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Accounting for Electric-light and Power Industries*

By FRED L. WILKINSON

In presenting this thesis upon the subject of accounting for electric-light and power industries, it is proposed to use the generally accepted methods of accounting for a simple manufacturing industry as a basis, for illustration and comparison. Proceeding from this, as common ground, it is proposed to show wherein the accounts of the electric light and power industry follow the ordinary accounting procedure of any simple type of factory and wherein they differ.

In this manner of presentation, it will be unnecessary to enumerate and discuss the multiplicity of accounts, detailed in the various "uniform systems" prescribed by the public service commissions of states. The publications of these bodies show in great refinement of detail the analysis to which the various properties and operations of this industry are amenable; but in reviewing the general system of accounts from the standpoint of the very limit of analysis the basic principles and logic underlying the scheme of accounts are lost to sight. In order to keep within the limits of the thesis, no attempt will be made to discuss these commission systems of accounts. We shall also eliminate from the discussion all consideration of the large power-transmission companies, which generate power on a large scale and transmit it to subsidiary, affiliated or perhaps independent companies for resale to the consumers of the power.

We shall consider in logical order the various classes of property essential to the operation of the average electric light and power company, examine the function of each and determine what account or perhaps group of accounts will best reflect each item or class of property in the balance-sheet and what accounts will express its operation, always keeping in mind for comparative purposes the activities and accounts of a simple factory.

THE FRANCHISE

The sine-qua-non of an electric light and power company, operating as a public utility, is a franchise. This is a right granted by the local governing body to construct in the streets of a city,

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the poles, lines, wires, conduits, cables and other equipment necessary to convey the electric current from the power-house to the premises of the various consumers of the power.

A concern may manufacture electricity on its own premises; but all privately-owned public utilities, such as electric light and power, gas, water service or street railway companies must obtain a franchise before they can use the public thoroughfares, for the extension of wires and cables, or the laying of pipe, conduit or railway track.

It may then be conceded that a franchise is an asset of no inconsiderable value, though intangible, and frequently so merged with other assets in the accounts that its worth, to the company, as determined by the directors is difficult to determine. From its importance and the infrequency with which the franchise has been properly stated in the accounts, at least up to the time when the public service commissions were established, it seems advisable to discuss the basis of valuation and the manner in which it is most frequently stated in the accounting records.

The franchise is considered to be in some respects analogous to a patent right; or it is even considered as a mere makeshift for inflating the assets to permit the issue of watered stock. There is indeed a certain similarity to patent rights, but there is a permanence and stability in a franchise and also a monopolistic element in excess of that inherent in a patent. Electricity and gas are in a sense competitive commodities but have gradually developed separate fields of activity which it is not within the scope of this thesis to discuss.

The franchise frequently, if not in the majority of cases, has been granted for a term of years far in excess of the seventeen-year life of a patent; and while the terms of the franchise may not grant exclusive privileges for the territory covered, it is obviously not in the best interests of any city to have competing companies stringing lines of wires, digging up the streets for pipe, or laying railway track on the same or adjacent streets. Wherever competition has been attempted, it has brought not only disaster to the competing companies but demoralized service, damaged streets and the ultimate merging of the competing companies, after either the bankruptcy of the weaker company or the wish to avert it has convinced the public that competition in the field is not practicable.

It is true that the franchise may expire in time, like a patent, but there is little doubt of its renewal to a company which has furnished satisfactory service. An interruption of service for any length of time would be disastrous to the community affected, and in most cases it would be difficult to find another concern willing to undertake or able to accomplish the entire replacement, at one time, of a service which has been gradually built up during many years of expansion. Like patents or goodwill the value of a franchise will increase with the extension of the business, and in a progressive community, increasing rapidly in population, expansion is rapid and assured.

Under the provisions of accounting systems, established by the public service commissions of various states, it is frequently provided that the franchise must be valued at the amount of the consideration received by the municipality, with certain legal expenses and fees, of a reasonable amount, added. In a majority of cases, however, the franchise which we find valued in books of account was granted before the days of public service commissions, and nothing was paid for it, at least to the city which granted it, but after many revaluations of assets, incident to sale, reorganization or consolidation, the franchise has become one of the largest assets on the balance-sheet, usually merged with other assets under some such title as "plant and franchise." It frequently happens that the plant property transferred has little more than scrap value; that a practically new plant is constructed, with the value reflected in accounts designated "extensions" or "improvements"; and that the old property is abandoned or dismantled, without any adequate record. After the plant had been practically rebuilt or replaced, the plant and franchise account would remain almost intact, reflecting substantially the valuation of the franchise acquired. There would probably remain the land acquired, some portion of the old buildings, perhaps utilized for storage purposes, and possibly a few of the most modern items of plant equipment; but the tangible assets remaining in the account would be comparatively small.

In many instances the directors would not care to publish a balance-sheet, disclosing a high valuation of a franchise for which nothing had been paid to the municipality when it was granted. It might be detrimental when petitioning the governing body for an extension of any kind. For this reason, public utilities will

avoid stating their franchise valuations separately, except when obliged to do so by some governmental commission or agency.

THE POWER PLANT (A FACTORY)

Most manufacturing industries have a power plant to furnish power for the operation of the factory machinery. In the present case, the power plant is the factory and the finished product is power. Most of the customers using the electric current for lighting purposes may consider that they purchase light, but this is only the utilization of the power. The meter records the quantity of power delivered to the customer, and where the bill is computed on the number of lamps burned instead of upon the record shown by a meter, the charges are still based on the amount of power required to heat the filaments within the lamps to the required degree of brilliance.

The raw material, eliminating hydro-electric plants, is fuel, generally coal, but sometimes oil and, possibly, in a few localities, natural gas.

There are three processes involved in converting the latent energy or power contained in the fuel into the active commercial power sold to the customer. The first process consists of burning the coal under boilers, releasing power in form of heat and converting the heat into the expansive power of steam. The second process consists of conveying the steam through pipes into the cylinders of engines or into steam turbines, and converting the expansive power of the steam into the mechanical power of rapidly rotating shafts. The third process is accomplished by mounting the rotating element of a dynamo upon these rapidly revolving shafts and converting the mechanical energy of the revolving shaft into electric power, which is the finished product.

The steam contained in the boilers may be compared to work in process, but analogy between the power inherent in the revolutions of a shaft and work in process may seem far fetched. It is possible to keep the finished product in stock by means of storage batteries, in the same way that gas is stored in holders; but it is not practicable to store electricity, except in extremely small quantities, and the finished product is delivered to customers as soon as manufactured.

It is now apparent that the power plant may be departmentalized, on this process basis, and that capital accounts, operating accounts and statistical records of cost of production

may be constructed. While many systems analyze the equipment and activities of each department in great detail, the departmentalization outlined above forms the basis for all well-designed systems of accounts for this industry.

It is also necessary to provide buildings to house the plant, and land for a building site. The accounts required to record the property values of the power plant will then consist of the following:

Land for Power Plant Site

It is preferable to carry land for power-plant site as a separate item rather than to merge it with other parcels of land acquired for storage or other purposes, rights-of-way, etc., under a general caption of "real estate." A power-plant site is generally permanent, unless badly situated. It must be close to a good water supply, is the center of an electric distribution system and cannot be removed without a great deal of expense. Parcels of land, used for various purposes, such as the storing of poles or bulky material, may be sold as the property increases in value, and a cheaper, a larger or a more conveniently situated plot of land may be secured in its place.

Power-plant Buildings

Reasons much the same as in the case of land values exist for avoiding the merging of the cost of power-plant buildings with the cost of store-houses and other miscellaneous buildings.

Boiler and Boiler Accessory Equipment

In all except very small plants, it is desirable to keep sub-accounts, or at least analytical accounts, with the different classes of equipment, as boilers, piping systems, coal and ash-handling machinery, feed-water systems, etc. The amount of analysis depends upon the size of the plant, the demands of the management for detailed information, and in many states upon the requirements of a public service commission or similar board having power to prescribe the accounts which shall be carried.

Engine and Engine-accessory Equipment

Engine equipment, like the previous group, may be subdivided into various classes of apparatus, as engines or turbines, vacuum pumps, oiling system, piping system, etc.

It may be mentioned that in the small number of plants where the gas engine is used, the boiler room is of course eliminated.

Power-plant Electrical Equipment

There is a functional division only between power-plant electrical equipment and the previous department. Physically the two departments are merged. The engine and dynamos are mounted on the same shaft in close proximity, and the turbo-generator is really a unit.

The electrical equipment of the modern plant consists of a considerable variety of apparatus and devices. Besides the dynamos, which generate the electricity, there are numerous devices for regulating, controlling and measuring the current. There are switchboards equipped with controlling devices and meters; transformers for changing the voltage; rotary converters, for changing alternating current to direct current; lighting arresters, etc. This classification may be subdivided to suit the requirements of each property.

Miscellaneous Power-plant Accounts

In addition to the accounts mentioned, provision must be made for assets that do not fall within any of the above departments. These will vary with the size of the plant and with the different conditions prevailing. The more common items are repair shops, supply warehouses, coal storage and coal-handling facilities, railroad sidings and cranes. None of these is peculiar to this industry nor warrants further discussion.

THE ELECTRIC DISTRIBUTION SYSTEM

Up to this point the electric power plant has been discussed as a manufacturing industry, and the product has been traced from the raw material, in the form of fuel, to the finished product, in the form of electric power, delivered at the switchboard, the point at which the current is sent out over the lines—in effect, the shipping room. At this point the analogy to a manufacturing concern ceases and the company undertakes the delivery of its product to the premises of the consumer. It accomplishes this by means of copper wires or cables either extended above the streets on lines of poles or by cables placed in conduit systems beneath the pavements. The difference in cost of the two methods of distribution is so great that they are considered as entirely different systems in the accounts. The distribution system is then classified as underground and overhead. The underground system is divisible into two parts, the conduit

system and the underground system of electrical conductors. A separate classification is provided for each division. In like manner the overhead distribution system is classified as overhead electrical conductors and pole lines.

Underground Conduits

Underground conduits account will reflect the cost of digging trenches and laying therein the ducts which will contain the cables. Manholes at intervals must give access to the ducts and contain transformers, which will be discussed later. The system must be provided with sewer connections to drain off surface water which will seep into the system, and the pavement above must be replaced. When the conduit system is constructed, ample provision is generally made for future requirements by laying a considerable number of ducts. Few changes are subsequently needed and this asset has a considerable degree of permanence. Sub-accounts may be used to show the cost of excavation, cost of duct and cost of manholes separately; or the conduit system may be divided by districts.

Underground Electrical Conductors

Underground electrical conductors consist of copper cables insulated with rubber and cased in lead to protect them from moisture. These are subject to frequent change on account of damage, to secure increased carrying capacity, or because of alteration in the system of distribution. This will be a very active account, and the close coöperation of the engineering department will be required, if the account is to reflect actual costs.

Pole Lines

The underground system of distribution is so expensive both in initial cost and maintenance that it can be used only in business or other districts where the revenue is considerable. In suburban districts, where the customers are scattered and the revenue small, pole lines are constructed. These are fairly permanent in character. They consist of the poles, cross arms, guy wires, glass insulators and the complete equipment necessary for supporting the wires. It is seldom feasible to make any analysis of this general account, except by geographical subdivision.

Overhead Electrical Conductors

Overhead electrical conductors consist of insulated copper wires and are fairly permanent in character. Greater carrying

capacity is usually obtained by stringing additional wires rather than by the substitution of wires of greater capacity. In a well designed system, replacements should not be frequent, but additions to the system will be practically continuous. In many systems, where there was not sufficient vision in planning for future growth or the original construction was cramped by insufficient capital, the changing and reconstruction of lines will be frequent.

Transformers

In order to reduce the size of the wires or cables necessary for the distribution of the power to customers, the current is sent out from the power plant at a high voltage, which may be roughly compared to the rate of flow of water—that is, as an increase in pressure will increase the volume of water conveyed, without enlarging the size of the pipe, so an increase in voltage will increase the amount of electric power transmitted without increasing the size of the wire. The transformer is a device for reducing the voltage from the high-power distributing lines to the low voltage required for operating motors and lamps. The transformer is placed upon a pole or in a manhole of the conduit system. It is frequently changed to meet fluctuating demands and can be subjected to only a general classification, embracing all transformers in service or, at most, separate pole type and manhole type.

Meters

Meters as devices for recording the quantity of electric power delivered are so well known that any discussion is unnecessary.

Having now considered, in logical order, each item of property essential to this industry, its respective function and the accounts necessary to express these functions, it will be a simple matter to account for the operation of each.

OPERATING ACCOUNTS

The first item is the raw material—fuel at cost of delivery in the bunkers. In the first process must be considered the labor of firemen and other attendants, water purchased, supplies, maintenance charges, repairs and various services appertaining to this department, such as fuel tests.

The second and third processes cannot be separated in the operating accounts except upon a somewhat arbitrary basis. The

labor of engineers and their assistants, supplies, etc., must generally be considered as applying to both processes combined, or allocation can be made by estimates only. The maintenance and repair of the two classes of equipment, however, will be designated as applying to the respective classes.

The distribution system requires accounts which will reflect the cost of maintaining the distribution system in efficient operation, repairing damage from storm and accident, etc. Labor of linemen, cablemen and other electricians will be the largest item, with materials necessary for making such repairs constituting the greater portion of the balance. Accounts must be provided to classify these expenses among the various assets affected.

This very general outline will suffice to show upon what basis the system of operating accounts is devised.

Depreciation, Obsolescence and Inadequacy

The life of the power-plant equipment of electrical utilities will be shorter than the life of similar equipment in other industries. This is due to more continuous service. In the majority of properties of this character, obsolescence and inadequacy, rather than the physical deterioration of the equipment, govern the duration of serviceable life of the property.

The improvement of electrical machinery and equipment has proceeded with marvelous rapidity and has frequently necessitated sweeping changes in equipment. The rapidly increasing requirements of a growing city must be met; the demand for improved service made possible by a new invention cannot long be denied to the public.

This subject is too involved to be discussed in this brief thesis. The rather common method that utilities have employed to dispose of this question has been to capitalize the new property under the guise of extensions to plant. When many years have elapsed since the last sale or reorganization, in which all fixed assets were taken over in an account called "plant and franchise" or similar title, an essentially new power plant will be found, recorded at practically its entire cost under various accounts designated as extensions to plant. The huge account "plant and franchise" will reflect no physical asset other than an abandoned and partly dismantled power-plant or perhaps an old building or two used for the storage of material, with some obsolete equipment, stored

in various places. In this way the major cost of obsolete and inadequate plants has been absorbed, so far as the accounts are concerned; and there is considerable justice in the contention that at least a portion of this "cost of progress" is a legitimate item for capitalization as a franchise cost.

INCOME ACCOUNTS

Electric service companies have one grade of product for sale, but there is a great variation in the price charged. As a result of the impracticability of storing electric power, sufficient machinery must be installed to meet the greatest demand for power that may be made at any one time, even though this demand may continue for only a brief period each day and possibly for only a portion of the year. This necessitates a heavy investment in equipment, a portion of which must remain idle during the greater portion of the time. In consequence, a high rate is charged to short-time consumers, and a low rate will be given to a large consumer of power who is willing to use it during a time each day when the demand is slight. For this reason there is a considerable gradation of rates, and grouping is made approximately as follows:

Commercial Lighting

The great majority of consumers of current for lighting purposes use the current for only a very short period each day and all at approximately the same time, the dark hours of the evening. These consumers, as a class, are charged the highest rates, though subject to certain gradations, because some customers use the current for longer periods each day than others.

Municipal Lighting

Street lighting paid for by the city is continuous throughout the night and is consequently entitled to a lower rate than commercial lighting.

Power Service

It is frequently provided that the demand for current for power shall cease before the heavy demands for current for lighting commence. In this case an especially low rate is granted, in order to sell power during a portion of the day when there is practically no demand whatever for electricity for lighting. This service has many gradations, depending on the quantity of power consumed, the hours at which demanded and the uniformity in demand.

Street Railway Service

Current for street railway service is also furnished at a low rate on account of the long period of demand each day.

Sales of merchandise constitute an outside enterprise, and only the net income therefrom should appear in the income statement of the utility.

Other accounts reflecting the assets, liabilities or expenses of this industry do not differ materially from those of other industries and need not be discussed.