

APPLICATION GUIDE FOR THE PREPARATION OF DETAILED
DIAL CENTRAL OFFICE EQUIPMENT REQUIREMENTS

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1. GENERAL

1.1 This section provides REA borrowers, consulting engineers, contractors, and other interested parties with technical information for use in the design and construction of REA borrowers' telephone systems. It discusses in particular the design of dial central offices.

1.2 This section has been revised as Issue No. 7 to conform with the latest revision of the REA Central Office Equipment Contract, REA Form 525, revised September 1966 and REA Form 545, revised September 1966.

1.3 The General Specifications, REA Form 558a, which form a part of REA Central Office Equipment Contracts, REA Forms 525 and 545, establish minimum performance requirements and capabilities for dial central office equipment to be supplied for use on the telephone systems of REA borrowers. However, the many variables involved make it impracticable to devise a single overall specification for central office equipment which will insure the provision of adequate and appropriate facilities to fit every situation. Accordingly, Part III, "Detailed Central Office Equipment Requirements," REA Form 558c, was prepared to permit the particular arrangements and requirements for individual offices to be specified to prospective suppliers of the equipment. The "Detailed Requirements" are based upon the premise that the central office equipment is in compliance with the General Specifications. Therefore, prior to preparation of the "Detailed Requirements," the General Specifications should be consulted.

1.4 Most of the items covered by REA Form 558c are those that have purposely been left flexible in the General Specifications in order to meet the requirements of individual situations. In some instances it may become necessary to deviate from the basic requirements established in the General Specifications. Such deviations should be limited strictly to obtaining all the features required for each situation. They should be shown in detail in Part III, and will supersede the requirements established in Part I (General Specifications).

1.5 The Area Coverage Design for the project should be studied carefully and thoroughly understood since most of the required information for preparing the specifications and request for bids on central office equipment will be found therein.

1.6 For larger offices (1000 lines or more), it may be desirable to make some changes in REA Form 558. For engineering large offices refer to REA TE & CM-520, "Central Office Equipment Switch Quantities (Large Central Offices)," and specify in Item 23.0, Part III, REA Form 558c, that the traffic tables contained in REA TE & CM-520, "Central Office Equipment Switch Quantities (Large Central Offices)," were used as a basis for determining intraoffice trunking requirements.

2. APPLICATION GUIDE

2.01 The discussion that follows has been prepared to assist the borrower or its engineer in the completion of Part III, REA Form 558c, of the Central Office Equipment Contract. The item numbers shown correspond to those in Part III.

2.02 Each central office should be designated as being "attended" or "unattended" by checking the appropriate square in the box at the top of Page 1. An "attended" office is one where an attendant is available at all times. A dial office located in a building which also houses a toll board would be considered "attended," provided someone on duty can handle minor duties connected with the dial equipment, such as disconnecting a line which has a permanent on it. An office also could be considered "attended" if the maintenance man lives nearby and has all alarms indicated in his home when he is not at the office.

2.03 Items 2.01 through 2.12

2.0301 The data to be entered in Items 2.01 through 2.11 represent the number and classification of central office lines to be equipped initially (five-year figure from the Area Coverage Design).

2.0302 Determination of the numbers of subscribers' lines should be based upon the number of subscribers in the various categories (as determined in the Area Coverage Design), and the assumed "line fills" (average number of parties served from one line).

2.0303 It is anticipated that for both buried and aerial plant approximately an 80 percent line fill will be achieved for all classes of service by the end of the five-year period. On this basis, the following line fills should be assumed:

<u>Class of Service</u>	<u>Main Stations Per Line</u>
Two-Party	1.6
Four-Party	3.2
Five-Party	4.0
Eight-Party	6.4

2.0304 The subscriber data for the five-year period, by classes of service, should be entered in Column (b) of Item 11.01. Care should be exercised in this connection to insure the separation between business and residence subscribers.

2.0305 Utilizing the line fills and subscriber data discussed above, the number of lines should be determined for each class of service, maintaining the separation between business and residence service wherever applicable. The number of lines, in every case, should be rounded off to the next highest whole number.

2.0306 The "number of lines" figures to be entered in the "initially equipped" column of Item 2.0 for offices served by aerial plant should be determined from Item 11.01 in the following manner:

2.03061 Assume that the number of business two-party main stations is 12.

2.03062 Assume that the number of residence two-party main stations is 60.

2.03063 The number of business two-party lines will be 12 divided by 1.6 or 7.5 lines. Enter 8 lines in Item 11.01.

2.03064 The number of residence two-party lines will be 60 divided by 1.6 or 37.5 lines. Enter 38 lines in Item 11.01.

2.03065 The number of lines to be entered in Item 2.02 will be the sum of the two-party lines; that is 8 lines plus 38 lines, or 46 lines.

2.0307 The number of "official lines" need not be calculated, but should be estimated for each exchange involved. Any lines not included in the Area Coverage Design, such as business office line(s), manager's line, repairman's line, etc., should be entered under Item 2.07. One line should be shown for wire chief, Item 2.08.

2.0308 Thought should be given to the possible requirements for consecutively numbered line service or key systems, Item 2.09. Business establishments not large enough to require a PBX often can make good use of this type of service. As the use of one-party service increases, it is probable that the use of consecutively numbered lines will also increase. Item 1.033 of Part I states that if an office has no immediate need for consecutively numbered line groups, the equipment shall be arranged initially to permit the addition at a later date of a trunk hunting line group. This means that if an office has no immediate requirements for consecutively numbered line groups, the "initially equipped" column (Item 2.09) should read "0". If the requirement of Item 1.033 of Part I were not provided, it might later prove difficult and expensive to modify the equipment supplied to add this feature.

2.0309 If the number of subscriber lines as totaled in Item 2.10 is not an even multiple of ten, the total should be "rounded off" to the next higher multiple of ten and this "rounded off" figure entered in Item 2.11.

2.0310 In determining line and terminal requirements, consideration should be given to the number of lines and terminals required for test purposes as specified in Items 1.025 and 1.026 of Part I.

2.0311 The total number of connector terminals to be entered in Item 2.12 will be the same as the "rounded off" number of main stations entered in Column (c) of Item 11.01. Each connector terminal can serve only one station.

2.04 Item 2.13

2.041 The switchboard wired capacity requires careful thought since this item should indicate the actual number of subscriber lines which the equipment will be wired to serve. One thing that makes this item difficult to fill in is the difference in the types of equipment furnished by the various manufacturers. The wired capacity of a switchboard generally refers to the number of line circuits which may be added and utilized without the necessity of adding interconnecting wiring.

2.042 Since the wiring for line circuits usually is intimately associated with linefinder groups, the wired capacity of the larger size switchboards will usually be a multiple of 100 lines. If the equipped size of the switchboard is equal to a multiple of 100 lines, often the equipped capacity and wired capacity will be the same since to do otherwise might require frames with nothing but wiring on them. If the equipped number of lines exceeds 100 lines or exceeds a multiple of 100 lines, it is the usual practice to wire for the next higher multiple of 100 lines. For example, if 120 lines are to be equipped, wiring for 200 lines would usually be specified.

2.043 Where small central offices are involved, particularly those equipped initially for less than 100 lines, the wired capacity will usually be 100 lines.

2.044 Basically the dial central office equipments, which are being used on REA borrowers' projects, are the linefinder-selector-connector type.

2.045 With the linefinder-selector-connector office the wired capacity will be 100 or a multiple thereof. Trunk groups are accessed from selector levels and therefore do not reduce the possible number of subscriber lines.

2.046 Enter the same quantity of connector terminals in Item 2.132 as is shown in Item 2.12, since to do otherwise would require empty frames or shelves.

2.05 Item 2.14

2.051 The ultimate number of lines and trunks should be estimated from the Area Coverage Design. In the absence of detailed information, and provided the present population trend is not downward, an ultimate capacity for $1\frac{1}{2}$ to 2 times the initial number of subscribers may reasonably be assumed. It may also be assumed that the service will become totally one party within 25 years.

2.052 Since manufacturers make different types of equipment for different size offices, the number of lines specified in Item 2.14 will aid the manufacturer in determining the type of equipment to provide initially so that future growth may be handled in the most economical manner.

2.053 Very careful consideration should be given to each situation since an error in judgment in this respect might prove very costly. The ultimate size practically always will be a multiple of 100.

2.054 The ultimate number of lines and connector terminals usually may be determined by assuming that the service will become totally one party within 25 years and then rounding off the resulting lines to the next highest multiple of 10 and the terminals to the next highest multiple of 100.

2.06 Item 3.01

2.061 Equipment purchased under the REA Central Office Equipment Specification is capable of serving subscriber lines with loop resistances, including the telephone set, up to and including 1900 ohms. The addition of extra central office equipment such as long line adapters, may be necessary in certain cases where the loop resistance of some lines exceeds 1500 ohms and the Bidder is not willing to guarantee operation without adapters. If there are any lines with a greater loop resistance, the number of such lines should be indicated in the appropriate space. The manufacturer is required by the specification to provide long line adapters for all lines which are above 1500 ohms, if this is the upper limit for his standard equipment. It should be assumed that the resistance of a telephone set is 200 ohms on all loops. Refer to Item 1.021, Part I.

2.062 The subscriber loops exceeding 1500 ohms resistance are divided into three categories; namely, 1501-1900 ohms, 1901-3200 ohms, and 3201-4500 ohms. Long line adapters used in the 1501-3200 ohms category shall be connected to a 24-volt booster power supply and those used in the 3201-4500 ohms category shall be connected to a 48-volt booster power supply. See Part I, Item 1.022. If a 48-volt booster is required for one or more long line adapters, it shall be applied to all long line adapters. The long line adapters supplied by most manufacturers will

operate satisfactorily over these long loops, but additional treatment may be necessary to provide acceptable voice transmission. Refer to TE & CM-424, "Design of Two-Wire Subscriber Loop Plant."

2.07 Item 3.02

2.071 The number of paystation lines with loop resistances, including the paystation, greater than 850 ohms, but not more than 1600 ohms, should be indicated in this item. The loop limit is dictated by the minimum amount of current which will operate the d.c. relay in the paystation which is 26 milliamperes at 44 volts. It may be assumed that the resistance of a paystation is 300 ohms.

2.08 Item 4.0

2.081 Certain special types of operation may require a more sophisticated arrangement than conventional direct control. For example, a call may require special circuitry to store, translate, and transmit information to effect a connection from the calling to the called party because of unusual numbering plans.

2.082 These special operations include but are not limited to EAS translation for complex trunking networks, alternate routing to achieve greater trunking flexibility and efficiency, MF outpulsing to match connecting circuits and certain other features such as push button calling.

2.083 Special types of operation which are needed should be indicated in Items 4.01 to 4.04 inclusive. Sufficient information should be given and if necessary, include a note opposite the proper item saying "See Item 23.0, Explanatory Notes, for details."

2.09 Item 4.05

2.091 Two types of paystations are commonly used in the Class 5 offices of REA borrowers. The semi-postpay type has been used most extensively and requires the least amount of central office equipment. The calling party dials a local number and when the called party answers, the current in the calling line is reversed. This disables the transmitter in the calling telephone. The calling party hears the distant party answer, but conversation cannot take place until a proper coin is deposited by the calling party. When a call is made to an operator, the current in the line is not reversed and a coin need not be deposited. This type of paystation circuit also transmits a tone to an operator for identification.

2.092 The local prepay, toll postpay, is an economical system well suited for those areas in close proximity to metropolitan exchanges where full prepay paystations are in service. The differences will be less apparent to users in that a coin must be deposited before dialing can be accomplished. Automatic refund of coins takes place on calls to an operator or where a busy or "no answer" condition is encountered. The collecting or refunding of coins is automatic and is not controlled by an operator. The cost for this type of paystation equipment in the central office will be higher than the semi-postpay type, but considerably less than the full prepay service.

2.093 Full prepay service is usually limited to Class 4 offices where a toll board is available for manually collecting and refunding coins.

2.10 Item 5

2.101 The lockout feature permits the switching equipment to automatically disconnect any line equipped with lockout after an interval of 15 seconds to 6 minutes should a "permanent" condition occur prior to the transmission of dial impulses. Where the outside plant is predominately buried plastic insulated cable, the chances of shorts and crosses between the conductors is greatly reduced and the need for the lockout feature is not so acute. However, open wire plant and telephones "off hook" still remain possible sources of permanents. See Item 1.101, Part I.

2.102 Some operating companies prefer to equip for lockout only the rural lines or those not in cable. If such lines are a large percentage of the total equipped lines, then 100 percent lockout should be specified. Offices which require less than 100 percent line lockout will be arranged so that the lines equipped with lockout are evenly distributed over all the linefinder groups in the office.

2.103 If conditions are such that the lockout feature is not considered a necessity, it may be possible to effect significant savings in the purchase of some types of central office equipment by omitting this feature. An office which will have a maintenance man in attendance most of the day may not require the lockout feature. Whether the omission of lockout will result in significant savings could be determined by showing 100 percent (or less) in Item 5.01 and requesting that the omission of lockout be quoted as an alternate. A note could be inserted in Item 23.0 with words to this effect: "Note: Quote amount to be deducted from purchase price if the lockout feature specified in Item 5.01 is omitted."

2.11 Item 6.01

2.111 Conversation timing may be had on all nontoll calls, except revertive and special service calls. At the end of a predetermined time (six to nine minutes), the connection will be broken down. A warning tone is applied to the line approximately one minute preceding the breakdown of the connection.

2.112 Although it might be desirable, it is not possible to obtain equipment at reasonable cost which will time party lines and not individual lines. When conversation timing is applied to any line, it must usually be applied to all lines.

2.113 In general, conversation timing has been associated with subscribers on multiparty lines. It is often a problem to impose this restriction on individual line subscribers. Therefore, serious consideration should be given before requiring conversation timing on all nontoll calls in an office with a high percentage of individual lines. See Item 1.104, Part I.

2.12 Item 6.02

2.121 If conversation timing is considered necessary on local-to-local calls only, this item should be checked.

2.13 Items 6.03 and 6.04

2.131 Conversation timing may be applied on extended area service trunk calls only. This is a desirable feature when the trunk group is smaller than actual requirements at the time of cutover due to connecting company limitations or if this feature is required by the connecting company.

2.132 If conversation timing is desired on extended area service trunks, this feature should be coordinated with the connecting offices to determine which method of timing would best fulfill the requirements. Some companies will not permit conversation timing. REA recommends that sufficient trunks be installed so that conversation timing is not necessary.

2.14 Item 7.0

2.141 Busy verification is a feature which permits a toll operator to override a busy line condition. The purpose is to permit an operator to determine if a line is out of order or if there is somebody talking on the line. It also permits an operator to verify the number given by a subscriber on a toll call. Under no circumstances should busy verification be made available to anyone except the toll operator and supervisory personnel, such as the wire chief. The problem of restricting the busy verification feature to the toll operator when the toll trunks are also used for direct distance customer dialing is discussed under Item 2.152. Also, see Item 1.083, Part I.

2.15 Items 7.01 and 7.02

2.151 The universally accepted method of busy verification over regular toll trunks has been one in which the operator prefixes the directory number with a single digit. This single digit may be any digit "1" to "0", but any digit except "0" will use a level which may be required later for more urgent uses. The level "0" is very useful for verification since on incoming toll selectors it cannot be used for any other purpose. REA is attempting, wherever possible, to standardize on the use of the level "0".

2.152 The problem of distinguishing between incoming operator dialed calls and incoming customer dialed calls to prevent customers on direct distance dialed calls from having access to busy verification can be solved in some cases by assigning a two-digit busy verification code, such as "00". On a call to another telephone in the same numbering plan area, if a customer dials the two-digit code (00) between the office code and the last four digits of the subscriber directory number (SDN), the call will be blocked in common control systems because the senders will not handle over eight digits. On interarea calls, the three-digit area code must be dialed first, in which case the sender can accept 11 digits, but with "00" preceding the last four digits of the called number, the total number of digits dialed will be 12 and the sender will reject the call. The "00" code is satisfactory when cut-through to the called line on a verification call is effective on the last digit. If, however, the equipment is designed to cut-through to the called line on a verification call on the next to last digit, it becomes necessary to use "000" code. It should be determined that the "000" code, if assigned, is effective in blocking access to busy verification to customers on direct distance dialed calls. It should not be possible to dial either "00" or "000" and enter a busy line if the verification code is "000".

2.153 In areas where customer toll dialing is anticipated in the near future, the connecting company may ask for this double or triple digit arrangement. If the connecting company does not request the multiple digit code, it should be questioned as to exactly what method will be used to prevent customers in the Nationwide Network from having access to the busy verification feature. The digits need not be the same although "00" or "000" is preferred. When the multiple digit code is used, it is only necessary to specify the two-digit code under Item 7.01. Refer to Item 1.083 of Part I.

2.154 Access to busy verification may also be denied the customer on a direct distance dialed call by arranging only one operator office trunk for busy verification and then making it last choice to the intertoll train at the toll center or not even giving the intertoll train access to it. These arrangements, of course, will be under control of the company operating the toll center.

2.155 Some connecting companies are requesting that a separate trunk be dedicated to only two functions; namely, busy verification from the toll board to the end office and intercept from the end office to the toll board. Access from the intertoll network to busy verification would thereby be impossible. If a dedicated one-way verification trunk for inward usage only is desired, check Item 7.021. If a two-way trunk to be used only for verification inward and intercept outward is desired, check Item 7.022.

2.16 Item 8.01

2.161 A choice must be made as to the type of ringing current generator to be used. For operating requirements, see Item 4.08, Part I.

2.162 The magnetic, static type of ringing current generator is very popular since it requires very little maintenance. It is obtainable in one, two, four, or five frequencies. When using superimposed ringing, the single frequency (20-cycle) unit will be specified. When frequency ringing is utilized, the five frequency unit is generally used for multiparty service. Since the static type of generator operates directly from commercial 120-volt line voltage, each of the frequencies is derived from the 60-cycle line voltage. It is possible to provide the magnetic, static unit at a much lower cost for the decimonic frequency series (20, 30, 40, 50, and 60 cycles) than for any other series because the frequencies are sub-multiples of 60 cycles. Magnetic, static machines of the synchronomic series (20, 30, 42, 54, and 66 cycles) are available, but are quite expensive.

2.163 The solid state, static type of ringing current generator operates directly from the central office battery. It is available in any series of frequencies. The cost is the same for any series and compares favorably with the cost of the magnetic type. If solid state ringing generators are used, the synchronomic series of frequencies should be specified, unless the project is already committed to some other series by existing exchanges. The synchronomic series, being a "non-multiple" series, has less tendency toward false ringing than either the decimonic or harmonic series.

2.164 Only the required frequencies should be specified and the power requirements in watts should be indicated for each ringing frequency according to the information contained in REA TE & CM-212, "Ringing Systems."

2.17 Item 8.02

2.171 Item 4.083 in Part I of the Specifications requires that provision be made for the continuity of ringing current if the commercial a.c. power is off or the primary ringing current generator fails. The solid state type is a good choice for a standby ringing current generator because it operates directly from the central office battery, requires very little maintenance, and is stable in operation.

2.18 Item 8.03

2.181 The superimposed type of ringing is used widely in the Bell System. It provides full selective ringing for lines having up to four stations and semi-selective ringing on lines having five to eight stations. Superimposed ringing has the advantage of requiring comparatively simple and, therefore, inexpensive ringing equipment in the central office. It has the disadvantage of requiring a polarizing tube for each station on lines with more than two stations. If the exchange consists principally of one- and two-party lines, superimposed ringing is very desirable.

2.20 Item 8.04

2.201 Part I of the Specifications requires only one long ring on multifrequency connectors, or on any connectors in a system designed for service to not more than five parties on any one line. With five ringing frequencies and one long ring only available, a maximum of five parties may be placed on one line if the ringers at the telephones are to be bridged across the line. The ringing cycle will not exceed eight seconds on connectors arranged for one long ring only, but may require eight to ten seconds

if both one long and two short rings are needed. It is recommended that one long ring only be checked if no more than five-party service is specified, or if eight-party service is included and the outside plant does not contain lines with more than 10 miles of open wire in joint use nor more than 15 miles of open wire without joint use. Check one long and two short rings if eight-party service is specified and the outside plant contains lines which exceed the above limits. In this case, bridged ringing will probably be required.

2.21 Item 8.05

2.211 When frequency ringing is utilized, it is necessary to have a means of checking the frequencies and the output voltage on each frequency. When a telephone company has only one central office, a panel-mounted set of frequency and voltmeters is desirable. In cases where a telephone company operates several offices, it is desirable to have portable meters which can be carried about by the maintenance man.

2.22 Item 9.0

2.221 One form of restricted service is intended to prevent certain subscribers from making extended area service calls which other subscribers can make on a flat rate charge basis. This feature has not been widely used in community dial offices for several reasons. One reason is the cost in additional outside plant facilities since all subscribers on any one line must necessarily have the same type of service. This considerably reduces the flexibility in the operation of the outside cable plant and makes it more difficult to maintain good line fill.

2.222 Another form of restricted service is intended to prevent paystations, and other special lines if specified, from reaching trunks for direct distance dialing.

2.23 Items 9.01, 9.02, and 9.03

2.231 There are two means for providing restricted service. If there are just one or two lines which require this feature, it is usually better to specify Item 9.011 or Item 9.021. Items 9.012 or 9.022 calls for the setting aside of one or more levels on linefinder banks which are to be used exclusively for restricted service lines.

2.232 The term "Restricted Level" in Item 9.03 refers to the selector level from which access is had to the trunk group that is restricted to some subscribers. The term "Trunks To" serves to further identify the trunk group.

2.233 "Number of Restricted Lines in Group" gives the manufacturer an estimate of how many lines to provide for restricted service facilities.

2.234 Facilities for Direct Distance Dialing are constantly being expanded and preparation should be made to provide this service. Paystations, and other special lines if specified, must be restricted from reaching DDD trunks. It is recommended that the equipment to block paystations, and other special lines if required, from reaching DDD trunks always be specified initially to prevent the necessity for making expensive modifications at a later time. The exception would be where automatic toll ticketing equipment with automatic number identification is to be installed in this office. In this case the blocking will be provided in the automatic number identification equipment.

2.24 Item 10.0

2.241 The General Specifications (Item 1.111, Part I) requires that subscribers on the same line shall be able to call each other. Several methods by which this may be accomplished are explained below:

2.2411 Item 10.01

2.24111 This item covers the "Special Number" or "Revertive Call Switch" method where a special one, two, or three-digit code, followed by one identifying digit for the calling party and one for the called party are dialed. On terminal-per-station offices the digits dialed to identify the calling and called parties will have no relation to the subscriber's directory number. Therefore, on terminal-per-station systems it is necessary to either keep all parties on a party line informed as to the SDN of each party on their line, what digit to use in making a revertive call to each party or inform all party line subscribers to obtain instructions from the operator or some other source when it is desired to make a revertive call. With this type operation, both the calling and called parties' telephones ring until either one is answered.

2.2412 Item 10.02

2.24121 This item should be checked only for offices when there is no preference between revertive call by code plus directory number or by directory number only. The "Directory Number" method is simply the dialing of the subscriber's directory number. The General Specifications require that if only the directory number is dialed to establish a revertive call, the calling party must receive a distinctive tone or a recorded announcement when he dials another party on the same line, and the called party must receive a distinctive tone when he answers. A warbling or tick tone is considered distinctive. This will indicate to both parties that a revertive call has been made. By prefixing the SDN with a revertive call code, the possibility of anyone unknowingly setting up a revertive call is virtually eliminated. Certain types of equipment provide for ringing the calling party's telephone by dialing the calling party's identification digit after the SDN. This, of course, results in the most satisfactory operation, but is not available on all types of central office equipment.

2.2413 Item 10.03

2.24131 This item should be checked if reverting call by directory number only is desired. The General Specifications require that when directory number only revertive call of the type in which only the called party's telephone rings is furnished, the equipment shall be designed to provide a distinctive tone or a recorded announcement to the calling party when he dials another party on the same line, and a distinctive tone to the called party when he answers. This type of operation is desirable in that it eliminates the necessity of keeping the parties on the same line advised of moves or changes. If there is a preference for either the tone or recorded announcement, it should be indicated in Item 23.0.

2.2414 Item 10.04

2.24141 This item should be checked if there is no preference for the method of making revertive calls.

2.2415 When revertive calling is provided by means of special switches, determination of the required number of revertive call circuits should be made as follows: Add the unit calls for two, four, five, and eight-party lines and multiply this total by .0075 if the board is arranged for 100 percent line lockout. Otherwise, use .05 as the multiplier. This figure is the total unit calls which the revertive call switches must handle. From the intraoffice trunking tables (REA TE & CM-510, Figure 2A, "Telephone Traffic - Dial Central Office Switch Quantities") under the P=.01 column, select the required number of revertive call circuits. The .0075 figure is arrived at from the following two assumptions:

- (a) That five percent of the party line traffic will be revertive call traffic.
- (b) That the average holding time of a revertive call circuit is 15 seconds.

Note: A minimum of two revertive call circuits should be provided.

2.25 Item 11.0

2.251 This item will serve as a work sheet to determine the traffic requirements for terminal-per-station offices. The results obtained from filling in this item will be transferred to the Switching Diagram included under Item 26.0. Item 1.0701, Part I, states that, "The number of intra-office trunks shall be calculated from the traffic information furnished on the Switching Diagram, Item 26.0, Part III, of these specifications, based on the tables given in Items 7 or 8 (whichever is appropriate) of Part I." Therefore, it is essential that all the traffic information appear on the Switching Diagram. Item 11.0 is worded so that it is furnished for information only and the Bidder will not be bound by the traffic figures in it, but will be bound by the traffic figures shown on the Switching Diagram.

2.252 Item 11.01

2.2521 This item should be filled in only when it has been impossible to obtain the actual measured traffic data in the approved Area Coverage Design. This actual traffic data, when available, should be used to show the originating and terminating traffic in Items 11.02 and 11.03. If it is not available, then fill in Item 11.01, using the number of main stations for the five-year period as obtained from the Area Coverage Design. The following unit calls per main station shall be used, unless justification for different values is given prior REA approval:

<u>Class of Service</u>	<u>Unit Calls per Main Station</u>
Individual - Business	1.5
Individual - Residence	1.0
Two-Party - Business	1.2
Two-Party - Residence	0.8
Four-Party	0.6
Five-Party	0.6
Eight-Party	0.5-0.6
Paystations	1.5
PBX Lines	4.0
Official Lines	2.0
Wire Chief	1.0

When an office contains a large number of interoffice trunks, the interoffice trunk traffic should be compared with the total originating traffic to make sure the unit station calling rate is high enough. This is especially true if there are EAS trunks. Determination of the number of lines to be entered in the schedules under Item 11.01 should be made in the manner described in Paragraph 2.03 of this section of the TE & CM.

2.253 Item 11.02

2.2531 If the computed calling rate, using the factors in Paragraph 2.252, comes to less than 1.6 UC/L for offices with eight-party service or 1.4 UC/L for offices with four or five-party service, the offices should be engineered to handle 1.6 UC/L or 1.4 UC/L, respectively. It is recommended that a minimum of 1.1 unit calls per line for single party systems and 1.3 unit calls per line for one and two-party systems be used to assure adequate traffic handling capacity for these systems. REA believes these figures are the minimum which may be used to insure that adequate traffic carrying capacity will be provided.

2.254 Item 11.03

2.2541 If it is necessary to increase the originating calling rate to obtain the values as described above, then the terminating rate should be increased in the same proportion.

2.255 Items 11.031 and 11.032

2.2551 To insure that manufacturers of different types of equipment will be providing equivalent operational features and traffic carrying capacities, both Items 11.031 and 11.032 must be completed and the results included on the Switching Diagram. Certain types of equipment are arranged so that the PBX groups can be distributed throughout all the regular connector groups. Of course, this sort of arrangement would require a higher average calling rate for connector terminals than the arrangement where all the PBX trunks are confined to one or two connector groups. It is also important that the Switching Diagram show if the connector group arranged for PBX trunk hunting is to handle Multiparty or Individual line service.

2.256 Example for the completion of Item 11.0.

11.0 Traffic Calculation (See Item 1.0701, Part I, for Quantities of Intraoffice Trunks to be Furnished).

11.01 Applicable parts of this item shall be completed for all types of offices.

Estimated Initial Originating Traffic (Busy Hour)					
Terminal-per-Station					
		a	b	a x b	
Class of Service		Unit Calls Per Main Station	No. of Main Stations	Total U.C. by Class of Service	No. of Lines ***
One Party (Excl. PBX)	B	1.5	80	120	80
	R	1.0	50	50	50
Two Party	B	1.2	32	39	20
	R	.8	48	39	30
Four Party	B				
	R	.6	192	116	60
Five Party					
Eight Party					
Pay-station		1.5	2	3	2
PBX		*4.0	**6	24	6
Official Lines		2.0	2	4	2
Wire Chief		1.0	1	1	1
Total			<u>413</u> (500) (c)	396 (d)	<u>251</u> (260) (e)

- * This figure is the unit calls per PBX (PABX) trunk.
- ** This figure is the number of PBX (PABX) trunks.
- *** See Item 2.0.
- **** The number of main stations (c) should be increased by ten percent and then rounded off to the next multiple of 100. The number of lines (e) should be rounded off to the next multiple of 10, as shown in Item 2.11, Part III.

11.02 Originating Traffic

$$\frac{(d)}{(e)} = \frac{396}{260} = 1.52 \text{ UC/L}$$

This office has been engineered to handle an initial average originating busy hour traffic of 1.60 unit calls per line. It is anticipated that during the next ten-year period, the average originating busy hour traffic will increase to 2.0 unit calls per line.

11.03 Terminating Traffic

11.031 Note to Engineer: Show originating and terminating traffic on Switching Diagram.

11.0311 Where the PBX groups are distributed throughout the regular connector groups:

$$\frac{(d)}{(c)} = \frac{396}{500} = .792 \text{ UC/Connector Terminal}$$

This office has been engineered to handle an initial average terminating busy hour traffic of .80 unit calls per connector terminal specified in Item 2.12.

11.0322 Where the PBX groups are confined to a separate connector group (or groups):

$$\frac{(d) - (\text{Total PBX UC})}{(c) - (\text{Total PBX Trunks})} = \frac{396 - 24}{500 - 6} = .753 \text{ UC/Regular Connector Terminal}$$

This office has been engineered to handle an initial average terminating busy hour traffic of .76 unit calls per connector terminal, except in the 33XX (PBX) group.

The 33XX (PBX) groups shall be equipped to handle 94 unit calls and shall be arranged to provide, in addition to PBX trunk hunting, the service indicated on the Switching Diagram. Please refer to Figure 1.

2.2561 The 94 unit calls were determined as follows:

<u>Type of Service</u>	<u>Unit Calls</u>
6 PBX terminals at 4 UC	<u>24</u>
92 Regular Terminals at .76 UC	<u>70</u>
Total	<u>94</u>

The maximum number of usable terminals in the PBX trunk hunting group of connectors is 98 since two terminals will be used for test purposes.

2.26 Item 12.0

2.261 In offices of 300 lines or more, it is desirable that a test man be able to rapidly test all of the lines in the office. To do this a separate train of switches is provided which enables the test man to connect metallicly to each line to make all his tests from his test board. One test distributor for each access trunk to the test train is normally required. REA TE & CM-520 discusses when additional test distributors are required.

2.262 In general it may be said that offices up to 300 lines do not require test trains. In small offices the line testing can easily be done from the main distributing frame.

2.27 Item 13.0

2.271 Since the introduction of direct distance dialing, intercept facilities have become mandatory. Intercept is considered adequate by the Bell System if the following criteria are met:

- (a) Interception of vacant levels, where practicable.
- (b) Interception of nonworking numbers (connector terminals) for which there are two or more incoming calls per week. If a count is not available, nonworking numbers listed in the current directory are to be intercepted until reassigned.

2.272 There are two basic types of intercept equipment. The calls may be intercepted either by a recorded announcement or by an operator. Intercept by an operator is probably the preferred method for most REA borrowers because it gives the calling subscriber the most complete service. The cost of operators is included in the operator assistance agreement. The time the operator office trunks are used for intercept is very small.

2.273 In the larger offices (over 500 lines), the recorded announcements and operator intercept are often handled over separate trunks. The recorded announcements are used for disconnected and unassigned numbers while calls to changed numbers are handled by operators.

2.274 One intercept trunk circuit (Item 13.03) is usually sufficient for offices up to 500 lines, if only a recorded announcement or only operator intercept is employed. This trunk circuit is the common intercept equipment which connects the intercepted line to a recorder or to an operator trunk. If both recorded announcement and operator intercept are used, a minimum of two trunks will be required, one for each type of service.

2.275 Where the regular interoffice toll trunks are not used to carry intercepted calls to operators, a separate intercept trunk group is used (Item 13.041). There will be as many operator intercept trunks specified under Item 13.03 as there are intercept trunks appearing at the attended location. The method of reaching the operator (Item 13.04) will depend on the local situation. If the dial equipment is in the same building as the toll switchboard, a separate trunk group (Item 13.041) is advisable. In unattended dial operation regular interoffice trunks (Item 13.042) are usually employed. For other details see Item 1.12, Part I, of the General Specifications.

2.28 Item 14.0

2.281 It has become increasingly important with the advent of intertoll dialing to give serious consideration to the numbering scheme to be used in any area. There are so many details that the subject of numbering cannot be covered in this section. The subject is discussed at length in REA TE & CM-156, "Nationwide Toll Dialing," and TE & CM-208, "Local Exchange Numbering Plans and Selector Level Assignments."

2.282 It is important that the scheme adopted should provide for universal numbering if present or future EAS is involved.

2.29 Item 14.01

2.291 Each office must have a separate three-digit office code. This code is assigned from a list maintained by the Bell System, and should be obtained from the connecting company prior to the preparation of this specification in order that the central office equipment may be designed for operation with the nationwide toll dialing plan.

2.292 All offices purchased under REA specifications will be equipped initially for seven-digit dialing. This is covered in Item 1.0717 of the General Specifications.

2.30 Item 14.02

2.301 Generally a directory number is composed of seven digits although only four or five digits may be required to complete a local call through the switching equipment. The figure to be inserted in this item is the minimum number of digits which the numbering plan requires to complete a local call. The equipment should still be designed so that local calls will also be completed if the full seven-digit number is dialed. Telephone users are generally instructed to dial all seven digits of the called number.

2.302 Local calls in direct control type equipment usually may be completed by dialing a minimum of four digits when no extended area service to other offices is involved.

2.303 When direct extended area service trunks to one or more offices are involved, five-digit dialing on local calls is required to maintain universal numbering within the EAS area. In this case this item would show five, however, it is advisable to instruct the customers to use the full SDN of seven digits.

2.304 When extended area service trunks to one or more offices tandem (switch) through an intervening office, seven-digit dialing on both local and EAS calls would be required to maintain universal numbering. While four or five-digit dialing could be used for completing local calls, all calls should be completed by dialing the seven-digit directory number.

2.305 The number of digits to be effective in the end central dial office on incoming toll calls usually will be stipulated by the connecting company. This number of digits should be kept to four wherever possible in order to avoid the provision of an absorption feature on the incoming switch. This is shown on the Switching Diagram.

2.306 Digit absorbing toll selectors should be furnished only when it is agreed that it is unduly expensive to absorb all three digits of the office code in the toll center. See Paragraph 2.152 of this section.

2.31 Item 14.03

2.311 This item refers to the Switching Diagram which is to be furnished under Item 26.0 for level assignments and other numbering information. See Paragraph 2.54 of this section for information required on the Switching Diagram.

2.32 Item 14.04

2.321 Item 14.04 should be checked if grading is required initially or may reasonably be expected to be required during the life of the equipment.

2.33 Items 15.01, 15.011, and 15.031

2.331 In most instances, special service calls will be handled by the operator at the toll center who will be reached over the regular toll trunks by dialing the digit "0". When this is the case, the name of the toll center should be entered in Item 15.01 in the space provided and Items 15.011 and 15.031 should be checked.

2.34 Items 15.012 and 15.032

2.341 In those instances where the toll center is located in a large town and has a separate special service desk, and where the tributary (borrower's) office has extended area service into the toll center, it may be required by the connecting company that the EAS trunks be used to handle special service calls.

2.342 Assuming that local subscribers in the connecting company exchange (toll center) dial "113" to reach the information operator, and the digit "8" is dialed by subscribers in the borrower's exchange to access EAS trunks to the toll center, the latter subscribers would dial "8113" to reach the information operator at the toll center.

2.35 Items 15.013 and 15.033

2.351 Provision of a special service desk in the same building with the dial equipment may be warranted if the dial office of the borrower is a large one. A cost comparison will disclose if this type operation would be feasible. In such cases it may be desirable to establish special service codes such as "113" for information, "114" for repair, etc. This procedure would require the provision of special service trunk groups and separate trunk circuits. See REA TE & CM-520, "Central Office Equipment Switch Quantities (Large Central Offices)."

2.36 Item 15.02

2.361 In some instances it may be desirable to handle special service calls locally. This may be done at a regular telephone in the business office by a clerk who also has other assigned duties. In this case the subscriber lines necessary for this purpose would be specified under Item 2.07, Official Lines.

2.362 In some cases it may be desirable to have special service calls handled locally during regular business hours and by the regular toll operator at all other times. In such event, appropriate explanation and notations should be made in both Items 15.01 and 15.02.

2.37 Item 16.0

2.371 The main distributing frame provides a place where the outside plant and the inside plant are both terminated and connected together by means of jumper wires.

2.372 A "B" type main distributing frame has all outside lines terminated on protectors on the vertical side and all switchboard cables terminated on terminal blocks. Because of the protection provided for the outside plant and due to the very little, if any, difference in cost between this type and the "A" frame which furnishes protection only to the switchboard side, the "B" type has been selected as the standard type to be used on REA borrowers' projects.

2.373 Generally, a floor type MDF is used in offices with an ultimate capacity of 100 lines or more.

2.374 A main distributing frame has line intermediate distributing frame (LIDF) facilities on it and is called a "combined distributing frame." The LIDF permits a redistribution of originating traffic without changing subscribers' numbers. Item 2.09, Part I, requires that an LIDF should be furnished on all offices.

2.375 Item 16.03

2.3751 Protectors will only be furnished for cable pairs specified in Item 16.02. If the connecting company requires any additional protectors, terminal blocks or verticals on the MDF, they should be specified under this item.

2.376 Item 16.04

2.3761 This item when properly completed will specify in detail exactly what is to be furnished to meet the requirements for main frame protectors. Care should be exercised in checking the features which are desired.

2.3762 The number of pairs of cable terminals will be the same or greater than that shown in Item 16.02 inasmuch as all cable pairs must be terminated.

- 2.3763 The number of arrester units will be the same as the number of pairs of cable terminals, unless only working pairs are to be equipped with arresters and provided an acceptable means for grounding unprotected pairs, such as strapping these terminals to ground, is furnished by the supplier as stated in Part I, Item 2.01. In this latter case it is only necessary to show the actual number of pairs to be equipped with arresters.
- 2.3764 When the grounding of unprotected pairs is provided, show the number of terminated cable pairs to be grounded. This will always be the difference between the total number of outside cable pairs to be terminated, Item 16.02, and the number of pairs of arrester units.
- 2.3765 Modular construction provides a compact, replaceable unit for each arrester or pair of arresters. If this type is desired, check "yes". If this is not desired or if there is no particular preference, check "no".
- 2.3766 The purpose of factory assembled tip cables is to obtain a factory grade of workmanship which reduces the danger of solder splashes and may be less costly than if assembled on the job site. Please refer to Item 2.06, Part I, of the General Specifications for details.
- 2.3767 The standard length of factory assembled tip cables is 20 feet. If for some reason a different length is required, it should be shown.
- 2.3768 Some protector units are arranged so that the terminals may be either wire wrapped or soldered as desired. If solder is once used on a terminal, it cannot be wire wrapped at a later time. If there is a preference for wire wrap or solder, it should be indicated. At the time these specifications were issued a combination of "dead front" and "solder only" terminals was not available.
- 2.3769 The single operation cutover feature, through the use of plastic picks, provides a means for the separation of switchboard circuits from outside cable conductors. The picks may be strung on cords in groups of 100, for example, and plugged into 50 line circuits to isolate 50 "in" and "out" circuits. A quick pull on the cord will immediately activate 50 lines. If this feature is desired, it should be so indicated.
- 2.3770 "Pairs per vertical" and "height of verticals" are self-explanatory and should be filled in to meet the particular requirements. Fanning strips are usually required.
- 2.38 Items 17.01 and 17.02 (Refer to Items 4.071-4.078, Part I)
- 2.381 A battery reserve of five busy hours usually will be adequate for offices located in areas where a.c. power failures are infrequent and where such failures last less than five hours. If an emergency a.c. power plant is to be used, a battery reserve of three busy hours is sufficient.
- 2.382 In areas where power failures are frequent or of longer duration, an eight busy hour reserve is desirable.
- 2.383 Engine-driven generators are often used to provide a.c. power when a failure occurs in the commercial power supply. These units may be of the portable type and may be used where required in a multioffice system. In offices over 1,500 lines, or offices including a toll board, or where there are frequent power failures, permanent units should normally be provided. Standby engine generators should be purchased separately and not included in the central office equipment specifications.
- 2.384 Check Item 17.011 to show whether an engine generator is to be permanently installed.
- 2.385 Both lead antimony and lead calcium batteries are available in the range of capacities required in REA borrowers' dial central offices.
- 2.386 Lead antimony batteries have an average useful life of approximately ten years when properly maintained, and cost about 15 to 20 percent less than the lead calcium type.
- 2.387 It appears that maintenance of the two types of batteries is about equal, except that water additions are much less frequent for the lead calcium battery.
- 2.388 Since the life of lead antimony batteries is roughly ten years, the size (ampere hour capacity) selected should be just ample to serve the office ten years from the time they are installed.
- 2.389 Lead calcium batteries have an estimated life of about 20 years and, therefore, lend themselves for use in those dial central offices only where future requirements for a 20-year period can be closely predicted.

2.390 The lead calcium type battery gases very slightly and, therefore, the electrolyte does not get thoroughly mixed for some time after the cells have been on charge following a discharge condition. For this reason, stratification of the electrolyte occurs and a specific gravity reading taken from the top of the cell will not be representative of the condition of the overall cell. Cell voltage readings are usually taken to determine the condition of the battery instead of specific gravity readings.

2.39 Item 17.03

2.391 This item should be checked whenever a lead calcium battery is specified and also should be checked when a lead antimony battery is specified if it is contemplated that voltage readings will be used in the battery maintenance.

2.40 Item 17.04

2.401 The type of battery rack specified should be determined by space considerations. In most cases a two-tier rack will be the best for use in small offices.

2.41 Item 17.05

2.411 A hydrometer is required if a lead antimony battery is specified. It is not as desirable for use with a lead calcium battery, unless the battery has a special construction so the electrolyte can be accessed at the proper level.

2.42 Items 17.06 and 17.07

2.421 Any 48-volt d.c. power requirements necessary for the operation of carrier, voice frequency repeaters, toll board or any other equipment not considered as part of the dial central office equipment should be set forth under Item 17.06. The total 48-volt direct current drain of the special equipment in amperes (drain required during an a.c. power failure) is required. The connecting company requirements for both this item and Item 18.02 are available from a properly executed REA Form 810, "Central Office Equipment Engineering Information." These current drains should be the estimated requirements to coincide with the life of the battery.

2.422 Specify in Item 17.061 battery and fusing requirements for connecting company equipment and special equipment that is not part of the dial equipment, based on current drain as specified in Paragraph 2.421 above.

2.423 A 24-volt booster power supply will be required to increase the voltage available at the long line adapter circuit on lines having a loop resistance exceeding 1500 ohms, including the telephone set, when long line adapters are supplied. A 48-volt booster power supply will be required to increase the voltage available at the long line adapter circuit on lines having a loop resistance exceeding 3200 ohms, including the telephone set. If the booster power supply with either the 24 volts or 48 volts output is specified, it should be connected to all long line adapters to gain maximum benefit, inasmuch as the current drain for each adapter is low. Insert the number of lines in Item 17.07 for the 15-year period which will have a loop resistance, including the telephone set, greater than 1500 ohms, so that a booster power supply of sufficient capacity will be furnished.

2.43 Item 18.01 (Refer to Items 4.061-4.065, Part I)

2.431 The solid state silicon rectifier has become widely used in charging central office storage batteries of the type generally found in REA borrowers' offices.

2.432 This type rectifier has an average life of about 15 years; therefore, the rectifier supplied should have sufficient capacity to handle the office 15 years after the date of installation.

2.433 If the future requirements of the office are very indefinite, it might be advisable to specify a rectifier suitable for a shorter period with the idea in mind that, when the future requirements are known, a second rectifier could be provided to supplement the first. Additional chargers may be added in parallel.

2.44 Item 18.02

2.441 Any special 48-volt d.c. power requirements necessary for the normal operation of carrier, voice frequency repeaters, toll board or any other equipment not considered as part of the central office equipment should be set forth under this item. The total current drain of the additional equipment in amperes during normal operation should be specified. These drains should be estimated requirements to coincide with the life of the charger.

2.45 Item 18.03

2.451 The data entered in this item should provide all pertinent information regarding the characteristics of the commercial a.c. power supply since it will be utilized by the equipment manufacturer in selecting the type of charging equipment with the specified input rating.

2.452 The following criteria should be utilized in determining the charger input rating according to the available primary (commercial) a.c. power supply:

2.4521 Offices up to 100 lines may best be served by 120-volt, single-phase, 60-cycle power.

2.4522 Offices from 100 lines to 400 lines may best be served by 120/240-volt, single-phase, 60-cycle power.

2.4523 Offices over 400 lines may best be served by 120/240-volt, three-phase, 60-cycle power.

2.46 Item 19.0

2.461 All central offices should be equipped with a hand test telephone and a wire chief's test set. These two items of test equipment are specified in Items 3.01 and 3.02, Part I. Additional equipment is listed under Item 19.0, which may be checked, if desired. As in the case of frequency meters, if several exchanges are involved, one set of some items of test equipment may be used on a portable basis for all exchanges.

2.462 The routine test set is used to run tests on the switching equipment. Because this test set differs widely between manufacturers, it is recommended that when the central office equipment is procured under competitive bidding, this item should not be specified. It may be purchased, if desired, after the contract is let and it is known what type of equipment is being furnished. On negotiated contracts where the type of equipment and the advantages of having a routine test set are known, the set may be specified.

2.463 A current flow test set is required to accurately adjust relays and to measure d.c. current. An exception to this would be where a supplier furnishes a resistance box and whose relay adjustment instructions are designed for such an instrument. It is suggested that this item should be purchased separately when the supplier's recommended relay adjustment procedure becomes known.

2.464 The howler circuit can be quite helpful and will prove to be a timesaver if it is actually used. It should be kept in mind, however, that a man is required at the central office to place the howler on a line and then remove it. The General Specifications require that the howler circuit must operate through the wire chief test circuit and be arranged to remove tone and restore the line to a serviceable condition automatically when the receiver is replaced. The effectiveness of the howler has been reduced where the varistor equalized "500" type telephones are used.

2.465 There are several types of dial speed test sets. The panel type (Item 19.04) is one which is permanently mounted in the central office and is accessed by dialing a particular digit or code. It will return to the calling party readily identifiable signals to indicate that the dial speed is slow, normal, or fast. This type set is only recommended for the larger offices (600 lines or more). The portable type (Item 19.05), when used at the central office, requires a man to read it as well as someone at the telephone to operate the dial. One of these units may be used to serve several central offices.

2.466 It is desirable to provide a transmission test circuit to permit testing of toll connecting trunks from a distant toll office without any assistance in the local dial office. This is true where the trunks include electronic equipment such as carrier, microwave, or voice frequency repeaters. The equipment is also useful for testing EAS trunks and subscriber carrier circuits. A detailed description of this "loop around" test circuit is contained in Item 3.05 of Part I. If this test circuit is desired, check Item 19.061. The frequency or frequencies desired should be shown in Item 19.0611.

2.467 A special "loop around" test path may be provided in local Class 5 offices so that a test board attendant in the toll office can measure the transmission loss on outgoing CAMA trunks or other one-way outgoing trunks without assistance in the local office. This CAMA loop around test path would be entirely separate from that used for interconnecting incoming or two-way toll connecting trunks. Access to the CAMA test path would be provided on an unused level in the bank multiple of the incoming toll selectors, by relying on the fact that all ten of the "thousands" digits are practically never assigned for access to local numbers and to verification. Hence, an unused "thousands" digit can be assigned to the special loop around trunk. Vacant level tone without intercept facilities would be connected to this level, but the toll attendant would be instructed to

ignore this tone and he would continue to dial, first the number of the selected CAMA trunk and then "104", or an equivalent test code, for extending the CAMA trunk to the test board in the toll office. The outgoing end of the loop around trunk would be terminated ordinarily in a minor switch, or equivalent, since access will usually be required to ten or less CAMA trunks. Where more than ten CAMA trunks are required, a larger switch such as an out-trunk secondary would be required and two digits would be dialed for reaching the higher numbered CAMA trunks. The outgoing switch would not be arranged for trunk hunting, but would step only to the pre-selected trunk and cut in if the trunk were idle. This loop around path does not utilize the local office milliwatt supply circuit, since the transmission loss on the CAMA trunk can be readily ascertained in both directions from the known losses in both directions on the reference trunk. The loop around path should be completely free of any transmission bridges once the CAMA trunk has been selected by the toll attendant, the battery supply relay in the outgoing CAMA trunk being held operated by the loop closure in the two-way reference trunk. Since called party supervision is not repeated back by CAMA trunks and off-hook supervision is desired on the two-way reference trunk, it can be produced artificially by reversing the talking conductors in the loop around trunk thereby reversing the polarity of the battery supply from the CAMA trunk. Release of the reference trunk in the toll office should release the entire connection in the local office. If an access circuit for testing outgoing CAMA trunks is desired, check Item 19.062.

2.468 A circuit for testing the stability of voice frequency repeaters and other electronic equipment may be requested by the connecting company which owns the toll center. If it is to be provided, Item 19.063 should be checked.

2.469 If frequency marking is used in the connector circuits, a frequency marking alarm panel should always be provided if the number of equipped connector terminals equals or exceeds 500. A frequency marking panel is desirable, but should not be considered mandatory for offices equipped with 200 to 500 connector terminals. An alarm panel is not essential if less than 200 connector terminals are equipped. This panel will permit rapid identification by means of lamps and isolation by means of small toggle switches of grounded ringing leads whenever such a condition exists. Check Item 19.071 if a frequency marking alarm panel is desired.

2.47 Item 20.0

2.471 Unattended dial central offices always will have alarm checking and sending equipment as provided for in Item 1.06, Part I, of the General Specifications.

2.472 Sometimes it may be desirable to handle the alarm signals locally. It should be determined, however, that someone will always be in attendance to receive the alarm signals before considering this method of operation. It should also be kept in mind that when sending alarm conditions to a local telephone, a failure of all ringing supplies will prevent transmission of alarms, unless a special alarm panel is specified for use along with the local telephone and d.c. signaling is accomplished over a third conductor.

2.473 Carrier trunk groups are sometimes divided into two categories, those that have a lower priority and those that have a higher priority. The lower priority groups should be assigned a minor alarm and the higher priority groups should be assigned a major alarm. If such a distinction is to be made, the proper signals should be checked in Item 20.03. If priorities are not assigned at the time of the initial installation but may be assigned at a future time, check Item 20.033.

2.48 Item 21.0

2.481 The General Specifications require that the Bidder submit a tentative floor plan drawing showing the layout of the equipment. If a new building is contemplated, Item 21.01 should be checked. If the equipment is to be placed in an existing building, Item 21.02 should be checked and a drawing of the room should be attached. The drawing should show the clear ceiling height, location of any pillars, doorways, windows, radiators, etc., and room dimensions.

2.482 If the ultimate requirements are very uncertain, buildings are sometimes constructed so that an inside or outside wall can be removed after 10 to 12 years of growth to permit further expansion. In general, removal of an outside wall is practicable only for offices initially equipped for 300 lines or more.

2.49 Item 22.0

2.491 An interoffice trunking diagram is a very useful aid when setting up requirements for an office, particularly one which is part of a network of offices. One should be submitted with these plans and specifications and may be an up-to-date copy of the trunking diagram included in the Area Coverage Design as Exhibit C.

2.50 Item 23.0

2.501 Any items which need further clarification should be covered under Explanatory Notes, Item 23. See Paragraphs 1.6 and 2.5315 for examples. Also, if mobile radio service is planned, a note should be inserted under Item 23 stating that the feature described in the General Specifications, Part I, Item 1.0710, which provides for the release of the entire switch train under the delayed control of the called party, shall be a mandatory requirement for the connector group containing the mobile radio lines. This connector group should be specified in the note, and designated on the Switching Diagram, Item 26, as "release feature, see Item 23."

2.502 Any carrier equipment, voice frequency repeaters, or standby power plants which are to be installed should be purchased under a separate special equipment contract. Do not include this equipment in the Central Office Equipment Specifications.

2.503 Where it is desired to include a specification for furnishing a fire reporting system with the central office equipment, this may be done under Item 23. See REA TE & CM-141, "Fire Alarm Service (Community Dial Systems)."

2.504 Special arrangements of wiring or equipment not covered in Parts I or III of the specifications, but desired in some special situations, should be specifically described under Item 23. For example, an Owner may want the necessary circuits of linefinders, selectors, connectors and interoffice trunks wired to external patch jacks in 19-inch or 24-inch racks to facilitate making connections to traffic measuring devices. Or perhaps it may be considered desirable that the insulation on the marking wire for each ringing frequency be a separate color to facilitate identification. Each special feature or arrangement should be adequately described in a separate note under Item 23. The number of such notes should be kept to a minimum and should cover only essential features.

2.51 Item 24.0

2.511 If any size and/or shape restrictions apply to the central office equipment building due to lot size, lot location, or for any other reason, a sketch of the tentative building plan should be included under this item. Any detailed information which might be available at this time regarding the building should be included with the exception of overall dimensions.

2.512 Two optional floor plan arrangements are provided in Item 24.0. The first option is to provide for a partition to isolate the space occupied by that equipment to which frequent access is required from the switching equipment. This keeps much of the dust and dirt from the switching equipment and tends to reduce its maintenance.

2.513 The second option is to provide for a vestibule which also aids in preventing dust and dirt from being blown or tracked into the space occupied by the equipment. When either or both of these options are checked the Bidder will take them into consideration when arranging the floor plan.

2.52 Item 24.01

2.521 Any floor space which may be required for carrier, repeater, or any other equipment not furnished by the Bidder should be listed under this item. The connecting company requirements are readily available from a properly executed REA Form 810.

2.53 Item 25.0 Trunking Requirements Form

2.5301 General. Also see Item 1.08, Part I.

2.53011 A considerable portion of the information necessary to complete the Trunking Requirements Form can be obtained from a completely and properly executed REA Form 810 for the borrower's exchange. A completed REA Form 810 must be secured for each exchange before attempting to complete the Trunking Requirements Form. The Form 810 should be included with the specifications sent to suppliers for information purposes.

2.53012 The Trunking Requirements Form is made up of two general parts. Lines 1 through 22 shall contain information which will enable the manufacturer to furnish the desired types of trunks as well as the desired signaling. Lines 23 through 32 shall specify the actual wired and equipped quantities of trunks, repeating coils, incoming selectors, signaling circuits, composite sets, and hybrids required.

2.5302 Line 1 Group

2.53021 As is indicated, the name of the distant office is entered in the block at the head of the column. This is the geographical name of the distant office.

2.53022 The group of trunks will be designated as Two-Way, In, Out, or a combination of the three as desired. The quantity of each type should be indicated.

2.5303 Lines 2-9 Number and Type of Operation of Interoffice Trunks

2.53031 When there is a choice available, considerable care should be exercised in choosing the type of operation of interoffice trunks.

2.53032 The principal application for loop dialing is on one-way trunk groups where the distances between offices are relatively short. Standard loop dial trunks will operate satisfactorily over circuits up to 1200 ohms loop resistance. Above this figure special signaling is necessary. Above 2000 ohms loop dialing is not dependable except when very sensitive relays are used. Loop dial trunks should only be used on circuits above 1200 ohms when it is a requirement of the connecting company. There are two options for a loop type of operation. The battery-ground pulsing uses two windings at each end of the trunk, connected together with positive and negative potentials in series aiding. This effectively doubles the current in the loop. The loop pulsing has a relay at one end of the trunk, connected to positive and negative potentials, and operated by opening and closing a shunt at the other end. Before specifying either option the connecting company should be consulted. In such cases it is very important that the connecting company circuit drawing number for its end of the trunks is made available to the central office equipment supplier. Certain carrier derived trunks are coming into use where the trunk circuit is included as part of the carrier equipment. This eliminates the need for separate trunk circuits in the central office.

2.53033 Loop dial trunks cannot be used on phantom groups and where it is desirable to obtain an additional trunk circuit on two existing physical pairs composite operation must be used. The use of phantom circuits is not recommended because they are susceptible to induced noise.

2.53034 Simplex (SX) trunk operation has the following advantages:

1. Simplex trunks can operate over a much higher resistance circuit than loop dial trunks.
2. Trunk circuits arranged for simplex operation may be readily converted to composite type operation.
3. Trunk circuits designed for simplex polar-duplex operation (E-M) may be readily converted to carrier operation.

2.53035 Composite (CX) trunk operation is used either in conjunction with phantom groups or single conductor pairs. This single trunk compositing may be requested, in preference to SX operation, by certain connecting companies in areas where earth compensation is necessary. It will be a little more expensive than simplex due to the cost of the composite equipment. Because of the difficulties encountered in maintaining a good balance between side circuits of a phantom group, it is strongly recommended that the use of phantom groups be avoided.

2.53036 Carrier operation has the advantage of creating additional trunking paths with built-in signaling channels by superimposing voice modulated carrier waves upon existing physical trunk circuits. There is also certain application for radio-derived trunk circuits and when this facility is used, the central office trunk equipment should be arranged for E-M operation unless otherwise specified. A detailed discussion of carrier operation and radio-derived trunks may be found in the 900 series of this Manual.

2.53037 E-M operation of carrier-derived trunks is desirable and should be specified unless other operation is required by the connecting company. E-M type signaling when applied to physical circuits is also known as polar-duplex signaling.

2.53038 Item 1.085, Part I, General Specifications, states that idle circuit terminations shall be provided on interoffice trunks equipped for E and M signaling, and remain in the circuit until the called party answers. It is the purpose of this requirement to maintain the trunk in a terminated condition before the called telephone answers to prevent singing or other undesirable effects when carrier or multiplex equipment is involved. If the idle circuit termination normally in the circuit is removed upon seizure of the trunk, and some equivalent form of termination is substituted until the called party answers, the intention of the specification will be met. The objective is that the circuit shall have a terminated condition at all times to ensure quiet operation.

2.53039 DX operation will be requested by some of the Bell operating companies for use exclusively in cable circuits. It will be used instead of loop signaling on longer EAS or toll trunks and instead of SX or CX on short intertoll trunks. It can be operated without impairment through E type repeaters, or equivalent. DX operation requires a trunk circuit with E and M lead signaling. Therefore, a trunk circuit arranged for polar-duplex signaling (E-M) may be used over SX, CX, DX, or carrier facilities.

2.53040 Refer to REA TE & CM-319, "Interoffice Trunking and Signaling," for a more detailed description of trunk signaling and operation, including E type operation.

2.5304 Lines 10-12 - Usage

2.53041 The use to be made of the trunks should be checked in the usage column. If the same trunks are to be used for both extended area service and toll, both items should be checked. If special services are handled over the toll trunks, "special service" should be checked in addition to "toll."

2.5305 Lines 13-14 - Type of Switchboard at Distant End

2.53051 An indication should be given as to whether the switchboard at the distant end is dial or common battery toll.

2.5306 Lines 15-18 - Trunk Physical Characteristics

2.53061 The trunk physical characteristics should be given since this information helps the manufacturer determine the type of trunk circuit he is to furnish. The only time this information may be omitted is when the trunks are entirely owned by the connecting company and the connecting company is furnishing the simplex, composite or DX balancing and signaling sets in the local office, or when the trunks are carrier derived.

2.5307 Lines 19 and 20 - Type of Supervision on Loop Trunks

2.53071 Supervision on loop dial trunks is accomplished on either a "reverse battery" or a "reverse battery, high-low resistance" basis, and the applicable method should be indicated in this item. Where dial to dial trunks are involved, line 19 should be checked for loop trunks with reverse battery supervision. Where dial trunks to a manual office are involved, line 20 should be checked for loop trunks with reverse battery and high-low resistance supervision. In the latter case, it would be possible to eliminate the high-low resistance feature if the manual office operates on 48 volts, but this is not the usual situation.

2.53072 Reverse battery supervision, as the name implies, is supervision provided by effecting a reversal of battery potential on the trunk.

2.53073 When supervision on a trunk is accomplished by effecting a change in resistance of a bridge across the trunk, it is referred to as high-low supervision. Most two-way loop dial toll trunks will use the "reverse battery, high-low" type of supervision so that duplex (two-way) operation may be obtained. It is very important to specify the reverse battery, high-low type if this is to be employed by the connecting company.

2.5308 Lines 21 and 22 - Type of Signaling on SX and CX Trunks

2.53081 Signaling on simplex and composite trunks is usually either "Positive-Negative" or "Polar-Duplex" (E-M).

2.53082 Positive-negative signaling is best suited for use on relatively short trunks and does not provide all of the features that E-M signaling does. With "positive-negative" signaling, operation is generally limited to trunks with a maximum dialing leg resistance of 500 ohms. The signaling range of the trunk is affected by such factors as battery voltage, insulation resistance, and earth potentials.

2.53083 Positive-negative operation provides for signaling in only one direction at a time. Further, this type of signaling cannot readily be used with carrier equipment.

2.53084 In spite of the above-mentioned drawbacks, positive-negative type signaling is adequate for most extended area service trunks and is used to some extent on short haul toll trunks.

2.53085 A trunk circuit arranged for polar-duplex (E-M) signaling can be used interchangeably with simplex, composite equipment, carrier or microwave and is, therefore, somewhat more flexible than the positive-negative type trunk circuit.

2.53086 Polar-duplex operation provides simultaneous signaling in both directions (duplex operation), low impulse distortion, means for earth potential compensation and operation with a signal leg resistance at least five times that possible with positive-negative operation. Earth potential compensation should be used on SX and CX trunks with E-M signaling.

2.5309 Line 23 - Trunk Circuits

2.53091 Trunk circuits are also frequently referred to as impulse repeaters, or simply as repeaters by the manufacturers of dial central office equipment. It should be pointed out that the term "trunk terminating circuits," as covered in REA Form 810, refers to all equipment between the switchboard trunk circuit and the trunk conductors, whereas this item "trunk circuit" refers to the switchboard trunk circuit itself.

2.53092 The number of trunk circuits will usually be equal to the total number of trunks indicated in lines 2-6. The exception would be those carrier derived trunks where the trunk circuit is included as part of the carrier equipment. Trunks, if this type, should be deducted from the total number of trunk circuits. Otherwise, the trunk circuits will always be furnished by the manufacturer of the central office switch equipment since they are included as part of that equipment. If the connecting company into which the trunk group operates claims it will furnish the local trunk terminating equipment, it does not mean to imply that it will furnish the trunk circuits which are required in this item. The connecting company means, by such a statement, that it will furnish line balancing equipment, repeat coils, and signaling circuits.

2.53093 It is desirable to have only one type of trunk circuit in an office. Exceptions are where there is a substantial number of each type or the connecting company requests one type and it may be considerably cheaper to furnish another type for trunks to another office.

2.5310 Line 24 - Repeating Coils (Also see Item 1.085, Part I)

2.53101 The total number of repeating coils required to be furnished by the Bidder shall be specified in this line. All trunk circuits require a repeating coil except when carrier equipment is used. Omit repeating coils for carrier derived trunks. If the connecting company is furnishing the trunk terminating equipment, repeating coils need not be specified. Otherwise, or if in doubt, specify a quantity of repeating coils equal to the total number of physical trunk circuits.

2.5311 Line 25 - Incoming Selectors (See Item 1.081, Part I)

2.53111 Two-way trunks and one-way incoming trunks will usually terminate on incoming selectors. The equipped quantity of incoming selectors will always be equal to the total equipped quantity of these trunk circuits. The wired quantity of incoming selectors should be carefully considered. If it is known that additional trunks will be required in the near future, it may be advisable to provide space and wiring for these trunks and their incoming selectors initially. If it is known that a trunk group will not be expanded for some time, it probably will not be economical to provide space and wiring for additional selectors, especially if empty frames and shelves must be furnished initially.

2.5312 Lines 26-29 - Number of Duplex Signaling Circuits

2.53121 For SX trunks employing "positive-negative" type signaling, no separate signaling circuits are required.

2.53122 For SX trunks employing "polar-duplex" (E-M) signaling, one duplex signaling circuit will be required for each trunk. The signaling circuit will be furnished by the connecting company if it is furnishing the termination equipment.

2.53123 For CX trunks employing "positive-negative" type signaling, no separate signaling circuits are required.

2.53124 For CX trunks employing "polar-duplex" (E-M) type signaling, one duplex signaling circuit will be required for each trunk. Here again, the signaling circuit will be furnished by the connecting company if it is furnishing the termination equipment.

2.53125 For DX trunks, a DX signaling circuit is required. This circuit is different from the duplex signaling circuit used on SX or CX facilities and, therefore, must be specified in line 27 when required. This signaling circuit will also be furnished by the connecting company if it is furnishing the termination equipment.

2.53126 For carrier trunks employing (E-M) type signaling, no separate signaling circuits are required since the necessary signaling equipment is contained in the carrier equipment itself.

2.53127 Carrier trunks employing "loop-type" signaling will sometimes be encountered. However, no separate signaling circuits would be required with such trunks.

2.53128 Each set must be equipped with a 60-cycle filter as specified in Part I, Item 1.088.

2.5313 Line 30 - Quantity of CX Sets

2.53131 The CX sets are the line balancing equipments and are specified for single physical trunk operation, one for each CX trunk. These may be furnished by the connecting company. This must be determined.

2.5314 Line 31 - Carrier or Microwave Hybrid

2.53141 If trunks are to connect into carrier or microwave, the quantity of hybrids, their type and drop impedance, should be specified.

2.5315 If any trunk equipment is to be supplied at distant offices under the specification, it should be listed under lines 23 to 32, and an explanation listed under Item 23.0. If the distant end office is a manual board and the distant end terminating equipment is to be furnished under this specification, the cord circuit drawing number and manufacturer must be shown.

2.54 Item 26.0 - Switching Diagram

2.541 A switching diagram similar to Figure 1 for a terminal-per-station office shall be furnished.

In systems made up of several offices, it is advantageous to show the switching diagram of all exchanges on one drawing. Also, where both toll and local equipment are included under the same contract, as in the case of a toll center, a combined toll and local switching diagram should be used. Figure 2 is an example of a combined diagram.

2.542 It is absolutely necessary that this diagram shall contain all numbering and traffic information as it will be used by the supplier in furnishing the equipment.

2.543 The numbering plan for all offices should be set up on the basis that selectors will be employed. If the equipment proposed is not of a type which can readily be engineered according to this plan, the Bidder may furnish a plan which will be equivalent with respect to both numbering and traffic. This is covered in Item 1.0701, Part I.

2.544 Since the office will be "equipped" for seven-digit numbering, all levels may be assigned the N, A, AR, or B function based upon the requirements of the specific situation. These functions are defined in REA TE & CM-208, "Local Exchange Numbering Plans and Selector Level Assignments." In making up the numbering plan, one should analyze and thoroughly understand the operation of the switch and what happens when any digit is dialed for the first time and what happens when the same digit is dialed a second time.

2.545 Following are a few general criteria which should prove helpful in connection with the completion of this item:

2.5451 Digit "0" is the digit universally accepted for reaching the assistance and toll operator, and the "0" level of the first selector (or connector) should be reserved for this use and be assigned the "H" function.

2.5452 Digit "9". Wherever possible subscriber directory numbers ending with numerals between 9000 and 9999 should be reserved for paystations. There are situations, however, where this feature cannot be provided without a substantial increase in the cost of central office equipment. In those instances the possibility of using levels 7 or 8 should be investigated. It is customary practice for paystation lines to be assigned in the same hundreds group as other local lines, so level "9" ("8" or "7") is usually multiplied to a local connector level. The "function" assigned to this level may be B, H, AR, or A, as dictated by circumstances.

2.5453 Level "1" is usually made an AR level in order to absorb preliminary impulses such as false dialing and line slap, and will probably be used to access direct distance dialing trunks (Code 1X or 1XX) in the future. It is recommended that this level should be reserved for present or future use of the direct distance dialing code.

2.5454 In assigning selector levels to local connectors, it is preferable to start assignments with the lowest numbered selector level available, such as level "2", so assignments can proceed in an orderly manner.

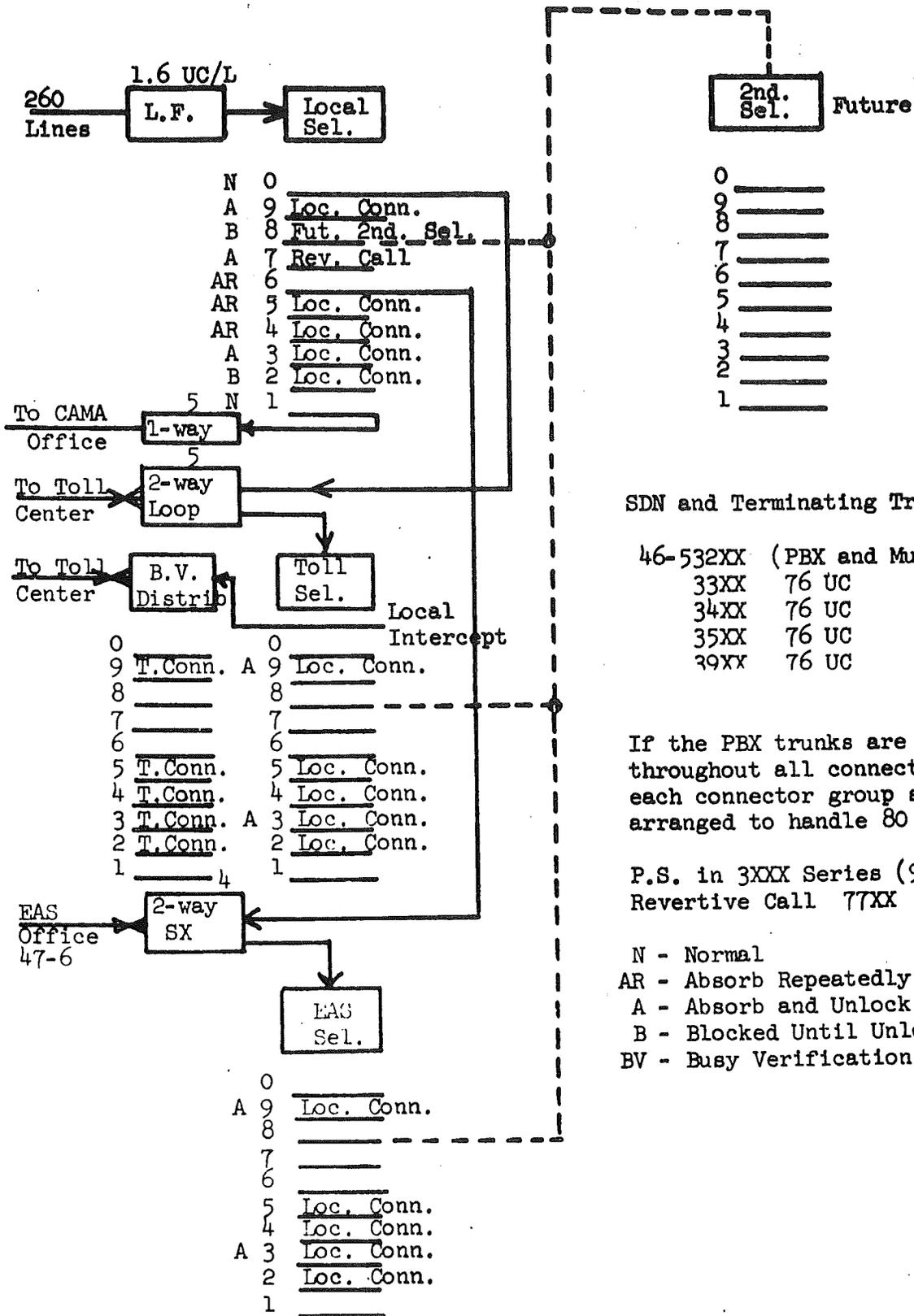
2.5455 Calls trunk to the connector on the third from last digit, leaving two digits effective in the connector. Because of this where second selectors are not used, the three office code digits are usually assigned the "AR" function with the fourth from last digit of the number assigned the "A" function. On this latter type office paystation number identification can be provided simply by assigning an "A" function to levels 7, 8, or 9.

2.5456 Wherever possible it is desirable to have the incoming toll calls come into the borrower's office with only the last four digits of the subscriber's number to be dialed to complete the call. If five digits are involved, this will require the absorption of one digit in the incoming toll selector. Very seldom should it be necessary to absorb more than one digit on any one incoming toll call. Digit absorption is also often necessary on incoming toll selectors even though only four digits are received over the toll trunks.

2.5457 It is very desirable to use level "0" of the toll selector for verification of a busy line because this level could not conveniently be used for any other purpose.

2.5458 In some cases EAS traffic will tandem (switch) through the office involved. In such instances the incoming EAS selectors will usually have access to trunks to the end CDO from the same levels as the local first selectors in the tandem office.

2.5459 Incoming EAS selectors will not have access to the "0" level for verification.



SDN and Terminating Traffic:

46-532XX	(PBX and Multiparty:	
33XX	76 UC	94 UC)
34XX	76 UC	
35XX	76 UC	
39XX	76 UC	

If the PBX trunks are distributed throughout all connector groups, each connector group shall be arranged to handle 80 UC.

P.S. in 3XXX Series (9XXX)
Revertive Call 77XX

- N - Normal
- AR - Absorb Repeatedly Until Unlocked
- A - Absorb and Unlock
- B - Blocked Until Unlocked
- BV - Busy Verification

EXAMPLE OF TPS SWITCHING DIAGRAM
for Office Used in Paragraph 2.256

FIGURE 1

