VIII - PRICE

1. INTRODUCTION

This section discusses the price history of No. 1 ESS. Major emphasis is placed on the current view of No. 1 ESS prices. In addition to the Western Electric bill for material, engineering, and installation (often denoted as EF&I; engineered, furnished and installed), floor space costs and operating company charges associated with installing a new No. 1 ESS switching system are discussed. To provide a basis of comparison, No. 5 Crossbar EF&I prices, floor space, and operating company charges for similar type offices are also presented.

There continues to be considerable Bell Laboratories and Western Electric effort devoted to No. 1 ESS cost reduction. Current development projects that appear to contain potential for future cost reductions on No. 1 ESS are also described.

The information given in this section indicates that on an EF&I basis, No. 1 ESS is less expensive than No. 5 Crossbar above about 15000 lines for low traffic and 13000 lines for high traffic offices. When floor space and operating company charges associated with installation of new equipment are considered in addition to the EF&I bill, No. 1 ESS becomes less expensive than No. 5 Crossbar above 12000 lines in low traffic cases and above 11000 lines in high traffic situations. No. 1 ESS becomes economic at even lower line sizes when special features like Centrex-CO and Custom Calling Services are considered.

Recent price trends have shown that No. 5 Crossbar prices are increasing at a greater rate than No. 1 ESS prices. This trend plus the continuing effort to reduce No. 1 ESS costs indicates that No. 1 ESS in the near future will also become economic when compared to No. 5 Crossbar for lower line size nonbusiness type offices.

2. NO. 1 ESS PRICE HISTORY

The system design and expected price relationship of No. 1 ESS to No. 5 Crossbar were monitored by BTL, AT&T, and WE from the beginning of the No. 1 ESS project in the late 1950's. Periodic formal reports of these initial price studies were made to the Tri-Company Joint Committee on ESS (now called the No. 1 ESS Tri-Company Committee).

The method first used to analyze system price was to price out typical actual No. 5 Crossbar offices and engineer and price out No. 1 ESS equipment to provide similar service as the No. 5 Crossbar equipment actually used. Comparisons were made between the No. 5 Crossbar and No. 1 ESS prices for each study office. The Western Electric Company bill for material furnished, engineering and installation (EF&I), was derived for each study office. In addition, floor space costs and potential operating company expenses associated with each office were estimated. Thus, the total price to the operating company was estimated for each office. The office prices were broken down into subcategories to identify potential areas for No. 1 ESS cost reduction.

These initial studies were intended to help make design decisions and were not for use in predicting the price of real No. 1 ESS offices. Objective prices for No. 1 ESS based on estimated No. 1 ESS production quantities in 1968 were used. Miscellaneous equipment items common to No. 5 Crossbar and No. 1 ESS were omitted from these studies.

The first BTL price study using a No. 1 ESS equipment configuration and technology essentially as it is today was completed in December 1961. This early study showed that on an EF&I basis No. 1 ESS would be less in price than No. 5 Crossbar above 10,000 lines and would save considerable money for higher traffic larger line size offices (Figure 1). The addition of building space and telco charges made ESS look even more favorable compared to No. 5 Crossbar. The last price study of this early series in mid-1963 indicated that on an EF&I basis No. 1 ESS would price out less than No. 5 Crossbar only for higher traffic offices above 20,000 lines (Figure 2). However, on a total price basis ESS was less expensive for offices above 11,000 lines.

Since by mid-1963 the hardware design was essentially chosen, the formal Tri-Company monitoring of price performance was discontinued. However, an informal study in late 1964 of the same offices was done by Bell Laboratories after the Western Electric Company published its first price list for No. 1 ESS equipment. The prices per frame were increased from the previously used 1968 objective price values used in the Tri-Company studies to reflect both the latest design information and WE start-up costs for the new technology in No. 1 ESS. The frame price increases resulted in about a 10 percent increase in overall system prices from the last Tri-Company study.

By late 1964 it became apparent that even on a total price basis No. 1 ESS would not price out less than No. 5 Crossbar except for larger line size higher traffic type offices (Figure 3). However, No. 1 ESS still would provide many features not available on No. 5 Crossbar and would be easier to administer and would save considerable floor space over No. 5 Crossbar equipment.

There were several reasons for the change in No. 1 ESS prices relative to No. 5 Crossbar. First, the total feature requirements desired on No. 1 ESS continually increased as the development progressed. Hardware component needs were increased to provide these additional feature requirements. At the same time, however, component costs with the new electronic technology continued favorable with decreases in cost for most new devices.

When detailed writing of the stored program began, it became obvious that more program words than initially expected would be required to provide all the call processing functions needed as well as provide the level of maintenance capability desired on No. 1 ESS. As a result, additional memory storage, both call store and program store, was required as the development progressed. In total, the price of a No. 1 ESS installation increased relative to No. 5 Crossbar as these initial price studies progressed.

2.1 Informal Studies — 1964-1967

Pricing studies of No. 1 ESS were continued by Western Electric and AT&T with some Bell Labs involvement. A different set of study offices were used in these new studies. Offices having traffic characteristics of suburban areas and offices characteristic of metropolitan areas were hypothesized. Both No. 1 ESS and No. 5 Crossbar equipment was engineered and priced out for each study office. Comparisons of No. 1 ESS and No. 5 Crossbar prices were made for both the high traffic and low traffic offices. These hypothetical offices along with contracts for actual No. 1 ESS offices were used to derive a No. 1 ESS EF&I planning price curve published for Operating Company use in April, 1966 (Figure 4). These curves were intended to accurately reflect the Western Electric bill to the Operating Company for No. 1 ESS installations. They were higher than the previously performed comparison studies with No. 5 Crossbar where only relative differences were important.

During 1966 and 1967 an intensive effort was made to more accurately establish the price relationship of No. 1 ESS and No. 5 Crossbar. The results of the study were to be used by AT&T to publish a comprehensive comparison in both first cost and annual charges of No. 1 ESS and No. 5 Crossbar. The seven previously used hypothetical offices were augmented by five additional hypothetical offices and also by nine actual No. 5 Crossbar offices for which No. 1 ESS equipment was engineered. The results of the study were published in an AT&T letter in April, 1968. (Figure 5.) This study showed No. 1 ESS to be more expensive on an EF&I basis than No. 5 Crossbar except for high traffic metropolitan offices when only one entity of No. 1 ESS was required but two entities of No. 5 Crossbar were needed. However, the addition of maintenance savings, Custom Calling Features, floor space, and Operating Company administration savings resulted in No. 1 ESS looking favorable on an annual cost basis above 8,000 lines in metropolitan applications and above 15,000 lines in suburban applications (Figure 6.) This was again a comparison study between No. 5 Crossbar and No. 1 ESS and no use of real No. 1 ESS bills or contracts was made. The absolute EF&I price levels for high traffic ESS offices were similar between the 1966 and 1968 AT&T letters. However, the low traffic No. 1 ESS price curve was substantially less in 1968 than in 1966.

2.2 Tri-Company Cost-Price Review Team Studies — 1968-Present

In late 1967 a formal Tri-Company structure to monitor the price of all new products from the design stages through first applications in the field was again established; this structure continues in existence. These committees are called Cost-Price Review Teams (CPRT) and are composed of representatives from WE and BTL.

The first No. 1 ESS price study done under CPRT direction was finished in early 1969. This study used a subset of the hypothetical and actual No. 5 Crossbar offices from the April, 1968 AT&T study. The office equipment lists were updated to reflect the current equipment needs of No. 1 ESS and to reflect the latest engineering practices for No. 5 Crossbar. Included in this study was not only the current equipment configuration but also potential cost reductions possible on No. 1 ESS due to new equipment designs and WE manufacturing improvements. The results of this first study were less favorable than reported in the April, 1968 AT&T letter. However, the price comparisons including potential price reductions were much more favorable to No. 1 ESS. This indicated that if all improvements could be realized, No. 1 ESS would price out less (including building space and telco charges) than No. 5 Crossbar in high traffic offices above 6,000 lines and in low traffic offices above 15,000 lines (Figure 7).

The price picture for No. 1 ESS POTS offices deteriorated somewhat in 1969 due to two factors. One was the decision to utilize one set of generic programs making all new offices purchase the program containing centrex features. This increased the requirement for program stores in POTS offices. In addition, price increases had occurred on both the No. 1 ESS and No. 5 Crossbar systems.

2.3 Comparison of CPRT Results and Actual Operating Company Bills

During 1970 and 1971 studies of actual Operating Company bills for No. 1 ESS indicated that the CPRT studies were not including all the charges actually being incurred by the Operating Companies in purchasing No. 1 ESS machines. The idealized assumptions of CPRT studies were minimizing the true Operating Company charges being incurred on all installations as well as not including the extensive charges due to more liberal engineering practices and supplemental orders to WE for engineering changes to initial orders. Since these additional charges were more extensive on No. 1 ESS than on No. 5 Crossbar, the resulting price picture as seen by the Operating Companies was considerably worse for No. 1 ESS than predicted by the CPRT results. (The CPRT studies were aimed at long-term relative price relationships suitable for making design decisions. However, the near term inaccuracies were upsetting to all involved). Attempts to establish a more meaningful short term price comparison of No. 1 ESS and No. 5 Crossbar was begun in 1971 and has been updated for this report as shown in Section 4.

3. CURRENT VIEW OF NO. 1 ESS PRICES

A single formula for estimating the EF&I prices for No. 1 ESS installations is difficult to derive due to the wide variation in features and traffic found in different No. 1 ESS offices. In addition, the purchase of line network concentration ratios based on long-term economic considerations rather than current CCS/line values affects the initial cost of the network and complicates the accurate prediction of total office price. The wide variation in the use of No. 1 ESS (from replacement of older equipment in complex metropolitan buildings to growth units in new buildings) creates wide variation in installation charges and further complicates the prediction of EF&I price for a potential installation.

A study was conducted by Bell Telephone Laboratories of actual No. 1 ESS bills (actual Operating Company records of charges against No. 1 ESS) from 1969 and 1970 cutovers. From these bills a price profile equation was derived useful in predicting the approximate price of a No. 1 ESS installation.

3.1 Price Profile Equation Form

The price profile is:

EF&I PRICE = getting started cost + (a) x number of equipped lines + $ (C) x number of Centrex main stations + $ (C′) x number of Centrex tie trunks.

The getting started cost, which is the same constant for all offices with the same generic program, the two coefficients (C and C'), and the parameter "a" (determined by the concentration ratio) are given constants; the user provides the number of equipped lines, the number of Centrex main stations, and the number of Centrex tie trunks. The equation was developed for the EF&I price charged to the ESS capital account which is referred to as the 77C account. This account includes the prices for material, WE engineering, WE installation, power (emergency power is excluded), and includes supplemental charges in addition to the initial contract charges. Some of the offices went in as new starts and the others as replacements. The amount of Custom Calling provided in the offices (in most offices less than 10 percent of engineered lines) was included. The getting started cost and the coefficient "a" were determined by curve fitting to a sample of actual No. 1 ESS Price data.

The Centrex portion of the price profile is given in terms of a price per Centrex main station plus a price per Centrex tie trunk. It should be noted that the profile only estimates the central office switching machine portion of Centrex; no customer premise equipment (Centrex consoles, etc.) is included.

A study of Centrex costs was made using actual No. 1 ESS price data. This data was from real No. 1 ESS offices installed in 1969 and 1970 which provide Centrex service. Curve fitting techniques were used to derive an average price estimate for a Centrex main station.

The price per Centrex tie trunk was derived by considering the material price of a 4-wire Centrex tie trunk and the associated material required. The material price for this trunk is given in the WE Broad Gauge Price Book. Adjustments were made to this price to reflect associated charges including the installation charge. The price including adjustments come to about $350 per Centrex tie trunk.

3.2 Price Profile Equations

The current EF&I price profile equation is:

CC (Central Control) Generic Program

EF&I PRICE = \$1125K + \$ (a) x (EL) + $\$40 \times MS_C + \$350 \times T_C$

SP (Signal Processor) Generic Program

EF&I PRICE = \$1450K + \$(a) x (EL) + $\$40 \times MS_C + \$350 \times T_C$

Where,

K — thousands.

"a" — network concentration ratio coefficient from line link network TABLE I.

EL — number of equipped lines, also often referred to as number of installed line terminations, (EL is approximately equal to the number of working lines at the end of the engineering period divided by the objective network fill).

MS_C — number of Centrex main stations.

T_C — number of Centrex tie trunks.

TABLE I
LINE LINK NETWORK

	Concentration Ratio	Coefficient "a"
Heavy (H)	2:1	169
	3:1	122
Regular (R)	4:1	82
	6:1	59

Results from testing the profile on recent actual No. 1 ESS EF&I bills indicate that the profile estimate is within ± 10 percent of the actual value for about 90 percent of the bills. In addition, an investigation was made for the offices which had profile estimates outside ± 10 percent of the actual value. The results of the investigation indicated that special circumstances contributed to the large errors. Figure 8 shows a plot of the estimated prices for No. 1 ESS non-Centrex offices for various network concentration ratios.

3.3 Current Estimate of No. 1 ESS Total Prices

The price to an Operating Company for a No. 1 ESS machine is composed of several parts. The major part is the EF&I bill from Western Electric for the equipment. However, in addition to the EF&I bill are the Operating Company expenses associated with planning, ordering, engineering, and testing a new machine and the building floor space required to house the new machine.

3.4 Operating Company Expenses

Associated with purchase of new switching machine are various Operating Company expenses. Included in Operating Company (Telco) expenses are:

planning engineering
equipment engineering
traffic engineering, including translation engineering
plant expense (precutover)
interest during construction (shipment to cutover)
taxes (if any)

The Operating Company expenses vary from installation to installation depending on the complexity of the job and the experience of the people involved. An estimate of the Telco expenses associated with No. 1 ESS was obtained from a survey of 70 actual No. 1 ESS installations cutover during 1969 and 1970. This survey resulted in the distribution of Telco expenses shown in Figure 9. The average expenses were 17 percent of the EF&I bill. In all likelihood the extremely low and extremely high Telco expense percentages are either data errors or special situations unlikely to reoccur.

Telco charges on No. 1 ESS should decline as more experience with the system is obtained. Plant and Engineering charges currently are large due to the inefficiencies associated with training people to utilize new technologies. Current estimates are that 14 percent of EF&I price is a satisfactory average value for future offices using the remreed network.

3.5 Floor Space

A real advantage of No. 1 ESS is in reduced floor space requirements for offices above 5,000 lines. Figure 10 shows a comparison of the floor space required for a No. 1 ESS type machine and No. 5 Crossbar machine as a function of line size. The recent availability of the remreed network reduces the No. 1 ESS floor space needs significantly. At the current average cost of about $60 per square foot for new floor space in metropolitan areas, No. 1 ESS has a significant advantage over the No. 5 Crossbar system.

3.6 Total Office Price

Representative cost curves for No. 1 ESS for a typical traffic situation (4 CCS/line) showing the EF&I, Telco charges (14 percent of EF&I) and floor space ($60/sq. ft.) components of the total price are shown in Figure 11.

4. COMPARISON OF NO. 1 ESS AND NO. 5 CROSSBAR PRICES

Since No. 5 Crossbar offices normally are not started at large line sizes like No. 1 ESS, it is not possible to gather enough real office data to determine an accurate price characteristic. However, a source of price data for No. 5 Crossbar offices similar to No. 1 ESS offices is available in the Cost Price Review Team studies of No. 1 ESS. In these studies No. 5 Crossbar new start offices are engineered and priced for installations varying from 2,000 to 20,000 working lines. The office characteristics of these study offices are chosen identical to No. 1 ESS offices to ensure an accurate comparison of No. 5 Crossbar to No. 1 ESS.

4.1 EF&I Price

A current EF&I price estimate for No. 5 Crossbar non-Centrex offices derived from the December, 1972 CPRT study is

No. 5 Crossbar
EF&I Price = $320K + $38 x working lines + $16 x total CCS + $266 x total interoffice trunks

K = thousands
CCS = originating plus terminating CCS

4.2 Operating Company Charges and Floor Space

Similar to No. 1 ESS, real bills were analyzed to determine the amount of Operating Company expenses associated with installing a new No. 5 Crossbar machine. A distribution of Operating Company expenses as a percent of EF&I price is shown in Figure 12. The average expenses are 12 percent of the EF&I bill. The exceptionally high and low Telco charge percentages are probably data errors or exceptional situations. An estimate of floor space requirements for No. 5 Crossbar are as previously shown in Figure 10.

4.3 Total Office Price

A sample price characteristic for No. 5 Crossbar showing the components due to EF&I, Telco expenses and building floor space is shown in Figure 13.

4.4 Comparison of No. 1 ESS and No. 5 Crossbar Prices

Using the data from the preceding sections, Figure 14 shows a comparison of the EF&I prices for No. 1 ESS and No. 5 Crossbar for 3 and 5 CCS per line. The average line capacity for the No. 5 Crossbar and No. 1 ESS at these traffic values is also indicated. If the Telco charges and floor space at their average values are also considered a total price comparison shown in Figure 15 can be derived. These results indicate that No. 1 ESS is less expensive on an EF&I basis for office greater than about 15,000 lines, and less expensive on a total price basis above about 11,000 lines.

There are several points that should be remembered when using Figures 14 and 15. One is that the No. 1 ESS EF&I prices represent the average prices derived from real bills while the No. 5 Crossbar prices are results from CPRT studies. It is possible that in real situations the No. 5 Crossbar price curve could be slightly higher by perhaps 5 percent, thus making a more favorable comparison for No. 1 ESS. The second point to remember is that No. 5 Crossbar Telco charge estimates come from offices that are not replacements. If No. 5 Crossbar were used for replacements it might well have higher average Telco charge percentages more nearly like the No. 1 ESS which includes many offices installed as replacements.

Because of these uncertainties of real bills versus CPRT results and the different applications of No. 1 ESS and No. 5 Crossbar, it is felt that Figures 14 and 15, if anything, give a conservative view of the current price relationship between No. 1 ESS and No. 5 Crossbar.

In addition to first cost alone, the other advangates inherent in ESS technology versus electromechanical systems should be considered, when selecting a new switching machine. Section 5 discusses in some detail the price effects of the feature advantages of No. 1 ESS over the No. 5 Crossbar System.

5. QUANTIFIED ADVANTAGES OF NO. 1 ESS

No. 1 ESS, by virtue of its stored program control, has a significant advantage over its electromechanical counterparts in its ability to easily and economically provide services and features for which it was not specifically designed. This flexibility often becomes the basis for qualitative arguments recommending the purchase of ESS if the tangible factors have failed to show the plan to be economical. The results of an effort to quantify some of the components of this flexibility, using the No. 5 Crossbar system for comparison, are presented in the following paragraphs.

Estimates of the additional EF&I cost of providing each of several features on the No. 5 Crossbar system as opposed to No. 1 ESS are given in Tables 2 and 3. The numbers thus represent credits which may be applied to a No. 1 ESS plan. Two sets of credits are shown. One assumes that the need for the various features are anticipated at the time the machine is ordered so that modification costs are minimized. The other assumes no anticipation and, therefore, generally higher modification costs, particularly for the No. 5 Crossbar system. The latter set of credits applies to the cost of providing these features on in-service machines rather than new starts. They are suggestive, however, of the savings which may be expected in providing new features likely to come along during the lifetime of a machine installed today.

In order to make proper use of these credits in first cost studies, the credits should be applied individually at the time they are expected to be realized. Even unanticipated features should have some dates (probably reasonably far out in time) associated with them. These credits should then be discounted to the time of purchase of the machine and applied as a single discounted first cost credit.

The total credits given in Tables 2 and 3 are undiscounted and therefore represent upper bounds on the credits available to a 15,000 line office. These total credits will be approached as features are applied nearer to the time of purchase.

The features listed in Table 2 are designated as universal since they apply to all machines in an area where the feature is to be provided. For instance, every local switching machine in an area to be served by a Traffic Service Position System (TSPS) or Automatic Intercept System (AIS) must interface with these systems. The total undiscounted credit for all of these universal features in a typical 15,000 line office is approximately $115,000 if all the services are anticipated and $214,000 if not anticipated.

The features listed in Table 3 are designated as selected features since they apply to certain classes of line service and generally are not required in every machine serving a given area. For instance, it may be possible to serve all Centrex customers from just one of the entities in a multientity building. Incidentally, the credit shown for CTX-CO, if unanticipated, is based on a single incidence in which a working No. 5 Crossbar system had been modified to provide CTX-CO service. Such a modification is now generally recognized as uneconomical in most situations. The $500,000 credit is considered to be modest. If the services are anticipated, the total effect of credits for the selected features may range from about $110,000 in a residential environment to $320,000 in an environment where two-thirds of the lines are classified as business lines. This latter category will be referred to later as "high business." The undiscounted credit ranges from $150,000 to about $730,000 if the services are not anticipated.

The features for which credits have been obtained do not exhaust the list of features which can be easily provided by ESS. However, they are sufficient to suggest the magnitude of the quantifiable advantages for most applications. It should also be noted that only capital expenditures for equipment have been treated. The effect of any savings anticipated with ESS for maintenance, administration, and building space should, of course, be included in any comparative economic study. These items may vary considerably with the particular situation, and applicable experience should be the basis for estimating relative costs.

The credits which should properly be given to No. 1 ESS for its flexibility in accommodating new features can be significant, particularly in a business environment. The credits developed under the assumption that the features cannot be anticipated is admittedly somewhat academic in the case of the features considered. However, they do illustrate the inherent flexibility of a stored program system, and are meaningful if it is assumed that the unforeseen features likely to come along will be comparable in complexity and rate of introduction to those considered.

6. POTENTIAL COST REDUCTIONS FOR NO. 1 ESS

Over the past few years new developments which will reduce costs have been introduced into No. 1 ESS and additional cost saving developments are continually being evaluated. These new developments in general are able to reduce costs because they take advantage of new technologies such as integrated and thin film circuits. All of these new designs also provide substantial floor space reductions as well as lower installation intervals and costs. The major projects are the 32K Call Store, remreed networks, 1A Processor, and small trunks.

6.1 32K Call Store

A new 32K Call Store has been designed to replace the 8K call store. The 32K call store is a 24-bit, 32,768-word memory which mounts in a two-bay frame. Up to six 32K call stores can be accommodated in this frame, five associated with the central control and one associated with the signal processor. Two such frames will be required for each No. 1 ESS office, providing up to 9 central control call stores, and 2 signal processor call stores. These two frames with this complement of 32K call store units will supply all the call store capacity requirements for No. 1 ESS offices.

The new store provides many attractive features. The first is a modest reduction in the price of temporary memory. As manufacturing technology improves, its cost can be expected to decrease even further. The floor space saving is significant also. A maximum equipped office will require only 8' 8" for 32K call stores, 1/12 that required by 8K stores (see Figure 16). In addition, the power required is also 1/12 of that required for 8K stores. Much of the present office wiring has been included on the frame and the remaining has been fully connectorized, greatly reducing the installer wiring and hence the cost and time required for call store installation. The store and its associated 20A memory are completely connectorized so that field installation and growth is a very simple and convenient process. The 32K call store includes improved circuit and physical design which provides greater operating reliability. Diagnosability and fault detection is considerably improved also.

The first office utilizing the 32K call store was cut into service at Alton, Illinois on April 4, 1971. Since the beginning of 1972, all new office shipments have included 32K call stores.

6.2 Remreed Network

A new series of switching networks to augment the existing ferreed networks now used in No. 1 ESS is currently under development. This development stems from a breakthrough in sealed reed technology which allows the manufacture of a switch which is more compact than the present ferreed switch. The new remreed switch is operated with an electronic controller instead of a relay controller.

The combination of the new smaller switch for the network crosspoints with new device and packaging technologies for the control circuitry provides a significant reduction in the size of network components. For example, the first network (see Figure 17) that has been designed is a 1:1 1024 trunk link network. This network is incorporated completely within a 6' — 6" long frame. This compares with the frame lineup of 26' which is required for the corresponding ferreed network (see Figure 18). The remreed network occupies therefore, only 1/4 of the floor space required for the existing ferreed network. Similar reductions are expected in the floor space requirements for other network components (e.g. 9'9" instead of 30' 4" for a 2:1 2048 terminal LLN). The line link networks will also utilize a redesigned ferrod scan element, which will be built into the switch package.

Since the size of the network has been so drastically reduced, a substantially larger proportion of the network wiring will be accomplished in the factory. This wiring will also be tested during manufacture. The installation effort required to wire and test network frames will be reduced accordingly.

The remreed network development will result in significant cost savings in both the manufacturing and installation areas. These new networks will also require reduced maintenance. All apparatus is replaceable on a plug-in basis. This feature coupled with the increased reliability of the new technology devices and packaging systems should substantially reduce the maintenance efforts required on these frames.

The first office utilizing a remreed TLN (Detroit, Michigan) was placed in service in June, 1973. Since the beginning of 1974, all new offices have been shipped with remreed TLNs. The first remreed LLN is scheduled to ship in July, 1974.

6.3 1A Processor

A new high-speed, integrated-circuit, stored-program processor, named the 1A Processor, is now being developed for use in high-call capacity systems including No. 1 ESS. When used with a No. 1 ESS periphery, the system will be known as No. 1A ESS.

The 1A Processor will provide a number of improvements over the No. 1 ESS Processor, the most important of which is a factor of about 2-1/2 increase in call handling capacity. The use of electrically writable memories will also permit more rapid program and translation changes. In addition to space and installation interval reductions, the 1A Processor will provide improved ault detection and maintenance, and significantly increased dependability. The

structural similarity to a No. 1 ESS processor and standardized I/O message formatting will minimize the additional training required for experienced ESS personnel.

The 1A processor interface with the switching network will be compatible with the No. 1 ESS network interface, thereby making it feasible to retrofit the 1A Processor into operational No. 1 ESS offices in order to increase the call handling capacity of the office.

The 1A Processor requires only one-half the floor space of the No. 1 ESS processor (see Figure 19). A fixed floor plan will be used which will minimize operating company and WE regional job engineering effort. The buses and other frame interconnections are connectorized to reduce installation effort and reduce the interval to turnover.

The first No. 1A ESS is presently scheduled for service in early 1977. It is expected that the 1A Processor will be introduced at a price level no greater than the No. 1 ESS Processor price level at the time.

6.4 Other Cost Reductions

The No. 1 ESS universal trunk frame is currently being redesigned to achieve cost reduction and a 2/3 savings in floor space (Figure 20). The new 2'2" home frame houses a maximum of 128 "small trunk" units. Each of the high runner trunk codes mounts two trunk circuits per unit.

The "small trunk" plug-in package makes extensive use of miniaturized, less costly components mounted on a printed wiring board. In particular, the components include miniature magnetic latching wire spring relays, mini-inductors and transformers, and a multicapacitor pack. In addition to the lower material cost of the new components, significant cost reduction is realized in unit wiring. The result is a trunk circuit that is less expensive, takes less space, and has better transmission characteristics than the present trunk.

The redesigned universal trunk frame also includes a repackaged scanner and signal distributor, both of which contribute to overall frame size reduction.

Design work is also being initiated on miscellaneous trunk and service circuits. This area offers not only savings in material cost and size, but large reductions in installation and engineering intervals as well.

No. 1 ESS vs No. 5 Crossbar prices . . .

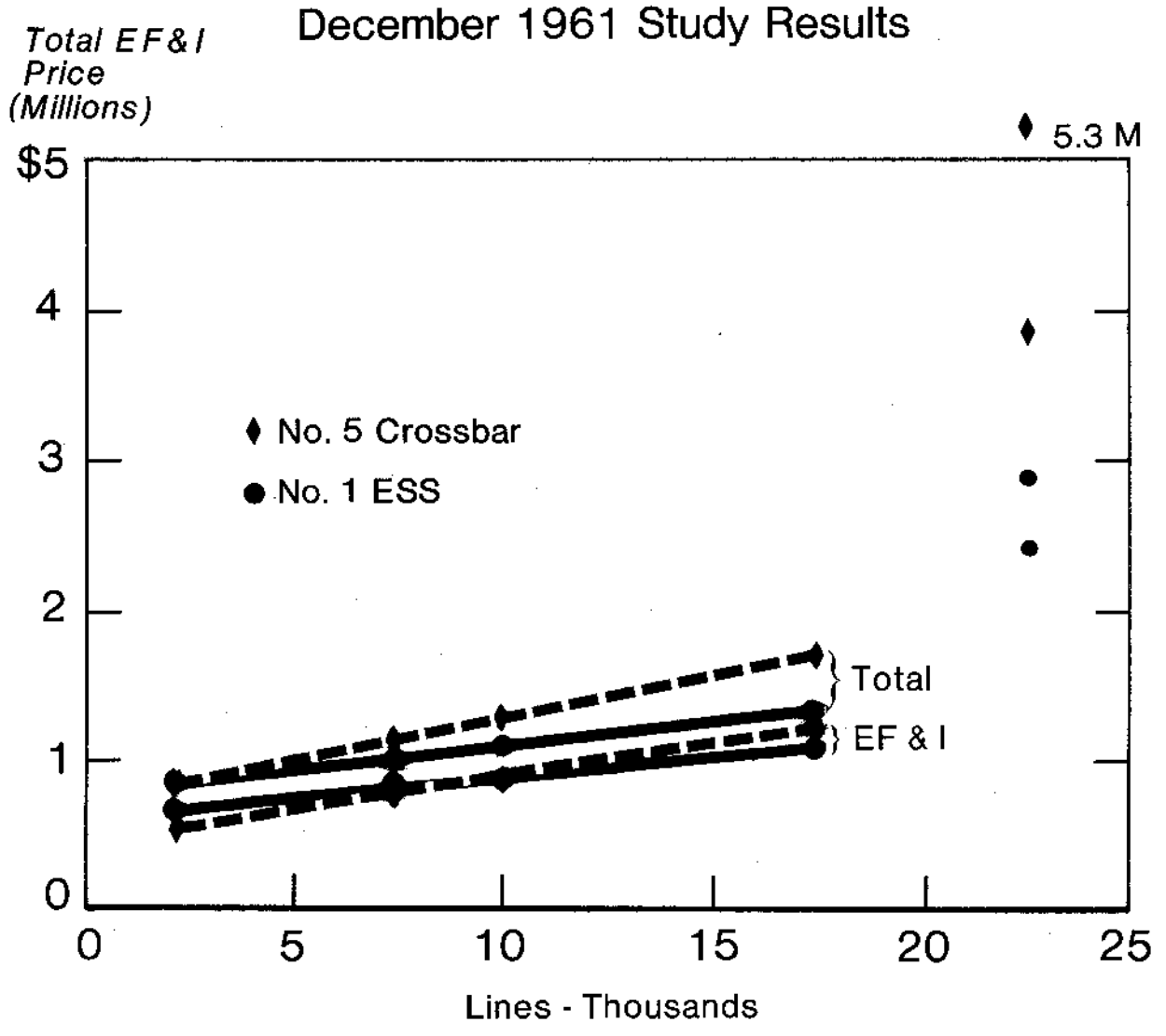


Figure 1

No. 1 ESS vs. No. 5 Crossbar prices . . .

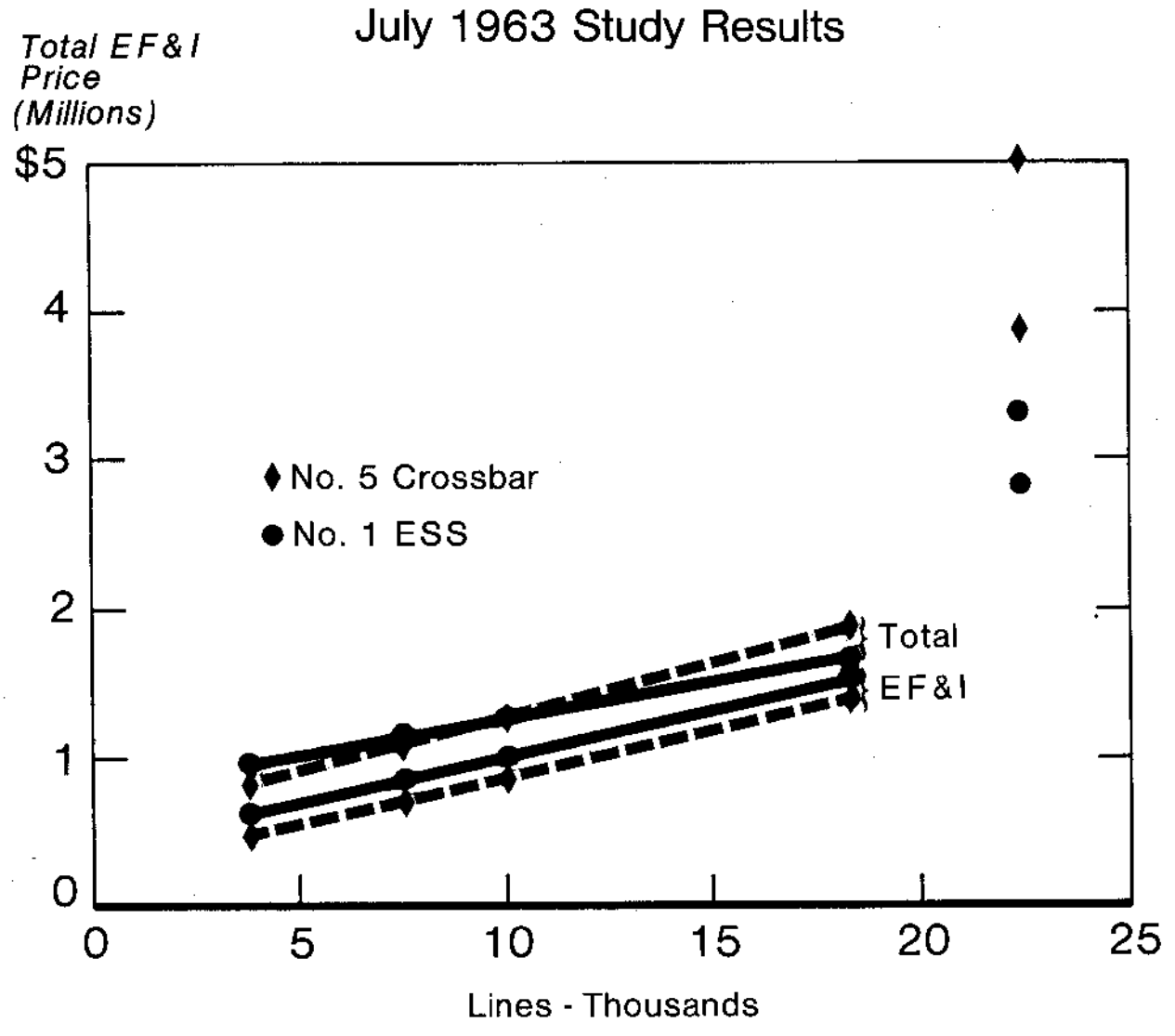


Figure 2

No. 1 ESS vs No. 5 Crossbar prices . . .

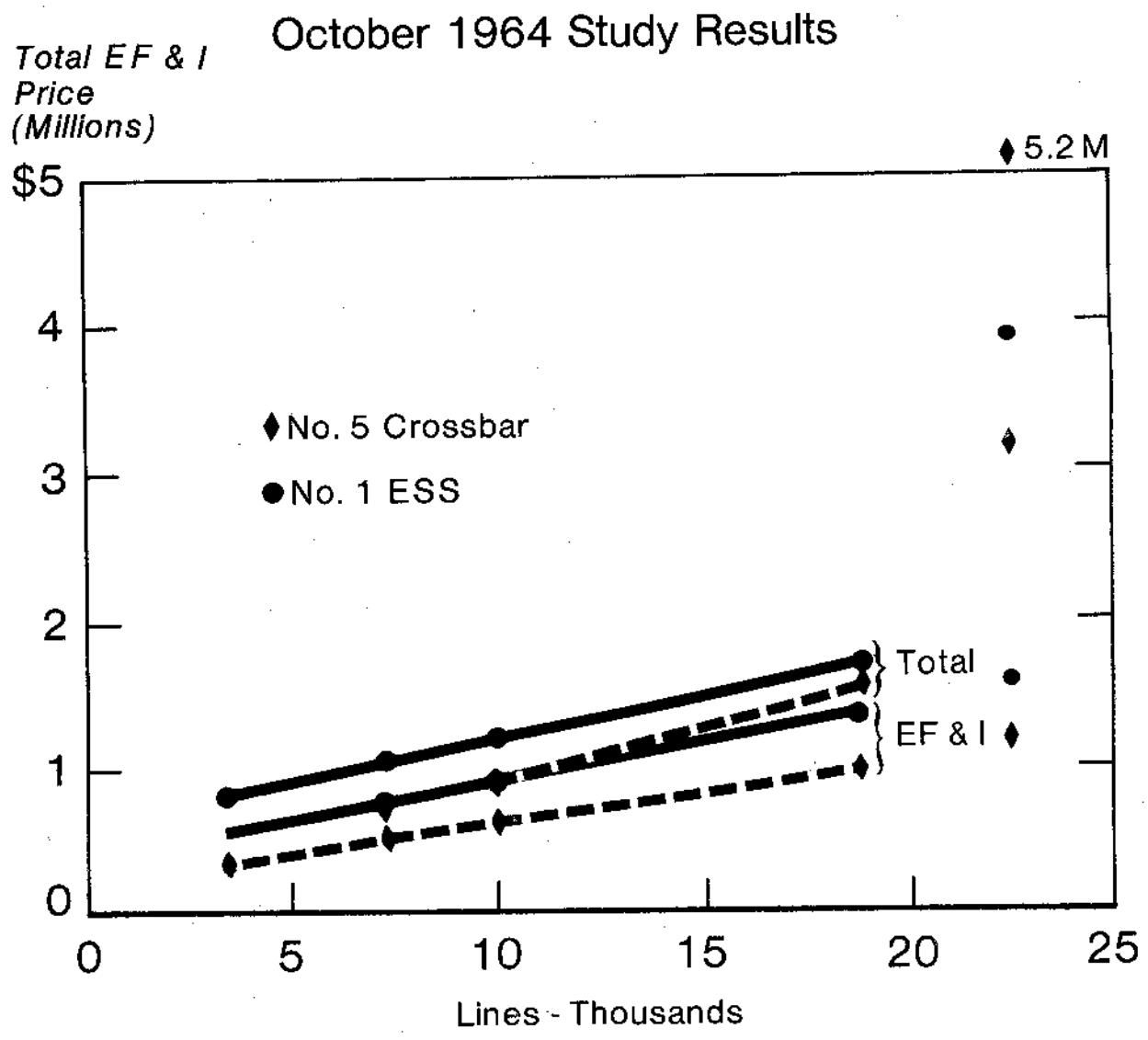
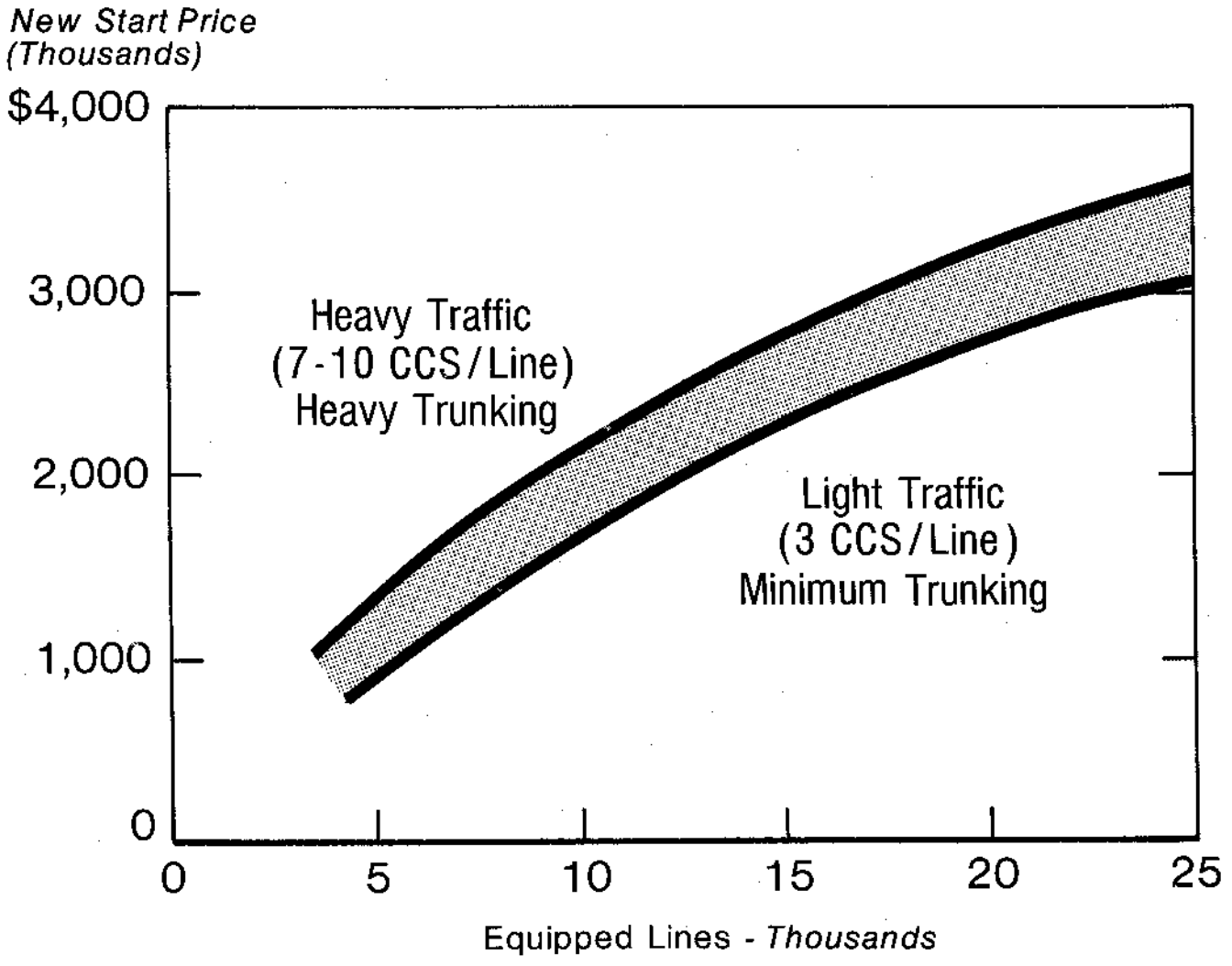


Figure 3

Planning Data - No. 1 ESS*. . .

Western Electric Company Material, Eng., Install.

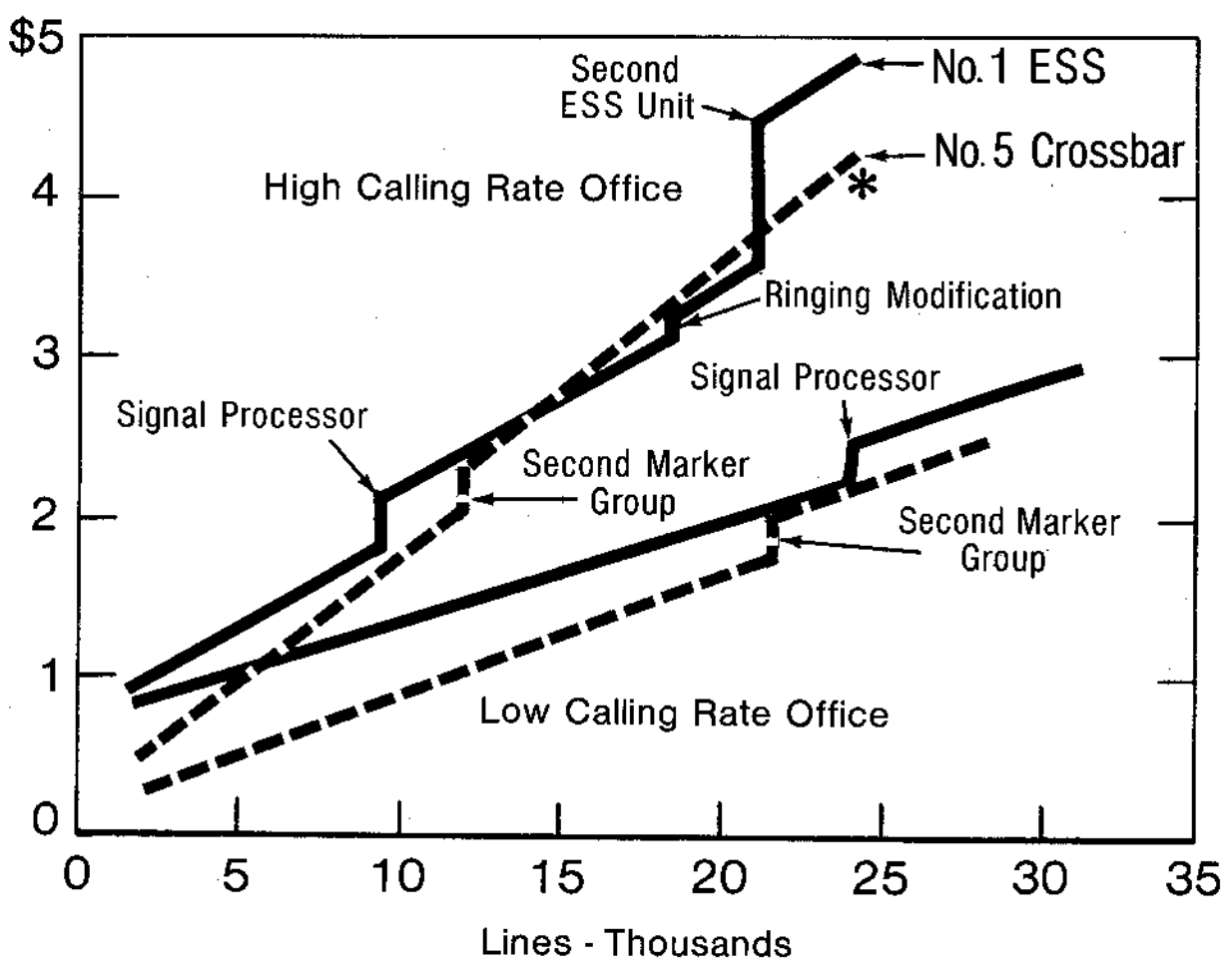


*AT&T Letter to Chief Engineers, C. R. Williamson, April 26, 1966

Figure 4

No. 1 ESS vs No. 5 Crossbar Installed Cost**.

Including - Material, WECO, Eng., & Installation

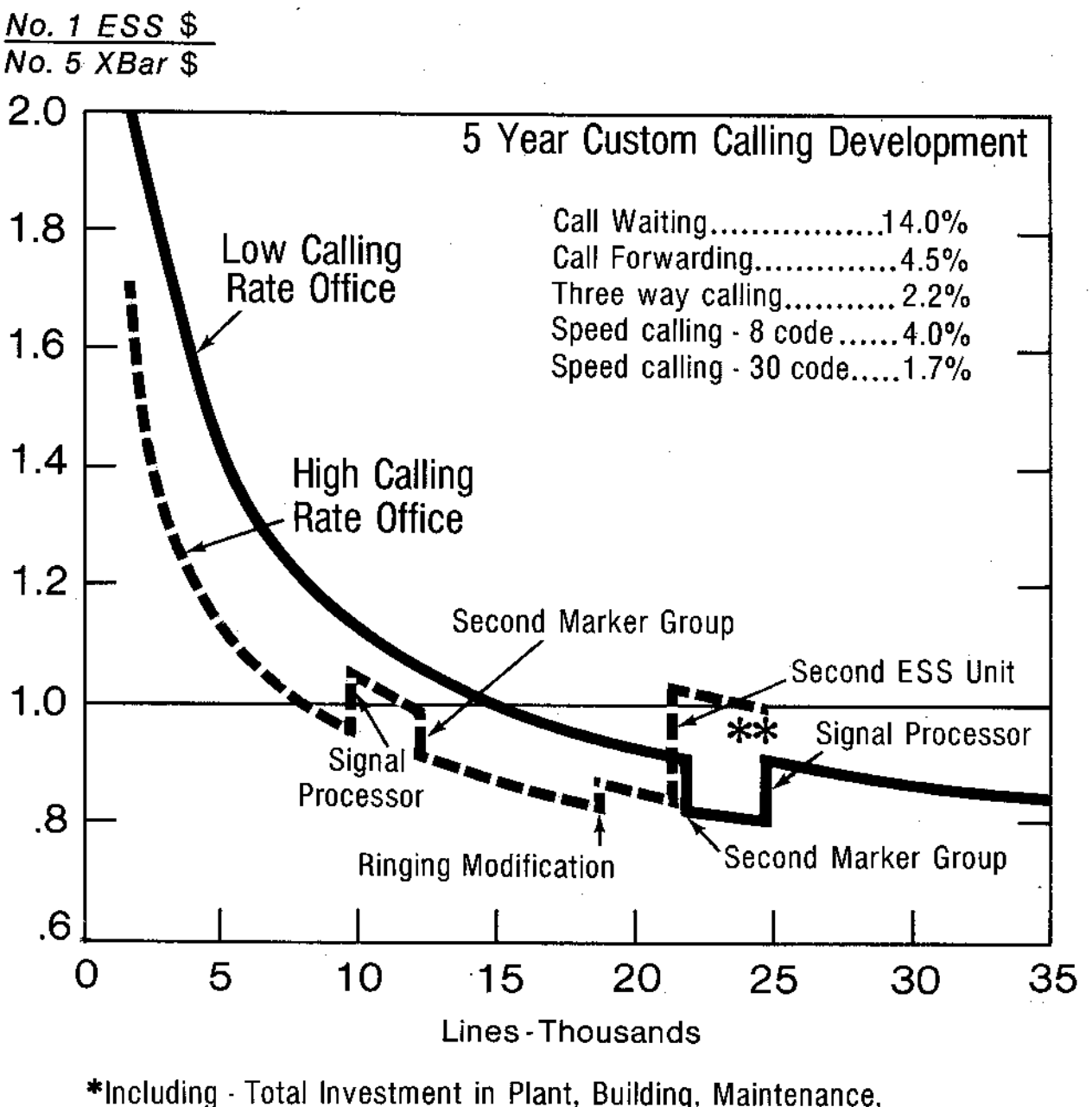


* Third No. 5 Crossbar Marker Group would be required. Because of various alternatives, specific plan should be evaluated and applied to this study.

**AT&T letter to Chief Engineers, C. R. Williamson, April 16, 1968

Figure 5

No. 1 ESS vs No. 5 Crossbar annual cost with Custom Calling*. . .



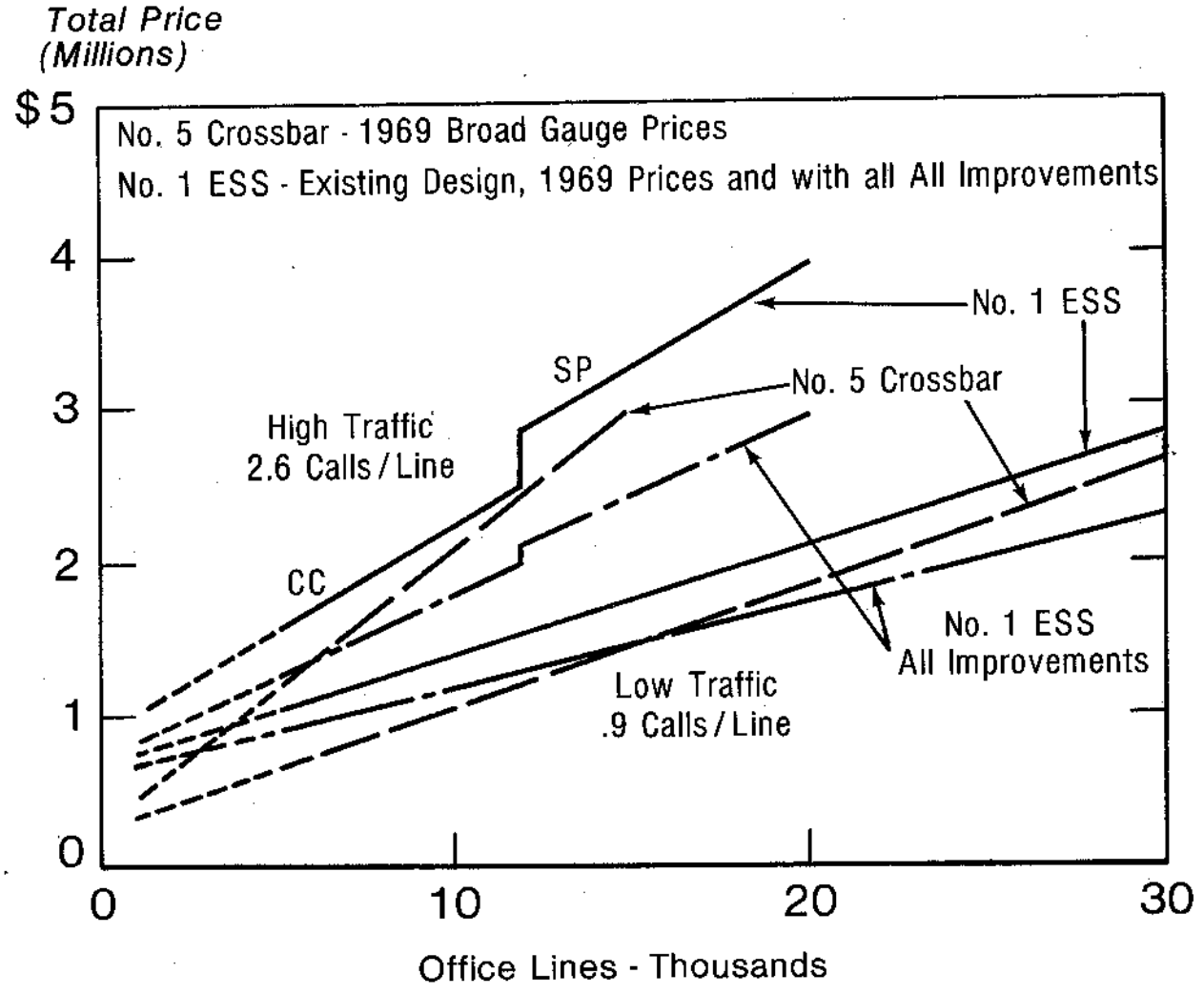
*Including - Total Investment in Plant, Building, Maintenance, & Custom Calling. AT&T letter to Chief Engineers, C. R. Williamson, April 16, 1968

**Third No. 5 Crossbar Market Group would be required. Because of various alternatives, specific plan should be evaluated and applied to this study.

Figure 6

Comparison of No. 1 ESS and No. 5 Crossbar price characteristics*

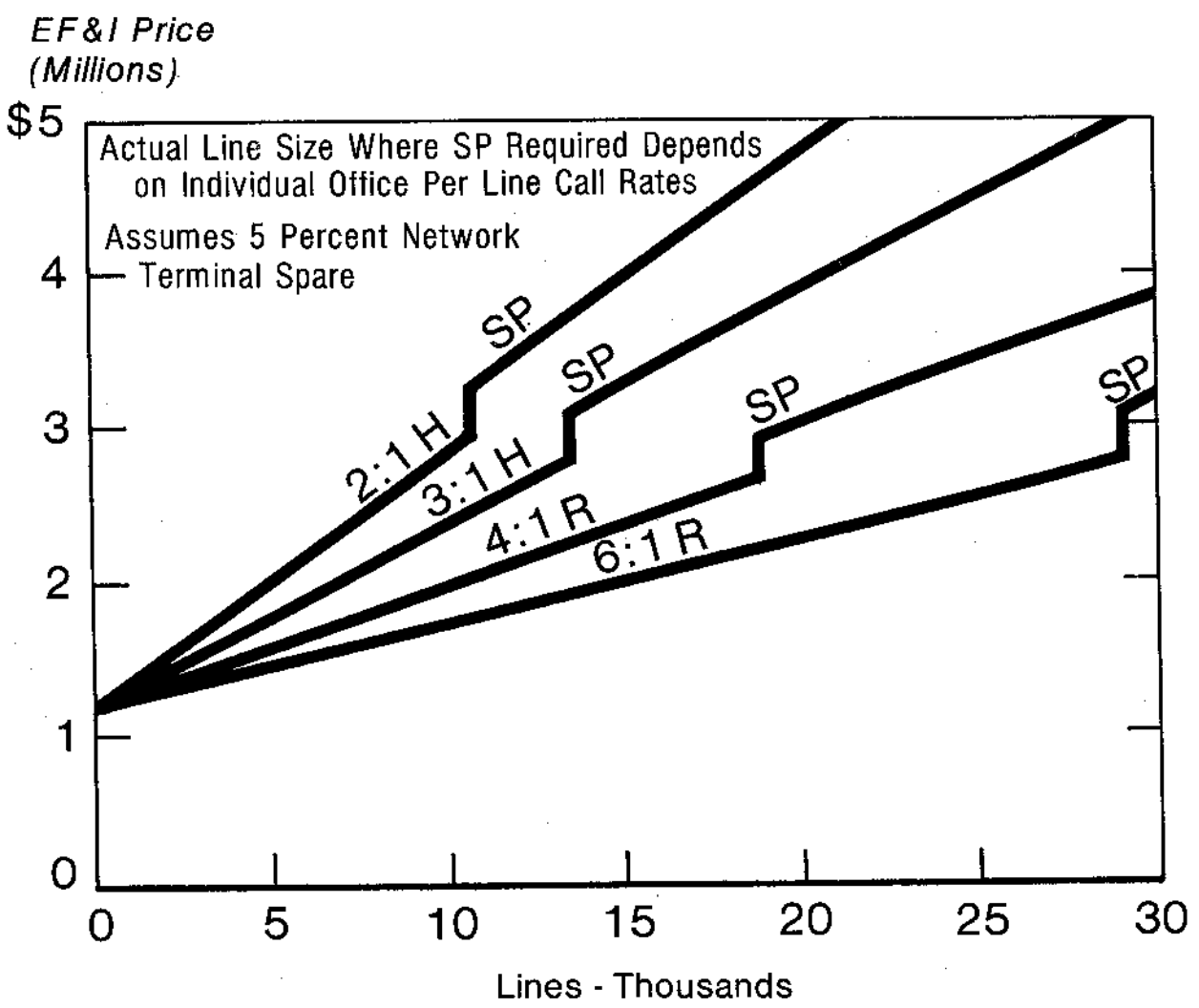
Include Equipment, WECO Engineering and Installation, Telco Expense and Building Space



*No. 1 ESS CPRT Study 1970

Figure 7

Estimates of No. 1 ESS EF&I price non centrex offices*



*No. 1 ESS Price Profiles for Initial Jobs

GL 72-05-198, May 26, 1972.

Figure 8

Distribution of No. 1 ESS Telco Expenses as a Percent of E F & I Price From 70 Actual Installations

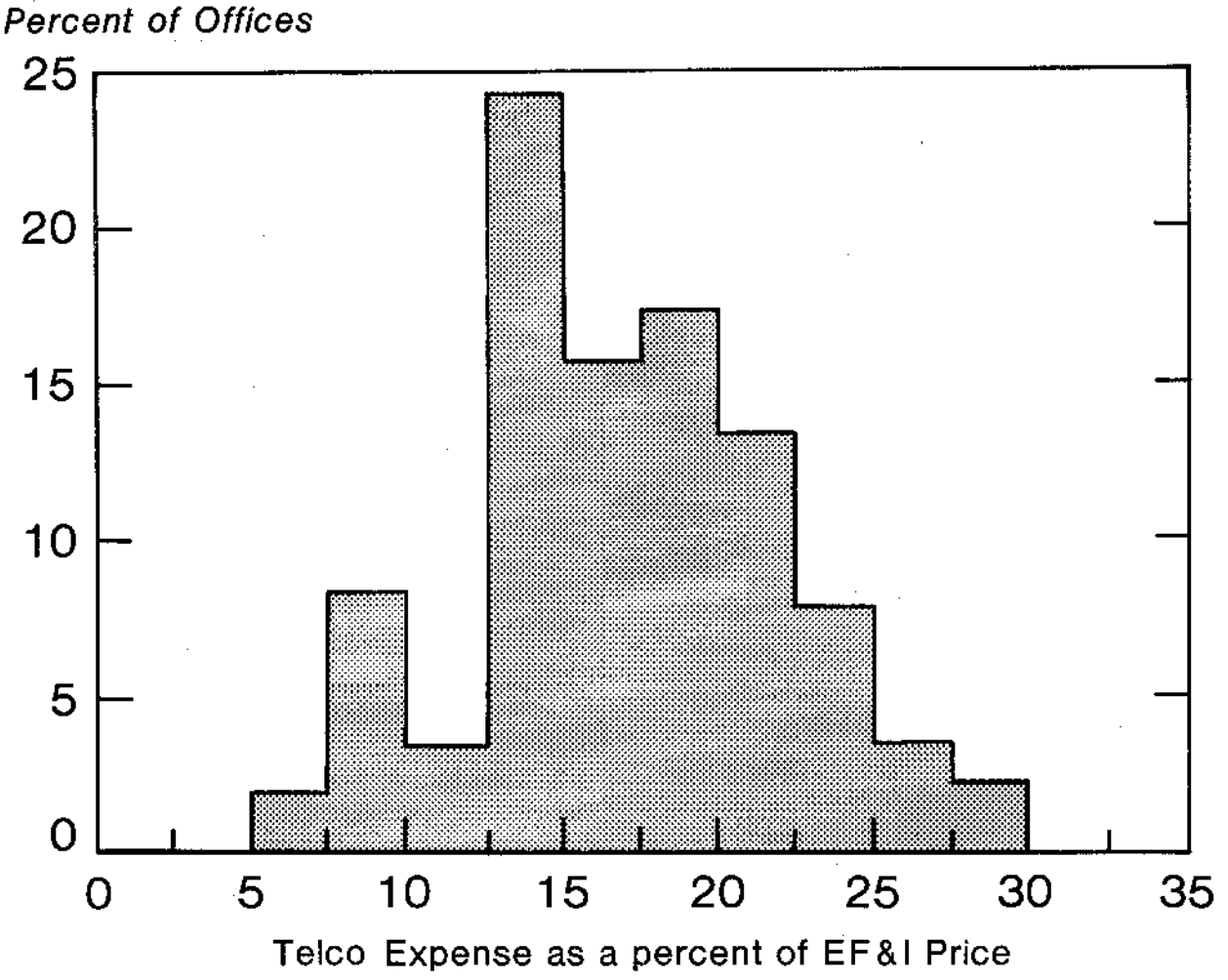
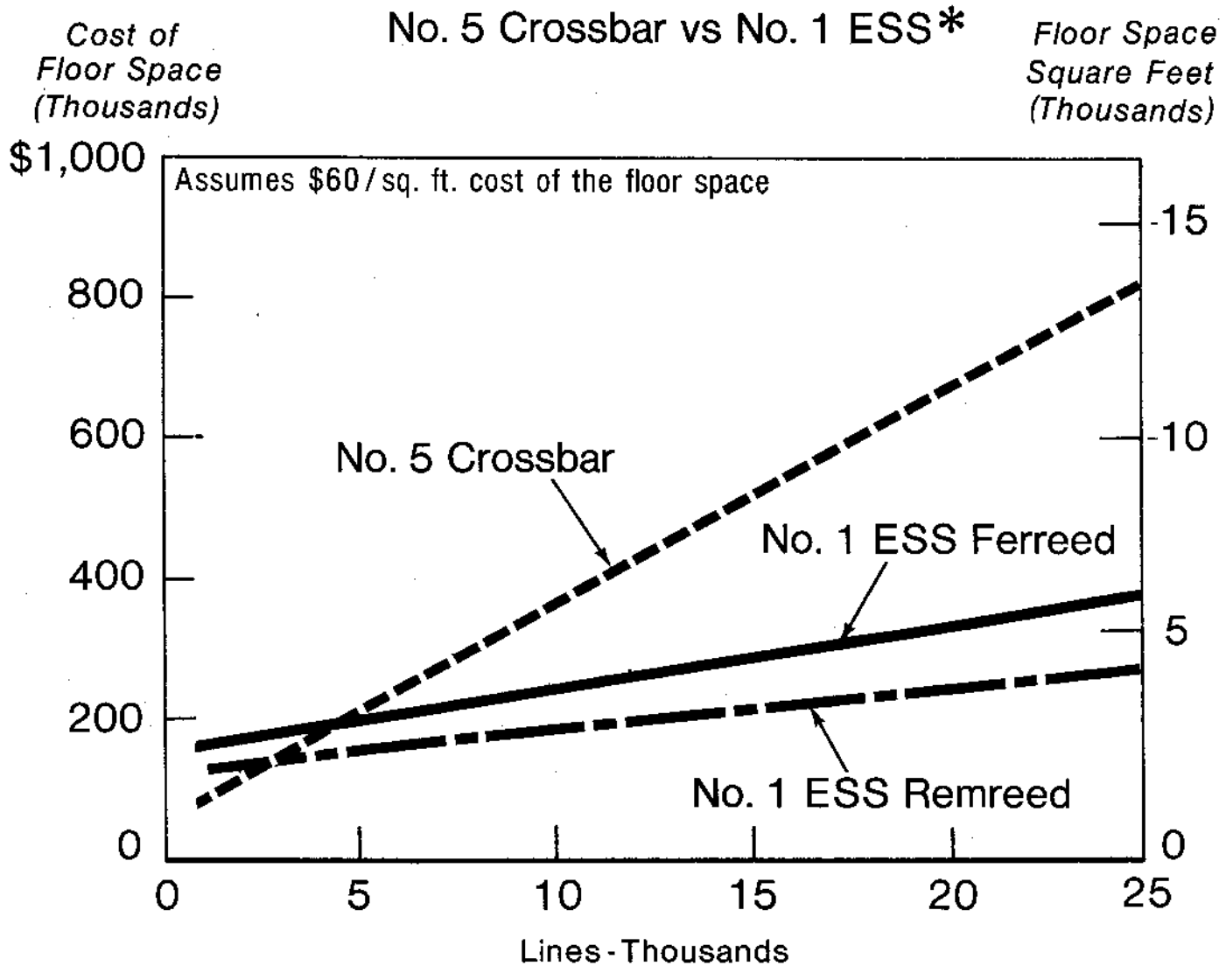


Figure 9

Switching equipment floor space . . .



*Updated from AT&T letter to chief Engineers - No. 1 ESS - Cost study comparing No. 1 ESS and No. 5 Crossbar prices April 16, 1968.

Figure 10

Estimate of components of No. 1 ESS office price for 4 CCS/line traffic with remreed network . . .

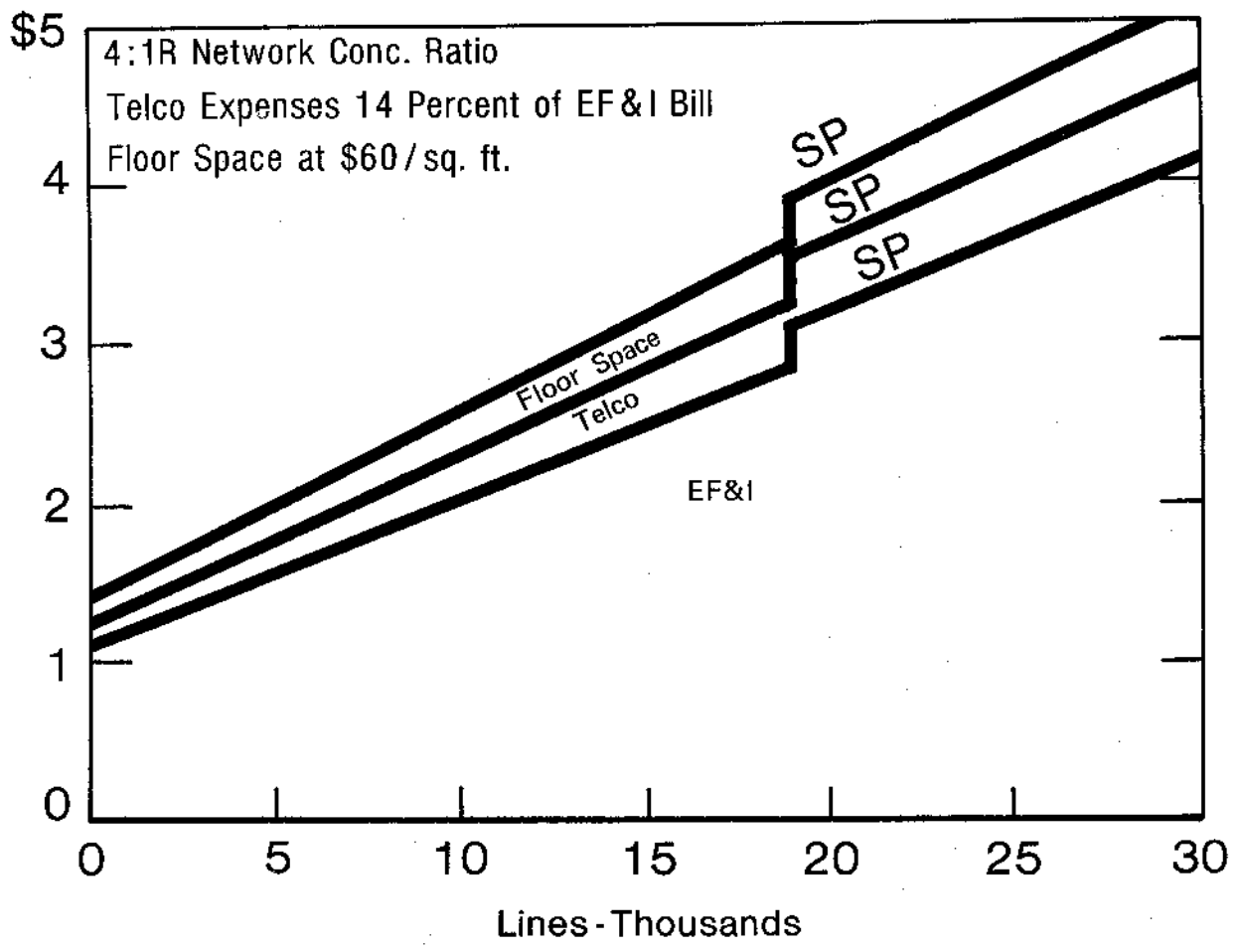


Figure 11

Distribution of Telco Expense as Percent of EF&I Price from 30 actual Installations

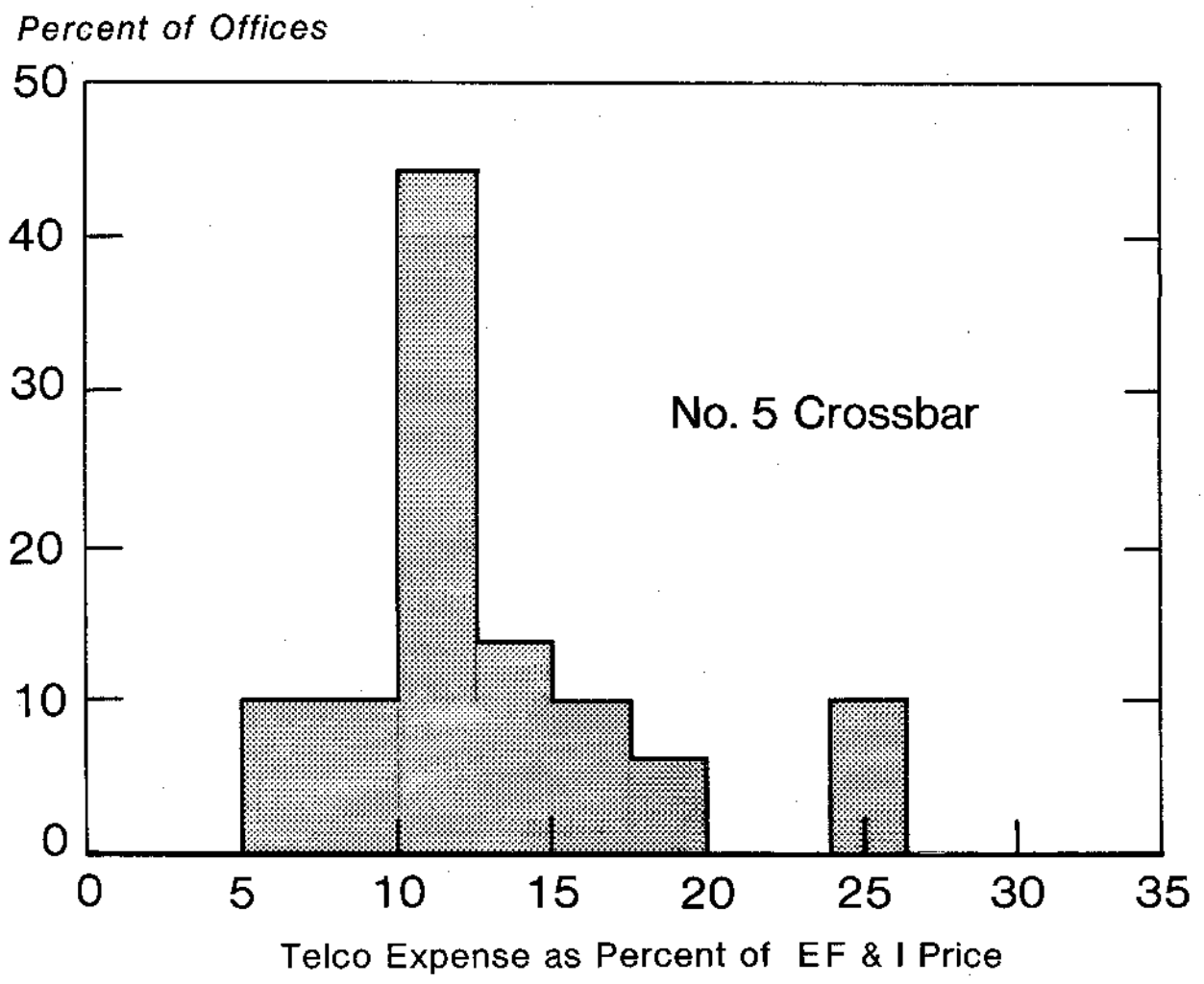


Figure 12

Estimate of components of No. 5 Crossbar office price for 4 CCS/Line traffic

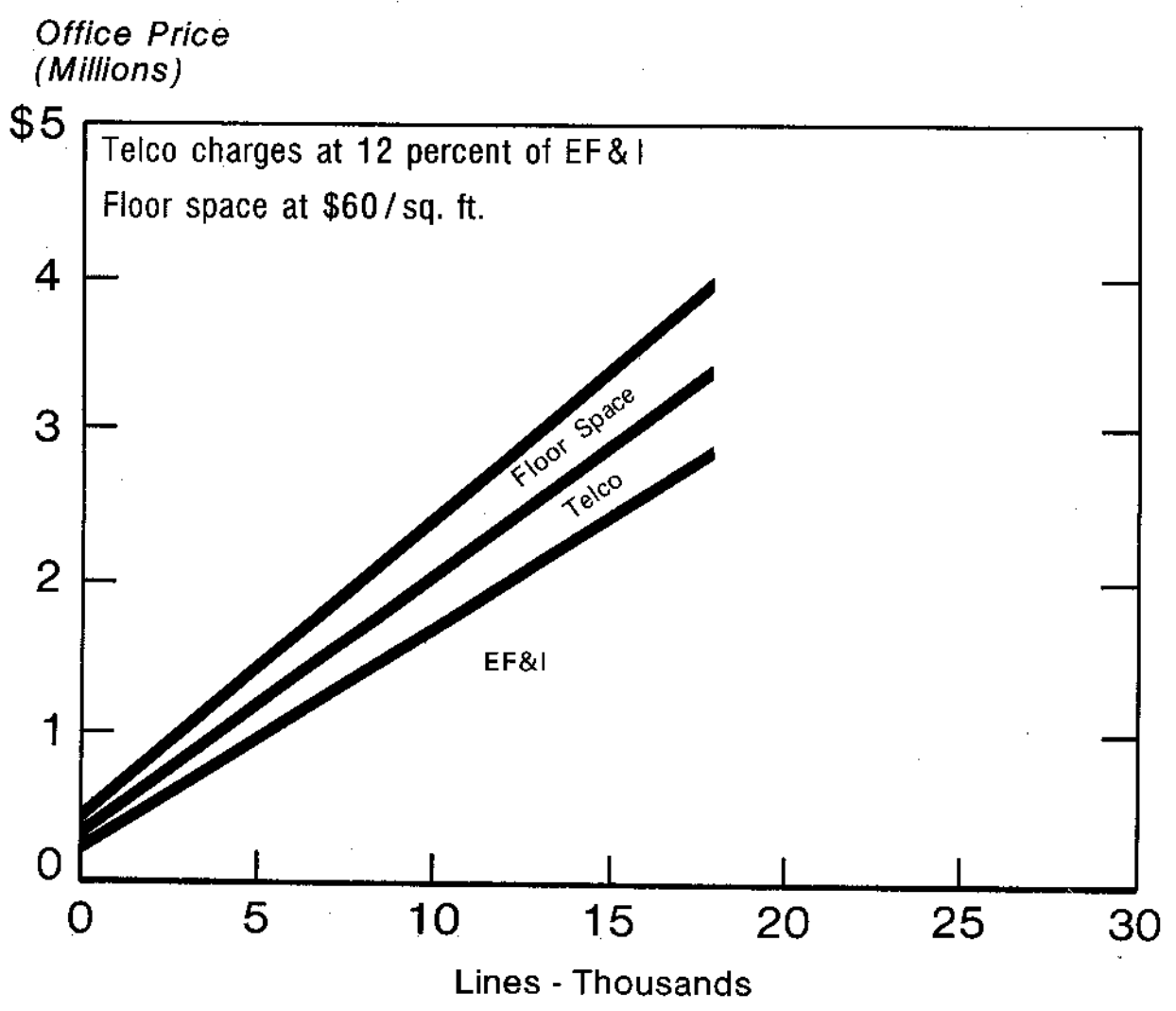


Figure 13

Comparison of No. 1 ESS and No. 5 Crossbar EF&I prices . . .

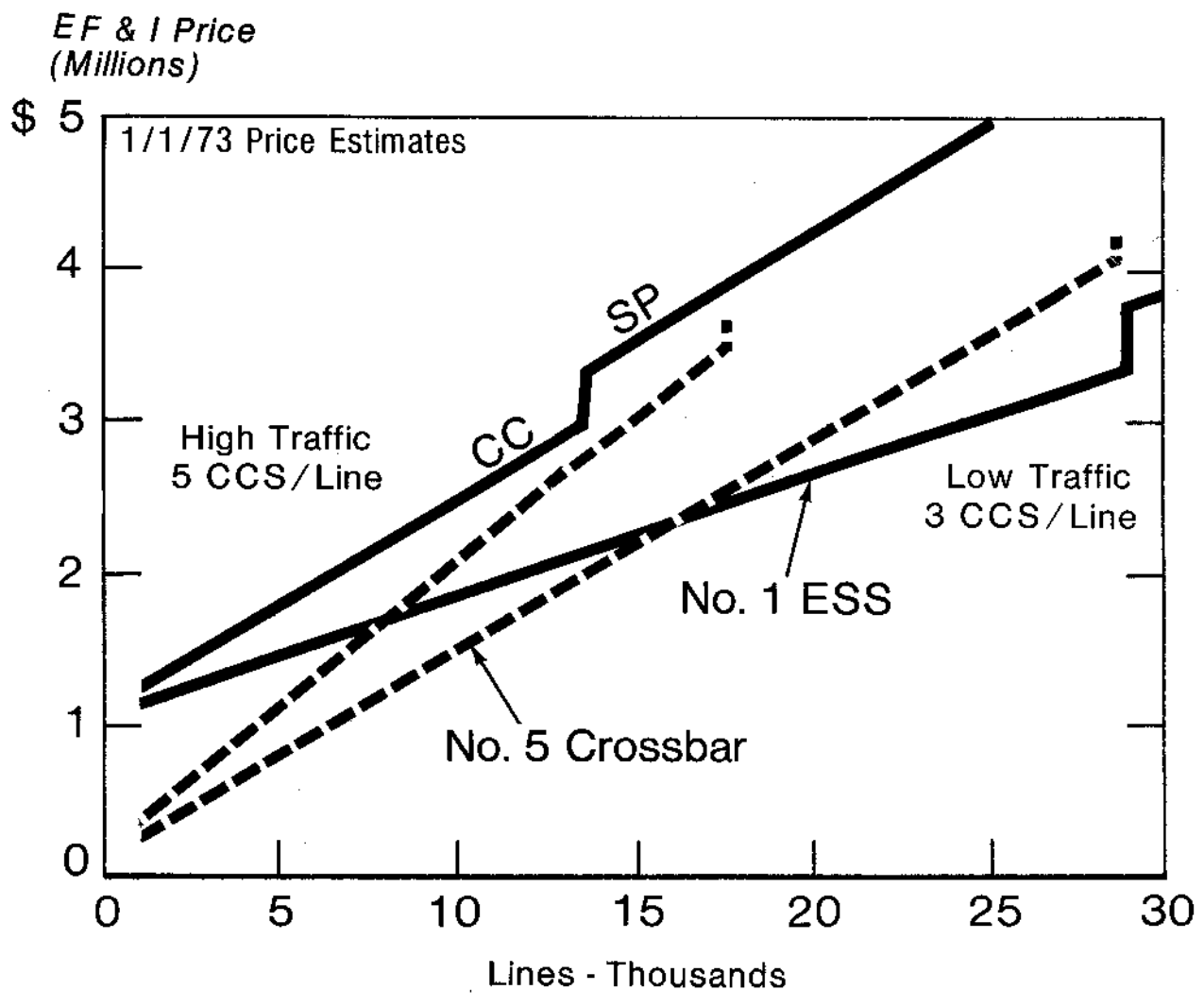


Figure 14

Total price comparison . . .

No. 1 ESS and No. 5 Crossbar (Includes E F & I plus Telco Expenses and Building Space)

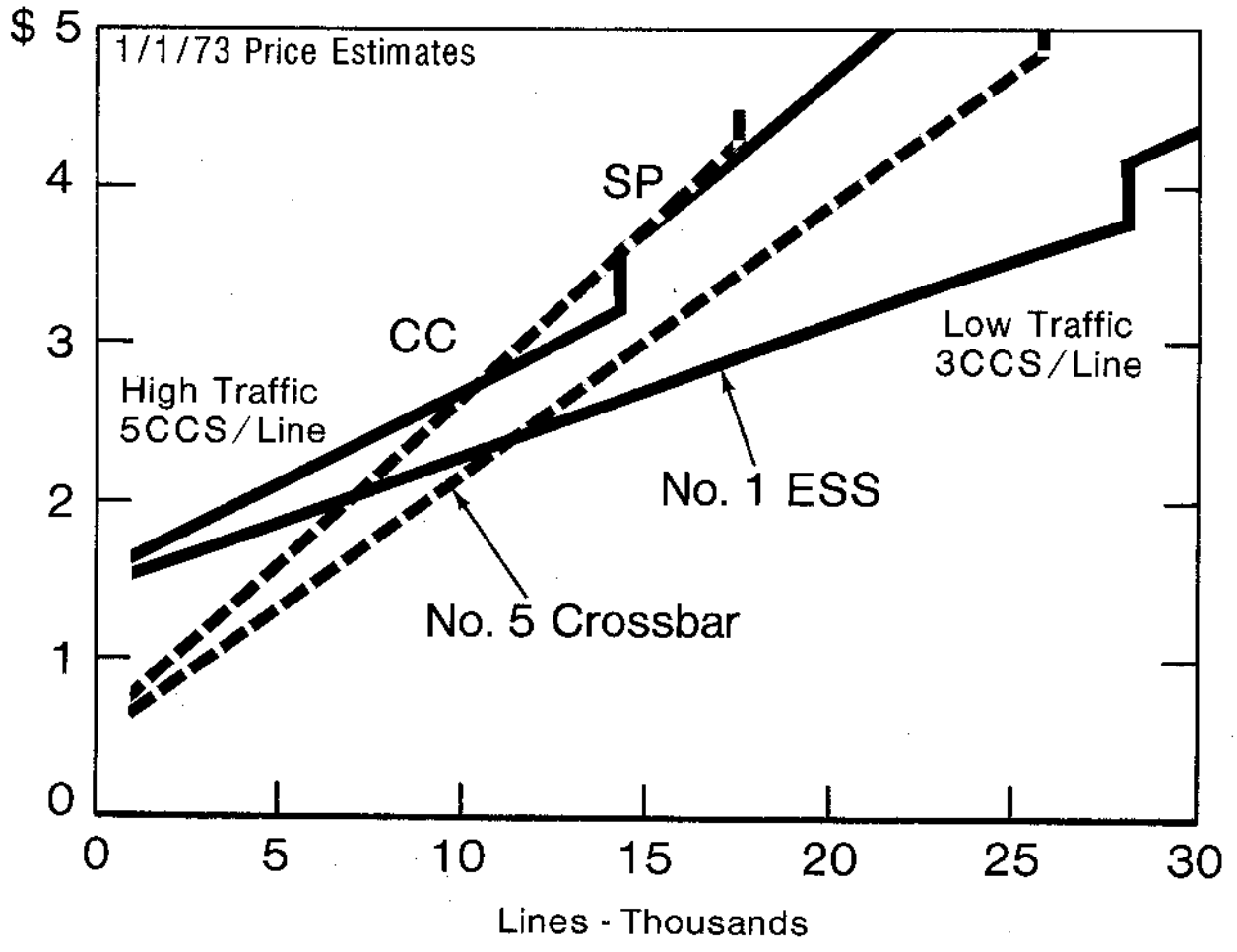


Figure 15

Quantified Features

Universal Features	ESS Credit (Installed Cost)	
	Service Anticipated	**Service Not Anticipated**
TSPS	$2K/Office + $90/TSPS Trk	$25K/Office + $90/TSPS Trk
AIS	$12K/Office	$12K/Office
Dir. Assis. Charging	$3K/Office	$4.5K/Office
Usage Sens. Rates	$5/Line	$10/Line
Traf. Meas.	$23K/Office	$23K/Office
ESS Credit for 15,000 Line Office	$115,000	$214,000

Table 2

Quantified Features

Selected Features	ESS Credit (Installed Cost)	
	Service Anticipated	Service Not Anticipated
AIOD & DID	$27K/Office	$27K/Office
CTX-CO	$45/CTX-CO Line	$500K
Call Waiting	$50/Equip M Line	$60/Equip Line
Coin DTF	— $3K/Office	$20K/Office
Perm. Sig. Treat.	$15/Equip Line	$15/Equip. Line
ESS Credit for 15K Line Office		
Residential	$110K	$150K
High Business	$320K	$730K

Table 3

No. 1 ESS 32K Call Store

Comparison of Equipment

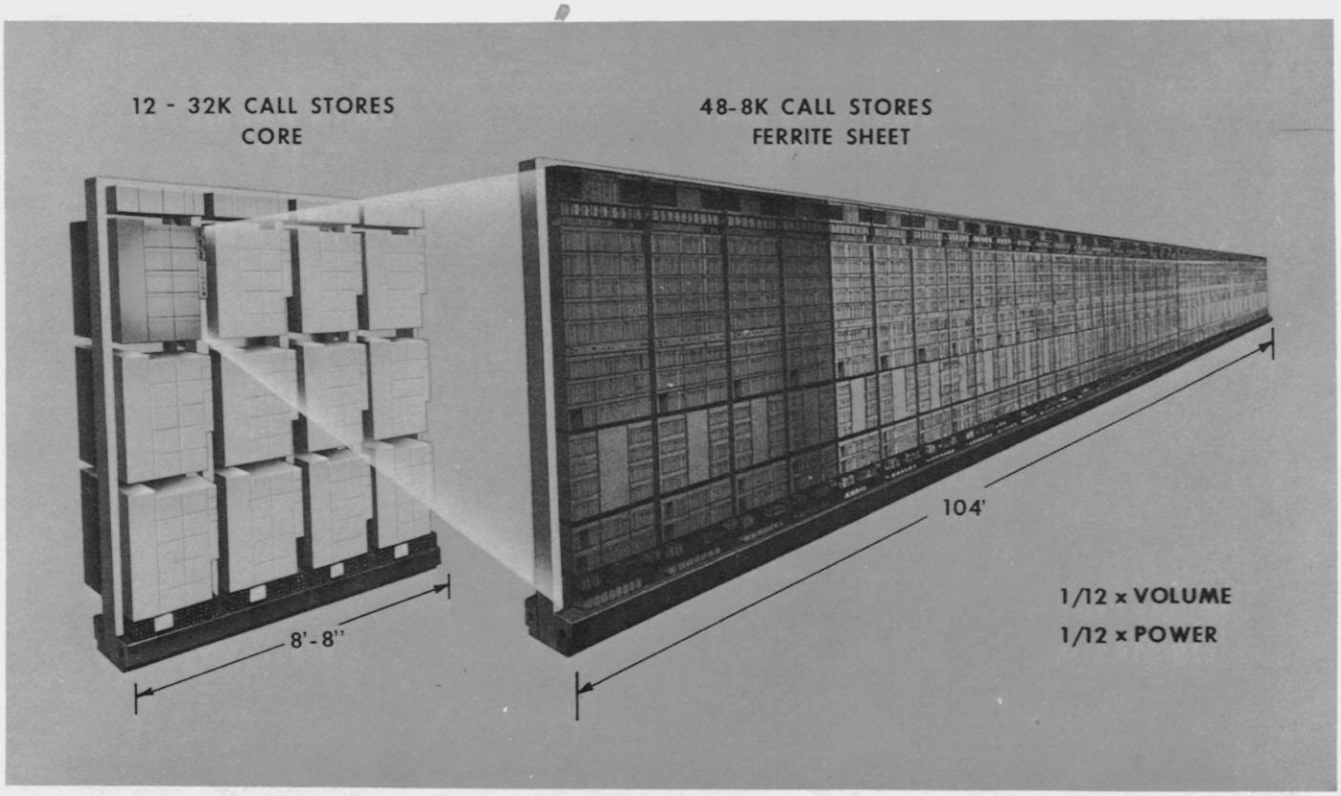


Figure 16

Remreed Trunk Link Network

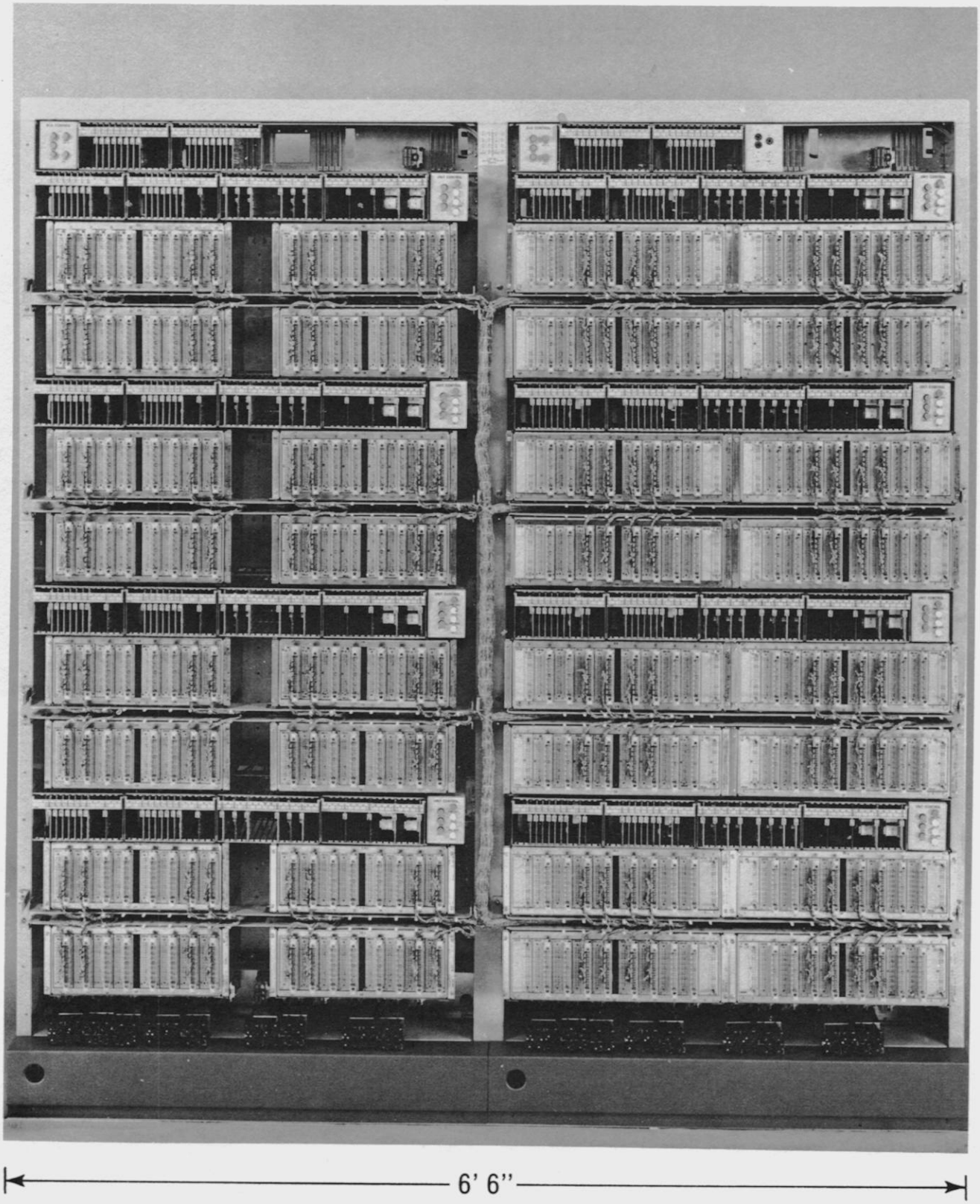


Figure 17

Remreed Trunk Link Network

1024 2-Wire

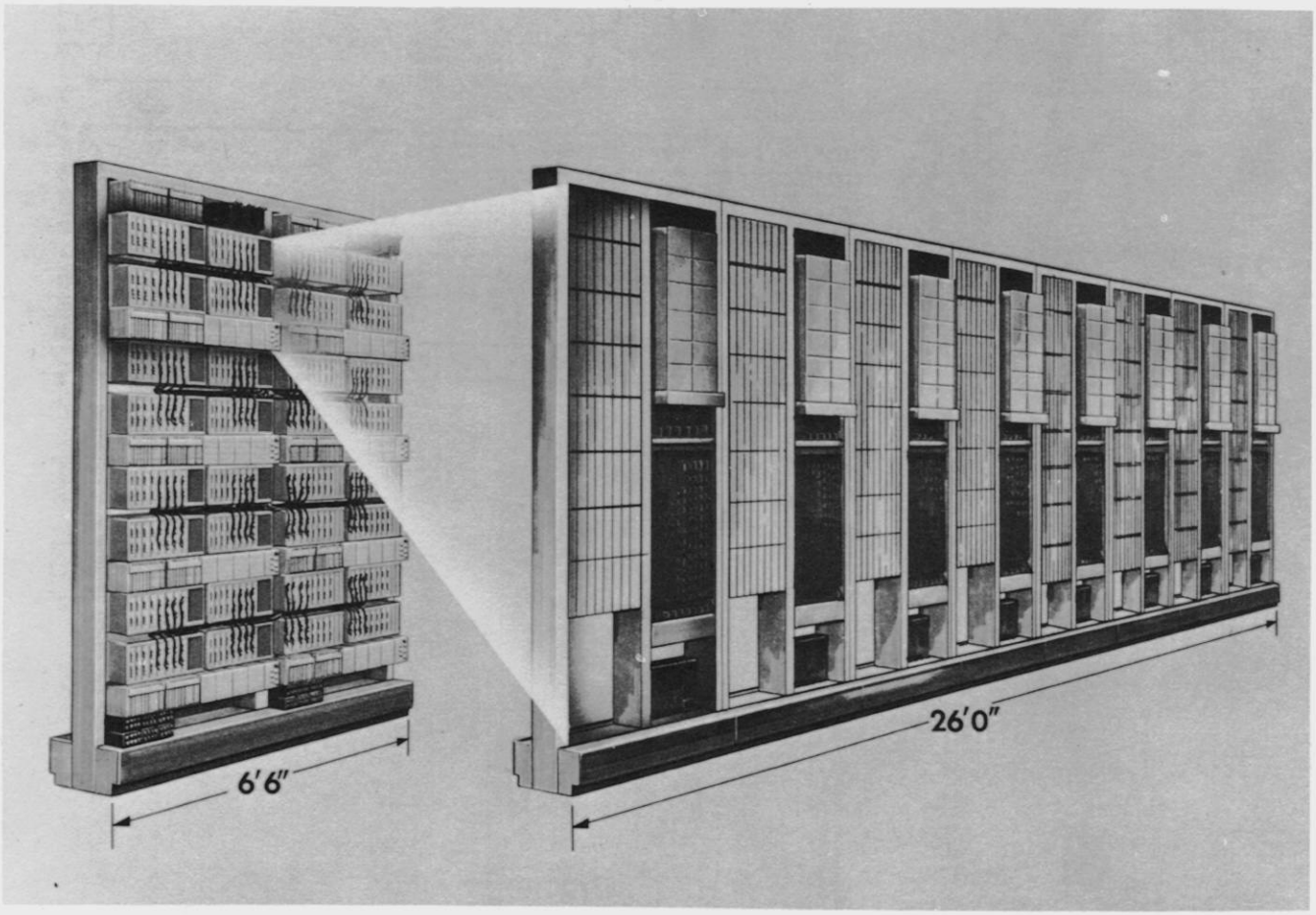


Figure 18

Proposed 1A Processor Floor Plan

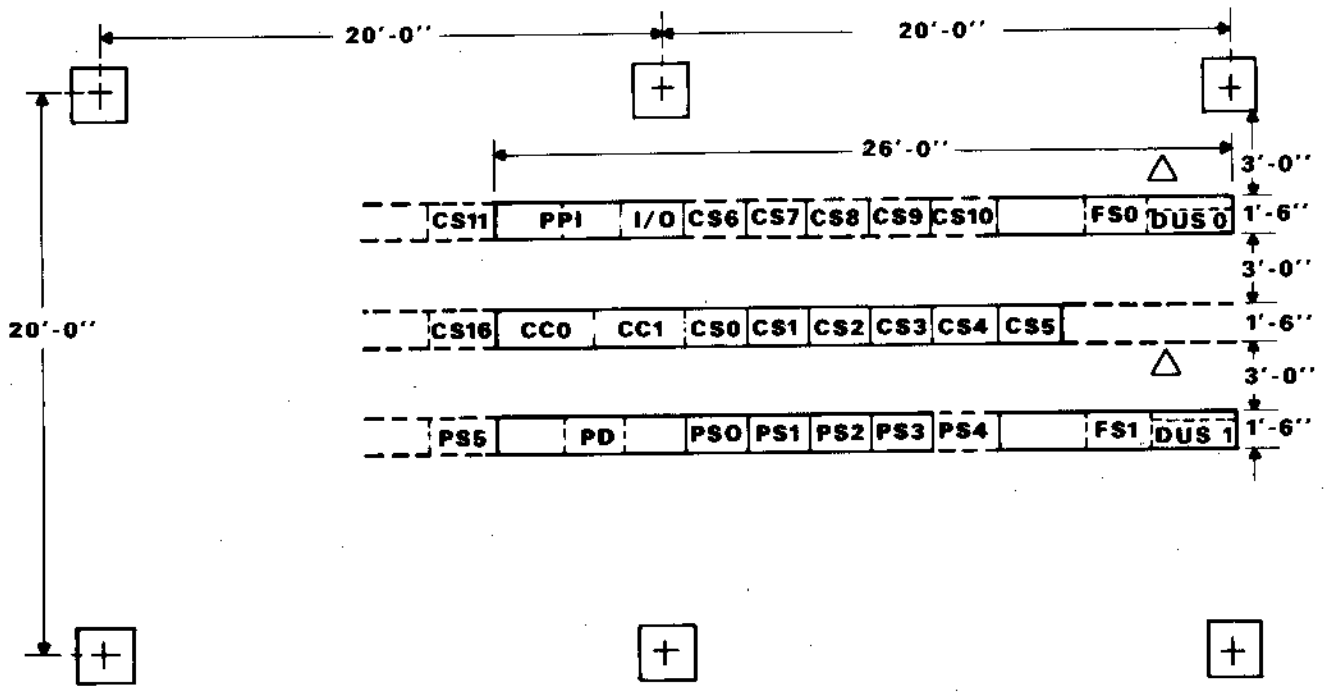


Figure 19

Small Trunk Frame

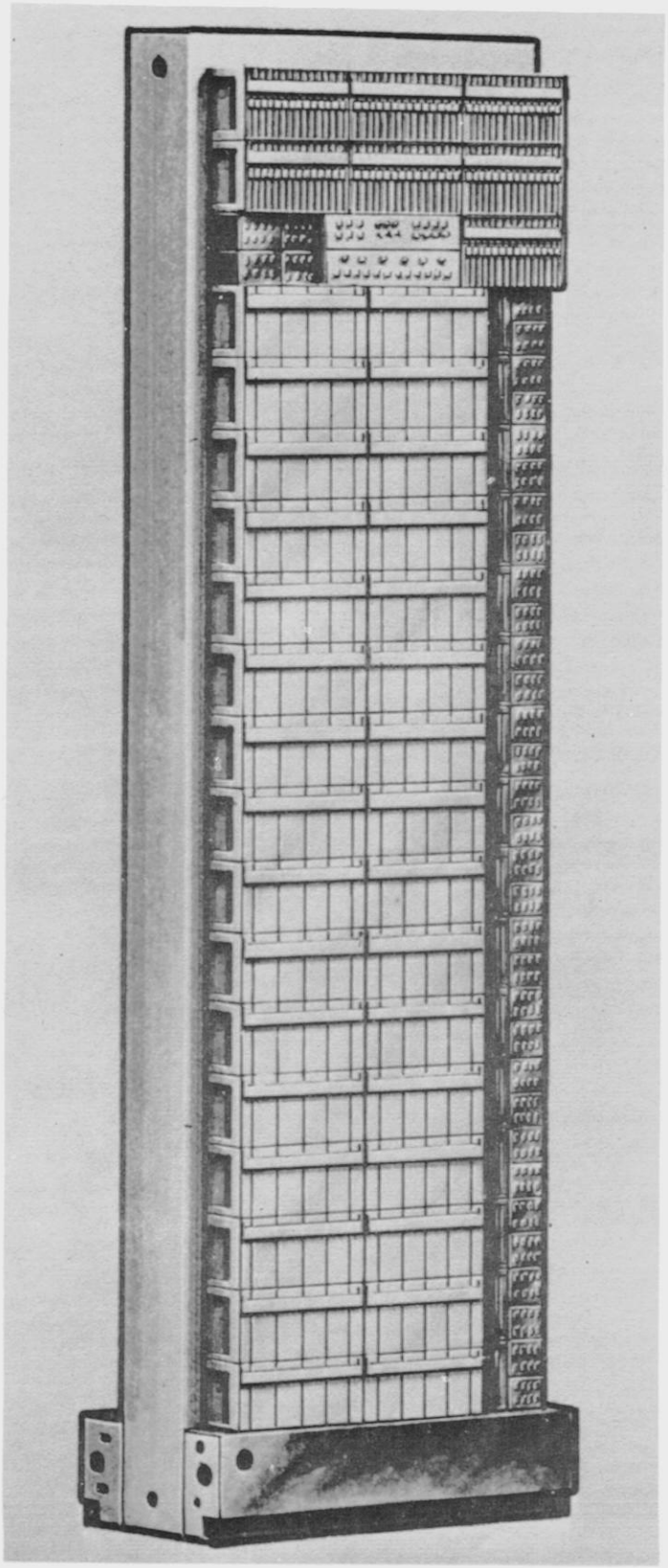


Figure 20

XIII - SYSTEMS IN SERVICE

Following is a list of No. 1 ESS (two-wire) installations, arranged by Operating Telephone Company, as of May 1, 1974. Some schedules are tentative and some are based upon Advanced Notification Orders (ANOs).

Each installation is shown, along with the generic program and the number of equipped lines. The cutover date or proposed service date is also shown.

Page XIII-13 summarizes, by generic program, the No. 1 ESS installations in service, as of May 1, 1974. It also lists the systems and lines in service for each year from 1965 to the present.

ESS INSTALLATIONS BY COMPANY

NEW ENGLAND TELEPHONE AND TELEGRAPH COMPANY

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Boston Back Bay #1	SP-CTX5	16.9	6/03/73
Boston Back Bay #2	SP-CTX5	21.5	6/03/73
Boston Bowdoin Sq #1	SP-CTX5	30.7	8/25/73
Boston Harrison #1	SP-CTX5	19.5	7/04/63
Boston Harrison #2	SP-CTX3	18.4	11/21/70
Boston Harrison #3	SP-CTX5	20.5	2/10/73
Brighton Stadium	SP-CTX5	31.7	11/23/63
Cambridge	SP-CTX3	41.0	5/20/70
Cambridge Kendall Sq	SP-CTX5	21.5	8/12/72
Cambridge Ware St.	SP-CTX4	12.3	2/25/72
Malden	SP-CTX3	15.4	7/17/71
Nashua	SP-CTX5	30.7	5/20/73
Provid. Green St. #1	SP-CTX3	32.8	11/18/67
Provid. Green St. #2	SP-CTX1	16.4	12/13/69
Quincy	SP-CTX5	12.3	9/02/72
Waltham	SP-CTX4	12.3	10/30/71

NEW YORK TELEPHONE COMPANY

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Albany State St.	SP-CTX6	12.3	12/13/70
Amherst	SP-CTX4	16.4	12/20/70
Bklyn. Ave R	SP-CTX5	12.3	1/27/73
Bklyn. Ave U	CC-CTX2	17.4	3/28/73
Bklyn. Ave Y	SP-CTX3	30.2	10/09/71
Bklyn. Bridge St. #1	CC-CTX1	14.3	6/29/63
Bklyn. Bridge St. #2	SP-CTX4	28.7	2/10/73
Bklyn. Bushwick	SP-CTX5	35.8	4/28/73
Bklyn. Clinton Ave	SP-CTX6	41.0	8/08/70
Bklyn. Liberty	SP-CTX5	25.6	8/11/73
Bklyn. Rockaway	SP-CTX4	41.0	12/11/71
Bklyn. 14th St.	SP-CTX4	35.8	5/06/72

NEW YORK TELEPHONE COMPANY (CONTD.)

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS (K)	CUTOVER DATE
Bronx Edson	CC-CTX4	35.8	5/20/72
Bronx Tiebout Ave	SP-CTX4	49.1	5/20/72
Bronx Tratman	SP-CTX5	41.0	7/21/73
Buffalo Franklin	SP-CTX5	12.3	5/05/73
Buffalo-Baily	SP-CTX6	25.6	11/27/73
Guilderland	SP-CTX4	8.2	4/23/72
Huntington Station	CC-CTX2	10.2	10/25/70
Latham	SP-CTX5	16.4	12/10/72
Lindenhurst	CC-CTX4	20.5	6/07/70
Liverpool	CC-CTX6	15.3	10/13/73
NYC Convent Ave	SP-CTX5	30.7	12/13/70
NYC E. 30th St.	SP-CTX5	18.4	5/23/70
NYC E. 38th St. #1	SP-CTX5	18.4	4/16/72
NYC E. 38th St. #2	SP-CTX5	24.6	6/16/73
NYC E. 56th St. #1	SP-CTX5	21.5	10/28/67
NYC E. 56th St. #2	SP-CTX5	25.1	2/06/71
NYC E. 56th St. #3	SP-CTX5	20.5	10/27/73
NYC E. 79th St. #1	SP-CTX3	25.6	6/27/70
NYC E. 97th St.	SP-CTX5	36.9	5/19/73
NYC Manhattan Ave.	SP-CTX5	35.8	9/15/73
NYC Varick St.	SP-CTX5	21.5	8/07/71
NYC WTC Tower A #1	SP-CTX5	16.4	2/16/74
NYC W. 18th St.	SP-CTX5	35.8	5/27/72
NYC W. 36th St. #E	SP-CTX5	17.9	6/27/71
NYC W. 36th St. #F	SP-CTX6	18.8	12/07/73
NYC W. 36th St. #1	SP1	10.8	3/02/63
NYC 104 Broad St. Ent F	SP-CTX5	16.8	3/30/74
NYC 104 Broad St. #1	SP-CTX5	17.4	6/25/71
NYC 104 Broad St. #2	SP-CTX5	14.3	3/30/73
NYC 1095 Ave America #1	SP-CTX5	21.5	7/07/73
NYC 1095 Ave America #2	SP-CTX6	21.5	1/12/74
NYC 140 West Ent L	SP-CTX5	16.4	8/26/72
NYC 140 West Ent M	SP-CTX5	16.4	7/21/73
NYC 140 West Ent N	SP-CTX5	17.9	3/30/74
NYC 140 WEST ST #1	SP-CTX5	18.4	6/22/69
Patchogue	CC-CTX4	10.2	7/01/72
Queens Forest Hills	SP-CTX5	8.2	10/26/73
Queens JFK Airpt	SP-CTX5	7.2	10/21/72
Queens Newtown	SP-CTX5	53,2	9/08/73
Queens Ravenswood	SP-CTX5	30.7	9/29/73
Queens Whitestone	SP-CTX5	28.7	2/24/73
Queens 115th Ave	SP-CTX5	24.6	5/19/73
Schenectady Franklin	SP-CTX4	16.4	6/27/71
Suffolk Deer Park	CC-CTX4	10.2	7/19/73
Syracuse Fairmount	SP-CTX5	8.2	4/06/72
Syracuse State GR2	SP-CTX5	32.8	7/29/73
West Seneca	CC-CTX6	11.3	10/06/73

NEW JERSEY BELL TELEPHONE COMPANY

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Atlantic City	SP-CTX3	29.7	3/07/71
Bayonne	CC-CTX6	4.1	11/11/73
Boonton	CC-CTX4	5.1	11/28/71
Camden	SP-CTX3	18.4	11/28/70
Dumont	CC-CTX6	2.0	12/02/73
East Orange	SP-CTX5	26.6	12/07/69
Elizabeth	SP-CTX5	32.8	5/24/70
Englewood	SP-CTX5	7.2	8/27/72
Freehold	CC-CTX6	8.2	12/02/73
Herbertsville	CC-CTX6	6.1	4/07/74
Irvington Essex	CC-CTX2	15.4	7/30/67
Jsy. City Journal Sq	SP-CTX4	13.3	12/05/71
Linden	CC-CTX4	8.2	11/12/72
Metuchen	CC-CTX4	8.2	12/05/71
Morristown	SP-CTX6	18.4	4/23/67
New Brunswick	SP-CTX5	24.6	12/06/70
Newark Humboldt	SP-CTX5	21.5	10/01/72
Newark Ironbound	SP-CTX3	18.4	10/11/70
Newark Market	CC-CTX4	12.3	10/13/68
Newark Waverly	CC-CTX6	13.2	12/30/73
Nutley	CC-CTX4	8.2	11/26/72
Passaic	CC-CTX6	10.2	9/30/73
Paterson Sherwood	SP-CTX4	25.6	1/26/69
Somerville	CC-CTX4	8.2	12/19/71
South Orange	CC3	17.4	8/04/68
Succasunna	CC-CTX4	9.2	5/30/65
Trenton State St.	SP-CTX5	47.1	12/08/63
Union City	SP-CTX4	16.4	12/19/71
Vineland	CC-CTX6	8.2	11/11/73
Wildwood	CC-CTX4	12.3	3/15/70
Williamstown	CC-CTX4	12.3	5/20/73

THE BELL TELEPHONE COMPANY OF PENNSYLVANIA

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Allentown	SP-CTX5	16.4	7/29/72
Bethlehem	SP-CTX4	24.6	1/26/69
Eastwick	CC-CTX4	6.1	8/06/72
Phila. Baldwin #1	SP-CTX5	20.5	11/23/69
Phila. Baldwin #2	SP-CTX6	15.4	1/27/74
Phila. Dewey	SP-CTX5	28.7	7/20/69
Phila. Germantown	SP-CTX5	32.8	6/25/67
Phila. Jefferson	SP-CTX5	19.5	11/07/70
Phila. Locust #1	SP-CTX5	20.5	1/14/68
Phila. Locust #2	SP-CTX5	20.5	5/14/72
Phila. Locust #3	SP-CTX6	15.4	4/28/74

THE BELL TELEPHONE COMPANY OF PENNSYLVANIA (CONTD.)

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS (K)	CUTOVER DATE
Phila. Market #1	SP-CTX5	17.9	10/03/71
Phila. Market #2	SP-CTX6	12.8	7/29/73
Phila. Mayfair	SP-CTX5	20.5	12/06/70
Phila. Orchard	CC-CTX4	4.1	11/19/72
Phila. Pennypacker	SP-CTX5	22.5	12/14/69
Phila. Poplar	SP-CTX5	14.3	7/09/72
Phila. Regent	SP-CTX5	28.7	10/15/72
Phila. Sherwood	SP-CTX5	24.6	11/07/71
Phila. Trinity	SP-CTX5	18.4	11/02/69
Phila. Waverly	SP-CTX5	24.6	9/12/71
Ptsbg. Crafton	SP-CTX6	17.9	8/26/73
Ptsbg. Downtown #1	SP-CTX4	23.0	10/26/68
Ptsbg. Downtown #2	SP-CTX5	15.4	5/01/71
Ptsbg. Oakland	SP-CTX5	28.7	1/30/72
Ptsbg. Sharpsburg	SP-CTX4	16.4	12/19/71
Ptsbg. Squirrel Hill	SP-CTX5	20.5	1/25/70
Ptsbg. Homestead	SP-CTX6	19.4	10/28/73
Scranton	SP-CTX6	16.4	5/20/73
Wilmington #1	SP-CTX6	41.0	7/15/73

THE CHESAPEAKE AND POTOMAC TELEPHONE COMPANY

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Arlington Barcroft	CC-CTX4	6.1	3/26/73
Arlington Irving	SP-CTX5	12.8	12/17/72
Arlington Pentagon	SP-CTX5	30.7	12/19/69
College Park Berwyn	CC-CTX4	4.6	6/10/72
Germantown, Md.	CC-CTX4	4.6	6/25/72
Rockville Center	CC-CTX4	4.1	11/20/71
Silver Springs	CC-CTX4	6.1	9/16/72
Wash. Brookland	SP-CTX3	10.8	3/28/71
Wash. Congress Hgts.	CC-CTX4	4.1	6/24/72
Wash. Downtown Me 8	SP-CTX3	18.4	6/15/68
Wash. Downtown Na 8	SP-CTX3	16.4	8/15/70
Wash. Dupont Ctr	SP-CTX5	31.7	8/20/72
Wash. Georgia Center	SP-CTX5	30.2	11/28/71
Wash. Midtown	SP-CTX4	21.5	9/05/71
Wash. Republic	SP-CTX5	14.3	2/25/73
Wash. Southeast Ctr	SP-CTX4	21.0	1/09/72
Wash. Southwest Ctr	SP-CTX5	15.4	5/10/72

THE CHESAPEAKE AND POTOMAC TELEPHONE COMPANY OF MARYLAND

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Balto. Charles St.	SP-CTX4	10.2	6/04/72
Balto. Chase	CC3	6.1	1/16/66
Balto. Edmonson	SP-CTX5	7.2	11/05/72
Balto. Hamilton	SP-CTX6	16.8	12/30/73
Balto. Liberty	SP-CTX5	17.9	8/21/71
Balto. University	SP-CTX4	26.1	8/03/69
Balto. Wolfe Ctr	SP-CTX5	10.8	11/04/72
Bethesda	CC-CTX6	3.6	12/21/73
Columbia City	CC3	14.3	11/24/68
Gaithersburg	CC-CTX6	8.7	12/14/73
Hyattsville	CC-CTX6	7.1	1/20/74

THE CHESAPEAKE AND POTOMAC TELEPHONE COMPANY OF VIRGINIA

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Newport News-Harpers.	CC-CTX4	2.0	9/16/73
Newport News-Jeff.	CC-CTX4	7.2	4/29/73
Norfolk Bute St.	SP-CTX4	26.6	8/18/68
Sandston	CC-CTX6	8.2	10/28/73
Virginia Beach Gt. Nk.	CC-CTX4	7.2	5/13/73

SOUTH CENTRAL BELL TELEPHONE COMPANY

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Birmingham	SP-CTX4	27.6	6/18/72
Jackson Pearl St.	CC-CTX4	12.3	8/18/68
Memphis Main #0	SP-CTX5	16.9	8/30/70
Memphis Main #1	SP-CTX6	23.0	12/15/73
Memphis Midtown	SP-CTX5	10.8	7/19/70
Nashville Main	SP-CTX5	6.1	11/17/68
Nashville Vanderbilt	SP-CTX5	20.5	4/19/70
New Orleans Main	SP-CTX4	18.4	4/30/70
Shreveport	SP-CTX6	25.6	8/25/73

SOUTHERN BELL TELEPHONE AND TELEGRAPH COMPANY

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Atl. Buckhead	SP-CTX3	0.5	10/16/70
Atl. Courtland #0	SP-CTX5	34.8	11/29/70
Atl. Courtland #1	SP-CTX6	6.6	12/07/73
Atl. Smyrna	CC-CTX6	5.1	12/02/73
Atl. East Point	SP-CTX4	6.7	12/06/71
Atl. Hollywood Rd	SP-CTX6	5.1	12/17/73
Atl. Peachtree #1	SP-CTX5	6.7	11/19/67
Atl. Peachtree #2	SP-CTX4	12.8	11/06/71

SOUTHERN BELL TELEPHONE AND TELEGRAPH COMPANY (CONT.)

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Atl. Toco Hills	SP-CTX4	8.2	4/13/72
Charlotte Caldwell	SP-CTX3	10.2	7/17/70
Clarkston Indian Crk	SP-CTX3	21.5	11/29/70
Florence	SP-CTX4	24.6	4/16/72
Ft. Lauderdale	SP-CTX5	39.9	5/02/71
Gainesville, Fla. Main	SP-CTX6	24.5	12/15/73
Hollywood Main	SP-CTX3	24.6	8/16/70
Jacksonville Clay St.	SP-CTX5	14.3	7/19/70
Miami Beach 672	SP-CTX5	17.9	11/15/70
Miami Metro #1	SP-CTX5	17.9	9/15/73
Miami Metro #2	SP-CTX6	10.2	4/20/74
Miami 378	CC3	8.2	11/05/67
Orlando Colonial	SP-CTX4	12.3	12/05/71
Rome	CC-CTX6	4.1	12/29/73
Winst.-Salem 5th St.	SP-CTX3	15.4	6/20/71

THE OHIO BELL TELEPHONE COMPANY

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Akron Blackstone	SP-CTX6	18.9	2/02/74
Canal Winchester	CC-CTX4	10.2	4/22/72
Cleveland Clearwater	CC-CTX4	4.1	9/15/73
Cleveland Main 621	SP-CTX4	20.5	10/07/67
Cleveland Main 687	SP-CTX5	12.8	7/18/70
Cleveland Main 771	SP-CTX6	18.4	7/14/73
Columbus Capitol	SP-CTX5	50.6	11/09/68
Columbus 231	SP-CTX4	8.2	10/02/71
Columbus 274	SP-CTX4	8.2	1/08/72
Dayton 222, 223	SP-CTX5	24.6	8/30/70
Dayton 293	SP-CTX4	8.2	10/16/71
Euclid Redwood	CC-CTX4	6.1	10/04/71
Maple Hts–Montrose	CC-CTX4	4.1	12/03/72
Shaker Heights	SP-CTX4	18.4	9/17/72
Toledo 382	CC-CTX6	11.3	1/26/74
Toledo 476	SP-CTX5	17.4	9/29/73
Toledo 536	SP-CTX5	7.2	5/30/72
Willoughby Whitehall	CC-CTX2	6.1	11/11/70

MICHIGAN BELL TELEPHONE COMPANY

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Ann Arbor	CC-CTX6	8.2	3/01/74
Detroit Fairborn	CC-CTX4	6.1	11/12/72
Detroit Lakeview	CC-CTX4	17.4	9/09/72
Detroit Trinity #1	SP-CTX5	17.9	12/01/68

MICHIGAN BELL TELEPHONE COMPANY (CONTD.)

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS (K)	CUTOVER DATE
Detroit Trinity #2	SP-CTX5	27.6	9/03/72
Detroit Tuxedo	CC-CTX4	20.5	11/11/72
Detroit University	SP-CTX6	28.7	1/20/74
Detroit Valley	SP-CTX1	28.7	6/22/69
Detroit Vermont	CC-CTX6	17.4	9/30/73
Detroit Webster	SP-CTX5	20.5	11/10/68
Detroit Woodward #1	SP-CTX3	20.5	10/27/68
Detroit Woodward #2	SP-CTX3	20.5	8/16/70
Detroit Woodward #3	SP-CTX5	25.6	7/08/72
Detroit Woodward #4	SP-CTX5	8.2	6/23/73
Grand Rapids Monroe	SP-CTX4	16.4	1/16/72
Highland Pk. Townsend	SP-CTX5	27.6	4/14/68
Lansing	SP-CTX6	14.3	3/02/74
Pontiac Main	SP-CTX5	15.4	4/01/73
Southfield	SP-CTX3	16.4	4/04/71
Sterling Hts Warren	CC-CTX6	6.1	6/23/73
Troy Somerset	SP-CTX5	20.5	11/22/71
Warren Techline	SP-CTX5	23.0	3/16/69

INDIANA BELL TELEPHONE COMPANY, INCORPORATED

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Bloomington	SP-CTX5	33.8	12/03/72
Indianapolis 262	SP-CTX4	9.2	8/27/72
Indianapolis 632	SP-CTX4	21.5	9/26/71
Muncie	SP-CTX5	43.0	5/21/72

WISCONSIN TELEPHONE COMPANY

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Green Bay East	CC-CTX4	10.2	8/21/71
Madison Main	SP-CTX4	15.4	8/22/70
Milw. Aetna Court	SP-CTX5	33.8	3/01/69
Milw. Broadway #1	SP-CTX5	28.7	7/12/69
Milw. Broadway #2	SP-CTX5	16.4	12/02/72
Milw. No. 26th St.	SP-CTX5	13.3	6/02/73
Milw. No. 41st St.	CC-CTX4	15.4	5/15/71
Milw. So. Logan	CC-CTX4	20.5	4/22/72
Milw. So. 26th St.	CC-CTX4	18.4	10/30/71
Milw. Wright	CC-CTX4	10.2	5/20/72
Somers Parkside	CC-CTX4	9.2	7/10/71

ILLINOIS BELL TELEPHONE COMPANY

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Alton College St.	SP-CTX4	18.4	4/04/71
Arlington Heights	CC-CTX4	8.2	12/23/71
Aurora Main	SP-CTX3	24.6	9/20/70
Bellwood	CC-CTX4	10.2	6/24/73
Calumet City	CC-CTX4	6.1	5/14/71
Champaign Main	SP1	28.7	7/04/69
Champaign University	CC-CTX2	15.4	11/27/69
Chicago Beverly	SP-CTX5	14.8	12/03/72
Chicago Calumet	SP-CTX5	36.9	4/12/70
Chicago Canal	SP-CTX6	17.9	2/24/73
Chicago Franklin #1	SP-CTX5	25.6	5/24/69
Chicago Franklin #2	SP-CTX6	16.4	5/28/72
Chicago Monroe	SP-CTX6	30.7	2/15/70
Chicago Portsmouth	CC-CTX4	7.2	11/28/71
Chicago Pullman	SP-CTX6	20.5	6/11/72
Chicago Superior #1	SP-CTX5	26.6	11/10/68
Chicago Superior #2	SP-CTX6	15.4	1/22/72
Chicago Wabash #1	SP-CTX5	16.4	5/27/73
Chicago Wabash #2	SP-CTX5	17.9	5/27/73
Decatur	SP-CTX4	36.9	10/31/71
Elk Grove	CC-CTX4	8.7	12/06/70
Gary North	SP-CTX5	11.3	7/22/73
Chicago Lake Shore	SP-CTX6	15.3	12/15/73
Hinsdale	CC-CTX6	14.3	11/02/69
Hoffman Willow Crest	SP-CTX5	25.6	4/08/73
Kankakee	SP-CTX4	27.6	8/29/71
Lombard	CC-CTX6	6.1	9/30/73
Moline	SP-CTX5	22.5	1/09/72
Peoria Jefferson	SP-CTX3	36.9	8/04/68
Rockford	SP-CTX6	41.0	3/07/71
Summit	CC-CTX6	7.2	2/21/71

NORTHWESTERN BELL TELEPHONE COMPANY

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Council Bluffs	SP-CTX4	25.6	7/10/71
Des Moines Ashworth	CC-CTX4	6.1	11/20/71
Des Moines Downtn	SP-CTX6	12.0	12/07/73
Minneapolis Cedar St.	SP-CTX5	14.3	8/11/72
Minneapolis Crystal	SP-CTX5	28.7	3/08/70
Minneapolis Dwntn #1	SP-CTX3	21.5	10/09/70
Minneapolis Dwntn #2	SP-CTX5	17.4	4/15/73
Minneapolis Franklin	SP-CTX6	16.4	2/16/74
Minneapolis Hopkins	SP-CTX5	28.7	2/24/73
Minneapolis Normandl	SP-CTX5	14.3	10/08/72
Minneapolis South	SP-CTX6	28.7	5/21/71

NORTHWESTERN BELL TELEPHONE COMPANY (CONT.)

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Minneapolis. Orchard	SP-CTX6	23.5	12/22/73
Omaha Douglas	SP-CTX5	24.6	9/05/70
Omaha Izard	SP-CTX5	20.5	3/03/73
Omaha 78th St.	SP-CTX4	16.4	5/16/71
Rapid City, Sd.	CC-CTX6	19.7	11/24/73
Rochester	SP-CTX4	14.3	2/26/67
Sioux Falls Downtown	SP-CTX5	41.0	3/25/73
St. Paul Cottage Gr.	CC3	10.2	10/15/67
St. Paul Market	SP-CTX5	16.9	2/18/72
St. Paul Park Row	CC-CTX6	16.4	2/16/74

SOUTHWESTERN BELL TELEPHONE COMPANY

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Austin, Greenwood	SP-CTX6	32.2	10/27/73
Ballwin Manchester	SP-CTX3	12.8	2/22/71
Dallas Addison 239	SP-CTX5	20.5	7/29/72
Dallas Emerson #1	SP-CTX5	28.7	4/30/70
Dallas Emerson #2	SP-CTX5	24.6	2/17/73
Dallas Farm. Branch	SP-CTX5	24.6	12/09/72
Dallas Riverside #1	SP-CTX5	20.5	1/29/72
Dallas Riverside #2	SP-CTX5	18.4	10/28/72
Dallas Whitehall	SP-CTX5	24.6	4/22/72
Ft. Worth Arlington	SP-CTX5	12.3	3/05/73
Ft. Worth Edison	SP-CTX5	20.5	5/19/73
Hazelwood	SP-CTX5	20.5	3/26/72
Houston Capitol #1	SP-CTX5	16.4	6/28/69
Houston Capitol #2	SP-CTX5	27.6	8/18/73
Houston Fairbanks	SP-CTX5	20.5	10/21/72
Houston Homestead	SP-CTX3	25.6	8/28/71
Houston Mohawk #1	SP-CTX5	24.6	1/27/73
Houston Mohawk #2	SP-CTX5	28.7	9/22/73
Houston Republic	SP-CTX5	23.0	9/29/73
Kansas City Drexel	SP-CTX3	24.6	5/29/71
Kansas City Hiland	SP-CTX5	28.7	4/08/73
Kansas City Wabash	SP-CTX3	25.1	5/23/71
Kirkwood, Mo.	SP-CTX6	.5	11/18/73
Little Rock Franklin	SP-CTX6	9.2	1/19/74
Oklahoma City Jacks.	SP-CTX5	21.5	8/31/73
St. Louis Chestnut #1	SP1	26.1	11/01/69
St. Louis Chestnut #2	SP-CTX4	15.4	2/12/72
St. Louis Evergreen	SP1	26.1	2/02/69
St. Louis Flanders	SP-CTX4	20.5	10/17/71

SOUTHWESTERN BELL TELEPHONE COMPANY (CONTD.)

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS (K)	CUTOVER DATE
St. Louis Forest	SP-CTX5	13.3	8/05/72
St. Louis Jefferson	SP-CTX5	21.5	6/17/72
St. Louis Mission	SP-CTX4	16.4	3/19/72
St. Louis Parkview	SP-CTX5	35.3	12/16/72
Tulsa Elgin	SP-CTX6	18.7	7/01/73

THE MOUNTAIN STATES TELEPHONE AND TELEGRAPH COMPANY

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Boulder Table Mesa	SP-CTX4	18.4	11/07/71
Broomfield Northglen	SP-CTX4	16.4	4/16/72
Colo. Spgs. Pikeview	SP-CTX3	10.2	12/13/70
Denver East	SP-CTX5	10.2	4/29/72
Denver Lakewood	SP-CTX5	20.5	7/17/71
Denver Littleton	SP-CTX5	26.1	1/17/71
Denver Main #1	SP-CTX6	29.2	2/26/69
Denver Main #2	SP-CTX4	24.6	10/31/71
Denver Main #3	SP-CTX5	18.4	6/02/73
Denver North	SP-CTX4	13.3	3/05/72
Denver South	SP-CTX5	12.3	8/20/72
Denver Southeast	SP-CTX5	12.3	9/20/69
Denver Westminster	SP-CTX4	8.2	6/06/70
El Paso Southeast	SP-CTX4	4.1	10/24/71
Los Alamos Main	CC-CTX1	8.2	2/14/70
Phoenix Main	SP-CTX6	10.8	4/28/73
Phoenix Maryvale	CC-CTX2	15.4	1/31/71
Phoenix McClintock	CC-CTX4	12.3	2/06/72
Phoenix Mesa	CC-CTX4	15.4	9/01/71
Phoenix North	SP-CTX6	25.1	8/17/69
Phoenix Northwest	SP-CTX4	10.2	2/06/72
Salt Lake City East	SP-CTX4	10.8	6/28/71
Salt Lake City Main	SP-CTX5	10.8	5/07/73
Tucson Craycroft	CC-CTX4	12.3	7/15/73

PACIFIC NORTHWEST BELL TELEPHONE COMPANY

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Bellevue Glencourt	SP-CTX5	16.4	7/02/67
Eugene 10th Ave	SP-CTX5	16.4	8/22/70
Olympia Evergreen	CC-CTX4	4.1	7/14/73
Olympia Whitehall	SP-CTX4	14.3	11/05/71
Portland Belmont	SP-CTX6	15.4	8/18/73

THE MOUNTAIN STATES TELEPHONE AND TELEGRAPH COMPANT (CONT.)

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Portland Capitol #1	SP-CTX6	17.9	12/03/71
Portland Capitol #2	SP-CTX5	14.3	12/02/72
Portland Capitol #3	SP-CTX6	14.3	8/18/73
Salem	SP-CTX5	8.2	12/09/72
Seattle Campus	SP-CTX5	12.3	5/28/72
Seattle Cherry	CC-CTX6	4.1	3/17/73
Seattle Main #1	SP-CTX6	10.2	1/29/71
Seattle Main #2	SP-CTX5	15.4	12/26/72
Seattle West	CC3	10.2	11/23/69
Springfield N.E. 10th	SP-CTX5	25.6	4/22/72
Tacoma Skyline	SP-CTX6	18.4	8/12/73

THE PACIFIC TELEPHONE AND TELEGRAPH COMPANY

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Alhambra 1st St.	SP-CTX4	12.3	10/04/69
Anaheim	CC-CTX4	6.1	10/17/72
Brea	CC-CTX6	12.3	3/23/74
Burlingame	SP-CTX3	10.2	1/09/71
Compton	CC-CTX6	7.2	4/27/74
Danville	CC-CTX6	12.3	1/07/74
El Cajon	CC-CTX4	5.1	6/18/72
Escondido	CC-CTX4	5.1	11/14/72
Hawthorne	SP-CTX4	15.4	9/25/71
Hayward	SP-CTX5	9.2	11/14/70
L.A. Daley	SP-CTX6	16.4	3/08/74
L.A. So. Vermont	SP-CTX4	8.2	12/18/71
L.A. West Adams	CC-CTX4	8.2	6/29/69
L.A. Whittier	SP-CTX4	7.2	4/17/71
L.A. 420 So. Grand #0	SP-CTX4	22.5	5/29/70
L.A. 420 So. Grand #1	SP-CTX5	20.5	3/17/72
L.A. 420 So. Grand #2	SP-CTX6	20.5	3/30/73
L.A. 420 So. Grand #3	SP-CTX6	20.5	2/08/74
Monterey	SP-CTX6	2.0	2/15/74
Northridge	SP-CTX3	10.2	1/23/71
Oakland Franklin #1	SP-CTX4	21.5	2/26/71
Oakland Franklin #2	SP-CTX5	28.7	2/17/73
Oakland Franklin #3	SP-CTX5	12.3	2/17/73
Oakland Holly	SP-CTX4	24.6	7/15/72
Palo Alto	SP-CTX4	8.2	2/12/72
Pasadena	CC-CTX6	6.1	7/21/73
Rosemead	SP-CTX4	8.2	7/01/71
S.F. McCoppin St.	SP-CTX4	20.5	9/19/70
S.F. 2nd & Folsom	SP-CTX6	20.5	5/25/73
S.F. 2345 Pine St. #1	SP-CTX5	8.2	10/24/70

THE PACIFIC TELEPHONE AND TELEGRAPH COMPANY (CONT.)

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
S.F. 2345 Pine St. #2	SP-CTX4	23.6	2/04/72
S.F. 555 Pine St. #1	SP-CTX5	26.1	4/16/71
S.F. 555 Pine St. #2	SP-CTX4	20.5	1/21/72
S.F. 555 Pine St. #3	SP-CTX5	20.5	8/04/72
S.F. 9th Ave	SP-CTX4	8.2	12/04/71
S.J. Almaden Valley	SP-CTX4	10.2	1/29/72
S.J. So. White Road	CC-CTX4	12.3	1/22/72
Sacramento Wabash	CC-CTX4	4.1	4/08/72
San Bruno SF Airpt	SP-CTX5	10.2	6/03/72
San Diego Lindavista	CC-CTX4	10.2	8/26/72
San Diego 9th Ave	SP-CTX5	17.9	3/12/71
San Jose Main	SP-CTX4	16.4	1/28/72
San Juan Capistrano	CC-CTX4	12.3	12/18/71
San Mateo	SP-CTX5	20.5	11/08/69
Santa Ana-5th St.	SP-CTX4	13.8	9/02/67
Santa Ana, Irvine	CC-CTX6	12.3	9/23/73
Stockton Main	CC-CTX4	8.2	4/03/71
Van Nuys Cedros	SP-CTX6	4.1	1/09/72
W.L.A. Bev. Hills #1	CC-CTX6	11.3	1/08/67
W.L.A. Bev. Hills #2	SP-CTX4	22.5	9/06/70

CINCINNATI BELL INC.

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Avondale	SP-CTX5	8.7	7/15/73
Cincy. East	CC-CTX4	9.2	1/10/71
Cincy. Groesbeck	CC-CTX4	4.1	6/04/72
Cincy. Valley	CC-CTX4	12.3	5/07/72
Cincy. W. 7th St. #1	SP-CTX5	27.6	10/26/68
Cincy. W. 7th St. #2	SP-CTX5	18.4	6/14/70
Covington	SP-CTX4	16.4	8/01/71
Hamilton	SP-CTX3	27.7	11/02/69
Norwood	SP-CTX5	22.5	4/16/72

THE SOUTHERN NEW ENGLAND TELEPHONE COMPANY

INSTALLATION	GENERIC PROGRAM	EQUIP. LNS(K)	CUTOVER DATE
Bridgeport	SP-CTX6	32.8	1/26/74
Bristol	CC-CTX4	6.1	4/21/68
Hartford	SP-CTX6	17.5	12/31/73
Manchester	CC-CTX4	7.7	8/26/67
Meriden	CC-CTX4	3.1	1/18/70
New Haven Hamden	CC-CTX2	3.1	12/06/70
New Haven Westville	CC-CTX4	3.1	5/31/70
Norwalk	CC-CTX4	8.7	10/21/67
Stamford	CC-CTX6	6.1	2/25/73
Stratford	CC-CTX4	5.6	12/17/67

No. 1 ESS Offices in Service as of May 1, 1974

CC-3	6
SP-1	4
CC-CTX-1	2
CC-CTX-2	7
CC-CTX-4	66
CC-CTX-6	32
SP-CTX-1	2
SP-CTX-3	31
SP-CTX-4	72
SP-CTX-5	174
SP-CTX-6	55
	451

Bell of Canada

SP-CTX-1	11

No. 1 ESS (2-wire) Systems and Lines in Service

	1965	1966	1967	1968	1969	1970	1971	1972	1973
Systems	1	2	18	41	70	127	208	315	427
Working Lines (Millions)	.004	.008	.076	.339	.642	1.233	2.107	3.585	5.347