer	Total Send-out from Substation kw-hr.	Present Loss of Send-out	% of Total Substation Send-out	Allocation of Transmission Loss on basis of % send- out from Substation kw-hr.	Net Generation for each group of customers kw-hr.	% of Generation	Percent Loss between Gen. Station & customer
Residential	13,500,000	1,885,000	15,385,000	12.3	15.8	395,000	15,780,000	15.78	14.45
Commercial	16,500,000	1,992,000	18,492,000	10.8	19.0	475,000	18,967,000	18.97	13.00
Industrial	56,000,000	3,340,000	59,340,000	5.6	60.8	1,520,000	60,860,000	60.86	7.99
Suburban	1,500,000	283,000	1,783,000	15.8	1.8	45,000	1,828,000	1.83	18.00
Municipal Street Lighting	2,500,000	000	2,500,000	0	2.6	65,000	2,565,000	2.56	2.56
Total	90,000,000	7,500,000	97,500,000	7.7	100.0	2,500,000	100,000,000	100.00	10.00

Table IX

LOAD FACTOR FOR EACH GROUP OF CUSTOMERS

	Net Generation for each group of customers kw-hr.	Highest Demand kw.	Hours per year use of demand	Annual Load Factor	Avg. Daily Generation for each group of customers kw-hr.
Residential	15,780,000	6,000	2,630	.300	43,200
Commercial	18,967,000	5,500	3,440	.393	51,900
Industrial	60,860,000	25,000	2,430	.277	166,900
Suburban	1,828,000	650	2,810	.321	5,000
Municipal Street Lighting	2,565,000	700	3,670	.419	7,000
Total	100,000,000	30,000	3,330	.380	274,000

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Exhibit H
ALLOCATION OF FIXED CAPITAL

	Generating Station	Substation	Distribution
Intangible fixed capital	\$ 85,000		
Land	170,000	3,000	5,000
Structures	860,000	2,000	3,000
Generating - steam plant	3,503,000		
" - hydro	166,000		
Substation equipment		300,000	
Storage battery equipment		3,000	
Underground conduits		12,200	109,800
Poles, towers and fixtures		38,000	342,000
Overhead conductors		85,000	765,000
Underground conductors		37,500	337,500
Transmission roads and trails		6,000	
Services			
Residential 18,000 @ \$25			
Commercial 2,000 @ 75			
Industrial 100 @ 500			
Suburban 2,500 @ 40			
Line transformers and devices		40,000	750,000
Line transformer installation		12,500	360,000
Consumers meters and installation			112,500
Residential 20,000 @ \$13.25			
Commercial 2,100 @ 40			
Industrial 100 @ 360			
Suburban 2,500 @ 16			
Consumers installation			425,000
Subtotal	4,784,000	532,200	3,472,800
General office and misc. land	\$52,000	1,300	32,000
General office and misc. structures	\$220,000	7,000	210,000
General equipment	\$172,000	10,500	68,000
Overhead and other undistributed items	\$693,000	43,000	274,000
Total	\$5,328,200	\$601,000	\$4,070,800
			\$10,000,000

Table X

Unit Investment Cost of Services

	No. of Services	Investment per Service
Residential	13,000	\$ 25.00
Commercial	2,000	75.00
Industrial	100	500.00
Suburban	2,500	40.00

Table XI

Unit Investment Cost of Meters

	No. of Meters	Investment per Meter
Residential	20,000	\$ 13.25
Commercial	2,100	40.00
Industrial	100	360.00
Suburban	2,500	16.00

Sufficient data has not been compiled so the proper allocation of the fixed capital can be made. The first allocation is made upon the basis of the use of the capital, whether it is for generation, substation or distribution. The first allocation is a summary of the notation made opposite each item in Exhibit B. Exhibit H shows the first allocation.

The next logical step is the allocation of the distribution fixed capital. Exhibit I shows this allocation. Notations are made following the total amount to indicate the basis of allocation. This allocation is made to the different groups of customers, residential, commercial, industrial, suburban and municipal street lighting.

Exhibit I

ALLOCATION OF DISTRIBUTION FIXED CAPITAL

	Total		Residential	Commercial	Industrial	Suburban	Municipal St. Lighting
Land	\$5,000	Appraisal	1,500	1,500	1,000	1,000	
Structures	3,000	"	500	500	1,500	500	
Underground conduits	109,800	"	20,000	60,000	24,000	2,800	3,000
Poles, towers and fixtures	342,000	"	172,000	90,000	70,000	10,000	
Overhead conductors	765,000	"	450,000	180,000	115,000	20,000	
Underground conductors	337,500	"	60,000	200,000	75,000	1,500	1,000
Services	750,000	Unit cost of service	450,000	150,000	50,000	100,000	
Line transformers and devices	360,000	Appraisal	120,000	140,000	82,000	18,000	
Line transformer installation	112,500	"	40,000	45,000	22,000	5,500	
Consumers' meters and installation	425,000	Unit cost of meters	265,000	84,000	36,000	40,000	
Customers' installation	270,000	Appraisal	60,000	8,000	2,000		200,000
General office and misc. land	39,000)	\$317,000					
General office and misc. structures	210,000)	on no. of customers					
General equipment	68,000)		256,800	26,800	1,300	32,000	100
Subtotal	\$3,796,800		\$1,895,800	\$985,800	\$479,800	\$231,300	\$204,100
Percent of subtotal			50.0	26.0	12.6	6.1	5.3
Overhead and other undistributed items	274,000		137,000	71,300	34,500	16,700	14,500
Total	\$4,070,800		\$2,032,800	1,057,100	514,300	248,000	218,600
Percent of total	100.0		50.0	26.0	12.6	6.1	5.3

Exhibit J

Subtotals of items in Exhibit I necessary for allocation of some items of expense

Underground conduits	\$ 109,800	Appraisal	20,000	60,000	24,000	2,800	3,000
Poles, towers and fixtures	342,000	"	172,000	90,000	70,000	10,000	
Overhead conductors	765,000	"	450,000	180,000	115,000	20,000	
Underground conductors	337,500	"	60,000	200,000	75,000	1,500	1,000
Total	\$1,554,300		\$702,000	\$530,000	\$284,000	\$34,300	\$4,000
Percent of total	100.0		45.2	34.1	18.2	2.2	0.3
Line transformers and devices	360,000		120,000	140,000	82,000	18,000	
" " installation	112,500		40,000	45,000	22,000	5,500	
Total	\$472,500		\$160,000	\$185,000	\$104,000	\$23,500	
Percent of total	100.0		33.9	39.2	22.0	4.9	

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Exhibit K shows the distribution of the payroll of the hypothetical utility.

Exhibit L shows the allocation of the operating expense to the generating station, substation and distribution. This exhibit is a summary of the notations made on Exhibit F. Exhibit M is the allocation of the distribution operating expenses as to groups of customers.

A summary of the total operating and fixed costs is shown in Exhibit N, the allocation being to the various groups of customers. Generation station costs have been prorated on the basis of generation required for each group. The substation costs have been prorated on the basis of send out energy required for each group. Distribution expenses have been brought forward from Exhibit M.

The allocation of all the fixed capital to the groups of customers is shown in Exhibit P. The capital in generating and substations has been prorated on the basis of highest kilowatt demand. The capital for the distribution was brought forward from Exhibit I.

The next step should be the allocation of the Rate base which was determined for the entire property in Exhibit G. The calculation in Exhibit Q for each group of customers is similar to the calculation for the whole group. The fixed capital, which is the starting point for a rate base calculation, is obtained from Exhibit P. Other items are self explanatory.

Exhibit R is the determination of the rate of return from the property as a whole and also from the different groups of customers which are served by the electric utility. It is this calculation that determines the reasonableness of the rates in effect. Regulatory commissions are concerned principally with the rate of return of the entire property and unless there is a gross disparity of the rate of return between groups they will consider the proportioning of the amount necessary for the rate of return as a managerial function. The rates of return as determined from the above cost analysis cannot be considered as unfair to any group. Exhibit R is the first place in the revenue considered. Previous exhibits have considered the cost of rendering service.

WVH 1011 K

PAYROLL

	Generating Station	Substation	Distribution
Operation - Superintendence			
Boiler labor	\$14,000		
Engine labor	19,000		
Electrical labor	18,000		
Misc. labor	17,000		
Maintenance	9,000		
Hydro labor	41,400		
Hydro maintenance labor	7,000		
Transmission superintendence	1,500		
Substation labor		6,500	
Transmission labor		4,000	
Transmission maintenance labor		7,500	
Distribution superintendence		8,800	10,500
Substation labor		3,000	
Storage battery labor		3,500	
Distribution labor		3,500	
Meter department		3,500	
Testing meters		6,500	
Misc. expenses - Meter Dept.		3,500	
Removing and resetting meters		24,800	
Removing and resetting transformers		34,000	
Distribution-maintenance		26,500	
Utilization - labor		8,100	
Commercial - labor			
New Business expense - labor			
Sub Total	\$127,200	\$35,300	\$137,400
Per cent of sub total	.424	.117	.450
Administrative salaries and general office salaries	\$101,000	11,800	46,400
Maintenance general structures	2,000	200	1,300
Operating and Maintenance of communication system	10,000	1,000	6,500
Transportation	4,000	400	2,600
Total Payroll	\$174,000	\$48,700	\$194,200
Per cent of total	.41.7	11.7	46.6
			100.0

Exhibit L

ALLOCATION OF OPERATING EXPENSE

	Generating Station	Substation	Distribution
Steam power generation	\$422,000		
Steam power maintenance	103,500		
Hydro electric generation and maintenance	12,800		
Transmission expense		\$41,500	\$10,500
Distribution - superintendence			
Substation expense		10,500	13,500
Distribution labor and expense			22,000
Meter department expense			1,500
Maintenance of structures			
Maintenance substation		9,000	28,500
Maintenance of distribution system			8,000
Maintenance of services			8,500
Maintenance of line transformers			6,500
Maintenance of customer's meters			76,000
Utilization			27,500
Commercial			12,800
New Business expenses			46,400
Administrative and General Office salaries			16,500
General Office expense	42,800	11,800	
Insurance	6,500	2,600	
Law and store expense	9,000	1,000	3,500
Transportation and other misc. general expenses	4,500	500	12,100
Retirement expense	4,600	1,800	122,000
Claims, medical, injuries and accidents	160,000	600	3,800
Regulatory commission expenses	1,500		
Employees welfare pensions	3,000		
Franchise requirement and amortization	3,800	1,000	4,200
	1,900	200	1,400
Total	\$775,000	\$88,500	\$425,600
			\$1,300,000

Exhibit M

ALLOCATION OF DISTRIBUTION OPERATING EXPENSE AS TO GROUPS OF CUSTOMERS

	Total	Basis of Allocation	Residential	Commercial	Industrial	Suburban	Municipal St. Lighting
Distribution - Superintendence	10,500	Basis of distributed fixed capital	5,200	2,700	1,300	600	600
Distribution - Labor & Expense	13,500	"	6,800	3,500	1,700	800	800
Maintenance of structures	1,500	"	200	200	800	300	
Maintenance of distribution system	28,500	"	12,900	9,700	5,200	600	600
Maintenance of services	8,000	No. of services	6,300	600	200	900	
Maintenance of line transformers	8,500	No. of transformers	2,900	3,300	1,900	400	
Meter Department expense	22,000	) No. of meters					
Maintenance of customer's meters	6,500		23,100	2,400	200	2,800	
Utilization	76,000		21,000	3,200	200	2,600	49,000
Commercial	27,500		22,100	2,300	200	2,800	100
New Business expense	12,800		10,300	1,100	100	1,300	
Administration & General Office Salaries	46,400	) \$88,300					
General Office expense	16,900						
Law and store expense	3,500						
Transportation & other misc. gen. exp.	12,100						
Claims, medical, injuries & accident	3,800						
Employees' welfare and pensions	4,200						
Franchise requirement and amortization	1,400						
Subtotal	\$303,600		71,400	7,500	500	8,800	100
			\$182,200	\$36,500	\$12,300	\$21,900	\$50,700
Retirement expense	122,000		61,000	31,700	15,400	7,500	6,400
Total Distribution Operating Expense	\$425,600		\$243,200	\$68,200	\$27,700	\$29,400	\$57,100

ATTACHMENT 10 TO CONTRACT

[illegible]

Exhibit N

SUMMARY OF TOTAL OPERATING AND FIXED COSTS

	Total	Generating Station	Substation	Distribution
Total operating expense	\$1,300,000	\$775,900	\$98,500	\$425,600
Less Insurance and Retirement expense	310,000	169,000	19,000	122,000
Net expense	\$ 990,000	\$606,900	\$79,500	\$303,600
Fixed charges				
Insurance (basis of Fixed Capital)	10,000	9,000	1,000	
Retirement Expense (basis of Fixed Capt.)	300,000	160,000	18,000	122,000
Taxes(basis of Fixed Capital)	290,000	154,500	17,500	118,000
Total Fixed Costs (Return on investment not included)	\$600,000	\$323,500	\$36,500	\$240,000

ALLOCATION OF OPERATING COSTS AS TO GROUPS OF CUSTOMERS

	Total	Residential	Commercial	Industrial	Suburban	Municipal St. Ltg.
Kw-hr. generated	100,000,000	15,780,000	18,967,000	60,860,000	1,828,000	2,565,000
Percent of total Generating Station Oper- ating Cost less insurance and retirement	100.00	15.78	18.97	60.86	1.83	2.56
	\$606,900	\$95,500	\$115,000	\$369,800	\$11,100	\$15,500
Kw-hr. from substation	97,500,000	15,385,000	18,492,000	59,340,000	1,783,000	2,500,000
Percent of total Sub-station Operating Cost less insurance and retirement	100.00	15.81	19.00	60.80	1.83	2.56
	\$79,500	\$12,600	\$15,100	\$48,300	\$1,500	\$2,000
Distribution Operating Exp. less retirement	\$303,600	\$182,200	\$36,500	\$12,300	\$21,900	\$50,700
Total Operating Costs (less retirement)	\$990,000	\$290,300	\$166,600	\$430,400	\$34,500	\$68,200
Uncollectible bills	12,000	19,700	1,000	100	1,200	
Subtotal	\$1,002,000	\$300,000	\$167,600	\$430,500	\$35,700	\$68,200
Retirement Expense (Distr)	\$122,000	61,000	31,700	15,400	7,500	6,400
Retirement Expense (Gen.)	160,000	25,400	23,200	105,700	2,700	3,000
Retirement Expense (Substa)	18,000	2,900	2,600	11,900	300	300
Insurance (Generation)	9,000	1,400	1,300	6,000	100	200
Insurance (Substation)	1,000	100	100	600	100	100
Taxes	290,000	46,400	42,400	190,800	4,900	5,500
Total Fixed Costs	\$600,000	\$137,200	\$101,300	\$330,400	\$15,600	\$15,500
Total Operating Costs in- cluding Taxes & Uncollectible Bills, but not return on investment	\$1,602,000	\$437,200	\$268,900	\$760,900	\$51,300	\$83,700

Exhibit P

ALLOCATION OF FIXED CAPITAL

	Total	Residential	Commercial	Industrial	Suburban	Municipal St. Lighting
Ratio of Peak Demands	100.0	15.9	14.5	66.0	1.7	1.9
Fixed Capital Generating Station	\$5,328,200	\$847,100	\$772,700	3,516,600	90,600	101,200
Fixed Capital Substa.	601,000	95,500	87,100	396,800	10,200	11,400
Subtotal	\$5,929,200	\$942,600	\$859,800	\$3,913,400	\$100,800	\$112,600
Fixed Capital Distr.	4,070,800	2,032,800	1,057,100	514,300	248,000	218,600
Total Fixed Capital	\$10,000,000	\$2,975,400	\$1,916,900	\$4,427,700	\$348,800	\$331,200

Exhibit Q

ALLOCATION OF RATE BASE

	Total	Residential	Commercial	Industrial	Suburban	Municipal St. Lighting
Fixed capital as of Dec. 31, 1932	\$10,000,000	\$2,975,400	\$1,916,900	\$4,427,700	\$348,800	\$331,200
Fixed capital as of Dec. 31, 1931	9,500,000	2,730,200	1,817,900	4,302,100	340,200	309,600
Average fixed capital	9,750,000	2,852,800	1,867,400	4,364,900	344,500	320,400
Less retirement reserve plus replacement fund	800,000	250,500	153,800	354,500	14,700	26,500
Subtotal	\$8,950,000	\$2,602,300	\$1,713,600	\$4,010,400	\$329,800	\$293,900
Less contributions for extensions	400,000	140,000	100,000	120,000	40,000	
Subtotal	\$8,550,000	\$2,462,300	\$1,613,600	\$3,890,400	\$289,800	\$293,900
Plus working cash capital \$250,000						
" stores, materials & supplies \$48,500						
" general office material & supplies \$6,500						
" Prepayments \$35,000	\$340,000	106,500	65,200	150,700	6,300	11,300
Subtotal	\$8,890,000	\$2,568,800	\$1,678,800	\$4,041,100	\$296,100	\$305,200
Plus coal in storage (basis of kw-hr. gen.)	80,000	12,600	14,800	49,100	1,500	2,000
Subtotal	\$8,960,000	\$2,581,400	\$1,693,600	\$4,090,200	\$297,600	\$307,200
Plus going concern value (5% on \$8,550,000)	427,500	130,700	80,600	194,500	7,100	14,600
Rate Base	\$9,397,500	\$2,712,100	\$1,774,200	\$4,284,700	\$304,700	\$321,800
Return chargeable to each classification based on a possible return of 7%	657,800	189,800	124,200	300,000	21,300	22,500

Exhibit R

DETERMINATION OF RATE OF RETURN FROM THE DIFFERENT GROUPS OF CUSTOMERS

	Total	Residential	Commercial	Industrial	Suburban	Municipal , St. Lighting
Total operating costs	\$1,002,000	\$300,000	\$167,600	\$430,500	\$35,700	\$68,200
Total fixed costs	600,000	137,200	101,300	330,400	15,600	15,500
Subtotal	\$1,602,000	\$437,200	\$268,900	\$760,900	\$51,300	\$83,700
Credit misc. revenue	7,000	5,600	600	100	700	
Subtotal	\$1,595,000	\$431,600	\$268,300	\$760,800	\$50,600	\$83,700
Amount contributed by each classification	\$2,250,000	\$611,500	\$460,300	\$1,002,400	\$73,300	\$102,500
Cost of service	1,595,000	431,600	268,300	760,800	50,600	83,700
Excess	\$ 655,000	\$179,900	\$192,000	\$ 241,600	\$22,700	\$ 18,800
Rate base allocated to each classification	\$9,397,500	\$2,712,100	\$1,774,200	\$4,284,700	\$304,700	\$321,800
Rate of return, percent	6.97	6.63	10.82	5.64	7.45	5.84
Average revenue per kw-hr.	.025	.0460	.0238	.0189	.0479	.0425

At this place in the rate determination adjustments can be made between groups of similar customers. If the residential customers were being burdened with too large a share of the amount of the return and the industrial customers were contributing an insufficient amount, a more equitable division could be made by adding a smaller quantity to the residential costs and a larger quantity to the industrial costs. If the rate of return was excessive, the analysis would indicate which group would be first entitled to a rate reduction.

The total amount of revenue which should be collected from each group of customers has not been ascertained; the rate determination from this point on deals with the proper rate to charge the different customers in the same group. Customers in the same group have different requirements as to quantity of energy and demand on the generating station.

Exhibits for this phase of the rate determination will be designated with lower case letters.

Exhibit a is the allocation of the amount to be collected above costs. The amounts for each group of customers have been brought forward for Exhibit R and have been allocated to generating station, substation and distribution in proportion to the investment as determined in Exhibits I and P.

Exhibit b is a summary of the total costs including return. These costs are classified into three

groups; fixed charges, energy charges and customer charges. All amounts in this exhibit have been determined in previous exhibits.

Exhibit c shows the determination of unit costs of service divided into the cost of fixed charges per kw. demand, energy charges per kw-hr. at the generating station (costs included transmission losses and costs) and customer costs.

The unit costs of service have now been determined in detail and now a rate schedule will be determined for each group of customers. The residential rate schedule will be first determined. Before the unit costs of service can be applied to the different customers in the same group, it is necessary to determine the number of statements per year for different amounts of consumption; i.e., the number of statements per year between 0 and 10 kw-hr, the number between 10 and 20 kw-hr., etc. This data is shown on Figure 11.

Exhibit A

ALLOCATION OF THE AMOUNT TO BE COLLECTED ABOVE COSTS

	Total	Generating Sta. Investment	Substation Investment	Distribution System Investment
Residential Investment	\$2,975,400	\$847,100	\$95,500	\$2,032,800
Percent of total	100.0	28.5	3.2	68.3
Allocation of amount above costs	\$ 179,900	51,200	5,700	123,000
Commercial Investment	\$1,916,900	772,700	87,100	1,057,100
Percent of total	100.0	40.3	4.6	55.1
Allocation of amount above costs	\$ 192,000	77,300	8,800	105,900
Industrial Investment	\$4,427,700	3,516,600	396,800	514,300
Percent of total	100.0	79.4	9.0	11.6
Allocation of amount above costs	\$ 241,600	191,900	21,700	28,000
Suburban Investment	\$ 348,800	90,600	10,200	248,000
Percent of total	100.0	26.0	2.9	71.1
Allocation of amount above costs	\$ 22,700	5,900	700	16,100
Municipal Street Lighting Investment	\$ 331,200	101,200	11,400	218,600
Percent of total	100.0	30.6	3.4	66.0
Allocation of amount above costs	\$ 18,800	5,800	600	12,400
Total amount allocated	\$ 655,000			
Total Investment	\$10,000,000	\$5,328,200	\$601,000	\$4,070,800

Exhibit B

SUMMARY OF TOTAL COSTS INCLUDING RETURN

	Total	Residential	Commercial	Industrial	Suburban	Municipal St. Lighting
Fixed charges						
Generating station retire- ment and insurance	\$169,000	\$26,800	\$24,500	\$111,700	\$2,800	\$3,200
Substation retirement and insurance	\$19,000	3,000	2,700	12,500	400	400
Taxes	\$290,000	46,400	42,400	190,800	4,900	5,500
Allocated amount over costs (generating sta.)	\$332,100	51,200	77,300	191,900	5,900	5,800
Allocated amount over costs (substation)	\$37,500	5,700	8,800	21,700	700	600
Total	\$847,600	133,100	155,700	528,600	14,700	15,500
Energy charges						
Generating sta. operating	\$606,900	95,500	115,000	369,800	11,100	15,500
Substation operating	79,500	12,600	15,100	48,300	1,500	2,000
Total	\$686,400	108,100	130,100	418,100	12,600	17,500
Customer charges						
Distr. system operating	\$99,000	57,400	22,400	11,300	6,400	1,500
Utilization	76,000	21,000	3,200	200	2,600	49,000
Commercial	27,500	22,100	2,300	200	2,800	100
New Business	12,800	10,300	1,100	100	1,300	100
General expenses	88,300	71,400	7,500	500	8,800	
Uncollectible bills	12,000	9,700	1,000	100	1,200	
Credit misc. revenue	7,000	5,600	600	100	700	
Subtotal	\$308,600	186,300	36,900	12,300	22,400	50,700
Retirement	122,000	61,000	31,700	15,400	7,500	6,400
Allocated amount over costs, (distribution)	285,400	123,000	105,900	28,000	16,100	12,400
Total	\$716,000	370,300	174,500	55,700	46,000	69,500
Grand Total Charge	\$2,250,000	\$611,500	\$450,300	\$1,002,400	\$73,300	\$102,500
(amt. to be collected by rate schedules)						

UNIT COST OF SERVICE INCLUDING RETURN

	Total	Residential	Commercial	Industrial	Suburban	Municipal St. Ltg.
Fixed charges						
Total	\$847,600	\$133,100	\$155,700	\$528,600	\$14,700	\$15,500
Kw. demand		6,000	5,500	25,000	650	700
Fixed charges per kw. demand at generating station		\$ 22.18	\$ 28.31	\$ 21.14	\$ 22.62	\$ 22.14
Energy charges						
Total	\$686,400	\$108,100	\$130,100	\$418,100	\$12,600	\$17,500
Kw-hr. generation	10,000,000	15,780,000	18,967,000	60,860,000	1,328,000	2,565,000
Energy charge per kw-hr. generated	\$.00686	\$.00686	\$.00686	\$.00686	\$.00686	\$.00686
Customer charges						
Subtotal	\$308,600	\$186,300	\$ 36,900	\$ 12,300	\$22,400	\$50,700
No. of customers	24,701	20,000	2,100	100	2,500	1
Subtotal per customer	\$ 12.49	\$ 9.32	\$ 17.57	\$ 123.00	\$ 8.96	\$50,700
Retirement and allocation amount over costs						
Total Customer charges	\$407,400	\$184,000	\$137,600	\$ 43,400	\$23,600	\$81,900
Customer charge per customer	\$716,000	\$370,300	\$174,500	\$ 55,700	\$46,000	\$69,500
	\$ 28.99	\$ 18.52	\$ 83.10	\$ 557	\$ 18.40	\$69,500

The relative cost of the distribution system is lower than the average for small users and higher for the large users. The relative investment is determined by estimating the capital necessary for the small user as well as the large user. Losses also vary with use and may be determined from tests or calculations based on the average user. Figure 12 shows the variation of these two items with variation in annual utilization. The load factor (demand) varies with the consumption and is determined by measuring typical customers. This data is shown in Figure 13.

Exhibit d shows the details in calculating the average cost of serving residential customers of different annual utilizations.

Exhibit e shows the size of residential customer statements, average kw-hr. per statement and number and the total number of kw-hr. for each block.

The next and last step is the actual determination of the residential rate schedule. No calculation can be made to determine the size of the blocks in the schedule nor can the form of the schedule be determined by mathematical procedure. Judgment and experience only can be used. The average customer will use on the order of 600 kw-hr. per year for lighting and small appliances; an electric refrigerator will add 540 kw-hr. per year; an electric range another 1500 kw-hr. and an electric water heater another 3600 kw-hr. The present tendency is to encourage electric refrigeration,

[illegible]

cooking and water heating. Statements are usually rendered monthly and the utilization per month for these services would be:

Lighting and small appliances	50 kw-hr. per month
Refrigeration	45 " " "
Range	125 " " "
Water heater	300 " " "

A rate schedule can be designed to encourage the use of energy over and above that required for lighting which is the prime use of the energy. The block form of rate is easiest understood by the residential consumer and is equitable except in extreme cases which are few in both number and quantity of use. The lighting requirement can be taken in the first two blocks, say 25 kilowatts each; each block can be taken as 150 kilowatt-hours which is to represent the use of refrigerators and ranges and the balance can be considered as a promotional rate for water heating.

STATEMENTS FOR RESIDENTIAL SERVICE

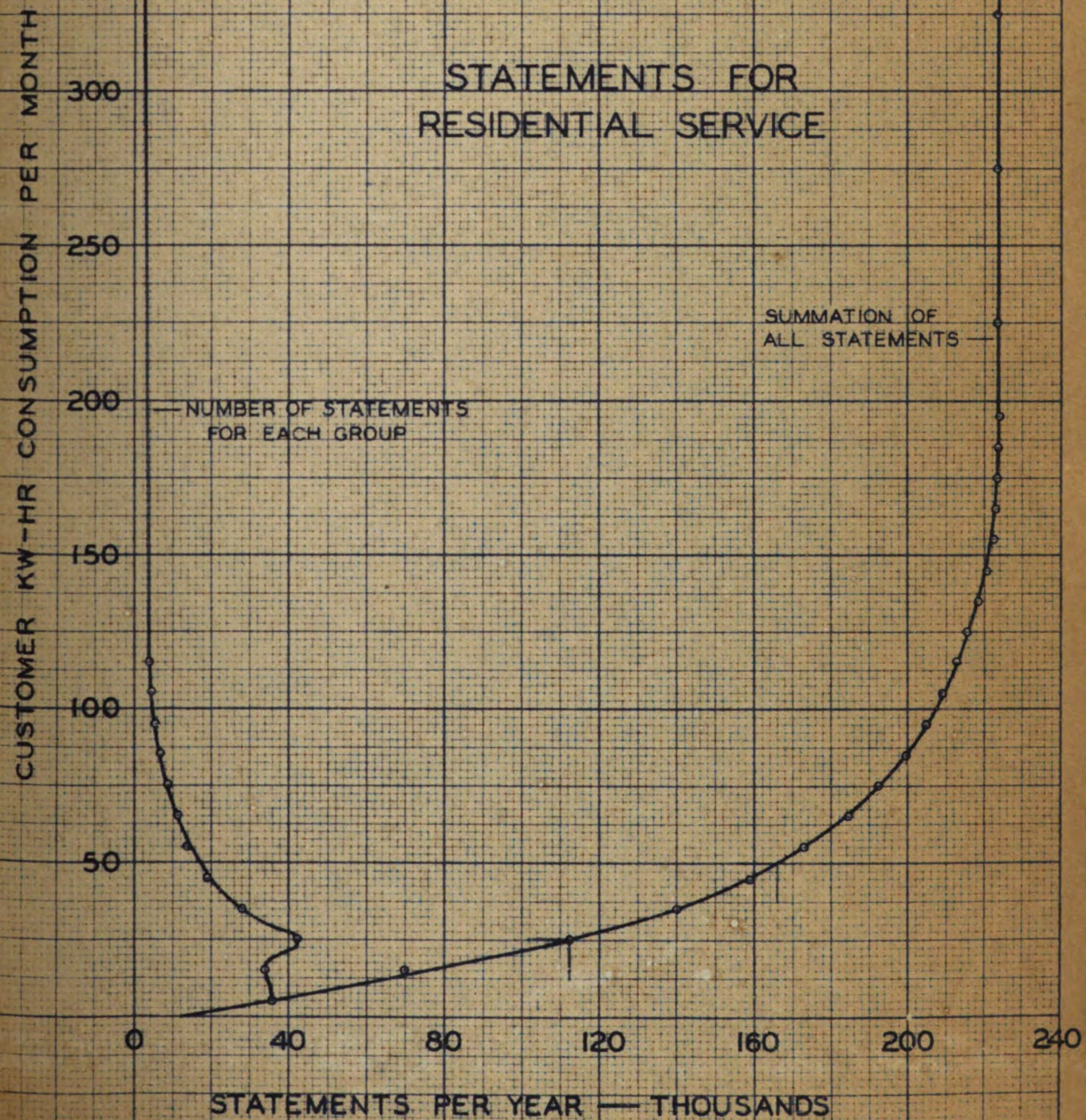


FIGURE 11

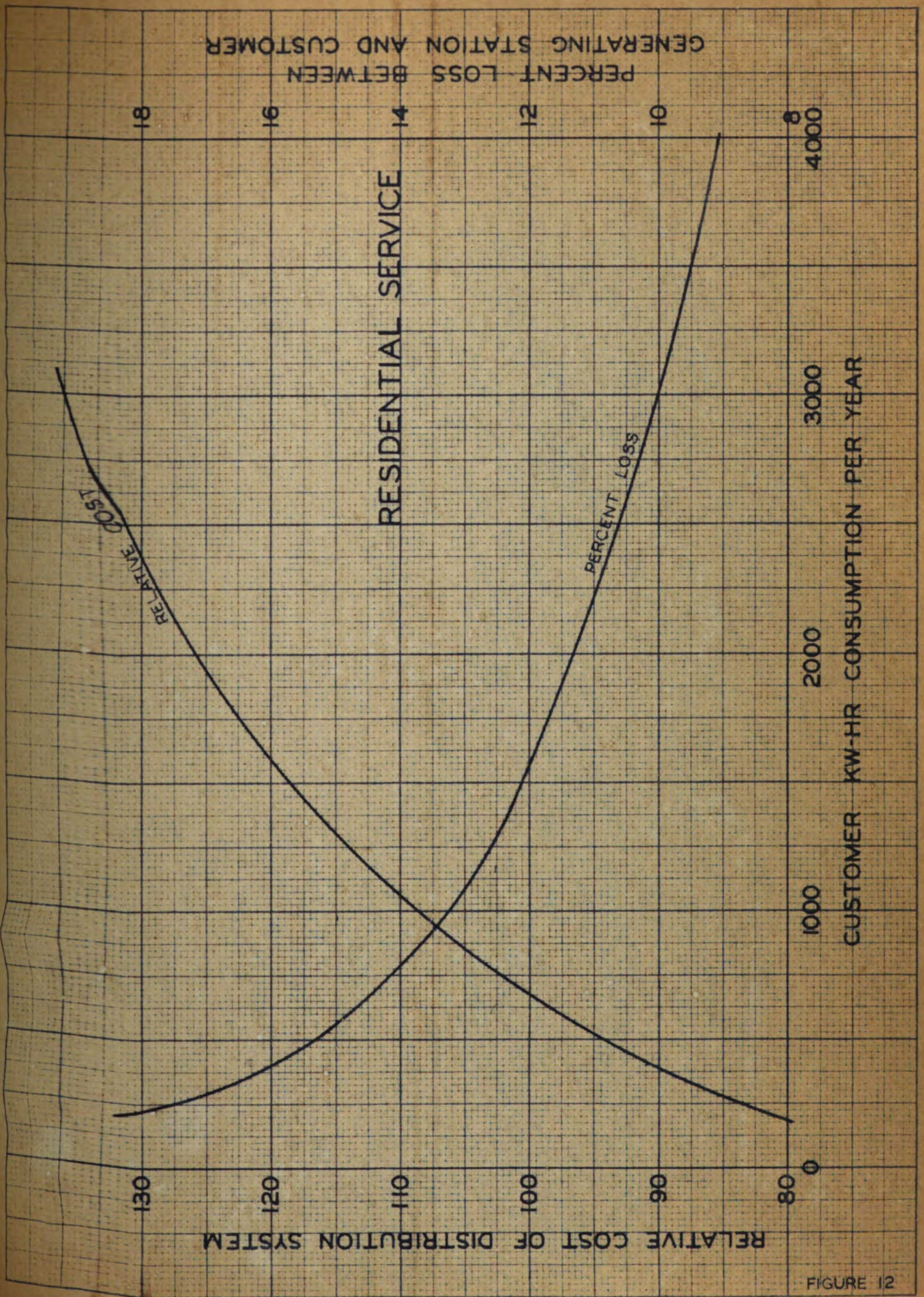


FIGURE 12

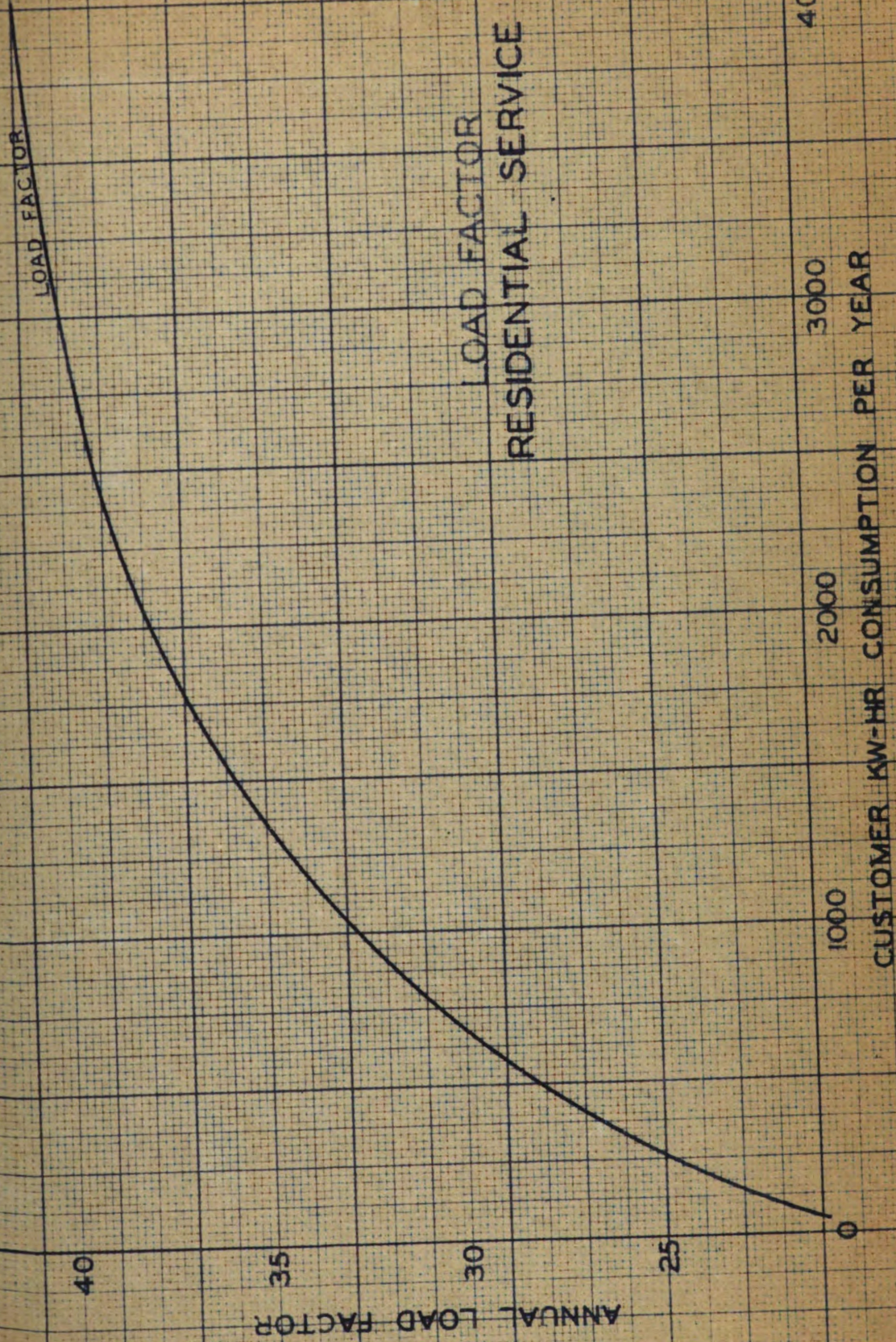


FIGURE 13

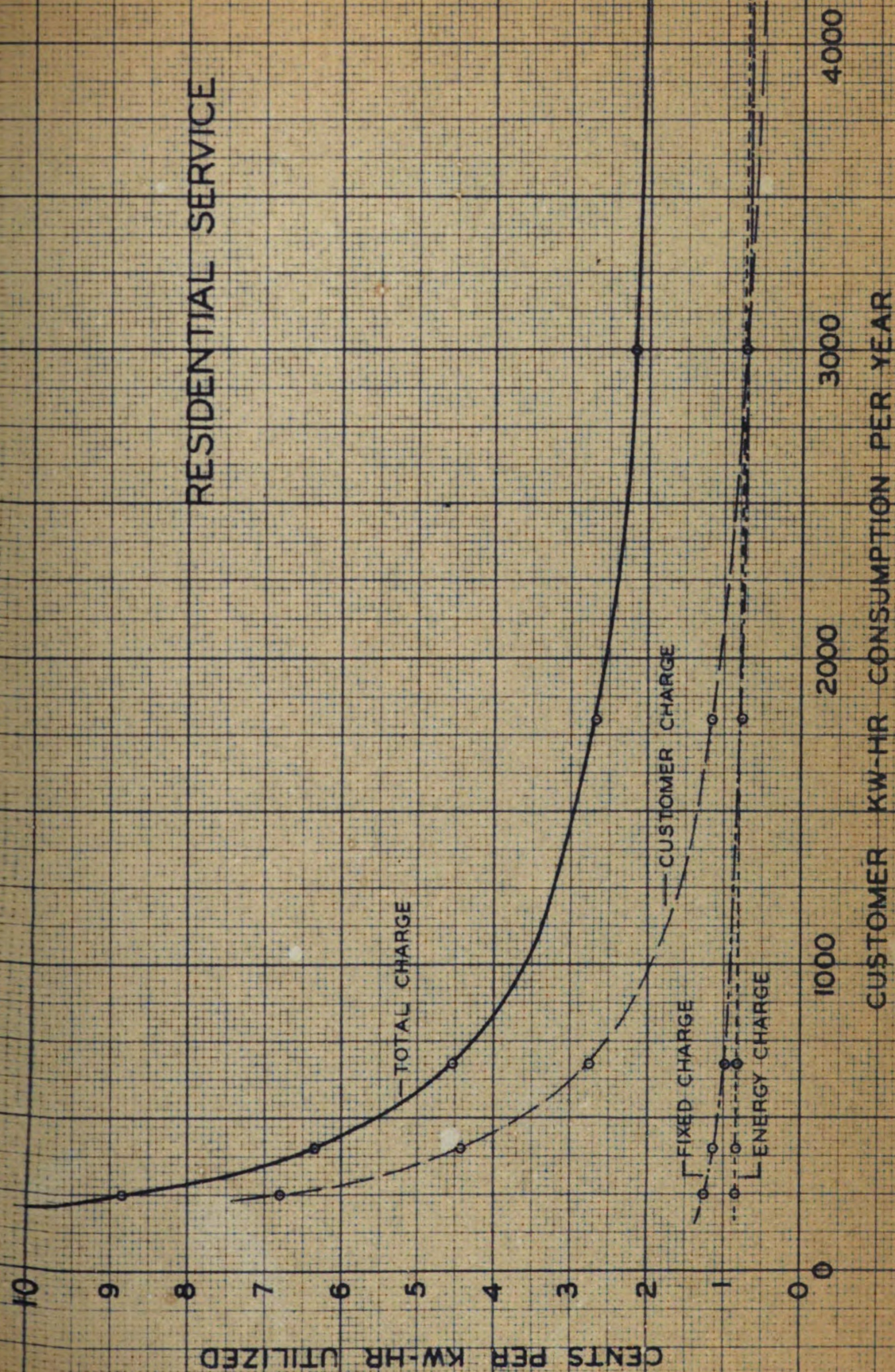


FIGURE 14

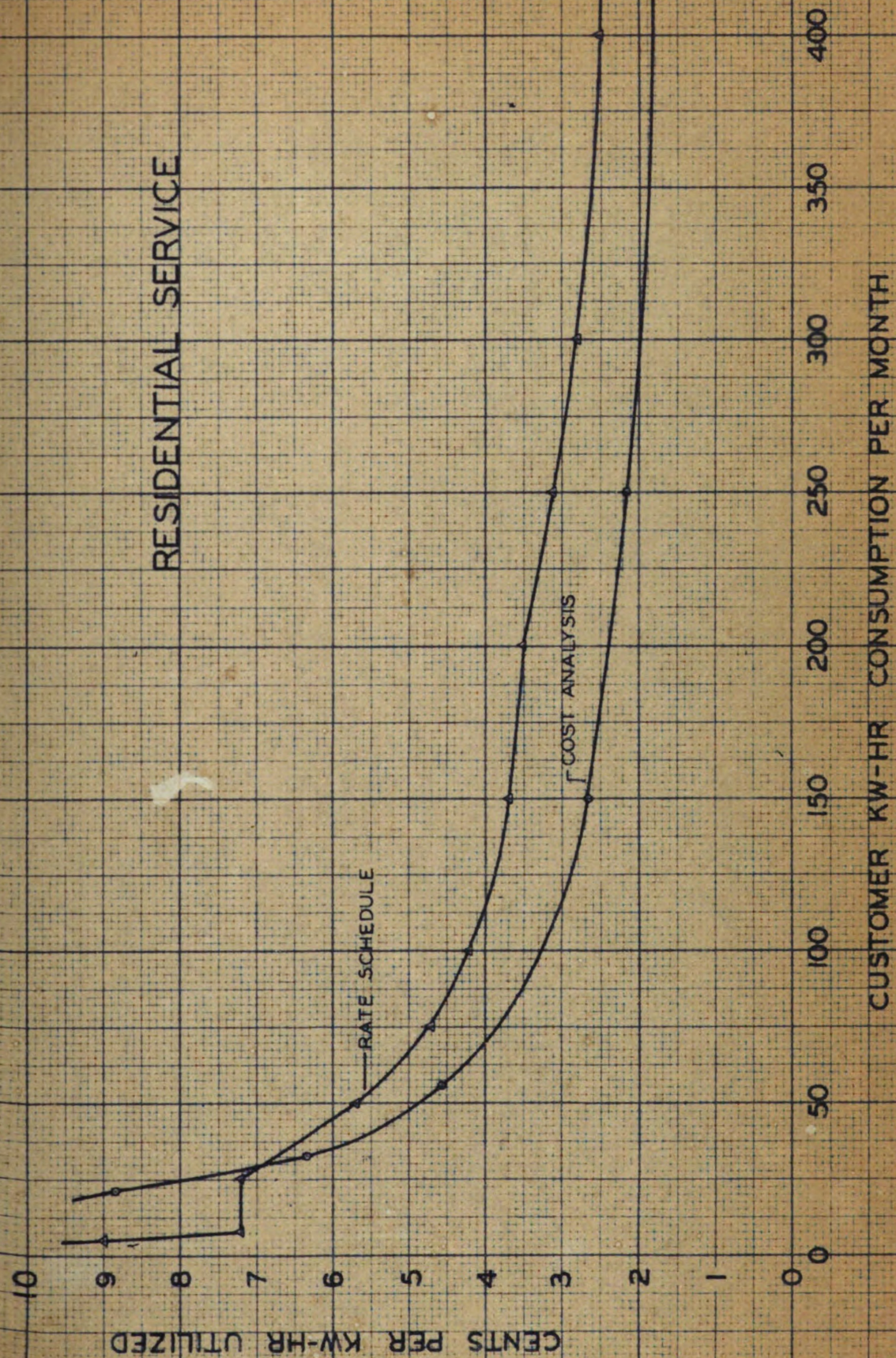


FIGURE 15

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Exhibit e

AMOUNT OF RESIDENTIAL CUSTOMER ENERGY REQUIREMENTS

Consumption per Statement kw-hr.	No. of Statements	Summation of all Statements	Average kw-hr. per Statement	Total kw-hr. for block
0 - 10	36,000	36,000	5	180,000
10 - 20	34,000	70,000	15	510,000
20 - 30	42,400	112,400	25	1,060,000
30 - 40	27,900	140,300	34	950,000
40 - 50	19,300	159,600	44	850,000
50 - 60	13,900	173,500	54	750,000
60 - 70	10,600	184,100	64	680,000
70 - 80	8,250	192,350	74	610,000
80 - 90	6,550	198,900	84	550,000
90 - 100	5,260	204,160	95	500,000
100 - 110	4,380	208,540	105	460,000
110 - 120	3,740	212,280	115	430,000
120 - 130	3,200	215,480	125	400,000
130 - 140	2,810	218,290	135	380,000
140 - 150	2,470	220,760	145	360,000
150 - 160	2,180	222,940	155	340,000
160 - 170	1,930	224,870	165	320,000
170 - 180	1,710	226,580	175	300,000
180 - 190	1,480	228,060	185	275,000
190 - 200	1,280	229,340	195	250,000
200 - 250	2,670	232,010	225	600,000
250 - 300	2,540	234,550	275	700,000
300 - 350	1,850	236,400	325	600,000
350 - 400	1,330	237,730	375	500,000
400 and over	2,270	240,000	425	965,000
	240,000			13,500,000

1

Exhibit f

RESIDENTIAL RATE DETERMINATION

No. of kw-hr. sold in each block	
first 25 kw-hr.	4,940,000
No. of kw-hr. sold	
next 25 kw-hr.	2,627,800
No. of kw-hr. sold	
next 150 kw-hr.	4,700,200
Over 200 kw-hr.	1,232,000
 Total kw-hr.	 13,500,000

No. of kw-hr. sold at minimum rate
 180,000 from 36,000 statements at .45 net = \$16,200

4,940,000 kw-hr. first block
180,000 " on minimum bills
 4,760,000 kw-hr. collected for at first block

Amount to be collected	\$611,500.00
Collected at minimum rate	<u>16,200.00</u>
	\$595,300.00
4,760,000 kw-hr @ 7.2¢	<u>342,720.00</u>
	\$252,580.00
2,627,800 kw-hr @ 4.23¢	<u>111,155.94</u>
	\$141,424.06
4,700,200 kw-hr @ 2.70¢	<u>126,905.40</u>
	\$ 14,518.66
1,232,000 kw-hr @ 1.62¢	<u>19,958.40</u>
Excess	\$ 5,439.74
	<u>611,500.00</u>
Total amount	\$616,939.74

Exhibit g
RESIDENTIAL RATE SCHEDULE

THE HYPOTHETICAL POWER CORPORATION

B, STATE

Rate No. 1	Residence Service
Who may take service	Any residence within corporate limits of City of B. Apartment house may elect this rate provided that the number of kilowatt hours in each step of the rate for a single residence shall be multiplied by the number of apartments in the building. No credit will be given for unoccupied apartments.
Nature of service	Twenty-four (24) hour, alternating current single phase, 60 cycle, 120-240 volt. This rate applies to all uses of electricity in the home including electric ranges and other large electric appliances. No special rate is offered for electric ranges as this rate is very favorable to the use of such equipment. The ordinary uses of electricity in the home come in the first two steps of the rate, so that practically all electricity used for electric ranges and other large electric appliances is paid for at the third and lowest step in the schedule.
Rate	8 cents per kilowatt hour for the first 25 kw-hr. used per month. 4.7 cents per kilowatt hour for the next 25 kw-hr. used per month. 3 cents per kilowatt hour for the next 150 kw-hr. used per month. 1.8 cents per kilowatt hour for all over 200 kw-hr. used per month.
Minimum Charge	50 cents per meter per month.
Discount	A discount of 10% of the above rates will be allowed on all bills paid on or before the last discount day shown on bill

With this assumption the rate to be charged for each block can be calculated. The average customer charge is \$1.50 per month. Theoretically the minimum charge would be even a higher figure (about \$2.50) but when consideration is given to good public relations, the managerial policy should be to arbitrarily set the minimum charge at 50 cents which is nearly as much as the traffic will bear. If the discount for prompt payment is 10 percent the actual minimum charge will be 45 cents. From the customer analysis and the unit cost determination the rate is calculated as shown in Exhibit f. The calculation indicates a yield which is \$5,439.74 in excess of the requirements. This is less than one percent of the total requirement. The block rates should not contain more than one digit to the right of the decimal and if possible should be in even cents or half cents. Exhibit g shows the detail of the published rate schedule as determined by these calculations and filed with the regulatory commission.

Exhibit h shows the details in calculating the average cost of serving commercial customers of different annual utilizations.

Exhibit i shows the size of commercial customer statements, average kw-hr. per statement and number and the total number of kw-hr. for each block. This data is illustrated in graphic form in Figure 16. Figures 17, 18 and 19 are used in the calculations on Exhibit h, which calculations are similar to those which have been described in detail for the residential customers.

As for the residential customer, the form of rate must be chosen from experience. The Hopkinson demand rate is better suited for the commercial type of customer than other forms. The requirements of these customers vary considerably particularly in the quantity of energy consumed. The energy and customer costs are added and the energy rate determined on this amount. The demand rate is calculated to cover the fixed costs. Exhibit k shows the details in the determination of the rate for each block of energy and demand. The calculations indicates a yield which is 1433 in excess of the requirements. The calculated rate should show a slight excess because in the actual application the yield cannot be controlled. Exhibit l shows the detail of the published rate schedule.

STATEMENTS FOR COMMERCIAL SERVICE

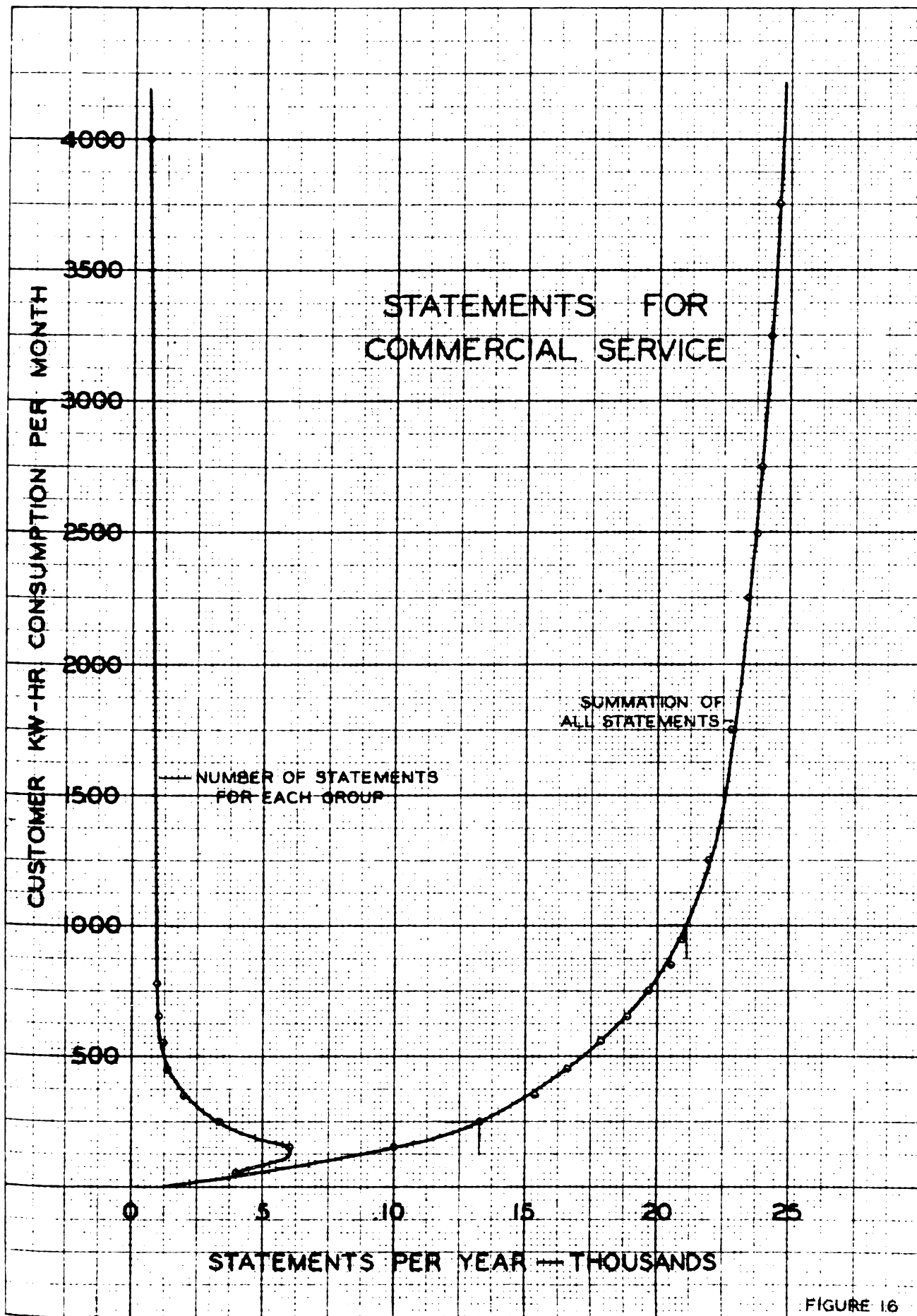
SUMMATION OF
ALL STATEMENTS

NUMBER OF STATEMENTS
FOR EACH GROUP

CUSTOMER KW-HR CONSUMPTION PER MONTH

STATEMENTS PER YEAR — THOUSANDS

FIGURE 16



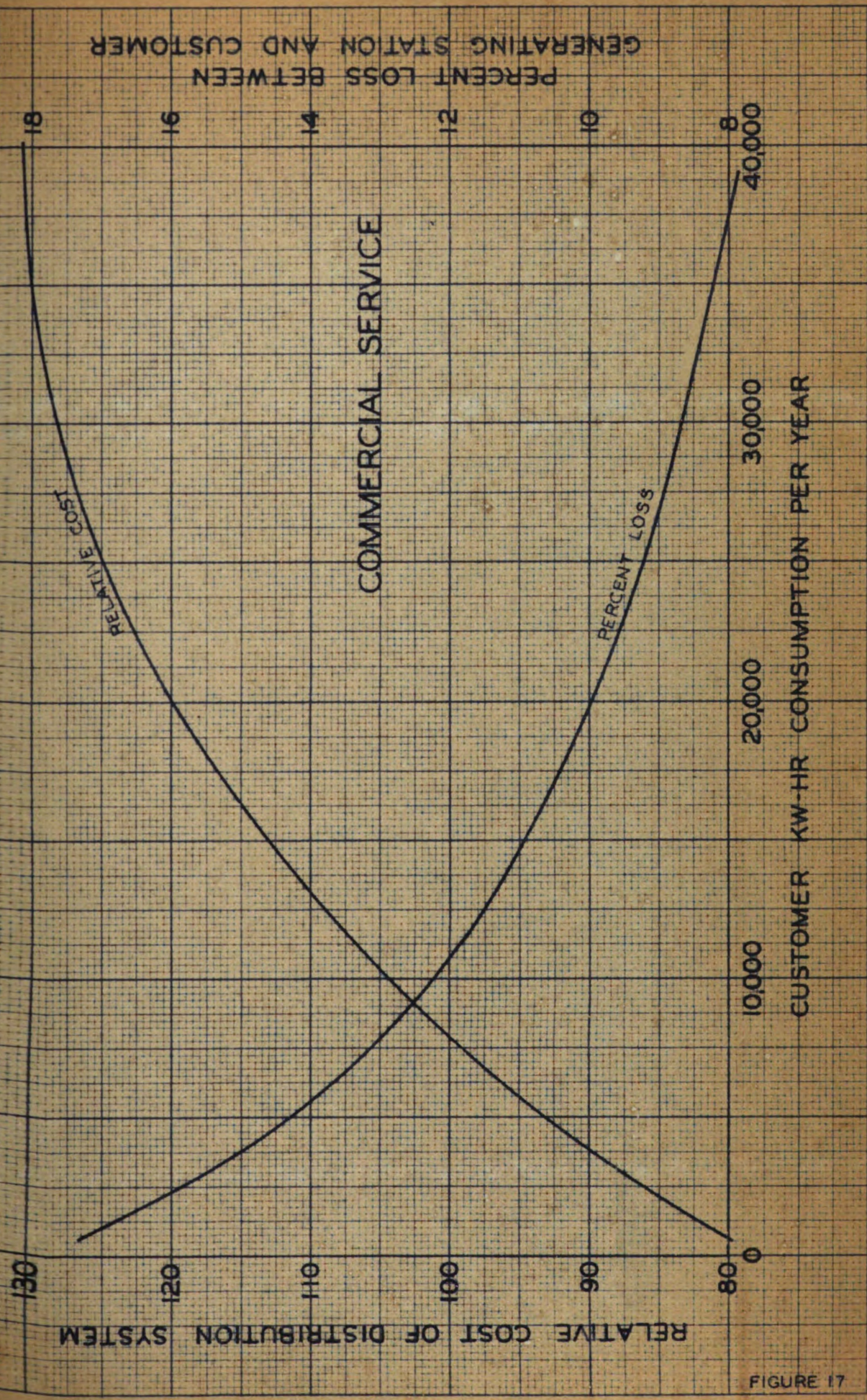


FIGURE 17

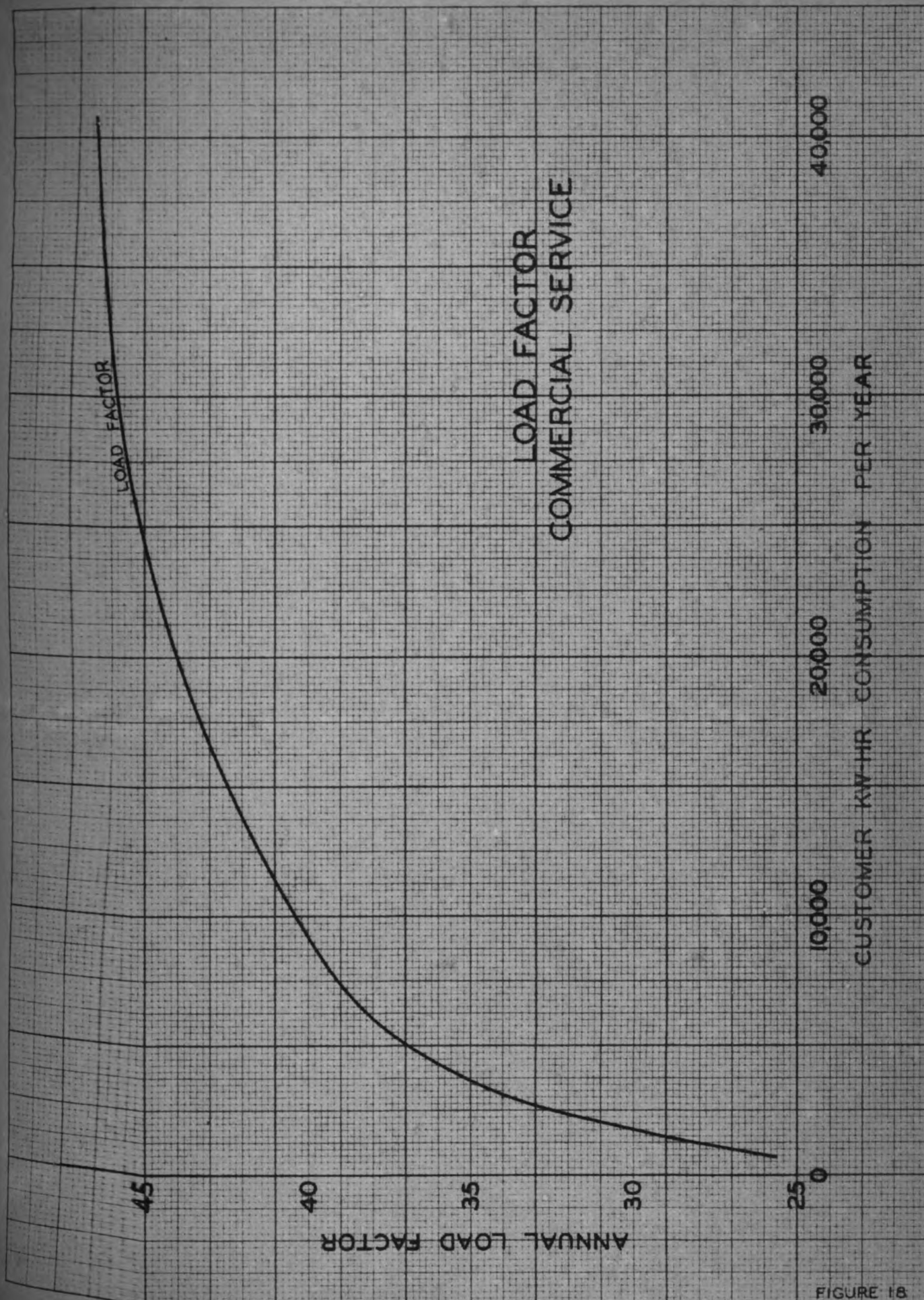


FIGURE 18

COMMERCIAL SERVICE

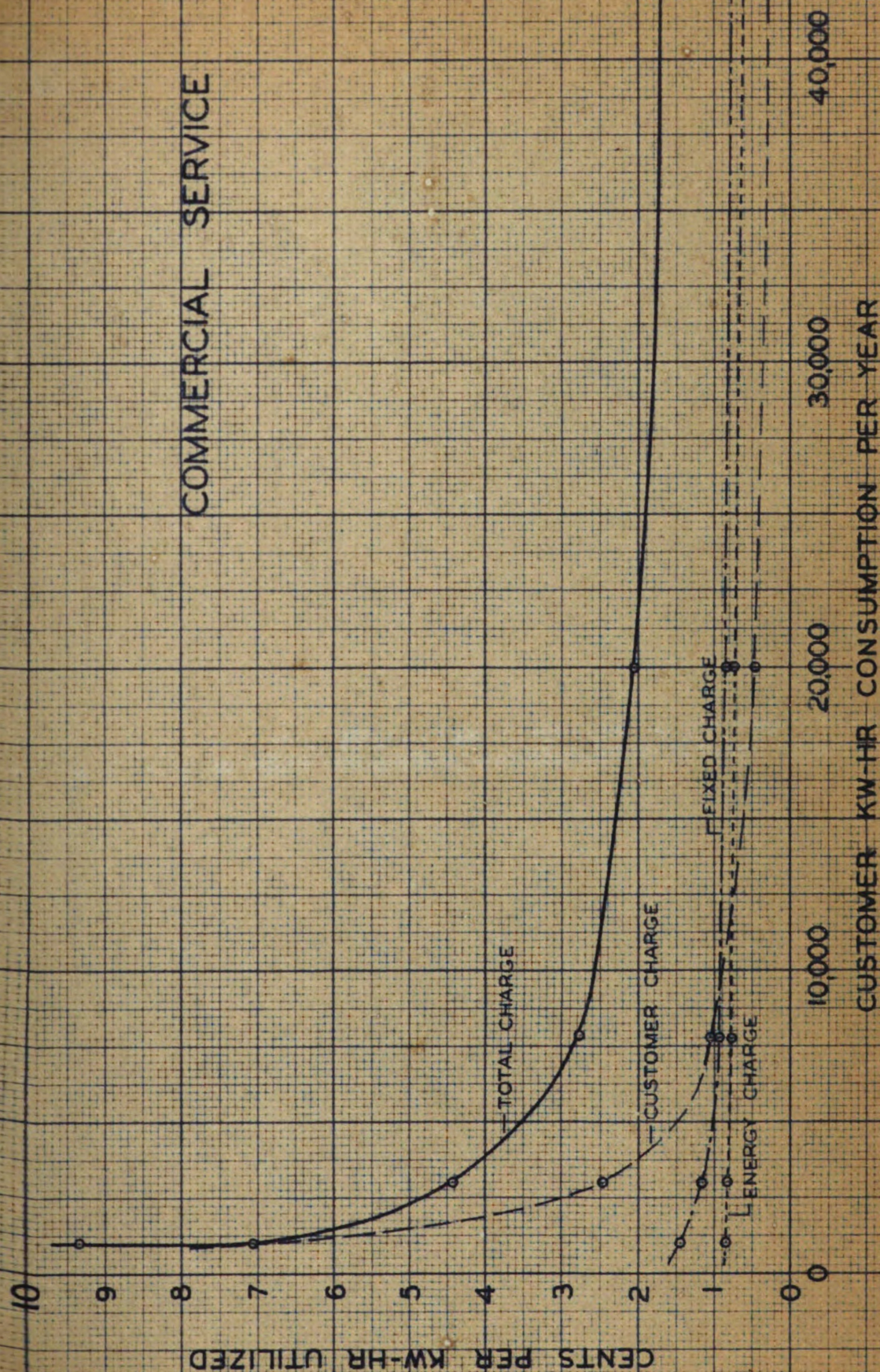


FIGURE 19

COST OF COMMERCIAL SERVICE

	Annual Utilization - kw-hr.			
	1000	3000	7850	20,000
Loss between Generation Station and Customer	17.0	15.5	13.00	10.0
Generation required at station	1205	3550	9020	22,220
Load factor	.27	.34	.393	.44
Kw. demand at Generating Station	.51	1.19	2.62	5.76
Relative costs of distribution system (%)	81.5	87.5	100.0	120.0
				132.5

	Total Annual Charges			
Fixed charges (\$28.31 per kw. demand)	\$14.44	\$33.69	\$74.17	\$163.07
Energy charge (.00686 per kw-hr. generated)	\$ 8.27	24.35	61.88	152.43
Customer charge (excepting retirement and allocated amount over cost of distribution system charges)	\$17.57	17.57	17.57	17.57
Retirement and allocated amount over cost of distribution system charges	\$53.41	57.34	65.53	78.64
Total customer charges	\$70.98	74.91	83.10	96.21
Total annual charges	\$93.69	132.95	219.15	411.71
				840.81

	Unit Charges per Kw-hr. Utilized			
Fixed charges	\$.01444	.01123	.00945	.00815
Energy charges	\$.00827	.00812	.00788	.00762
Customer charges	\$.07098	.02497	.01059	.00481
Total charges				
(dollars per kw-hr. utilized)	\$.09369	.04432	.02792	.02058
				.01682

Exhibit 1

AMOUNT OF COMMERCIAL CUSTOMER ENERGY REQUIREMENTS

Consumption per Statement kw-hr.	No. of Statements	Summation of all Statements	Avg. kw-hr. per Statement	Total kw-hr. for block.
0 — 100	4000	4,000	50	200,000
100 — 200	6000	10,000	150	900,000
200 — 300	3300	13,300	250	825,000
300 — 400	2000	15,300	350	700,000
400 — 500	1350	16,650	450	607,500
500 — 600	1200	17,850	550	660,000
600 — 700	1000	18,850	650	650,000
700 — 800	890	19,740	750	667,500
800 — 900	750	20,490	850	637,500
900 — 1000	500	20,990	950	475,000
1000 — 1500	1000	21,990	1250	1,250,000
1500 — 2000	850	22,840	1750	1,487,500
2000 — 2500	650	23,490	2250	1,462,500
2500 — 3000	460	23,950	2750	1,265,000
3000 — 3500	350	24,300	3250	1,137,500
3500 — 4000	300	24,600	3750	1,025,000
over 4000	600	25,200	4250	2,550,000
	25,200			16,500,000

Exhibit j

AMOUNT OF COMMERCIAL CUSTOMER DEMANDS

Demand per Statement kw.	No. of Statement	Summation of all Statements	Avg. Demand per Statement kw.	Total Demand for block kw.
0 - 5	15,500	15,500	2.5	38,750
5 - 10	6,930	22,430	7.5	51,975
10 - 20	1,500	23,930	15	22,500
20 - 30	700	24,630	25	17,500
30 - 40	120	24,750	35	4,200
40 - 50	100	24,850	45	4,500
50 - 60	90	24,940	55	4,950
60 - 70	80	25,020	65	5,200
70 - 80	70	25,090	75	5,250
80 - 90	60	25,150	85	5,100
90 - 100	50	25,200	95	4,750
	25,200			164,675

Total billed kw. 164,675
 Group demand kw. 5,500
 Diversity $\frac{164,675}{12 \times 5,500} = 2.5$

Exhibit K

COMMERCIAL RATE DETERMINATION

Total energy charge \$130,100
 Total customer charge 174,500

Total amount to be
 collected by energy rate \$304,600

Total charge to be collect-
 ed by demand rate \$155,700

Number of kw-hr. sold in first block of 250 kw-hr.	4,900,000
" " " " " next " " 750 "	5,532,500
" " " " " over " " 1000 "	<u>6,067,500</u>

Total energy utilized 16,500,000 kw-hr.

Amount to be collected by energy rate	\$304,600
4,900,000 kw-hr. @ 2.7¢ (3¢ gross)	<u>132,300</u>
	\$172,300
5,532,500 " @ 1.8¢ (2¢ gross)	<u>99,585</u>
	\$72,715
6,067,500 " @ 1.26¢ (1.4¢ gross)	<u>76,450</u>
	\$3,735
Excess	<u>304,600</u>
Total amount	\$308,335

Number of kw. demand billed in first block of 5 kw.	87,250 kw.
" " " " " next " " 20 "	57,725 "
" " " " " over " " 25 "	<u>19,700 "</u>

Total billed demands 164,675 kw.

Amount to be collected by demand rate	\$155,700
87,250 kw. @ \$1.08 (\$1.20 gross)	<u>94,230</u>
	\$61,470
57,725 kw. @ \$0.81 (.90 gross)	<u>46,757</u>
	\$14,713
19,700 kw. @ \$0.63 (.70 gross)	<u>12,411</u>
Deficiency	\$2,302
Total amount	\$153,398

Total collected by energy rate	\$308,335
" " " demand "	<u>153,398</u>
	\$461,733
Total amount required	<u>460,300</u>
Excess	\$1,433

Demand

Gross	Net
\$1.20 per kw. for first 5 kw.	\$1.08
.90 " " " next 20 "	.81
.70 " " " all over 25 kw.	.63

Energy rate

Gross	Net
3 cents for first 250 kw-hr.	2.7 cents
2 " " next 750 "	1.8 "
1.4 " " all over 1000 kw-hr.	1.26 "

K JALIXE

COOPERATION WITH JALIXE

COOPERATION WITH JALIXE
COOPERATION WITH JALIXE

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COOPERATION WITH JALIXE

Exhibit 1

COMMERCIAL RATE SCHEDULE

THE HYPOTHETICAL POWER CORPORATION

B, STATE

Rate No. 2	Commercial Lighting and Miscellaneous Power Service.
Who may take service	All commercial lighting and miscellaneous power customers, who are not specifically provided for in other rate schedules.
Nature of service.	Twenty-four (24) hour, alternating current, 60 cycle, 120-240 volt, single phase, and 440 volt, three phase.
Rate	
Demand Charge	\$1.20 per kilowatt per month for the first 5 kw. of maximum demand. \$0.90 per kilowatt per month for the next 20 kw. of maximum demand. \$0.70 per kilowatt per month for all over 25 kw. of maximum demand.
Energy Charge	Plus the following: 3 cents per kilowatt hour for the first 250 kw-hr. used per month. 2 cents per kilowatt hour for the next 750 kw-hr. used per month. 1.4 cents per kilowatt hour for all over 1000 kw-hr. used per month.
Minimum charge	\$1.00 per meter per month.
Discount	A discount of 10% of the above rate will be allowed on all bills that are paid on or before the last discount day shown on bill.
Demand	The maximum demand will be obtained by the use of a demand meter or demand indicator attached to the meter, which registers the maximum demand for a period of 15 minutes or at the option of the Corporation, the maximum demand will be considered as 75% of the connected load in kilowatts.

Remarks

Where customers have both lighting and power service supplied through separate meters, the demand and consumption as registered by the different meters will not be combined, but the bill for each meter will be computed separately. Ranges, refrigerators, water heaters and battery chargers may be excluded in determining demand.

Approved - December 3, 1932
A. Public Utility Commission

Effective - Jan. 1, 1933

Exhibit m shows the details in calculating the average cost of serving industrial customers of different annual utilizations.

Exhibit n shows the size of industrial customers statements, average kw-hr. per statement and number and the total number of kw-hr. for each block, also the nature of the demands. This data is illustrated graphically in Figure 20. Figures 21, 22 and 23 are used in the calculations in Exhibit m, which calculations are similar to those of the residential and commercial customers. The Hopkinson demand rate is the most popular form for industrial customers. The energy and customer costs are added and the energy rate is determined to cover this amount. The demand rate is calculated to cover the fixed costs. Exhibit o shows the details in the determination of the rate for each block of demand. The energy costs are less than half the total for industrial customers; there is no particular advantage of blocks for energy. Industrial customers usually determine the capacity of the generating station so a rate which places more emphasis on the customer controlling demand and encourages the use of energy is the most practical and satisfactory to both the utility and the customer. The calculation for power factor penalty and bonus is shown on Exhibit p and the factors are illustrated in Figure 24. The calculation indicate a yield of only \$335 in excess of the requirements. Exhibit q shows the detail of the published industrial rate schedule.

Exhibit r shows the detail of the published power factor penalty and bonus.

The rate determination for the suburban customers is identical in method with the residential calculation except different values are used. These values are shown in Figures 25, 26, 27 and 28 and on Exhibits s and t. Exhibit y show the detail of the published suburban rate schedule.

The rate calculation for municipal street lighting is determined by totaling all the costs allocated to this type of service. Then being only one customer the unit price is the total costs divided by the total energy requirements. This can be billed at a straight line rate; the demand is fixed and also the quantity to a large extent. This service would be billed at 4.1 cents per kw-hr. The high customer charge is due to replacement and maintenance of lamps and equipment on the streets. Exhibit w shows the details of the rate determination for municipal street lighting.

Exhibit x is a summary of the total and unit charges for service. This tabulation shows the principal items that are involved in rendering service to the customers of an electric utility.

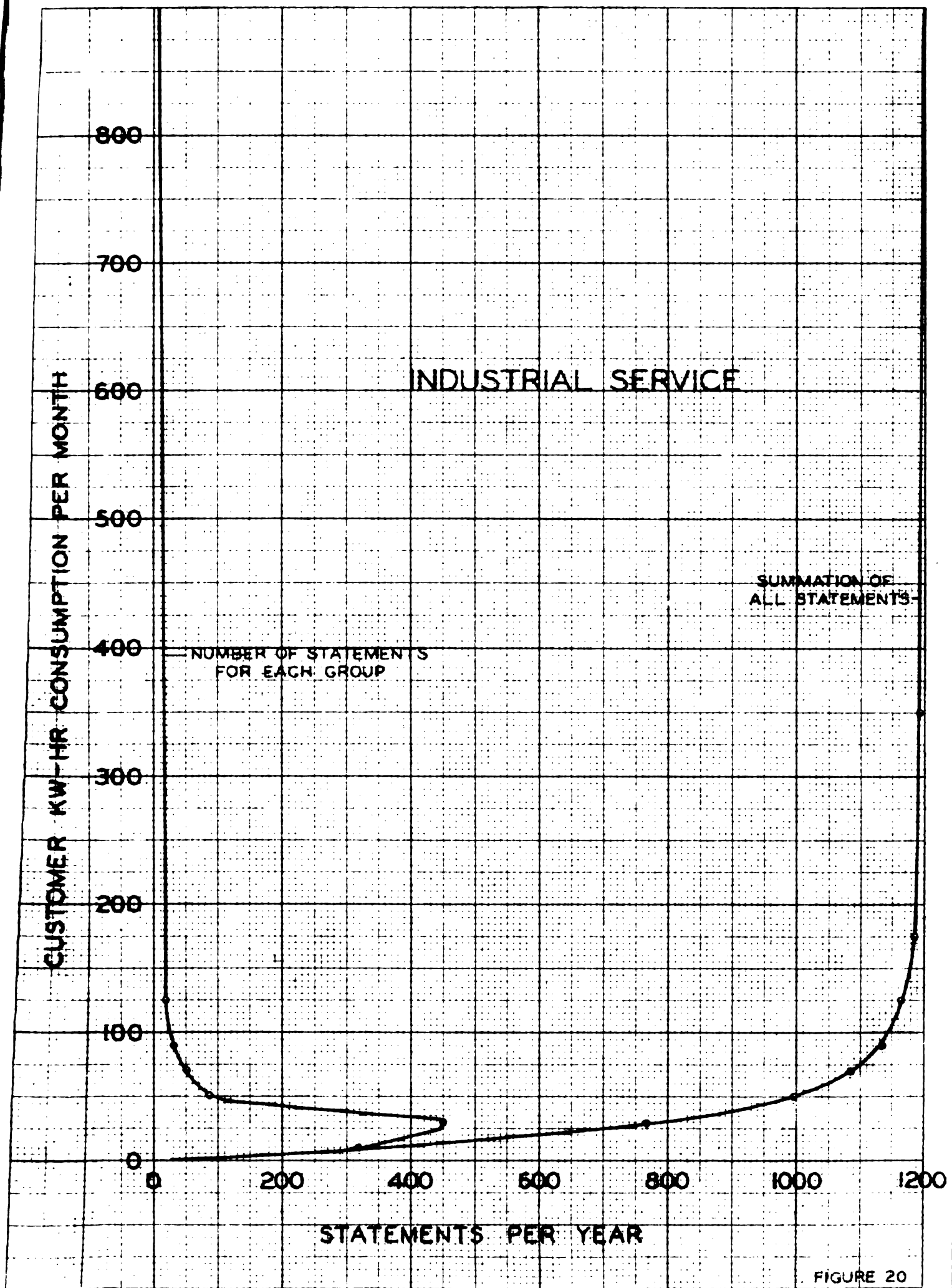


FIGURE 20

PERCENT LOSS BETWEEN
GENERATING STATION AND CUSTOMER

INDUSTRIAL SERVICE

RELATIVE COST OF DISTRIBUTION SYSTEM

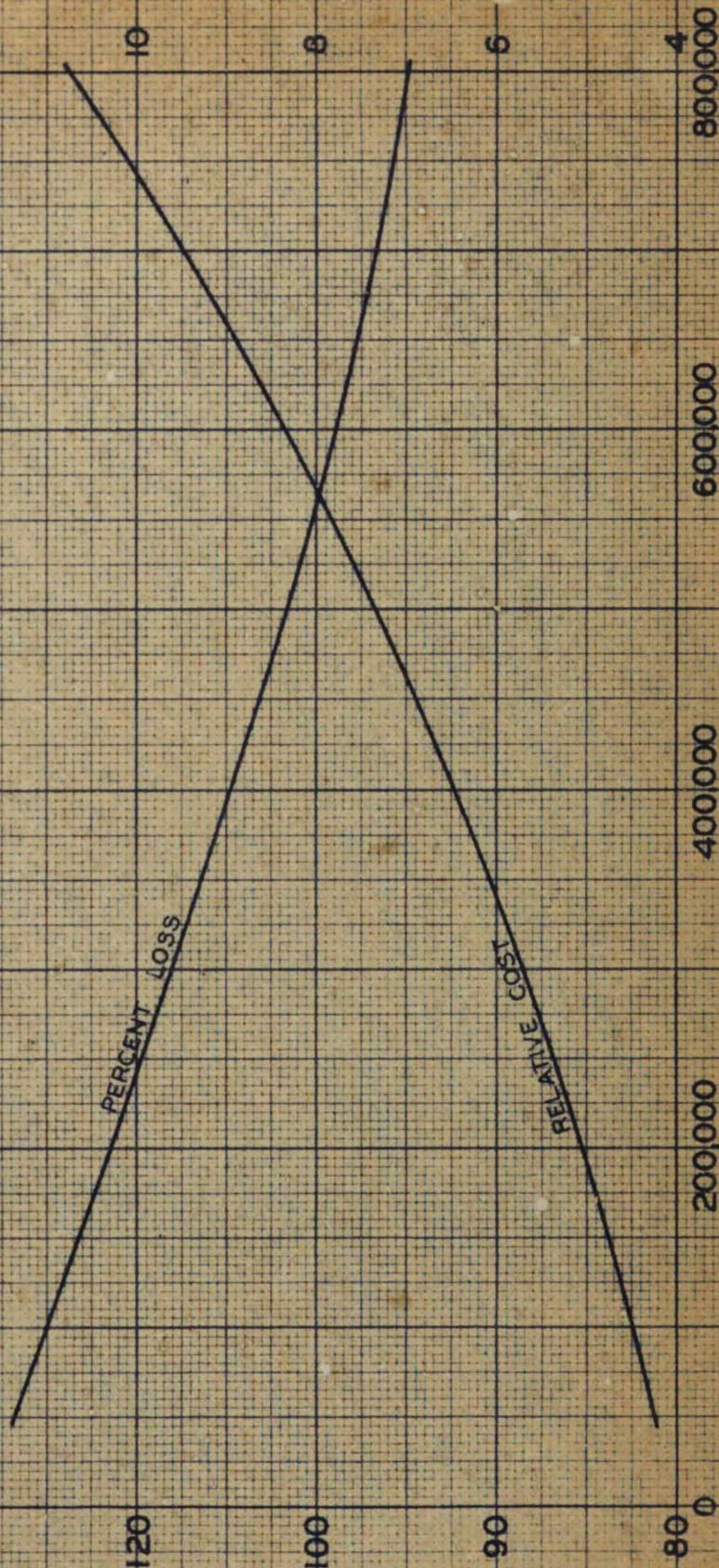


FIGURE 21

LOAD FACTOR INDUSTRIAL SERVICE

ANNUAL LOAD FACTOR

LOAD FACTOR

800,000

600,000

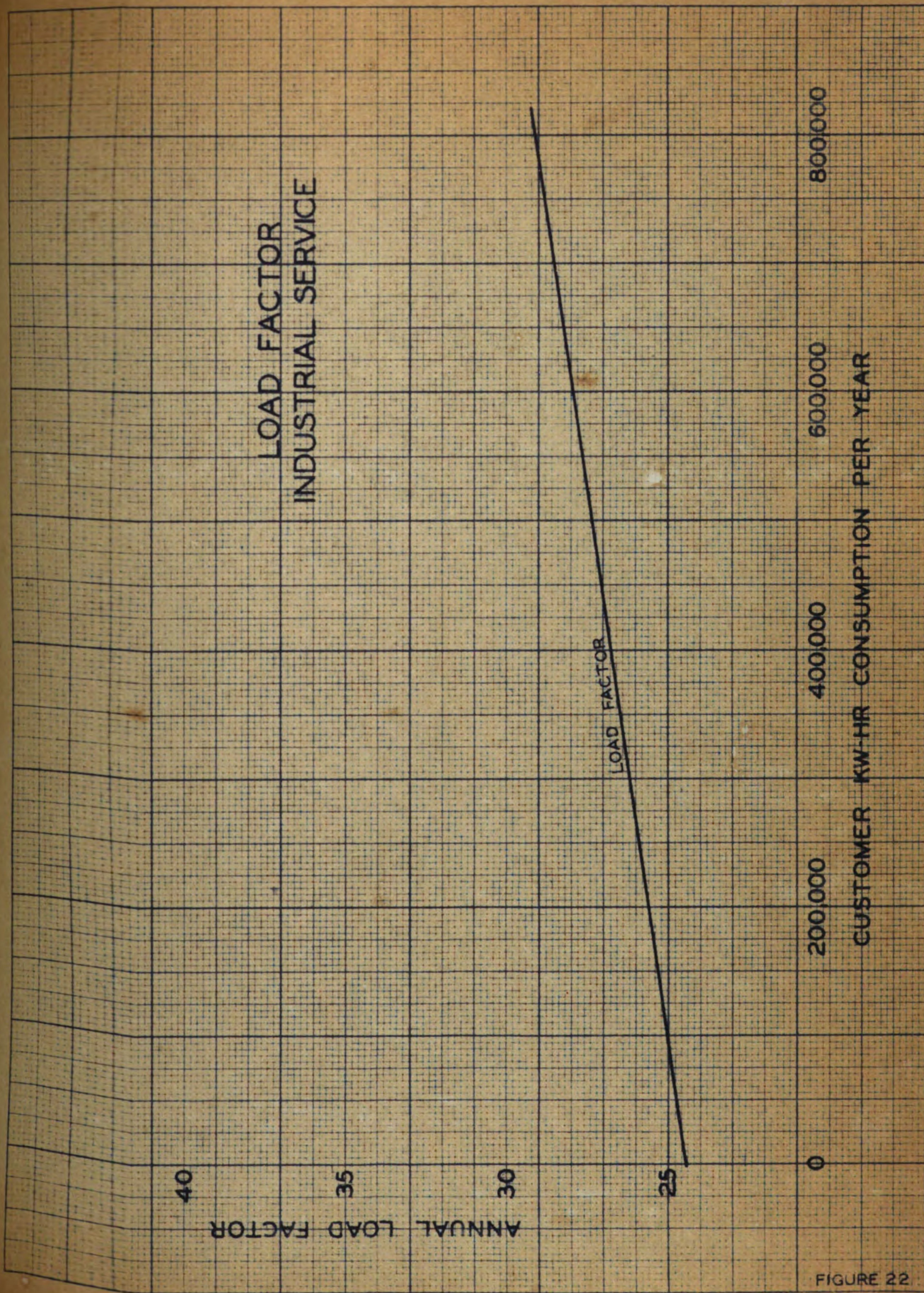
400,000

200,000

0

CUSTOMER KW-HR CONSUMPTION PER YEAR

FIGURE 22



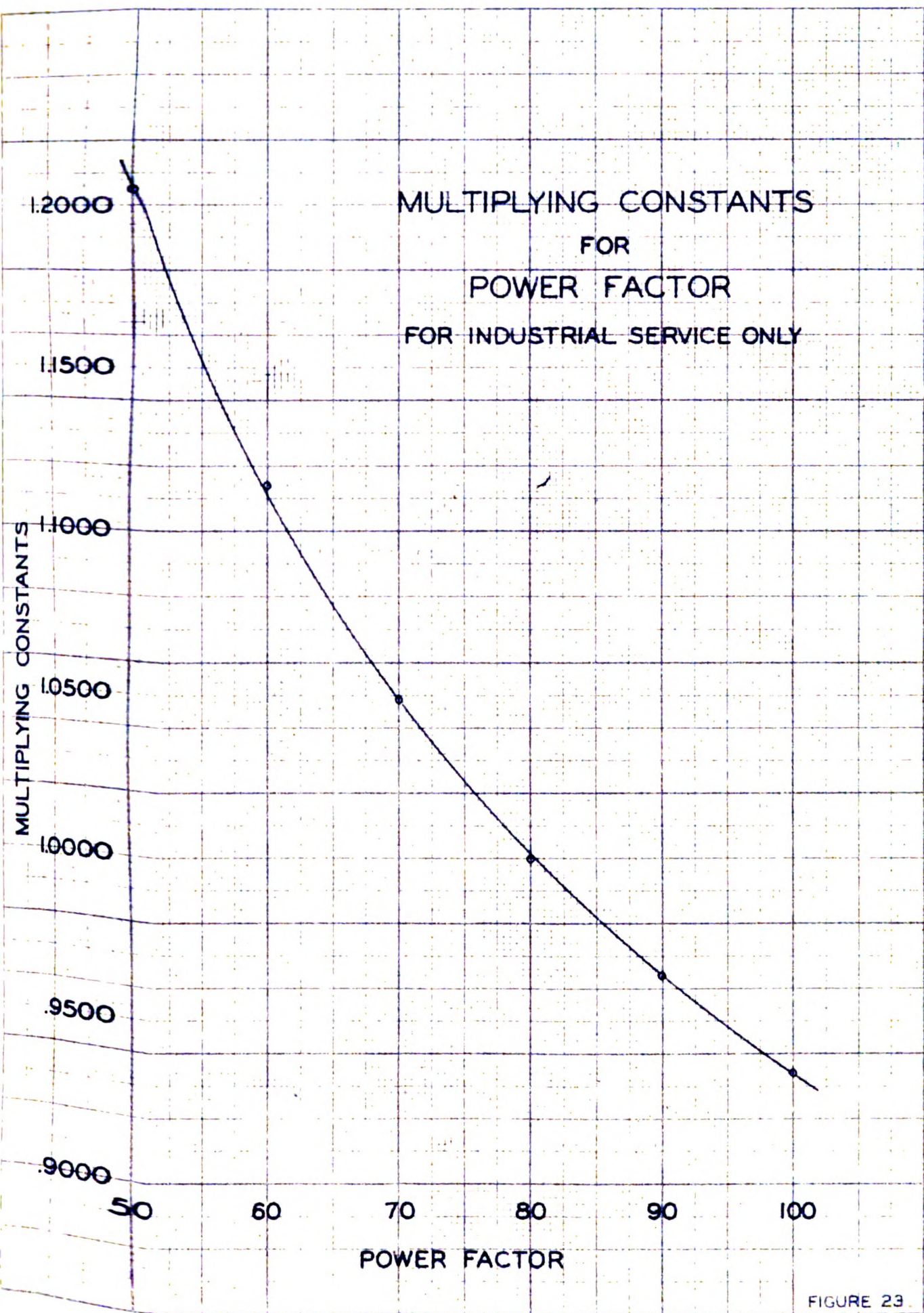


FIGURE 23

INDUSTRIAL SERVICE

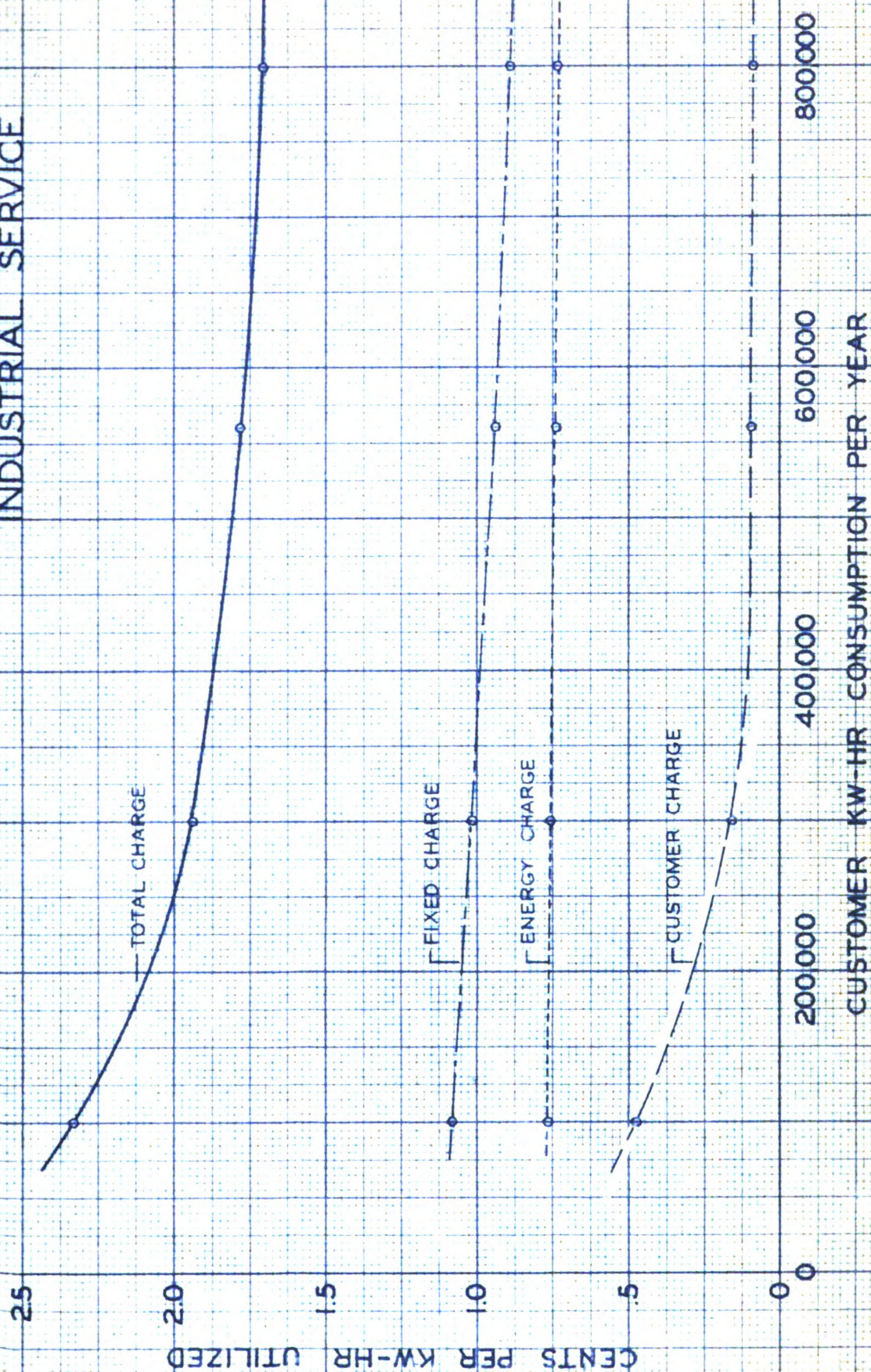


FIGURE 24

- 121 -

Exhibit n

AMOUNT OF INDUSTRIAL CUSTOMERS ENERGY REQUIREMENTS

Consumption per Statement kw-hr.	No. of Statements	Summation of Statements	Average Kw-hr. per Statement	Total Kw-hr. for Block
0 - 20,000	318	318	10,000	3,180,000
20,000 - 40,000	450	768	30,000	13,500,000
40,000 - 60,000	229	997	50,000	11,450,000
60,000 - 80,000	88	1085	70,000	6,170,000
80,000 - 100,000	50	1135	90,000	4,500,000
100,000 - 150,000	30	1165	125,000	3,750,000
150,000 - 200,000	20	1185	175,000	3,500,000
200,000 - 500,000	7	1192	350,000	2,450,000
500,000 - 1,000,000	5	1197	750,000	3,750,000
Over 1,000,000	3	1200	1,250,000	3,750,000
	1200			56,000,000

AMOUNT OF INDUSTRIAL CUSTOMERS DEMANDS

Demand per Statement kw.	No. of Statements	Summation of all Statements	Average Demand per Statement	Total Demand for Block kw.
100 - 200	406	406	150	60,900
200 - 300	500	906	250	125,000
300 - 500	170	1076	400	68,000
500 - 1000	100	1176	750	75,000
1000 - 3000	20	1196	2000	40,000
3000 - 7000	4	1200	5000	20,000
	1200			388,900

Total billed kw. 388,900
 Group demand 25,000
 Diversity $\frac{388,900}{12 \times 25,000} = 1.295$

Exhibit o

INDUSTRIAL RATE DETERMINATION

Total energy charge	\$418,100
Total customer charge	<u>55,700</u>
Total amount to be collected by energy rate	\$473,800

Total charge to be collected by demand rate	\$528,600
---	-----------

All energy will be billed at same rate
 56,000,000 kw-hr. @ .855¢ net = \$478,800

Number of kw. demand billed in first block of 100 kw.	120,000
" " " " " next " " 100 kw.	99,700
" " " " " " 200 kw.	83,800
" " " " " over 400 kw.	85,400

Amount to be collected by demand rate	\$528,600
120,000 kw. @ \$1.71 net (\$1.80 gross)	<u>205,200</u>
	\$323,400
99,700 kw. @ \$1.425 " (\$1.50 gross)	<u>142,073</u>
	\$181,327
83,800 kw. @ \$1.14 " (\$1.20 gross)	<u>95,532</u>
	\$85,795
85,400 kw. @ \$0.95 " (\$1.00 gross)	<u>81,130</u>
	\$4,665
Deficiency	<u>528,600</u>
Total amount	\$523,935

Total collected by energy rate	\$478,800
" " " demand "	<u>523,935</u>
	\$1,002,735
Total amount required	<u>1,002,400</u>
Excess	\$ 335

Demand rate

Gross	Net
\$1.80 per kw. first 100 kw.	\$1.71
1.50 " " next 100 "	1.425
1.20 " " " 200 "	1.14
1.00 " " all over 400	.95

Energy rate

.9 cents per kilowatt hour

5% discount for prompt payment



Exhibit p

POWER FACTOR BONUS AND PENALTY FOR INDUSTRIAL CUSTOMERS

	Total investment	Per cent Effected		Total investment Effected by Power Factor	Allocated to industrial Customers
Turbo generator units, steam	\$950,000	Generators	30%	285,000	188,000
Electric plant	650,000	Effected	30%	195,000	129,000
Turbo generator unit, hydro	30,000	"	30%	9,000	5,900
Substation equipment	300,000	"	25%	75,000	49,500
Overhead conductors					115,000
Underground conductors					75,000
Industrial services					50,000
Line transformer and devices					82,000

Total investment for industrial customers effected by power factor

\$694,400

15% fixed charges

\$104,160.

$\frac{\$104,000}{56,000,000} = .1855\phi$ per kw-hr. utilized at 80% power factor.

				increase or Decrease in Cost per kw-hr.	Avg. cost per kw-hr. at 80% P.F.	Per cent correction	Multiplying Constant
100% power factor	$\frac{100}{80} = 1.25$	$\frac{.1855}{1.25} = .1485$		.0370¢	1.785	-6.60	.9340
90% " "	$\frac{90}{80} = 1.125$	$\frac{.1855}{1.25} = .1650$		.0205¢	1.785	-3.56	.9644
80% " "	$\frac{80}{80} = 1.$	$\frac{.1855}{1} = .1855$		.0000¢	1.785	.00	1.0000
70% " "	$\frac{70}{80} = .875$	$\frac{.1855}{.875} = .2120$		.0265¢	1.785	4.72	1.0472
60% " "	$\frac{60}{80} = .750$	$\frac{.1855}{.750} = .2470$		.0615¢	1.785	11.4	1.114
50% " "	$\frac{50}{80} = .625$	$\frac{.1855}{.625} = .2960$		.1105¢	1.785	20.5	1.205

[illegible]

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1000000000	0000000000

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10. Indicate whether you believe that the teacher listed
 appropriate here? (5)

$$3 \text{ usque } 40^{\circ} \text{ de fahrenheit ad una de } 60^{\circ} \text{F.} = \frac{600,000}{300,000,000}$$
[illegible]

Exhibit q

INDUSTRIAL RATE SCHEDULE

THE HYPOTHETICAL POWER CORPORATION

B, STATE

Rate No. 3	Regular Primary Power Rate
Who may take service	Any power users in the City of B, or in the vicinity thereof with a demand load of 50 kilowatts or over.
Nature of Service	Twenty-four (24) hour, alternating current, 60 cycle, three phase, 4000 volts.
Rate	
Demand Charge	A - Transformer-installation owned by the customer. \$1.80 per kilowatt per month for the first 100 kilowatts of maximum demand. \$1.50 per kilowatt per month for the next 100 kilowatts of maximum demand. \$1.20 per kilowatt per month for the next 200 kilowatts of maximum demand. \$1.00 per kilowatt per month for all over 400 kilowatts of maximum demand. B - Transformer installation owned by the Corporation. \$2.00 per kilowatt per month for the first 100 kilowatts of maximum demand. \$1.70 per kilowatt per month for the next 100 kilowatts of maximum demand. \$1.30 per kilowatt per month for the next 200 kilowatts of maximum demand. \$1.10 per kilowatt per month for all over 400 kilowatts of maximum demand.
Energy Charge	PLUS THE FOLLOWING: 0.9 cents per kilowatt hour for all the kilowatt hours used per month
Discount	A discount of 5% will be allowed on above rates if bills are paid on or before the 15th of the month immediately succeeding that in which service is rendered.

Secondary Metering	If secondary metering is used, 4 per- cent will be added to demand and energy as meters for transformer losses and the corrected amounts used for billing.
Monthly Maximum Demand	Maximum demand shall be determined monthly by measuring the highest average kilowatt demand maintained by the customer over a period of fifteen minutes.
Power Factor Correc- tion	The power factor multiplier constant in schedule approved December 3, 1932 shall apply to above rates.
Minimum Charge	The minimum charge shall be the demand charge as given above and shall not be less than the demand charge on the reservation as requested by the customer.

Approved - December 3, 1932
A. Public Utility Commission

Effective - January 1, 1933

Exhibit r

THE HYPOTHETICAL POWER CORPORATION

B, STATE

POWER FACTOR CORRECTION SCHEDULE

Definition and
How Obtained

Power Factor shall mean the average power factor maintained by the customer during the month or period of time for which the demand is measured and shall be determined by the reactive component meter method and shall equal kilowatt hours (KWH) divided by the square root of the sum of the squares of kilowatt hours (KWH) and reactive kilovolt ampere hours (RKVAH).

Method of Application

The multiplier constant given below corresponding to the power factor as found by the above method shall be applied to the actual measured monthly demand and the actual measured monthly consumption of electric energy. The result in each case which will be known as billed demand and billed KWH shall be the basis for rendering customers bill.

To Whom Applied

The Corporation reserves the right to apply the above correction to the electric energy consumed by any power customer whose demand is 50 KW or over.

Exhibit r (continued)

TABLE OF CONSTANTS

Percent Power Factor	Mult. Constant	Percent Power Factor	Mult. Constant	Percent Power Factor	Mult. Constant
100	.9340	82	.9928	64	1.0974
99	.9370	81	.9964	63	1.1041
98	.9401	80	1.0000	62	1.1108
97	.9431	79	1.0047	61	1.1124
96	.9462	78	1.0094	60	1.1140
95	.9492	77	1.0141	59	1.1231
94	.9523	76	1.0188	58	1.1322
93	.9553	75	1.0236	57	1.1413
92	.9583	74	1.0383	56	1.1504
91	.9614	73	1.0430	55	1.1605
90	.9644	72	1.0477	54	1.1696
89	.9679	71	1.0524	53	1.1787
88	.9715	70	1.0472	52	1.1878
87	.9750	69	1.0539	51	1.1969
86	.9786	68	1.0606	50	1.2050
85	.9821	67	1.0773		
84	.9857	66	1.0840		
83	.9892	65	1.0907		

Approved - December 3, 1932
A. Public Utility Commission

Effective - January 1, 1933

SUBURBAN SERVICE

CUSTOMER KW-HR CONSUMPTION PER YEAR

— NUMBER OF STATEMENTS
FOR EACH GROUP

SUMMATION OF
ALL STATEMENTS

STATEMENTS PER YEAR — THOUSANDS

FIGURE 25

400

350

300

250

200

150

100

50

0

5

10

15

20

25

30

PERCENT LOSS BETWEEN
GENERATING STATION AND CUSTOMER

12
14
16
18
20
22

SUBURBAN SERVICE

CUSTOMER KW-HR CONSUMPTION PER YEAR

3000

2000

1000

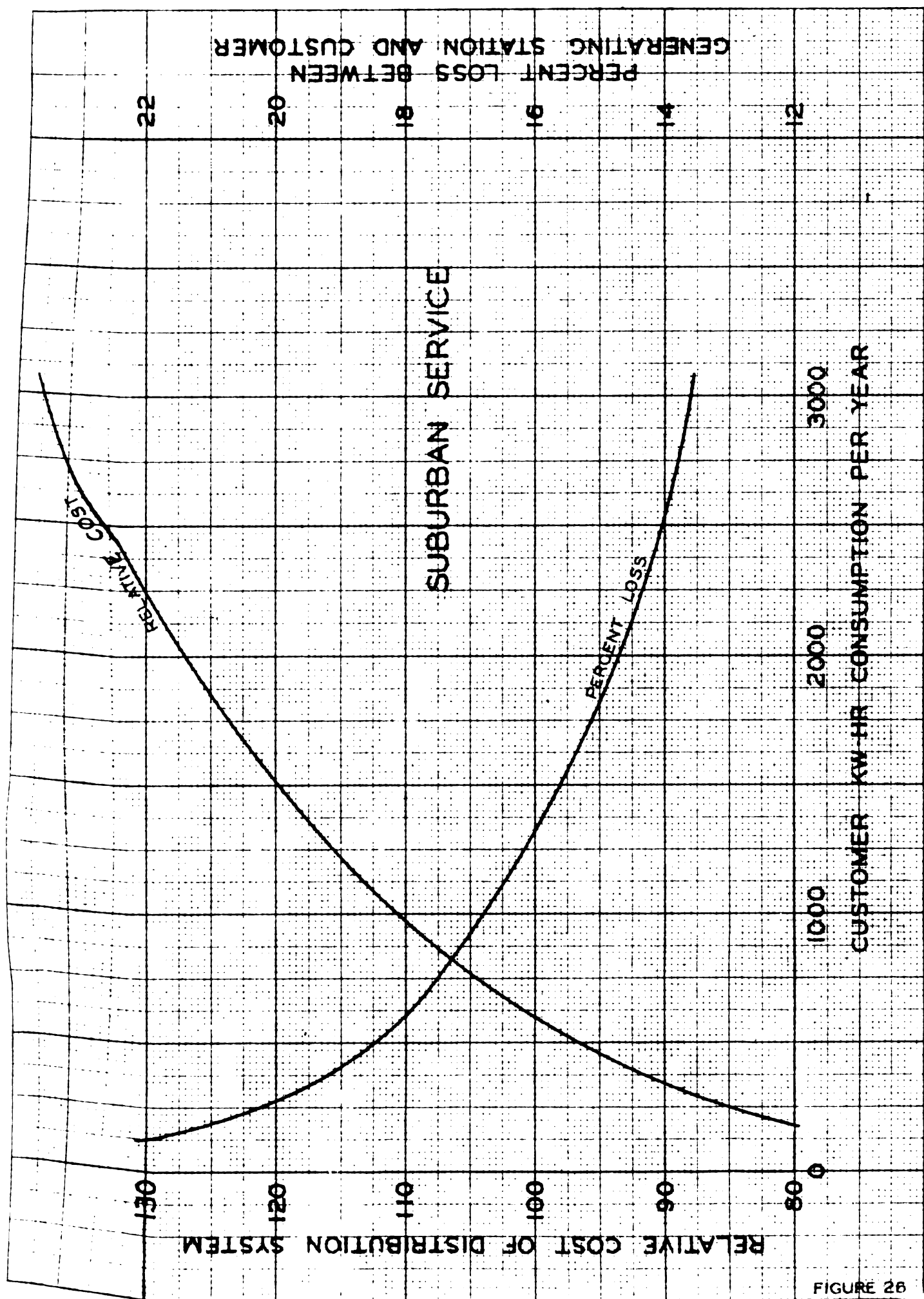
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PERCENT LOSS

RELATIVE COST OF DISTRIBUTION SYSTEM

130
120
110
100
90
80

FIGURE 26



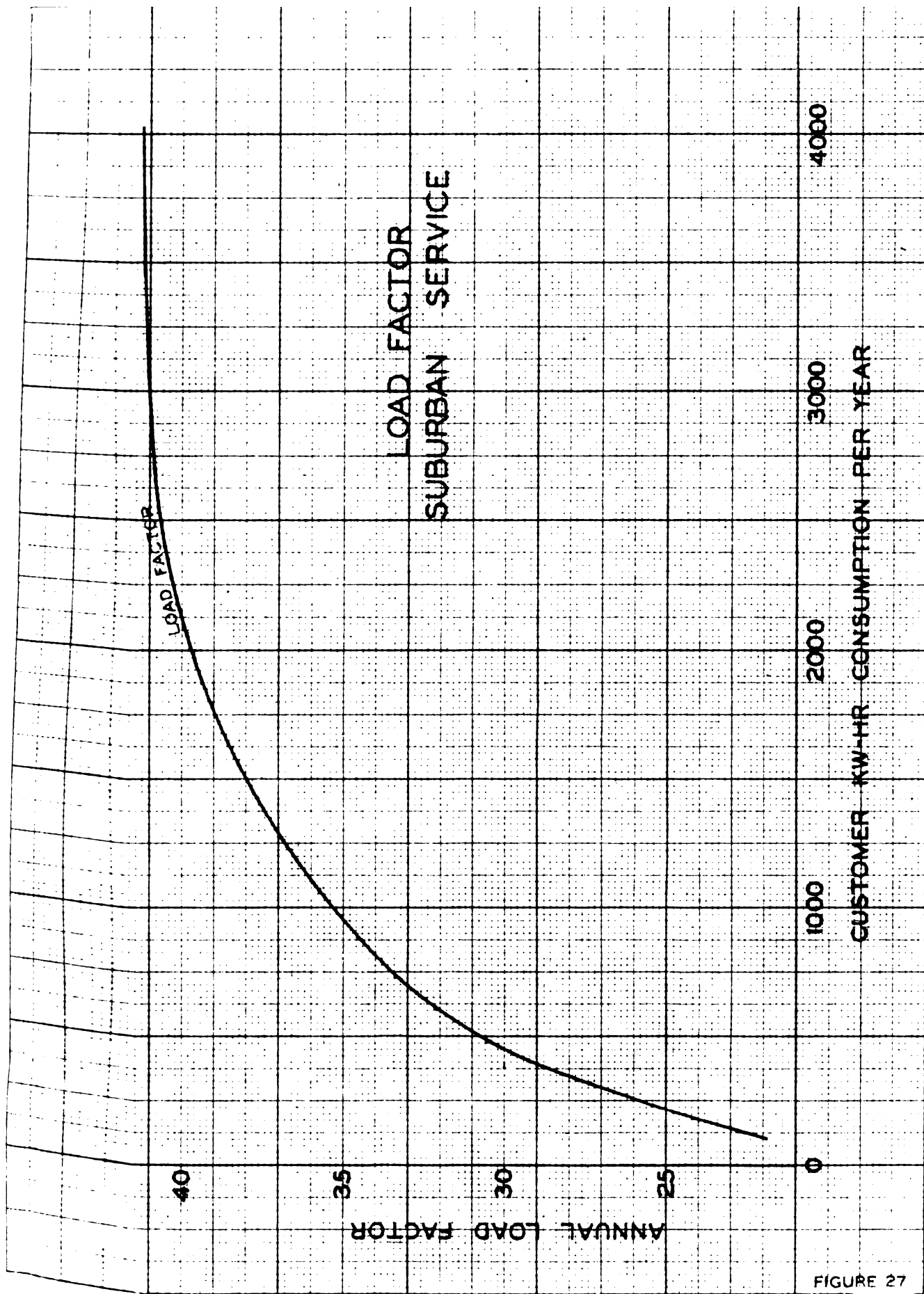


FIGURE 27

SUBURBAN SERVICE

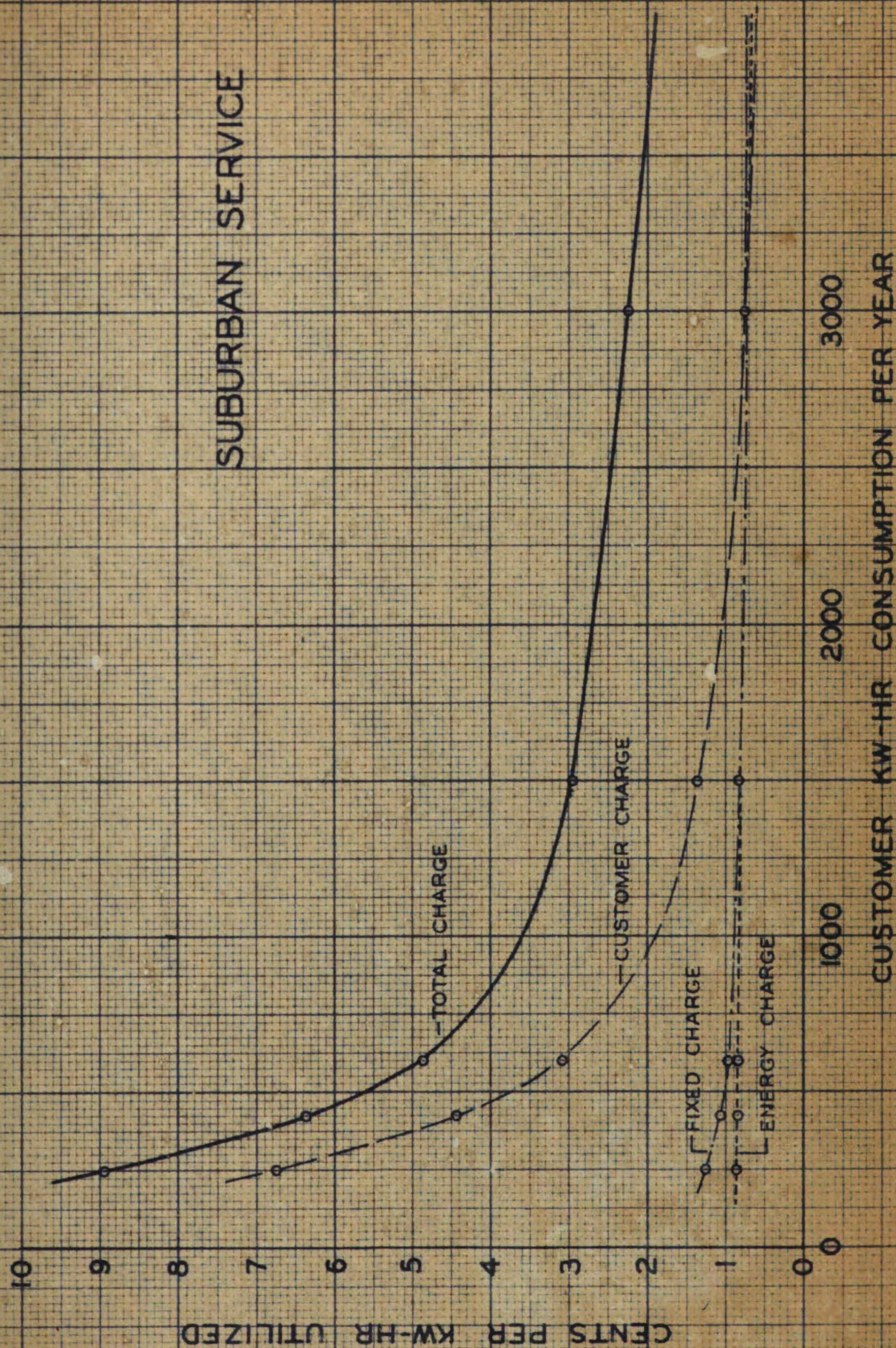


FIGURE 20

Exhibit a

COST OF SUBURBAN SERVICES

	Annual Utilization - Kilowatt Hours				
	250	400	600	1500	3000
Loss between generating station and customer	22.5	19.1	18.0	15.6	13.6
Generation required at station	322	494	732	1775	3470
Load factor	.26	.292	.321	.38	.41
Kw. demand at generating station	.141	.193	.260	.533	.965
Relative costs of distribution system %	85.0	92.5	100.0	120	137.5

	Total Annual Charges				
Fixed charges (\$22.62 per kw. demand)	\$ 3.19	4.37	5.88	12.06	21.83
Energy charge (.00686 per kw-hr. gen.)	\$ 2.21	3.39	5.02	12.18	23.80
Customer charge (excepting retirement and allocated amount over costs of distribution system charges)	\$ 8.96	8.96	8.96	8.96	8.96
Retirement and allocated amount over cost on distribution system charges	\$ 8.02	8.73	9.44	11.33	12.98
Total customer charges	\$16.98	17.69	18.40	20.29	21.94
Total annual charges	\$22.38	25.45	29.30	44.53	67.57

	Unit Charges per Kw-hr. Utilized				
Fixed charges	\$.01276	.01092	.00980	.00804	.00727
Energy charges	\$.00884	.00848	.00837	.00812	.00793
Customer charges	\$.06792	.04422	.03066	.01353	.00732
Total charges (dollars per kw-hr. utilized)	\$.08952	.06362	.04883	.02969	.02252

Exhibit t

AMOUNT OF SUBURBAN CUSTOMER ENERGY REQUIREMENTS

Consumption per Statement kw-hr.	No. of Statements	Summation of all Statements	Avg. Kw-hr. per Statement	Total Kw-hr. for Block
0 - 10	5660	5,660	5	28,300
10 - 20	4900	10,560	15	73,500
20 - 30	6150	16,710	25	153,750
30 - 40	3000	19,710	35	105,000
40 - 50	2000	21,710	45	103,500
50 - 60	1200	22,910	55	66,000
60 - 70	1000	23,910	65	65,000
70 - 80	800	24,710	75	60,000
80 - 90	700	25,410	85	59,500
90 - 100	550	25,960	95	52,250
100 - 110	500	26,460	105	52,500
110 - 120	450	26,910	115	51,750
120 - 130	400	27,310	125	50,000
130 - 140	350	27,660	135	47,250
140 - 150	300	27,960	145	43,500
150 - 160	260	28,220	155	40,300
160 - 170	250	28,470	165	41,250
170 - 180	210	28,680	175	36,750
180 - 190	170	28,850	185	31,450
190 - 200	160	29,010	195	31,200
200 - 250	270	29,280	225	60,750
250 - 300	250	29,530	275	68,750
300 - 350	170	29,700	325	55,250
350 - 400	100	29,800	375	37,500
Over 400	200	30,000	425	85,000
	30,000			1,500,000

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Exhibit u

SUBURBAN RATE DETERMINATION

No. of kw-hr. sold in each block

First block of 25 kw-hr.	587,800
Next " " 25 "	290,750
Next " " 150 "	512,200
Over 200 kw-hr.	<u>109,250</u>

Total	1,500,000
-------	-----------

No. of kw-hr. sold at minimum rate 28,300 kw-hr. from 5660 statements.

587,800 kw-hr. first block

28,300 " on minimum bills

559,500 kw-hr. collected for in first block at block rate

Amount to be collected	\$73,300
Collection at minimum rate	
5660 customers @ 90¢	<u>5.094</u>
	\$68,206
559,500 kw-hr. @ 7.2¢	<u>40.284</u>
	\$27,922
290,750 kw-hr. @ 4.23¢	<u>12.299</u>
	\$15,623
512,200 kw-hr. @ 2.7¢	<u>13.829</u>
	\$ 1,794
109,250 kw-hr. @ 1.8¢	<u>1.966</u>
	\$ 172
Excess	<u>73,300</u>
Total amount	\$73,472

Gross	Net
8.0 ¢ first 25 kw. per month	7.2
4.7¢ next 25 " " "	4.23
3.0¢ " 150 " " "	2.7
1.8¢ over 200 " " "	1.62

Minimum bill \$1.00

Less 10% for prompt payment

Exhibit v

SUBURBAN RATE SCHEDULE

THE HYPOTHETICAL POWER CORPORATION

B, STATE

Rate No. 4	Residence Service - Suburban
Who may take service	Any residence outside of corporate limits of the City of B
Nature of service	Twenty-four (24) hour, alternating current, single phase, 60 cycle, 120-240 volts. This rate applies to all uses of electricity in the home including electric ranges and other large appliances. No special rate is offered for electric ranges as this rate is very favorable to the use of such equipment. The ordinary uses of electricity in the home come in the first two steps of the rate, so that practically all electricity used for electric ranges and other large electric appliances is paid for at the third and lowest step in the schedule.
Rate	8 cents per kilowatt hour for the first 25 kilowatt hours used per month. 4.7 cents per kilowatt hour for the next 25 kilowatt hours used per month. 3 cents per kilowatt hour for the next 150 kilowatt hours used per month. 1.8 cents per kilowatt hour for all over 200 kilowatt hours used per month.
Minimum charge	\$1.00 per meter per month.
Discount	A discount of 10% of the above rate will be allowed on all bills paid on or before last discount day shown on bill.

Approved - December 3, 1932
A. Public Utility Commission

Effective - January 1, 1933

Exhibit w

COST OF MUNICIPAL STREET LIGHTING

Annual Utilization
kilowatt-hours

2,500,000

Loss between generating station and meters	2.56
Generation required at station	2,565,000
Load factor	.419
Kw. demand at generating station	700

Total Annual Charges

Fixed charges (\$22.14 per kw. demand)	\$15,500
Energy charges (.00686 per kw-hr. utilized)	17,500
Customer charge	69,500
Total annual charge	\$102,500

Unit Charge per Kw-hr. Utilized

Fixed charges	\$.00620
Energy charges	.00700
Customer charges	.02780
Total annual charge (dollars per kw-hr. utilized)	\$.04100

Exhibit x

SUMMARY OF TOTAL AND UNIT CHARGES FOR SERVICE

	Total Charge					
	Total	Residential	Commercial	Industrial	Suburban	Municipal St. Lighting
Fixed charges on generation station including retirement, insurance and return	\$ 501,100	78,000	101,800	303,600	8,700	9,000
Generating station operation including coal, labor and maintenance	\$ 606,900	95,500	115,000	369,800	11,100	15,500
Fixed charges on substation and transmission	\$ 56,500	8,700	11,500	34,200	1,100	1,000
Substation operation	\$ 79,500	12,600	15,100	48,300	1,500	2,000
Fixed charges on distribution system	\$ 407,400	184,000	137,600	43,400	23,600	18,800
Distribution system operation	\$ 99,000	57,400	22,400	11,300	6,400	1,500
Utilization (customers' inspection, trouble and calls)	\$ 76,000	21,000	3,200	200	2,600	49,000
Commercial (meter reading, billing and collecting)	\$ 27,500	22,100	2,300	200	2,800	100
New Business	\$ 12,800	10,300	1,100	100	1,300	00
General expenses less credit for misc. revenue	\$ 81,300	65,800	6,900	400	8,100	100
Taxes	\$ 290,000	46,400	42,400	190,800	4,900	5,500
Uncollectible bills	\$ 12,000	9,700	1,000	100	1,200	00
Total	\$ 2,250,000	611,500	460,300	1,002,400	73,300	102,500
Utilization, kw-hr.	90,000,000	13,500,000	16,500,000	56,000,000	1,500,000	2,500,000

Unit Charge - Cents per Kw-hr. Utilized

Fixed charges on generating station	.5568	.5778	.6169	.5420	.5800	.360
Generating station operation	.6743	.7074	.6969	.6604	.7400	.620
Fixed charges on substation	.0628	.0644	.0697	.0611	.0733	.040
Substation operation	.0883	.0933	.0915	.0862	.1000	.080
Fixed charges on distribution system	.4527	1.3629	.8339	.0775	1.5733	.752
Distribution system operation	.1100	.4252	.1357	.0202	.4267	.060
Utilization	.0844	.1556	.0194	.0004	.1733	1.960
Commercial	.0307	.1637	.0139	.0004	.1867	.040
New Business	.0142	.0763	.0067	.0002	.0867	--
General expenses less credit for misc. revenue	.0903	.4874	.0418	.0007	.5400	.040
Taxes	.3222	.3437	.2569	.3407	.3267	.220
Uncollectible bills	.0133	.0719	.0006	.0002	.0800	00
Total	2.5000	4.5296	2.7897	1.7900	4.8867	4.100



FIGURE 29

General Investment and Operating Ratios

A comparison of the financial reports of successful electric utilities shows a consistent relation between similar items. These relations, which can be reduced to either ratios or percentages, fall within rather narrow limits.

The investment in fixed capital will usually be 4 to 5 dollars per dollar of annual revenue for steam generating plant. The spread for hydro electric is greater due to the greater variety of conditions. The ratio for hydro electric plants is 4 to 8 dollars invested per dollar of annual revenue. Stated in other words, the turn over of capital only occurs once every 4 or 5 years. This indicates that considerable judgment must be used in making additions to the fixed capital. This can be contrasted with automobile factories which have in normal times only 60 cents invested per dollar of revenue. Retail stores usually turn over their investment 4 to 5 times each year and in some cases as high as 80 to 90 times a year.

Another ratio which is used as an index to indicate the operating efficiency of an electric utility is the operating ratio. This is the ratio of operating expenses (excluding retirement provisions but including taxes) to the revenue. This ratio should be between 45 and 60 per cent. The lower figure represents better operation.

A general rule used by utility managers to check the operation of the properties which considers both

the relation of investment to revenue and the relation of operating costs to revenue is, "The operating ratio, expressed as a per cent, should not be greater than 100 minus 10 times the ratio of investment to revenue". The hypothetical electric utility which has been analyzed has the following ratios:

Investment to revenue

$$\frac{\$10,000,000}{\$2,257,000} = 4.44$$

Operating ratio

$$\frac{\$1,302,000}{\$2,257,000} = 57.8 \text{ per cent}$$

The highest desirable operating ratio as determined by rule:

$$100 - 10 \times \frac{10,000,000}{2,257,000} = 55.6 \text{ percent.}$$

The higher the ratio of investment to revenue the lower must be the operating ratio. If a utility has \$6 invested per dollar of revenue, then the operating ratio should be on the order of:

$$100 - 10 \times 6 = 40 \text{ per cent}$$

Hydroelectric properties usually have a low operating ratio; between 25 and 50 per cent.

A general rule used for checking the safety of bond interest and principal is "The net income plus retirement provisions should not be less than 20 per cent of the revenue". This check applied to the hypothetical utility shows:

Net income	\$375,000
Retirement	<u>300,000</u>
Total	\$675,000 which is 30 per cent of the annual revenue.

The desirable ratio of bond issues (long term debt) should not be more than six times the net income plus retirement.

The cost of the entire electric property per kilowatt of generating capacity (not including reserve) is between \$300 and \$400. The higher unit cost prevails in cities where extensive distribution systems are necessary due to density of population and traffic.

The following table shows the unit cost of the several items that make up the electric utility property, per kilowatt of generating capacity (not including reserve capacity).

Table XII
Unit Cost of Property

Item	Per cent of Total	Normal Range	Cost per Kw. of Capacity
Intangible fixed capital	.8	.5 to 1	\$ 3
Land	2.3	1 to 4	8
Structures	11.5	9 to 13	38
Generating station	36.7	30 to 40	120
Transmission & distribution	37.4	30 to 40	124
Customer installation	2.7	2 to 4	9
General Equipment	1.7	1 to 3	5
Overhead costs	<u>6.9</u>	5 to 10	<u>23</u>
	100.0		\$330

The generating capacity (including 20 to 25 per cent for reserve) required per 1000 population will usually be from 200 to 400 kilowatts.

Residential customers will use from 500 to 700 kilowatt hours per year. Commercial and industrial customer requirements have wide variations.

The losses due to transmission and distribution of electric energy are dependent upon the design of the system. If transformers are well loaded and the system of good design, this loss will be about 10 per cent. A poor system may have losses of 20 per cent of the net generation.

The revenue per capita should be from \$15 to \$30 depending upon the industrial development of the territory.

The following table shows the division of the operating expenses using the revenue as 100 per cent.

Table XIII

Division of Operating Expenses

	Per Cent of Revenue Average	Normal Variation
Production expense	24	20 to 30
Transmission expense	2	1 to 4
Distribution expense	5	3 to 8
Utilization expense	3	2 to 5
Commercial expense	2	1 to 4
New Business expense	1	0 to 2
General and Misc. expense	8	5 to 12
Retirement expense	<u>13</u>	10 to 20
Total	58	

The following figures taken from the Statistical Bulletin of the National Electric Light Association June 1931 are indicative of the size of the electric utility industry:

Value of property	\$12,250,000,000
Capacity of generating stations, kw.	32,600,000
Power generated, kw-hr. per yr.	88,500,000,000
Operating revenue, per yr.	\$ 2,125,000,000
Residential customers	20,330,000
Commercial customers	3,680,000
Industrial customers	540,000
Total customers	24,550,000
Population served	85,000,000
Percent of total population	70

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