# SWITCHING SYSTEMS MANAGEMENT

# STEP-BY-STEP SWITCHING SYSTEM

# ADMINISTRATION

# LOAD BALANCING PROCEDURES

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## 1. GENERAL

**PURPOSE**

**1.01** This section describes load balancing techniques primarily as they relate to line group balance for customer lines in step-by-step (SXS) offices. Included is a description of how these techniques are incorporated into the new load balance index (LBI) plan described in Dial Facilities Management Practices (DFMP), Division A, Section 5b.

**1.02** Whenever this section is reissued, this paragraph will contain the reason for reissue.

**1.03** The title of each figure in this section includes a number(s) in parentheses which identifies the paragraphs in which the figure is referenced.

**1.04** This section is a full revision and consolidation of numerous documents on load balance. In conjunction with Dial Facilities Management Practices, Division A, Section 5b, Load Balance Index Plan, it replaces TL-562. This section also replaces all parts of the Central Office Management Guide, Division E, Section 4, which describes line balance by class of service and line loading including the

development and interpretation of the score system and quality control limits (QCLs).

**1.05** A LBI plan has been developed for all offices and applies to SXS offices which are capable of supplying line finder group usage data on at least a monthly basis.

**1.06** While the same data may be used for indexing and administrative purposes, the data qualifications for indexing purposes are more stringent to ensure uniformity among all offices. Therefore, the data requirements and procedures for indexing contained in Dial Facilities Management Practices, Division A, Section 5b, Load Balance Index Plan, will be followed.

**NETWORK ADMINISTRATION RESPONSIBILITIES**

**1.07** The network administrator of a SXS central office is responsible for ensuring that the dial system is providing the best possible service to customers for the offered traffic load. Good balance is required to achieve the maximum benefits of the load-service relationship. The line finder (LF) or line switch (LS) group equipment assignment procedures established by the network administrator for loading an office are reflected in the load balance of that office.

**1.08** To achieve the objectives of good balance, this responsibility includes the following:

(a) Loading plans

(b) Busy hour and side hour determination

(c) Scheduling of load balancing studies

(d) Data collection and validation

(e) Load balance analysis and corrective action

(f) Preparation of load balance form

(g) Preparation of customer line usage assignment forms

(h) Reporting of load balance index results.

## 2. PRINCIPLES OF LOAD BALANCE

### GENERAL

**2.01** Acceptable balance in an SXS office exists when the load generated by customer usage is distributed proportionately over the line finder switches in the switching train. Since customer-offered loads vary from day-to-day, the network administrator is responsible for keeping the load within practical limits. These are Quality Control Limits (QCL) which have been developed for SXS and are discussed in more detail starting in 2.21.

**2.02** Balancing an office improves service to the customer by reducing the probability of no dial tone, slow dial tone, and switching failures. Balance reduces subsequent subscriber attempts if the overflows (all finders busy) are kept to a minimum. **Rebalancing** an office is difficult, time-consuming, and expensive.

### DEFINITION OF TERMS

**2.03** The terminology and definitions used in this section are discussed in Dial Facilities Management Practices, Division A, Section 5b, Load Balance Index Plan. Those definitions that relate to SXS appear in the following paragraphs.'

**2.04** A **traffic unit** is the same as a **dial entity.** The terminology is used to conform with Common Language Location Identification Practice, Bell System Practices, Section 795-100-100. A traffic unit in the SXS System is a group of lines using line finder or line switch groups, selector bays, and connector bays and served by the same intermediate distributing frame (IDF) or its equivalent.

**2.05** A **loading division** is a group of load units of the same type of equipment with the same capacity designed to be loaded similarly by both usage and classes of service. Telephone number changes **are not** required to effect line load balance within the loading division.

**2.06** Loading divisions in SXS may include:

(a) Individual and 2-party flat rate (1FR and 2FR)

(b) Message rate business (1MB)

(c) Individual and 2-party flat rate business (1FB and 2FB)

(d) Coin (CB)

(e) 2-party message rate (2MR)

(f) 4-, 8-, or 10-party flat rate or message rate

(g) TOUCH-TONE® line group

(h) Permanent signal lockout line groups (PSLO) (100 percent equipped)

(i) Different-size line finder groups (16, 20, or 30 line finders in a group)

(j) Line switch groups.

**2.07** Where equipment features prevent similar loading and assigning due to equipment design, the operating telephone companies may create loading divisions. Creation of more than one loading division requires careful administraion to ensure proper loading among divisions. Care should be taken that the establishment of additional loading divisions does not create imbalances in other equipment components.

**2.08** Loading divisions of the same class of service, possessing approximately the same capacities, may be conveniently combined in order to assign customer lines. Combinations of this type are called **assignment divisions.**

### LOAD UNIT CONFIGURATION

**2.09** The SXS dial system consists of three major components of equipment as follows:

(a) **Line Group:** Line finders and/or line switches

(b) **Switch Train(s):** Selector switches

(c) **Connectors.**

**2.10** All three components may be monitored for proper balance. However, the greatest emphasis is placed on line group load balance. The

tools used to balance these components are as follows:

(a) *Line Finder Group/Line Switch Group:* Usage and all finders busy (AFB)

(b) *Selector:* Last trunk busy (LTB)

(c) *Connector:* Usage.

## BALANCE WITHIN A LOADING DIVISION

**2.11** The line finder group is the principle equipment requiring load balance in an SXS traffic unit. The network administrator can effectively balance a traffic unit by distributing customer usage (CCS) over all line finder groups.

**2.12** In addition to effectively distributing CCS usage, it is *extremely* important to maintain a good distribution by classes of service among the line finder groups in a SXS office. A balance which includes good distribution by usage and class of service aids in ensuring maximum use of installed equipment and providing an equal level of service.

**2.13** In addition to the traffic usage recorder (TUR) usage measurements taken on the major components of the SXS dial system, other service level indicators which may be indicative of imbalance are as follows:

(a) Dial tone delays

(b) Constant use of manual control to attempt to manage the traffic flow

(c) Repair center customer reports: no-dial-tone— no-trouble-found reports

(d) Switching failures—AFBs service observed overflows.

**2.14** An office which is experiencing an unacceptable level of service as measured by the above indicators requires analysis to determine the extent to which balancing is contributing to the problem. For example, poor dial tone speed may be caused by poor balance, overloads, a combination of both, or neither.

**2.15** Out of busy season and in other periods of light loading, the service indicators may not be adequate to signal the need for corrective action.

It is necessary to rely on the load balance data and determine whether changes in line assignments priorities will prevent poor service during the busy season when heavier loads occur. Line equipment transfers (LETs) may be required in extreme situations; however, they *should only be used as a last resort.*

## DETERMINATION OF BUSY HOUR AND ADJACENT SIDE HOUR

**2.16** The line finder group/line switch group busy hour by loading division must be the time-consistent hour of highest total usage generated in the busy season. This hour is determined by a periodic study of half hour TUR usage measurements, by manual readings of usage registers, or as discussed in Dial Facilities Management Practices, Division H, Section 1c(2), Busy Hour Determination—End Office. The side hour should be determined as discussed in Dial Facilities Management Practices, Division A, Section 5b, Load Balance Index Plan. These hours (10 hours per study) are called the session busy hour (SBH) and are used in load balance studies.

**2.17** The combination of CCS usage from *nonadjacent busy hours, such as a combination of 8 am to 9 am with 6 pm to 7 pm, is not allowed.* Studies show that in almost every case the characteristics are different for nonadjacent busy hours.

**2.18** Where there are two distinct nonadjacent busy hours nearly equal in usage, it may be necessary to study both periods separately if service is poor in the hour of lesser usage. Special attention to the line assignment procedures is required to ensure that groups that are below average in each hour are assigned an equal proportion of the various classes of service. As stated in 2.17, these two nonadjacent hours *cannot* be combined into a study period.

**2.19** Because of the need for statistical reliability, *10-hour study periods are required* for load balance index reporting. Five-hour studies may present a more difficult administrative problem. False or unreliable data can lead to faulty data conclusions. In cases where it is impossible to collect 10 hours of data, an adjustment for the number of data hours collected may be made on any studies *not* used for the LBI. This is discussed in more detail in 2.29. Two 5-hour studies from

adjacent weeks may be combined and used in one 10-hour study. These data may be used for index reporting purposes if necessary.

**2.20** Load balance usage data should be collected as frequently as required to ensure good balance with a minimum of 10 hours per month. The 10-hour minimum is imposed by the LBI plan requirement. As the SXS office approaches engineered capacity, more frequent studies are needed to ensure the most effective load balance possible.

## QUALITY CONTROL LIMITS

**2.21** The LBI plan, as discussed in Dial Facilities Management Practices, Division H, Section 5b, Load Balance Index Plan, provides requirements for developing QCLs as follows:

(a) A minimum of 10 hours of study per month

(b) Actual load as related to engineered capacity

(c) Average holding time (AHT) of the call generating usage on the line equipment.

**2.22** The quality control technique is a particular method of using mathematics to create a uniform approach to load balance procedures. This technique indicates reliably whether fluctuations in load data are the result of chance or are the results of differences in office performance, and therefore indicates whether corrective action should be taken. A successful QCL plan requires that limits be used which satisfactorily and accurately indicate a true imbalance.

**2.23** *Chance and imbalance* are two primary causes for variation of individual load unit usage from the average of a number of groups in the same division. Chance variations result from the random calling patterns of customers using their telephones. The size of chance variations depends on certain measurable office characteristics such as:

(a) Average holding time of calls

(b) The total load in the division (percentage of capacity).

As a general rule, the larger the sample measured, the smaller the change variation relative to the size of the sample. Each of the previously mentioned characteristics affects the size of samples observed in load studies.

**2.24** Studies show that group variations due to chance follow the normal distribution pattern which is a bell-shaped distribution about the mean (average). This normal distribution is described by establishing an average value and the measure of dispersion of group loads around that value. The measure of dispersion, adjusted for the number of hours of data, is commonly called the standard deviation (SD). Office trends are not a factor since each group is related to the average of all groups. An area representing one standard deviation (one sigma $[\sigma]$) from the average in a normal distribution may be expected to include 68.3 percent of all the group measurements. Two standard deviations or two $\sigma$ will be 95.4 percent of all measurements and three $\sigma$ will be 99.7 percent of all measurements. This is illustrated in the distribution curve which follows:
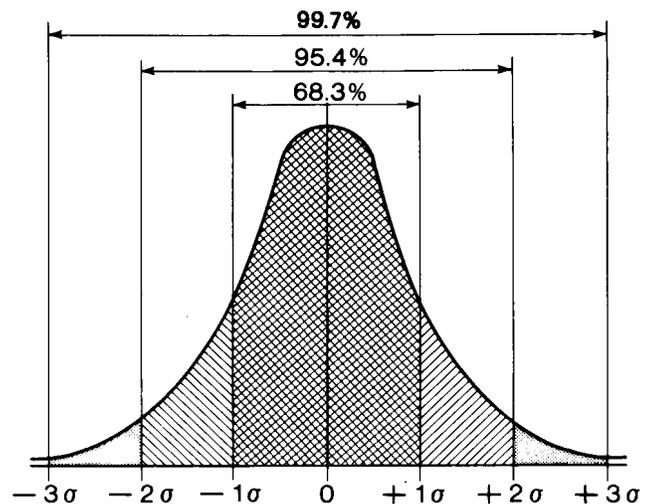


**2.25** The problem of isolating and evaluating chance variation may be resolved by using procedures involving the standard deviation. Using this method, the size of a deviation from the average may be used to judge whether that deviation is due to chance or is most probably due to imbalance. As a basis for this judgment, **standard QCLs representing three standard deviations have been developed.** For example, the

measured loads for 1000 groups are averaged. The analysis indicates that only three (0.3 percent outside the 99.7 percent) of those measurements should differ as a result of chance from the average by more than three standard deviations; that is, the QCL. In effect, all deviations from the average greater than the QCL can be assumed to result from imbalance. Choosing a larger QCL would increase this assurance; however, there will be a greater chance that some deviations ($\sigma$) which truly reflect imbalance will be ignored. These QCL values for SXS line finder switches are shown in Figure 1, Sheets 1 through 4.

**2.26** The first step in determining which QCL to use is to calculate the percentage of capacity for the study period. The percentage of capacity is calculated by comparing the **actual average load** to the **theoretical engineered load.** The QCL value derived from this computation makes allowance for the fact that group loads in a lightly loaded office can fluctuate more than those in a comparable heavily loaded office. Refer to Traffic Facilities Practices, Division D, Section 4h, Capacity Tables, 1.5 percent column.

**2.27** For example:

| Total loading division | = Total of individual line group registers or detector group units |
|---|---|

| Line finder groups | = 20 |
|---|---|

| Line finders per group | = 16 |
|---|---|

$$\frac{\text{Total loading division}}{} = \frac{5800 \text{ CCS}}{20}$$

$$290 \text{ CCS} = \text{Avg. actual load per load group (actual load)}$$

$$\frac{\text{Actual load}}{\text{Engineered load}} \times 100 = \frac{290}{324} \times 100$$

$$= 89.5 \text{ percent rounded}$$

$$= 90 \text{ percent}$$

Sheet 4 of Figure 1, representing 86 to 95 percent, would be selected. This value represents the percentage of capacity at which the line finder groups are operating for the given study period. This calculation is done for **each loading division.**

**2.28** Use of the QCL tables also require the average holding times of the calls creating usage on the line finder groups. Determination of the average holding time in a traffic unit is necessary for each balance study (SBH), by loading division if possible, in order to obtain the most accurate results. However, where this procedure is impossible or uneconomical to implement, one of the following methods (list preferentially) may be employed.

(a) Use an AHT for a SBH in the most recent available week.

(b) As a last resort, and only in cases where data are unavailable use 200 seconds as an AHT.

(c) In methods (a) and (b) when AHT for loading divisions cannot be established separately, use the AHT for the entire traffic unit. Average holding time in seconds is computed as follows:

$$\text{Average holding time} = \frac{\text{Total usage} \times 100}{\text{Total originating peg count}}$$

$$\text{or} \quad \frac{\text{Line finder group total usage} \times 100}{\text{Total originating peg count}}$$

*Note:* Use the peg count which is provided in the SXS office as the standard count of originating calls.

The following is an example of selecting QCL using average holding time.

(a) Use the example value in 2.27 and QCL table Figure 1, Sheet 4.

(b) Use average holding time of 232 seconds.

(c) In Figure 1, Sheet 4, under column labeled "average Holding Time-Seconds", find the line designated 231-250.

(d) Read across the line to column 15-16 under the heading "Line Finder Switches."

(e) Read the QCL percentage of 24 percent.

**2.29** The four tables (shown in Fig. 1) were constructed using 10 hours of data for a base. These tables are the only Bell System tables allowed for computing the LBI as described in Dial Facilities Management Practices, Division A, Section 5b, Load Balance Index Plan. It is recommended that 10 hours of data be obtained for all load balance procedures whenever possible. Where it is not possible to obtain 10 hours of data, an adjustment for the number of hours *only* for administrative load balance studies may be made. This adjustment corrects the QCL for the lesser reliability of smaller sessions and is calculated as follows:

$$Q = \sqrt{\frac{10}{N}} \times \text{TABLE QCL VALUE}$$

Where:

Q = the new QCL
N = the number of hours of the study

The value of the square root may be determined from the following table. This answer can then be multiplied by the table QCL value (Fig. 1, Sheet 4) to determine Q. (This procedure *may not* be applied to LBI studies.)

| N | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|
| $\sqrt{\frac{10}{N}}$ | 1.41 | 1.29 | 1.20 | 1.12 | 1.05 | 1.00 |

*Example:*

Given — Table QCL value = 48 percent
— N = 8 hours

$$Q = \sqrt{\frac{10}{8}} \times 48.0 \text{ percent}$$

$$= 1.12 \times 48.0$$

$$Q = 53.7 \text{ percent}$$

**2.30** After determining the QCL as shown in 2.21 through 2.28, CCS values can be established for ±3 sigma ($\sigma$) points (see distribution curve which follows). Load units that are approaching these limits should be indicated to the network administrator and can be established by designation of intermediate points at ±1.5 sigma as shown in the distribution curve which follows.

*Example:* Assume that average usage per *load unit* in a *loading division* is equal to 290 CCS and that the QCL is 24 percent.

290 × 0.24 = 70 CCS

+3.0 SD = 290 CCS + 70 CCS = 360 CCS

+1.5 SD = 290 CCS + 35 CCS = 325 CCS

0 = 290 CCS

-1.5 SD = 290 CCS - 35 CCS = 255 CCS

-3.0 SD = 290 CCS - 70 CCS = 220 CCS

This is illustrated in the distribution curve which follows:
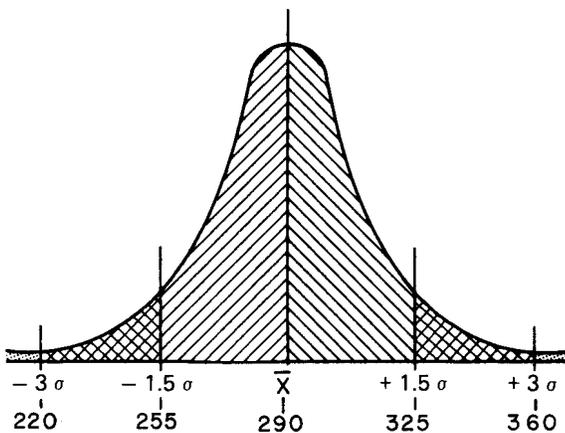


2.31 The use of CCS values at the 3 and 1.5 sigma limits is correct for one week's data.

However, when a history is maintained to increase statistical reliability, the mathematics becomes extremely complicated when done manually. This problem may be overcome by using an alternate method called the *score system.*

**DEVELOPMENT OF SCORES**

2.32 The score system was developed to simplify the mathematics required in load balance procedures. Numerical values are assigned to represent the extent to which each load unit has deviated from the group average during a measurement period. In application, all groups exceeding the QCL on a weekly record are assumed to be out of balance. The remaining groups may deviate to a lesser degree above and below the average.

2.33 The procedure for deriving scores is to take the QCL percentage (as determined in 2.21 through 2.28) and apply it as follows.

(a) Each load unit with exactly average CCS (290 CCS) is assigned a score of zero.

(b) Each load unit deviating a maximum of 1.5 standard deviations (one-half the QCL) above or below average is assigned a score of +1 or -1.

(c) Each load unit deviating within the range of 1.5 to 3.0 standard deviations above or below the average 3.0 is assigned a score of +2 or -2.

(d) Each load unit deviating above or below 3.0 standard deviations from the average is assigned a score of +4 or -4. Note that *4* is used rather than *3* in order to accentuate this undesirable deviation.

2.34 The distribution curve which follows is used in the accompanying example which illustrates the score method.
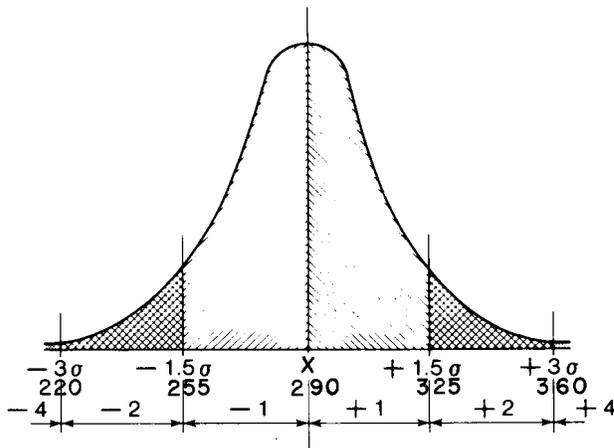
**Example:**

Assume that average usage per load unit in a loading division is 290 CCS and the QCL is 24 percent. The 3.0 standard deviations are 24 percent and 1.5 standard deviations are 12 percent. Scores are computed as follows:

| Score | Load Unit CCS |
|-------|---------------|
| +4 | 361 and higher |
| +2 | 326 through 360 |
| +1 | 291 through 325 |
| 0 | 290 |
| -1 | 255 through 290 |
| -2 | 220 through 254 |
| -4 | 219 through lower |

Form E-6615 (Fig. 2) is used for determining scores for record purposes and Form E-6616 (Fig. 3) is used for recording study data.

## 3. STEP-BY-STEP SWITCHING SYSTEM BALANCE CONSIDERATIONS

### GENERAL

**3.01** The purpose of a good load balancing program is to effect good balance and to ensure an equal grade of service in an economical manner. In addition, there is a need to achieve the traffic or main station capacity levels that the network design engineer planned for the office. In SXS offices the greatest emphasis on balance is placed on the line finder groups or line switch groups and the connector groups. The administrative principles discussed here are designed to be applied to No. 1 and No. 350A SXS Switching Systems but may generally be applied to all types of SXS equipment with equal facility.

### LOADING RESTRICTIONS AND FEATURES

**3.02** As stated earlier, the SXS dial system has three major components (see Fig. 4).

(a) **Line Group:** Consists of line relays, line finders, or line switches.

(b) **Switch Trains:** Selectors used by subscribers for intraoffice, outgoing, and incoming calls to access the called number.

(c) **Connectors:** Provide terminating access to the particular directory number being called (a connector may access 100 directory numbers).

**3.03** All of the components above can be monitored in varying degrees for balancing purposes. Line group balance is most crucial to good service and can be controlled by the network administrator. Inward and outward movement of lines affords the best opportunity to effect proper balance. In multientity offices where the SXS office is *not* the growth unit, considerable attention is required to maintain balance within that office.

**3.04** Some items in an SXS traffic unit can cause restrictions in line-assigning for load balancing as follows.

(a) **Class of Service:** Depending upon local configurations, a line group may serve one or more of the following classes of service:

(1) Flat rate (FR)

(2) Measured rate (MR)

(3) TOUCH-TONE (TT)

(4) Coin

(5) Rural

(b) Permanent signal lockout (PSLO)

(c) Capacity for obtaining usage measurements.

**3.05** In certain SXS offices, economic considerations may dictate initially equipping only a part of the line groups in an office for TOUCH-TONE but in any case they may be treated as two loading divisions, one dial pulse and one TOUCH-TONE, if empirical data indicate that their characteristics are significantly different.

**3.06** Usage data compiled by the TUR are the basic tool for achieving and monitoring balance between line groups. Therefore, administrators without usage data may have difficulty directing assignments to effect good balance. A good class-of-service spread coupled with AFB data will aid the administrator in directing assignments to achieve good balance.

## LOADING PLANS

**3.07** Continued practical balance of an SXS office should be maintained with the assignment of customer lines via service orders. The network administrator should develop a plan which will aid in maintaining good balance. The loading plan should be designed to improve balance at each opportunity and to ensure optimum balance during periods of peak loads. It should be recognized that as engineered capacitites are reached or exceeded, more administrative attention is needed to ensure that service goals will still be met. Good loading plans maintain a relative load balance between entities in multientity offices and balance between load units of a traffic unit.

### Line Groups

**3.08** To provide the best grade of service with the proper amount of equipment it is necessary for the offered traffic load to be equitably distributed among the line finders or line switches on the originating side. The total usage (CCS) per line group is a greater determining factor than the total number of subscribers assigned in a line group. The initial approach would be *class-of-service spread* and then fine-tuning with usage. For example, there are two considerations: class-of-service mix within a load unit and a proportionate mix of

each class and subclass (residence and business) *over all* line groups.

**3.09** The loading plan is constructed so as to maintain in each load unit, as far as is practicable, a proportionate number of both high- and low-usage lines and lines having their busy periods at different times of the day. A basic approach to this arrangement is to distribute the total number of lines of each class of service equally over all groups engineered for that class of service. This approach assumes that there is reasonable uniformity of call rate and holding time within a given class of service; therefore, the basic plan specifies the objective number of lines of each class to be assigned in each load unit. Where necessary, balance is maintained by modifying the objective number of lines of a particular class of service in certain load units and, if necessary, by moving individual high- or low-usage lines between line groups.

### Incoming Selector Groups

**3.10** Balance of local and incoming trains of selectors and balance of line groups are of equal importance in utilization and service. The incoming trunks are spread as evenly as possible over the incoming selector shelves. Usage data is not normally obtained on incoming selectors. However, the use of a portable No. 1 TUR can furnish the CCS data for balancing measurements. Refer to Bell System Practices, Section 252-121-301 for detailed information on the portable No. 1 TUR. Detailed data on selector engineering for SXS offices are found in Traffic Engineering Practices, Division D, Section 4c, SXS-Local Offices-Selectors.

**3.11** *Last trunk usage* (LTU) is a measurement procedure for identifying specific graded multiples (subgroups) with unacceptable blocking levels. The subgroup performance can be monitored by measuring the carried load on the last trunk of each subgroup. As the load in a subgroup increases, the load carried on the last common trunk also increases. By properly interpreting the LTU, the congestion level of the subgroup can be projected with considerable accuracy. Additional detail on LTU is provided in Dial Facilities Management Practices, Division H, Section 2d(10), Last Trunk Usage.

**3.12** Achievement of a balanced load on the incoming selectors in a SXS office primarily depends upon the manner in which incoming trunks are assigned to incoming selectors. The most practical method of ensuring proper trunk assignments is to spread the working trunks of each trunk group equally among all the selectors of a selector group. To assist in this distribution process, the trunks may be classified as heavy, medium, or light.

*Heavy Trunk:* Busy 67 percent of the busy hour = greater than 23 CCS.

*Medium Trunk:* Busy 33 to 66 percent of the busy hour = 12 to 23 CCS.

*Light Trunk:* Busy less than 33 percent of the busy hour = less than 12 CCS.

The classification of trunks may depend upon how the originating switching machine selects trunks.

**Terminating Connectors**

**3.13** Terminating calls access the called number through connectors. The primary load unit of connectors is the connector group. Administration of connector groups is as important to good terminating service as the balance of line finder groups is to originating service. Connector groups are designed based upon the types of main stations to be served and the expected terminating CCS (see Fig. 5).

**3.14** Actual CCS load data for administrative purposes can be determined on connector groups with TUR measurements. Where TUR data *is not* available, connector groups can be administered by reviewing data such as the following:

    (a) Last trunk usage (LTU) studies

    (b) Connector peg count registers

    (c) Connector last trunk busy (LTB) registers

    (d) Record of terminals in service per hundred group.

**3.15** Where available on a continual basis, CCS data can be used to administer connector groups within a traffic unit. This can be done simply by comparing the CCS load of individual connector groups to their theoretical capacity. A suggested format is provided as an administrative aid and is shown in Figure 6 (Form E-6899).

**3.16** In those cases where CCS data is *not* available on a continuing basis, other available data may be used (3.14). For example, with the assumption of a constant holding time, connector group capacity can be determined in terms of calls. A comparison of call capacity with actual terminating peg count can be made to aid in administration of connector groups.

**3.17** When the load on an SXS connector group is equal to or greater than the engineered capacity for two consecutive months based on an average group usage for five consecutive business days, any nonworking terminals should be considered *unusable.* The records of those connector groups should be *marked distinctively* to indicate their current status. One method is to use colored dots, with *red* representing *do not assign* (at or above capacity) and *yellow* representing *caution* (within 10 CCS of capacity). Groups that are 10 or more CCS below capacity (not marked) should be considered satisfactory for judicious assignment. If all connector groups become overloaded, other indicators such as all connectors busy peg count or equivalent may be used. (Refer to Dial Facilities Management Practices, Division H, Section 1b[9], Determination of Line and Number Requirements, Part 8.)

**3.18** Controlled assignment by embargoes is the only direct action that the network administrator can take. *No number changes* will be made to improve balance.

**LOAD BALANCE WITHOUT USAGE MEASURING DEVICES**

**3.19** This part provides guidelines to follow in traffic units without usage measuring devices. The first step toward load balance is an equitable class-of-service spread across all line groups.

**3.20** Fine tuning, which is usually accomplished with usage data, cannot be executed with the same precision. Instead, fine tuning will depend upon the interpretation of data recorded on all finders busy traffic registers. The use of these data as a balance indicator requires the exercise of good judgement by the network administrator in order to maintain good balance.

**3.21** In general, procedural steps for balance without usage data are as follows.

   (a) Establish an effective class-of-service balance or a plan to move toward an equitable class-of-service spread.

   (b) Collect service data (all finders busy) for a specified period, eg, session busy hour, total day, or total week.

**3.22** The format provided in Figure 3 may be useful in providing a view of balance based on all finders busy among load units. This form may be used as a guide for line assignment purposes. For ease of interpretation it may be useful in constructing a line assignment guide as discussed in Part 5 of this section.

**3.23** A similar approach can be used to administer connector groups through the use of connector group peg count registrations. Data can be accumulated and summarized by connector group (use Form E-6899). Corrective action to be taken is based upon the deviation from the capacity of the connector group.

**3.24** If the offices with all-finders-busy registers are under a camera, data can be collected during the session busy hour. If they are not under a camera, data can be read manually during the session busy hour daily or on a weekly basis.

**3.25** Where all-finders-busy registers are read manually on the first day of the study week and again in the following week on the same day at approximately the same time, a weekly total can be recorded for the load balance record.

## LOAD ANALYSIS

**3.26** Customer-offered loads vary from day to day and week to week and the effect on lines and trunks will vary proportionately. Constant analysis of these changes in loads is required to determine the effect on service.

**3.27** As is true of other dial systems, each No. 1 SXS has unique characteristics. The mix of high- and low-usage lines (centrex, PBX, business, coin, residence, etc), trunks (outgoing, incoming, intraoffice, tandem), and other circuits differ greatly from one SXS system to another.

**3.28** The busy-hour usage reflects the type of customer imposing the usage. If it is an evening busy hour, the residence customer very likely generates the highest load. Also, if the hour is a morning busy hour, the business customer, with some residence traffic, probably generates the highest load. Normally, an afternoon busy hour is a combination of business and residence traffic. Some busy lines contribute heavy usage during all hours because the customer's business dictates this kind of usage. Coin traffic may have its own busy hour.

**3.29** Studies of lines by class of service in the busy season are recommended in order to assign a CCS value to each class.

**3.30** Transfers of cable pairs, if done in great numbers, tend to create an exorbitant number of long jumpers on the main distributing frame (MDF). It is recommended that the network administrator work with the network assignment personnel to make assignment changes to shorten the jumpers as well as to maintain balance. The process of frame zoning should be investigated for possible use in the office.

**3.31** When the characteristics of an office change as a result of the growth or reduction of customers through area transfers, area cuts, new centrex additions, etc, a new usage busy-hour study should be scheduled to verify the busy hour and adjacent side hour.

## *Training*

**3.32** An appreciation of the relationship between load balance data and service indicators must be engendered in the clerical force. The clerical personnel must be trained to summarize and use the load balance data for best assignment advantage and to take corrective action. It is equally important that the maintenance forces have an appreciation of load balance principles in order to enhance the early detection of potential problems and their rapid correction.

## 4. DATA COLLECTION

### DATA ACQUISITION

**4.01** Load balance usage data are normally collected on a weekly measurement schedule. These data are collected by a TUR. TURs can provide

the data on a daily basis or, through the use of a limited scan feature, on a total-week basis. Total-week readings reduce the clerical effort required. The TUR can measure total usage by line groups on individual registers.

**4.02** In SXS offices, total office usage may be scored on detector group usage registers. Detector group usage registers may be provided for each type and size of load unit. Load balancing procedures use the detector group usage register scoring in computing the office average CCS per line finder group by size and type of line group.

## DATA COLLECTION FREQUENCY

**4.03** Data must be collected and reported once per month for index purposes. They may be collected more frequently for administrative purposes for the following reasons:

(a) The office is out of balance and the network administrator wants to analyze the results of specific corrective action procedures.

(b) The office is nearing the end of the job interval and/or is load limited; therefore, fine-tuned assignments are required to ensure objective service levels.

(c) The office is a new installation (at or greater than 30 percent of capacity) or a growth addition has just been completed and a new load balance data base is required. The faster the new data are collected, the sooner the balance may be analyzed.

(d) The office has just completed an area cut and the network administrator wants to evaluate the effects of the applied loading plan.

## INCOMPLETE DATA

**4.04** There are circumstances under which the data for the study week may be incomplete as a result of equipment malfunctioning, lost or damaged recording devices (either tape or registers), etc. The criterion for data reporting in compliance with Dial Facilities Management Practices, Division A, Section 5b, Load Balance Index Plan, is that a *minimum of 7.1 hours* is required but that the *full 10 hours* are preferrable. For administrative purpose, if 6 hours of data are available, it can be approached in several ways as follows.

(a) If they are available, 4 hours of data with the same traffic characteristics may be used from the previous collected week within the study month.

(b) The entire 10 hours from the previous study may be used if available.

(c) As a last resort (see note below) as few as 2 hours with the same traffic characteristics from the previous collected week may be used.

*Note:* In mechanized data collection systems, load balance data substitution is not always possible.

If valid data cannot be obtained within the study month for index purposes the data are considered *not available.* For administrative purposes, the criteria outlined in 2.29 will be followed.

## DATA VALIDATION

**4.05** The network administrator is responsible for the validation of load balance measurements. There are only a few ways to validate load balance data. These involve visual inspection and other methods to determine if the measurements are reasonable and accurate.

(a) A visual check of the data should be made to ensure that there are no zero register readings.

(b) When individual line-finder-group registrations are available, they should be checked for reasonableness. Any unusual peaking of registrations over those obtained in previous weeks, along with an absence of unusual deviations from average in working lines, may indicate equipment malfunctioning.

(c) Sudden changes in register readings may indicate register trouble. When these irregularities are present, every effort should be taken to correct them as soon as possible.

(d) Compare actual line finder group usage with the engineered capacity of that line finder group. (The busy-hour engineered CCS-per-line-finder-group must be modified to state the 10-hour measurement in order to be comparative.) Measurements which are at or exceed capacity can be evaluated on the basis of whether they

reflect valid data and/or a load balance problem. The percentage of capacity is relative to the expected load. A loading division at 50 percent of capacity should not expect to find line finder group loads nearing capacity whereas an office running greater than 75 percent would expect such line finder group loads. Service indicators associated with load balance should be expected more frequently as the percentage of capacity is approaching engineered capacity.

## 5. BALANCE TECHNIQUES

### MANUAL PROCEDURES

**5.01** Three forms are available for use in manual processing of load balance data. Form E-6615, Load Balance Score Control Record, is used for developing the weekly CCS ranges for the loading division (Fig. 2 is a copy of Form E-6615 with instructions for preparation). Form E-6616, Load Unit Load Balance Chart and Instructions, is shown in Fig. 3. Form E-6899, Load Balance Guide for Connector Groups (Fig. 6) is used to record the CCS/CALL load per connector group for the administrator's use in determining a course of corrective action to achieve good balance.

**5.02** The clerical effort required for scoring every load unit individually is time consuming. However, in offices without computer access, this is a necessary operation to develop scores and penalty points for an LBI. (Manual data processing is discussed in more detail in 5.36.)

### MECHANIZED PROCEDURES

**5.03** A method has been devised for providing procedures for the proper balance and assignment of lines in addition to computing an LBI. It is called the Load Balance System (LBS) and is a Business Information System (BIS) development with full user documentation.

**5.04** The user is responsible for providing specific information to the program in order for necessary calculations to be made. This specific information defines the parameters and includes:

(a) Number of main stations

(b) Average holding time

(c) Theoretical capacity by load unit

(d) Average office CCS/main station or lowest CCS/main station

(e) Service observing end-of-month data.

**5.05** Once parameters and usage information have been inputted to the mechanized program, four basic reports are available in an off-line mode.

(a) *Traffic Unit Index Report:* This report is prepared by loading divisions and traffic units each time an LBI study is taken and includes load units installed (measured and not measured), capacity data, and balance and hot spot penalty points. The content of this report follows that of Form E-6402. Indexes are provided for the company by areas, for divisions by districts, and for districts by traffic units. The contents of these reports closely follow Forms E-6403 and E-6404.

(b) *Index Study-Data Summary:* Provides a working report that allows manual inspection of all load unit data being used for index calculation. Information includes: average hour CCS (for the current study week), balance and hot spot penalty points for the three latest valid index study weeks, and a series of validation codes which point to a suspected problem.

(c) *Balance Guide Reports:* Develops a line assignment guide to be used for line assigning purposes. This particular output is discussed in 5.21 through 5.35. A similar removal guide is developed to identify potential line transfers from overloaded line groups. For line assignment purposes, this report should be requested at least monthly and supplemented with other reports as required.

(d) *Selected Report-Connectors:* Provides a list of connector groups with a CCS deviation value (±) from the theoretical capacity.

Refer to GL 75-12-029 for more detailed information on the new Load Balance System or Dial Facilities Management Practices, Division A, Section 5b, Load Balance Index Plan.

**5.06** *Flagging capabilities* are available for *data validation purposes.* The system

automatically flags line finder group data that register:

(a) Zero usage

(b) Usage exceeding the number of line finders being measured times 36 times the number of hours of input

(c) As a hotspot following the criteria of the values provided in Division A, Section 5b, Load Balance Index Plan (Fig. 2) times the number of hours.

## CORRECTIVE ACTION

**5.07** Corrective action is taken when there are adverse service indications or when the load measurements point to areas where there are high probabilities of blockage and hence a possible source of customer dissatisfaction.

**5.08** In order to be more meaningful, the proper corrective action must have an established sequence of operation as follows:

(a) Review all load balance data. This review should indicate load units that are working at exceptionally heavy or light loads.

(b) Review data on the load units highlighted in (a) above. This review may prove to be the most valuable step. Errors at this stage cause unnecessary or incorrect action. Any equipments made busy should be investigated when verifying data.

(c) Assuming that the data are valid, review the required CCS corrective action.

(d) If time and service conditions permit, achieve balance by directed line assignments.

(e) If LETs are required, several indicators should be analyzed to determine the proper lines to move (eg, customer reports, all finders busy, etc).

**5.09** The most economical method of achieving and maintaining a good load balance in line finder groups is through line assignment procedures (directed line assignments). The network administrator assigns new connects to lightly loaded line finder groups (load units) and allows disconnects to accumulate in heavily loaded units.

**5.10** Disconnects of lines in heavily loaded units serve to equalize the carried CCS in line finder groups. On the other hand, disconnects in lightly loaded line finder groups serve to heighten the imbalance.

**5.11** LETs accomplish the same objective as directed line assignments with quicker results. LETs must be kept to a minimum unless serious imbalance exists (+4s and hot spots) and the condition cannot be quickly corrected with line assignments.

**5.12** LETs are expensive to implement and therefore, should be the *last-choice method of corrective action.*

**5.13** A method of corrective action to effectively achieve and maintain good load balance should contain the following features:

(a) It should be based on empirical CCS measurements rather than scores. Differences in loads, even among line finder groups with the same scores, could then be detected.

(b) It should be sensitive to usage trends to avoid future overloads.

(c) It should supply more weight to recent measurements since they are more representative of the actual load situation.

(d) Finally, it should correct the usage in load units to the average for the loading division to avoid wasteful overcorrection.

**5.14** In manual data processing environments, it is uneconomical to expend clerical time to achieve each of the four features discussed in 5.13. Manual data processing is discussed further in 5.36.

**5.15** The mechanized procedure developed for the LBI plan incorporates all of the desirable features outlined in 5.13.

**5.16** Basically, the mechanized procedure takes historical load unit information and utilizes a weighted linear regression to estimate *expected* loads on these units as shown in the graph which follows. As can be seen, weekly loads do not fall

on the best fit or weighted linear regression line. Each point on the line corresponds to a week and represents the expected values. The weeks are numbered from week one (oldest) to week seven (newest).

> *Note:* The graph shows a period of seven weeks. However, this number would differ according to the amount of historical data that has been recorded (or is in memory).
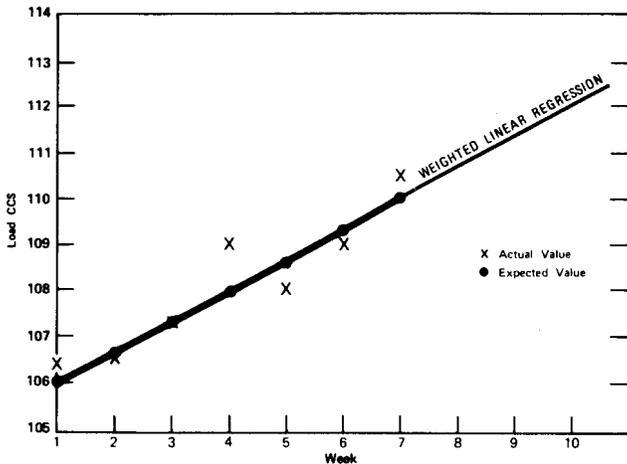




**5.17** A similar approach is taken for the average load unit load in the loading division. Individual load units are then compared to their traffic unit line to determine the CCS amount to be added or removed (see graphs A through F in 5.18).

**5.18** The CCS corrections are applied to the load units shown in the corrective action graphs below as follows:
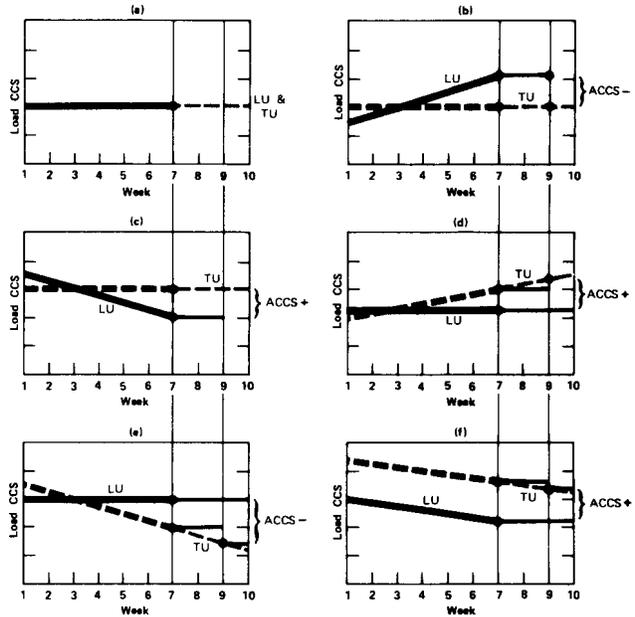
*Graph A:* None. The load unit and traffic unit average track exactly.

*Graph B:* Subtract CCS because the load unit is increasing and the traffic unit load is stable. The CCS difference for the latest week indicates a need for removal of load. Assuming that action will be taken in week nine, this difference during week seven should be removed. This amount is taken at week seven levels because the load unit line is not as stable as the traffic unit line and should not be extrapolated.

*Graph C:* Add CCS. The load unit is decreasing and the traffic unit load is stable. The CCS difference for the latest week indicates a need for additional load. Assuming that action will be taken during week nine, this difference during week seven should be added.

*Graph D:* Add CCS. The traffic unit load is increasing and the load unit

load is stable. The CCS difference for the latest week indicates a need for additional load. If action is taken during week nine and the difference during week seven is added, there will be a slight undercorrection. Therefore, an additional amount must be loaded into this unit.

*Graph E:* Subtact CCS. The traffic unit load is decreasing and the load unit load is stable. The CCS difference for the latest week indicates a need for less load. If action is taken during week nine and the difference for week seven is subtracted there will be a slight undercorrection. Therefore, an additional amount must be removed from this unit.

*Graph F:* Add CCS. Both the load unit and traffic unit loads are decreasing at approximately the same rate. The CCS difference for the latest week indicates a need for additional load. If action is taken during week nine and the difference during week seven is added there will be a slight overcorrection. Therefore, a smaller amount must be loaded into this unit.

**5.19** Corrective CCS values developed from the information in 5.18 cannot be considered exact because of the variable factors involved. Any overestimation in the CCS correction could result in more line moves than necessary to attain balance. It might be necessary to compensate for these additional moves at a later date. Consequently, the computer scales down all values derived in this manner.

**5.20** Any method for scaling the CCS correction to be applied to load units is fairly arbitrary. The procedure adapted for this section is to scale the values by a factor based upon the variance of estimated CCS to be added or subtracted. Study results indicate that this procedure produces better

load balance than the method used in the current plan.

**LINE ASSIGNMENT GUIDE**

**5.21** The CCS corrective action list is a line assignment guide in that it provides information to accomplish the ultimate requirement: the assignment of lines. Once corrective CCS values are established for each load unit during a study period, a line assignment guide can be constructed (with the units that are most below average presented first) as follows:

Estimated CCS/Main Station = 4

| BAY NO. | LG NO. | CCS TO ADD | LINES TC ADD |
|---|---|---|---|
| 36 | 82 | 70 | 17 |
| 26 | 62 | 60 | 15 |
| 13 | 36 | 54 | 13 |
| 35 | 80 | 54 | 13 |
| 6 | 17 | 53 | 13 |
| 8 | 24 | 50 | 13 |
| 33 | 76 | 46 | 11 |
| 28 | 67 | 40 | 10 |

**5.22** This list is not as useful as it might first appear. The network administrator must still determine the order in which these lines should be assigned, what to do if sufficient spare line finder equipment is not available in each line finder group, and how to use disconnect information.

**5.23** There are two alternate mechanized procedures which provide the network administrator with some guidance in answering the questions raised in 5.22. These procedures are also features of the new Load Balance System developed by Bell Laboratories BIS.

**5.24** The first procedure presumes that the SXS office is predominately one broad class of

service such as residence. This procedure should only be used when **any** of the following conditions are true.

(a) The deviation from this message CCS per line (CCS/main station) is minimal.

(b) Previous subscriber line usage (SLU) studies are unavailable and approximations of CCS/main station for each class of service are impossible.

(c) A reduction in the length of the line assignment guide is necessary. (This reduction requires considerable experience in its application.)

**5.25** The second procedure should be used when more detail is required and especially when capacity is being approached. It provides a line assignment guide by distinguishing between lines of three load characteristics: light, medium, and heavy.

**5.26** *Procedure No. 1:* The average CCS (ACCS) per main station is calculated by dividing the actual load (CCS) by the number of main stations handled within the loading division(s). For example:

$$\frac{\text{ACCS/Main}}{\text{Station}} = \frac{\text{Office CCS}}{\text{Working Main Stations}}$$

$$\text{Main Stations} = \frac{8720}{2180}$$

$$= 4.0 \text{ CCS/Main Station}$$

*Note:* The working main station count must include trunks such as PBX "dial 9" that have an appearance in the line finder groups.

**5.27** The computer program provides a list generated by *desired order* of next assignment as follows:

(a) Selects a load unit which needs the largest CCS addition for the next assignment

(b) Subtracts the average CCS/main station from the CCS correction of the load unit just selected

(c) Goes back to (a).

**5.28** The network administrator must determine the number of lines required to satisfy the assignment demand. A guide is then requested and prepared to fulfill that demand. The spare line equipment selected may be recorded in the appropriate columns of the line assignment guide form (Fig. 7). "NA" is noted when spare equipment is not available. The remaining columns are provided for administrative purposes such as listing the class of service (CS), noting the CCS to be added, or entering remarks, etc.

**5.29** The line assignment guide form (Fig. 7) also takes into account the disconnect activity because this movement may counteract the efforts to bring load units closer to the average or it may satisfy a need for space equipment. The line assignment guide may also be used to account for the impact of disconnect activity on CCS. This involves keeping track of the number of disconnects within designated line groups and incorporating the information into the line assignment guide. For example:

(a) Since every disconnect negates an assignment, a flagging system may be used to identify in the line records those line groups with a consistently low usage trend. As disconnects occur within these line groups, they should be noted on the line assignment guide.

(b) Shortages of spare equipment (NAs) begin to appear when the traffic unit is working at a higher percentage of fill. When an NA is noted on the line assignment guide, an indication should also be made in the line records in order to take advantage of the disconnect activity. The presence of an NA means that there is still a requirement for additional CCS.

**5.30** The procedure in 5.26 through 5.29 specifies the order of assignments of lines by the network administrator. The network administrator is responsible for determining both the class of service of available lines and the number of lines that should be given to the assignment office.

**5.31** *Procedure No. 2:* In Procedure No. 1, it was assumed that each customer generated approximately the same usage. This is not true in all cases. Offices that include several classes of service or offices which are growing toward an equivalent class of service mix may find it ineffective

to load by average office CCS. Procedure No. 2 was developed to distinguish between line finder groups with different load characteristics.

**5.32** There are several ways to establish a CCS/main station by class of service. The most commonly used methods are:

(a) Subscriber line usage studies

(b) Use of CCS/main station for offices with similar characteristics.

**5.33** First, establish a CCS per line (CCS/main station) for each class of service. Select major classes within the loading division and place them in ranges such as light (LCCS), medium (MCCS), and heavy (HCCS). Medium- and heavy-usage customers are assumed to have *two* and *three* times the LCCS, respectively.

**5.34** The line assignment guide is then built in a manner similar to the method used to build the one for Procedure No. 1.

(a) Select a load unit which needs the largest CCS addition for the next assignment.

(b) Subtract LCCS from the CCS correction of the load unit just selected.

(c) Go back to (a).

**5.35** An example of an assignment list established according to this procedure is shown in Figure 8. The line assignment guide is prepared according to the type of user being assigned. For example, if the network administrator determines that a *light* user is required in a load unit, an *L* is placed adjacent to the load unit's appearance on the list and the remaining columns are filled in as previously described in 5.28. If the load unit requires a *medium* user, a line should be drawn through the assigned column adjacent to the *first* appearance of the load unit. An *M* and the appropriate information are placed adjacent to the *second* appearance of that load unit. A *heavy* user is designated by drawing a line through the *first* two appearances of the load unit and all required information is placed opposite the *third* appearance on the line assignment guide. The disconnect activity should be shown as outlined in 5.29.

*Manual Procedures*

**5.36** It is uneconomical to expend clerical time to achieve all four features discussed in 5.13. The method provided in 5.37 through 5.43 is a compromise for manually processed data.

**5.37** For clerical ease, the proposed plan uses weekly scores rather than actual CCS values (as used in the mechanical plan). The plan weighs recent data more heavily than it weighs older data and attempts to correct group loads to average usage without overcorrecting.

**5.38** This procedure is based upon computing an estimate of the average weekly score for each load unit, determining a factor, and calculating the CCS correction as follows:

$$\text{Corrective CCS} = \frac{(\text{QCL})\,(\text{ACCS})\,(F)}{3}$$

Where:

QCL = Quality control limit of the loading division

ACCS = Average load unit load within the loading division for the latest study divided by the number of study hours.

$$\text{ACCS} = \frac{\text{Avg. load unit CCS}}{\text{Number of study hours}}$$

*Note:* If this information is not available, use the latest actual week's average load unit load.

F = Factor derived from the scores and study intervals

3 = Fixed factor.

**5.39** Form E-6617, CCS Correction (Fig. 9), is used in determining the CCS corrective values for each load unit.

**5.40** The QCL and average CCS values are known for each study and remain constant for an

entire loading division. The product of their multiplication is also a constant that can be multiplied by each factor F for individual load units. F remains the only unknown and is determined as follows.

**First Study**

*Step 1:* Develop the corrective CCS values for each of the factor F possibilities. Negative scores produce CCS to be added and positive scores produce CCS to be subtracted as illustrated below. Place results at the top of the first section of Form E-6617 (the first or beginning study).

$$\text{Corrective CCS} = \frac{(QCL)(ACCS)(F)}{3}$$

| SCORE | FACTOR (F) |
|-------|-----------|
| ±4 | 3.0 |
| ±2 | 1.0 |
| ±1 | .5 |
| 0 | 0 |

*Step 2:* First study period scores for each load unit are listed in the first section in column labeled *SC.*

*Step 3:* Knowledge of each score will allow F-factors to be selected from the table in *Step 1.*

*Step 4:* The appropriate CCS corrective values are taken from the top of the first section and entered for each load unit.

**Second or Subsequent Study Period**

*Step 5:* Factor W is selected from the following table. This factor is a weighted estimate of past scores for each collection interval. It is placed in column W for each load unit in the second study period.

| FACTOR (W) FREQUENCY | | | | |
|---|---|---|---|---|
| SCORE | WEEKLY | BIWEEKLY | TRIWEEKLY | MONTHLY* |
| ±4 | ±3.2 | ±2.6 | ±2.0 | ±1.6 |
| ±2 | ±1.6 | ±1.3 | ±1.0 | ± .8 |
| ±1 | ± .8 | ± .6 | ± .5 | ± .4 |
| 0 | 0 | 0 | 0 | 0 |

\* Includes four week intervals

*Step 6:* Add the W-factors to each load unit score.

$$W + SC = WSC$$

*Step 7:* New F-factors for this study and W-factors for the next study are shown in Fig. 10 for each WSC value, depending upon the collection interval being used.

*Step 8:* Only seven F-factors are possible for the second and subsequent studies: (0.5, 1.0, 2.0, 3.0, 4.0, 5.0, and 6.0). Develop CCS corrective values for each of these factors using the following formula and place at top of the appropriate column of Form E-6617.

$$\text{Corrective CCS} = \frac{(QCL)(ACCS)(F)}{3}$$

*Step 9:* The appropriate corrective CCS values are then selected from this listing for the corresponding F-factor for each load unit.

**Subsequent Studies**

*Step 10:* Scores for each load unit are listed in the column labeled SC on Form E-6617.

*Step 11:* The scores listed in Step 10 are added to the W-factors found in Step 7.

$$W + SC = WSC$$

**Step 12:** Same as Step 8.

**Step 13:** Same as Step 9.

**5.41** Once corrective CCS values are established for each load unit during a study period, a line assignment guide can be constructed using one of the two alternative methods shown in the mechanized procedure (5.21 through 5.35). If this method proves to be too difficult or time-consuming to develop, a third alternative is proposed. This procedure is to establish a list similar to one shown in 5.21. Extreme care must be taken when this list is used.

**5.42** If a score is unavailable for a group in a measurement period, it is suggested that the last weekly score be used in the calculation. When measurements are unavailable for more than one month, it is suggested that the latest study be considered as week 1 and that the process be started over again (Steps 1 through 4).

## LINE TRANSFER GUIDE

**5.43** Line transfer guides are constructed in a manner similar to the manner in which the line assignment guides are constructed. Line transfer guides are used primarily for making decisions pertaining to LETs. However, the listing starts with the most heavily loaded unit rather than the lighest loaded one. The guide is developed using an ACCS or ranges of CCS such a LCCS, MCCS, or HCCS, depending upon the degree of detail required for administration purposes. A line transfer guide is shown in Figure 11.

**5.43** Proceeding in order of removal, the network administrator lists the line group and terminal number beside each load unit under the *Selected* column. This listing shows the line group number, the terminal number and the class of service of the subscriber being considered for moving. Disconnects are accounted for before choosing lines to be transferred in order to avoid any overcorrection.

**5.44** Once corrective action has begun, the LET list should be sent immediately through the proper channels. The time frame for completing the transfer should be kept to a minimum. If the LET list is outstanding beyond a week, the network administrator must follow up and request that the transfer be completed as soon as possible.

## 6. REFERENCES

**6.01** The following were used as references:

### Dial Facilities Management Practices

| Division | Section | Title |
|---|---|---|
| A | 5b | Load Balance Index Plan |
| H | 1b9 | Determination of Line and Number Requirements |
| H | 1c2 | Busy Hour Determination |
| H | 1d10 | Load on Last Trunk Measurement Procedures |
| H | 5d4 | Load Balancing Procedures— No. 5 Crossbar |

### Bell System Practices

| | |
|---|---|
| 984-503-100 | No. 4A Traffic Usage Record— General Description |
| 984-515-100 | Traffic Measurement System No. 1A—General Description |
| 984-524-100 | Dial Tone Speed Register Circuit—General Description |

### Traffic Facilities Practices

| Division | Section | Title |
|---|---|---|
| D | 4c | SXS Local Offices—Selectors |
| D | 4h | SXS Capacity Tables |

## 7. ORDERING FORMS

**7.01** Forms used in this section may be ordered from a local Western Electric service center as follows:

| Order Wording | Ordering Multiple |
|---|---|
| (QTY) Form E-6615 (5-75) | 50 per pad, 2 pads per pkg; unit 100 forms |

(QTY) Form E-6616    50 per pad, 2 pads per     (QTY) Form E-6899    50 per pad, 2 pads per
      (5-75)         pkg; unit 100 forms              (9-76)         pkg; unit 100 forms

(QTY) Form E-6617    50 per pad, 2 pads per
      (5-75)         pkg; unit 100 forms

## LOAD BALANCE QUALITY CONTROL LIMITS
### BASED ON 10 HOUR DATA

(MARCH 1975)

| STEP BY STEP & PANEL | 1.5% DTD |

**ACTUAL AVERAGE LOAD PERCENTAGE OF ENGINEERING LOAD**

| AVERAGE HOLDING TIME (SECS) | 30% TO 35% LINE FINDER SWITCHES | | | | | | | | | | | | 36% TO 45% LINE FINDER SWITCHES | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2–6 | 7–8 | 9–10 | 11–12 | 13–14 | 15–16 | 17–19 | 20–23 | 24–29 | 30–41 | 42–57 | 58–80 | 2–6 | 7–8 | 9–10 | 11–12 | 13–14 | 15–16 | 17–19 | 20–23 | 24–29 | 30–41 | 42–57 | 58–80 |
| 0 – 70 | 51 | 34 | 29 | 25 | 23 | 20 | 19 | 17 | 14 | 12 | 10 | 8 | 44 | 30 | 25 | 22 | 20 | 18 | 16 | 14 | 13 | 11 | 9 | 7 |
| 71 – 90 | 59 | 40 | 33 | 29 | 26 | 24 | 21 | 19 | 17 | 14 | 12 | 10 | 51 | 34 | 29 | 25 | 23 | 21 | 19 | 17 | 14 | 12 | 10 | 8 |
| 91 – 110 | 66 | 44 | 37 | 32 | 29 | 26 | 24 | 21 | 19 | 16 | 13 | 11 | 57 | 38 | 32 | 28 | 25 | 23 | 21 | 18 | 16 | 14 | 11 | 9 |
| 111 – 130 | 72 | 49 | 41 | 36 | 32 | 29 | 26 | 23 | 20 | 17 | 14 | 12 | 63 | 42 | 35 | 31 | 28 | 25 | 23 | 20 | 18 | 15 | 12 | 10 |
| 131 – 150 | 78 | 52 | 44 | 38 | 34 | 31 | 28 | 25 | 22 | 19 | 15 | 13 | 67 | 46 | 38 | 33 | 30 | 27 | 24 | 22 | 19 | 16 | 13 | 11 |
| 151 – 170 | 83 | 56 | 47 | 41 | 37 | 33 | 30 | 27 | 24 | 20 | 16 | 14 | 72 | 49 | 41 | 36 | 32 | 29 | 26 | 23 | 20 | 17 | 14 | 12 |
| 171 – 190 | 88 | 59 | 50 | 44 | 39 | 35 | 32 | 29 | 25 | 21 | 17 | 14 | 76 | 52 | 43 | 38 | 34 | 31 | 28 | 25 | 22 | 18 | 15 | 13 |
| 191 – 210 | 93 | 63 | 53 | 46 | 41 | 37 | 34 | 30 | 26 | 22 | 18 | 15 | 81 | 54 | 46 | 40 | 36 | 32 | 29 | 26 | 23 | 19 | 16 | 13 |
| 211 – 230 | 97 | 66 | 55 | 48 | 43 | 39 | 35 | 32 | 28 | 23 | 19 | 16 | 85 | 57 | 48 | 42 | 37 | 34 | 31 | 27 | 24 | 20 | 17 | 14 |
| 231 – 250 | * | 69 | 58 | 50 | 45 | 41 | 37 | 33 | 29 | 24 | 20 | 17 | 88 | 60 | 50 | 44 | 39 | 35 | 32 | 29 | 25 | 21 | 17 | 15 |
| 251 – 270 | * | 71 | 60 | 52 | 47 | 43 | 38 | 34 | 30 | 25 | 21 | 17 | 92 | 62 | 52 | 45 | 41 | 37 | 33 | 30 | 26 | 22 | 18 | 15 |
| 271 – 290 | * | 74 | 62 | 54 | 49 | 44 | 40 | 36 | 31 | 26 | 21 | 18 | 95 | 64 | 54 | 47 | 42 | 38 | 35 | 31 | 27 | 23 | 19 | 16 |
| 291 – 310 | * | 77 | 64 | 56 | 50 | 46 | 41 | 37 | 32 | 27 | 22 | 19 | 99 | 67 | 56 | 49 | 44 | 40 | 36 | 32 | 28 | 24 | 19 | 16 |
| 311 – 330 | * | 79 | 67 | 58 | 52 | 47 | 43 | 38 | 33 | 28 | 23 | 19 | * | 69 | 58 | 50 | 45 | 41 | 37 | 33 | 29 | 24 | 20 | 17 |
| 331 – 350 | * | 82 | 69 | 60 | 54 | 49 | 44 | 39 | 34 | 29 | 24 | 20 | * | 71 | 59 | 52 | 46 | 42 | 38 | 34 | 30 | 25 | 21 | 17 |
| 351 – 370 | * | 84 | 71 | 62 | 55 | 50 | 45 | 40 | 35 | 30 | 24 | 20 | * | 73 | 61 | 53 | 48 | 43 | 39 | 35 | 31 | 26 | 21 | 18 |
| 371 – 390 | * | 86 | 72 | 63 | 57 | 51 | 46 | 41 | 36 | 31 | 25 | 21 | * | 75 | 63 | 55 | 49 | 45 | 40 | 36 | 31 | 26 | 22 | 18 |
| 391 – 410 | * | 89 | 74 | 65 | 58 | 53 | 48 | 42 | 37 | 31 | 26 | 22 | * | 77 | 65 | 56 | 50 | 46 | 41 | 37 | 32 | 27 | 22 | 19 |
| 411 – 430 | * | 91 | 76 | 66 | 59 | 54 | 49 | 44 | 38 | 32 | 26 | 22 | * | 79 | 66 | 58 | 52 | 47 | 42 | 38 | 33 | 28 | 23 | 19 |
| 431 – 450 | * | 93 | 78 | 68 | 61 | 55 | 50 | 45 | 39 | 33 | 27 | 23 | * | 81 | 68 | 59 | 53 | 48 | 43 | 39 | 34 | 28 | 23 | 20 |
| 451 – 470 | * | 95 | 80 | 70 | 62 | 57 | 51 | 46 | 40 | 34 | 28 | 23 | * | 82 | 69 | 60 | 54 | 49 | 44 | 40 | 35 | 29 | 24 | 20 |
| 471 – 490 | * | 97 | 81 | 71 | 64 | 58 | 52 | 47 | 41 | 34 | 28 | 24 | * | 84 | 71 | 62 | 55 | 50 | 45 | 40 | 35 | 30 | 24 | 21 |

* FOR QCL DATA IN THIS RANGE CONSULT WITH AT&T COMPANY STAFF

**Fig. 1—Load Balance Quality Control Limit Chart (Sheet 1 of 4) (2.27, 2.29, 2.30, 2.31)**

# LOAD BALANCE QUALITY CONTROL LIMITS
## BASED ON 10 HOUR DATA

(MARCH 1975)

| | STEP BY STEP & PANEL | 1.5% DTD |

| | ACTUAL AVERAGE LOAD PERCENTAGE OF ENGINEERING LOAD | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AVERAGE HOLDING TIME (SECS) | 46% TO 55% LINE FINDER SWITCHES | | | | | | | | | | | | 56% TO 65% LINE FINDER SWITCHES | | | | | | | | | | | |
| | 2–6 | 7–8 | 9–10 | 11–12 | 13–14 | 15–16 | 17–19 | 20–23 | 24–29 | 30–41 | 42–57 | 58–80 | 2–6 | 7–8 | 9–10 | 11–12 | 13–14 | 15–16 | 17–19 | 20–23 | 24–29 | 30–41 | 42–57 | 58–80 |
| 0 – 70 | 40 | 27 | 22 | 20 | 18 | 16 | 14 | 13 | 11 | 9 | 8 | 7 | 36 | 24 | 21 | 18 | 16 | 15 | 13 | 12 | 10 | 9 | 7 | 6 |
| 71 – 90 | 46 | 31 | 26 | 23 | 20 | 18 | 17 | 15 | 13 | 11 | 9 | 8 | 42 | 28 | 24 | 21 | 18 | 17 | 15 | 14 | 12 | 10 | 8 | 7 |
| 91 – 110 | 51 | 34 | 29 | 25 | 23 | 21 | 19 | 17 | 14 | 12 | 10 | 8 | 47 | 31 | 26 | 23 | 21 | 19 | 17 | 15 | 13 | 11 | 9 | 8 |
| 111 – 130 | 56 | 38 | 32 | 28 | 25 | 22 | 20 | 18 | 16 | 13 | 11 | 9 | 51 | 34 | 29 | 25 | 23 | 21 | 19 | 17 | 14 | 12 | 10 | 8 |
| 131 – 150 | 60 | 41 | 34 | 30 | 27 | 24 | 22 | 20 | 17 | 14 | 12 | 10 | 55 | 37 | 31 | 27 | 24 | 22 | 20 | 18 | 16 | 13 | 11 | 9 |
| 151 – 170 | 65 | 44 | 37 | 32 | 29 | 26 | 23 | 21 | 18 | 15 | 13 | 11 | 59 | 40 | 33 | 29 | 26 | 24 | 21 | 19 | 17 | 14 | 12 | 10 |
| 171 – 190 | 69 | 46 | 39 | 34 | 30 | 28 | 25 | 22 | 19 | 16 | 13 | 11 | 63 | 42 | 35 | 31 | 28 | 25 | 23 | 20 | 18 | 15 | 12 | 10 |
| 191 – 210 | 72 | 49 | 41 | 36 | 32 | 29 | 26 | 23 | 20 | 17 | 14 | 12 | 66 | 44 | 37 | 33 | 29 | 26 | 24 | 21 | 19 | 16 | 13 | 11 |
| 211 – 230 | 76 | 51 | 43 | 37 | 33 | 30 | 27 | 24 | 21 | 18 | 15 | 12 | 69 | 47 | 39 | 34 | 31 | 28 | 25 | 22 | 20 | 16 | 14 | 11 |
| 231 – 250 | 79 | 53 | 45 | 39 | 35 | 32 | 29 | 26 | 22 | 19 | 15 | 13 | 72 | 49 | 41 | 36 | 32 | 29 | 26 | 23 | 20 | 17 | 14 | 12 |
| 251 – 270 | 82 | 55 | 47 | 41 | 36 | 33 | 30 | 27 | 23 | 20 | 16 | 14 | 75 | 51 | 43 | 37 | 33 | 30 | 27 | 24 | 21 | 18 | 15 | 12 |
| 271 – 290 | 85 | 58 | 48 | 42 | 38 | 34 | 31 | 28 | 24 | 20 | 17 | 14 | 78 | 53 | 44 | 39 | 34 | 31 | 28 | 25 | 22 | 19 | 15 | 13 |
| 291 – 310 | 88 | 60 | 50 | 44 | 39 | 35 | 32 | 29 | 25 | 21 | 17 | 15 | 81 | 54 | 46 | 40 | 36 | 32 | 29 | 26 | 23 | 19 | 16 | 13 |
| 311 – 330 | 91 | 62 | 52 | 45 | 40 | 37 | 33 | 30 | 26 | 22 | 18 | 15 | 83 | 56 | 47 | 41 | 37 | 33 | 30 | 27 | 24 | 20 | 16 | 14 |
| 331 – 350 | 94 | 63 | 53 | 46 | 42 | 38 | 34 | 30 | 27 | 22 | 18 | 15 | 86 | 58 | 49 | 42 | 38 | 35 | 31 | 28 | 24 | 20 | 17 | 14 |
| 351 – 370 | 97 | 65 | 55 | 48 | 43 | 39 | 35 | 31 | 27 | 23 | 19 | 16 | 88 | 60 | 50 | 44 | 39 | 36 | 32 | 29 | 25 | 21 | 17 | 15 |
| 371 – 390 | 99 | 67 | 56 | 49 | 44 | 40 | 36 | 32 | 28 | 24 | 19 | 16 | 91 | 61 | 51 | 45 | 40 | 36 | 33 | 29 | 26 | 22 | 18 | 15 |
| 391 – 410 | * | 69 | 58 | 50 | 45 | 41 | 37 | 33 | 29 | 24 | 20 | 17 | 93 | 63 | 53 | 46 | 41 | 37 | 34 | 30 | 26 | 22 | 18 | 15 |
| 411 – 430 | * | 70 | 59 | 52 | 46 | 42 | 38 | 34 | 30 | 25 | 20 | 17 | 96 | 64 | 54 | 47 | 42 | 38 | 35 | 31 | 27 | 23 | 19 | 16 |
| 431 – 450 | * | 72 | 61 | 53 | 47 | 43 | 39 | 35 | 30 | 26 | 21 | 18 | 98 | 66 | 55 | 48 | 43 | 39 | 35 | 32 | 28 | 23 | 19 | 16 |
| 451 – 470 | * | 74 | 62 | 54 | 48 | 44 | 40 | 35 | 31 | 26 | 21 | 18 | * | 67 | 57 | 49 | 44 | 40 | 36 | 32 | 28 | 24 | 20 | 16 |
| 471 – 490 | * | 75 | 63 | 55 | 49 | 45 | 41 | 36 | 32 | 27 | 22 | 18 | * | 69 | 58 | 50 | 45 | 41 | 37 | 33 | 29 | 24 | 20 | 17 |

* FOR QCL DATA IN THIS RANGE CONSULT WITH AT&T COMPANY STAFF

Fig. 1—Load Balance Quality Control Limit Chart (Sheet 2 of 4) (2.27, 2.29, 2.30, 2.31)

## LOAD BALANCE QUALITY CONTROL LIMITS
### BASED ON 10 HOUR DATA

(MARCH 1975)

| STEP BY STEP & PANEL | 1.5% DTD |

**ACTUAL AVERAGE LOAD PERCENTAGE OF ENGINEERING LOAD**

| AVERAGE HOLDING TIME (SECS) | 66% TO 75% LINE FINDER SWITCHES | | | | | | | | | | | | 76% TO 85% LINE FINDER SWITCHES | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2–6 | 7–8 | 9–10 | 11–12 | 13–14 | 15–16 | 17–19 | 20–23 | 24–29 | 30–41 | 42–57 | 58–80 | 2–6 | 7–8 | 9–10 | 11–12 | 13–14 | 15–16 | 17–19 | 20–23 | 24–29 | 30–41 | 42–57 | 58–80 |
| 0 – 70 | 34 | 23 | 19 | 17 | 15 | 13 | 12 | 11 | 9 | 8 | 7 | 6 | 31 | 21 | 18 | 16 | 14 | 13 | 11 | 10 | 9 | 7 | 6 | 5 |
| 71 – 90 | 39 | 26 | 22 | 19 | 17 | 16 | 14 | 13 | 11 | 9 | 8 | 6 | 36 | 24 | 21 | 18 | 16 | 15 | 13 | 12 | 10 | 9 | 7 | 6 |
| 91 – 110 | 43 | 29 | 24 | 21 | 19 | 17 | 16 | 14 | 12 | 10 | 8 | 7 | 40 | 27 | 23 | 20 | 18 | 16 | 15 | 13 | 11 | 10 | 8 | 7 |
| 111 – 130 | 47 | 32 | 27 | 23 | 21 | 19 | 17 | 15 | 13 | 11 | 9 | 8 | 44 | 30 | 25 | 22 | 20 | 18 | 16 | 14 | 13 | 11 | 9 | 7 |
| 131 – 150 | 51 | 34 | 29 | 25 | 23 | 21 | 19 | 17 | 14 | 12 | 10 | 8 | 48 | 32 | 27 | 24 | 21 | 19 | 17 | 15 | 14 | 11 | 9 | 8 |
| 151 – 170 | 55 | 37 | 31 | 27 | 24 | 22 | 20 | 18 | 15 | 13 | 11 | 9 | 51 | 34 | 29 | 25 | 23 | 21 | 19 | 17 | 14 | 12 | 10 | 8 |
| 171 – 190 | 58 | 39 | 33 | 29 | 26 | 23 | 21 | 19 | 16 | 14 | 11 | 10 | 54 | 37 | 31 | 27 | 24 | 22 | 20 | 18 | 15 | 13 | 11 | 9 |
| 191 – 210 | 61 | 41 | 35 | 30 | 27 | 25 | 22 | 20 | 17 | 15 | 12 | 10 | 57 | 39 | 32 | 28 | 25 | 23 | 21 | 18 | 16 | 14 | 11 | 9 |
| 211 – 230 | 64 | 43 | 36 | 32 | 28 | 26 | 23 | 21 | 18 | 15 | 13 | 11 | 60 | 40 | 34 | 30 | 27 | 24 | 22 | 19 | 17 | 14 | 12 | 10 |
| 231 – 250 | 67 | 45 | 38 | 33 | 30 | 27 | 24 | 22 | 19 | 16 | 13 | 11 | 63 | 42 | 35 | 31 | 28 | 25 | 23 | 20 | 18 | 15 | 12 | 10 |
| 251 – 270 | 70 | 47 | 39 | 34 | 31 | 28 | 25 | 23 | 20 | 17 | 14 | 11 | 65 | 44 | 37 | 32 | 29 | 26 | 24 | 21 | 18 | 16 | 13 | 11 |
| 271 – 290 | 72 | 49 | 41 | 36 | 32 | 29 | 26 | 23 | 20 | 17 | 14 | 12 | 68 | 46 | 38 | 33 | 30 | 27 | 25 | 22 | 19 | 16 | 13 | 11 |
| 291 – 310 | 75 | 50 | 42 | 37 | 33 | 30 | 27 | 24 | 21 | 18 | 15 | 12 | 70 | 47 | 40 | 35 | 31 | 28 | 25 | 23 | 20 | 17 | 14 | 12 |
| 311 – 330 | 77 | 52 | 44 | 38 | 34 | 31 | 28 | 25 | 22 | 18 | 15 | 13 | 72 | 49 | 41 | 36 | 32 | 29 | 26 | 23 | 20 | 17 | 14 | 12 |
| 331 – 350 | 80 | 54 | 45 | 39 | 35 | 32 | 29 | 26 | 23 | 19 | 16 | 13 | 75 | 50 | 42 | 37 | 33 | 30 | 27 | 24 | 21 | 18 | 15 | 12 |
| 351 – 370 | 82 | 55 | 46 | 40 | 36 | 33 | 30 | 27 | 23 | 20 | 16 | 13 | 77 | 52 | 43 | 38 | 34 | 31 | 28 | 25 | 22 | 18 | 15 | 13 |
| 371 – 390 | 84 | 57 | 48 | 42 | 37 | 34 | 31 | 27 | 24 | 20 | 16 | 14 | 79 | 53 | 45 | 39 | 35 | 32 | 29 | 25 | 22 | 19 | 15 | 13 |
| 391 – 410 | 86 | 58 | 49 | 43 | 38 | 35 | 31 | 28 | 24 | 21 | 17 | 14 | 81 | 54 | 46 | 40 | 36 | 32 | 29 | 26 | 23 | 19 | 16 | 13 |
| 411 – 430 | 88 | 60 | 50 | 44 | 39 | 36 | 32 | 29 | 25 | 21 | 17 | 15 | 83 | 56 | 47 | 41 | 37 | 33 | 30 | 27 | 23 | 20 | 16 | 14 |
| 431 – 450 | 91 | 61 | 51 | 45 | 40 | 36 | 33 | 29 | 26 | 22 | 18 | 15 | 85 | 57 | 48 | 42 | 37 | 34 | 31 | 27 | 24 | 20 | 17 | 14 |
| 451 – 470 | 93 | 62 | 52 | 46 | 41 | 37 | 34 | 30 | 26 | 22 | 18 | 15 | 87 | 58 | 49 | 43 | 38 | 35 | 31 | 28 | 25 | 21 | 17 | 14 |
| 471 – 490 | 95 | 64 | 54 | 47 | 42 | 38 | 34 | 31 | 27 | 23 | 18 | 16 | 89 | 60 | 50 | 44 | 39 | 36 | 32 | 29 | 25 | 21 | 17 | 15 |

Fig. 1—Load Balance Quality Control Limit Chart (Sheet 3 of 4) (2.27, 2.29, 2.30, 2.31)

| | LOAD BALANCE QUALITY CONTROL LIMITS BASED ON 10 HOUR DATA | (MARCH 1975) |
|---|---|---|

| STEP BY STEP & PANEL | 1.5% DTD |
|---|---|

**ACTUAL AVERAGE LOAD PERCENTAGE OF ENGINEERING LOAD**

| AVERAGE HOLDING TIME (SECS) | 86% TO 95% LINE FINDER SWITCHES | | | | | | | | | | | | 96% AND UP LINE FINDER SWITCHES | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 – 6 | 7 – 8 | 9 – 10 | 11 – 12 | 13 – 14 | 15 – 16 | 17 – 19 | 20 – 23 | 24 – 29 | 30 – 41 | 42 – 57 | 58 – 80 | 2 – 6 | 7 – 8 | 9 – 10 | 11 – 12 | 13 – 14 | 15 – 16 | 17 – 19 | 20 – 23 | 24 – 29 | 30 – 41 | 42 – 57 | 58 – 80 |
| 0 – 70 | 30 | 20 | 17 | 15 | 13 | 12 | 11 | 10 | 8 | 7 | 6 | 5 | 28 | 19 | 16 | 14 | 12 | 11 | 10 | 9 | 8 | 7 | 5 | 5 |
| 71 – 90 | 34 | 23 | 19 | 17 | 15 | 14 | 12 | 11 | 10 | 8 | 7 | 6 | 32 | 22 | 18 | 16 | 14 | 13 | 12 | 10 | 9 | 8 | 6 | 5 |
| 91 – 110 | 38 | 26 | 22 | 19 | 17 | 15 | 14 | 12 | 11 | 9 | 7 | 6 | 36 | 24 | 20 | 18 | 16 | 15 | 13 | 12 | 10 | 9 | 7 | 6 |
| 111 – 130 | 42 | 28 | 24 | 21 | 18 | 17 | 15 | 14 | 12 | 10 | 8 | 7 | 40 | 27 | 22 | 20 | 18 | 16 | 14 | 13 | 11 | 9 | 8 | 7 |
| 131 – 150 | 45 | 30 | 26 | 22 | 20 | 18 | 16 | 15 | 13 | 11 | 9 | 7 | 43 | 29 | 24 | 21 | 19 | 17 | 16 | 14 | 12 | 10 | 8 | 7 |
| 151 – 170 | 48 | 33 | 27 | 24 | 21 | 19 | 18 | 16 | 14 | 12 | 9 | 8 | 46 | 31 | 26 | 23 | 20 | 18 | 17 | 15 | 13 | 11 | 9 | 8 |
| 171 – 190 | 51 | 35 | 29 | 25 | 23 | 21 | 19 | 17 | 14 | 12 | 10 | 8 | 49 | 33 | 27 | 24 | 21 | 20 | 18 | 16 | 14 | 12 | 9 | 8 |
| 191 – 210 | 54 | 36 | 31 | 27 | 24 | 22 | 20 | 17 | 15 | 13 | 11 | 9 | 51 | 35 | 29 | 25 | 23 | 21 | 19 | 17 | 14 | 12 | 10 | 8 |
| 211 – 230 | 57 | 38 | 32 | 28 | 25 | 23 | 21 | 18 | 16 | 13 | 11 | 9 | 54 | 36 | 30 | 27 | 24 | 22 | 19 | 17 | 15 | 13 | 10 | 9 |
| 231 – 250 | 59 | 40 | 33 | 29 | 26 | 24 | 21 | 19 | 17 | 14 | 12 | 10 | 56 | 38 | 32 | 28 | 25 | 23 | 20 | 18 | 16 | 13 | 11 | 9 |
| 251 – 270 | 61 | 41 | 35 | 30 | 27 | 25 | 22 | 20 | 17 | 15 | 12 | 10 | 58 | 39 | 33 | 29 | 26 | 23 | 21 | 19 | 17 | 14 | 11 | 10 |
| 271 – 290 | 64 | 43 | 36 | 32 | 28 | 26 | 23 | 21 | 18 | 15 | 12 | 10 | 61 | 41 | 34 | 30 | 27 | 24 | 22 | 20 | 17 | 14 | 12 | 10 |
| 291 – 310 | 66 | 45 | 37 | 33 | 29 | 27 | 24 | 21 | 19 | 16 | 13 | 11 | 63 | 42 | 35 | 31 | 28 | 25 | 23 | 20 | 18 | 15 | 12 | 10 |
| 311 – 330 | 68 | 46 | 39 | 34 | 30 | 27 | 25 | 22 | 19 | 16 | 13 | 11 | 65 | 44 | 37 | 32 | 29 | 26 | 23 | 21 | 18 | 15 | 13 | 11 |
| 331 – 350 | 70 | 47 | 40 | 35 | 31 | 28 | 25 | 23 | 20 | 17 | 14 | 12 | 67 | 45 | 38 | 33 | 29 | 27 | 24 | 22 | 19 | 16 | 13 | 11 |
| 351 – 370 | 72 | 49 | 41 | 36 | 32 | 29 | 26 | 23 | 20 | 17 | 14 | 12 | 69 | 46 | 39 | 34 | 30 | 28 | 25 | 22 | 19 | 16 | 13 | 11 |
| 371 – 390 | 74 | 50 | 42 | 37 | 33 | 30 | 27 | 24 | 21 | 18 | 15 | 12 | 71 | 48 | 40 | 35 | 31 | 28 | 26 | 23 | 20 | 17 | 14 | 12 |
| 391 – 410 | 76 | 51 | 43 | 38 | 34 | 31 | 28 | 25 | 22 | 18 | 15 | 13 | 72 | 49 | 41 | 36 | 32 | 29 | 26 | 23 | 20 | 17 | 14 | 12 |
| 411 – 430 | 78 | 53 | 44 | 39 | 35 | 31 | 28 | 25 | 22 | 19 | 15 | 13 | 74 | 50 | 42 | 37 | 33 | 30 | 27 | 24 | 21 | 18 | 14 | 12 |
| 431 – 450 | 80 | 54 | 45 | 39 | 35 | 32 | 29 | 26 | 23 | 19 | 16 | 13 | 76 | 51 | 43 | 37 | 34 | 30 | 28 | 25 | 21 | 18 | 15 | 12 |
| 451 – 470 | 82 | 55 | 46 | 40 | 36 | 33 | 30 | 26 | 23 | 19 | 16 | 13 | 78 | 52 | 44 | 38 | 34 | 31 | 28 | 25 | 22 | 18 | 15 | 13 |
| 471 – 490 | 83 | 56 | 47 | 41 | 37 | 34 | 30 | 27 | 24 | 20 | 16 | 14 | 79 | 53 | 45 | 39 | 35 | 32 | 29 | 26 | 22 | 19 | 15 | 13 |

Fig. 1—Load Balance Quality Control Limit Chart (Sheet 4 of 4) (2.27, 2.29, 2.30, 2.31)

## INSTRUCTIONS FOR PREPARING FORM E-6615

### SCORE CONTROL RECORD

Traffic Unit — Identify the traffic unit, eg, 532

Loading Division — Identify the loading division.

LUs Installed — Enter quantity of load units installed in the loading division.

LU Eng. CCS — Enter the engineered capacity in CCS for a load unit in the loading division (All load units must be engineered or designed to operate at the same capacity).

Study Date — Enter the beginning and ending date of each study, e.g. 2-9 to 2-13-75.

Study No. — These numbers may be circled to indicate the studies to be indexed when more than one study a month is made.

Total CCS — Enter the total usage read on the study for the loading division. This should include usage only from load units with valid data.

LUs Meas. — Enter the quantity of load units with valid data for the study.

% Eng. Cap. — Enter the percent the actual load is of the engineered capacity. The method for computing this percentage is outlined in paragraph 2.29 of this practice:

1) $\dfrac{\text{Total CCS}}{\text{LU's Meas.}}$ = Average Weekly Load

2) $\dfrac{\text{Average Weekly Load}}{\text{No. of Study Hours}}$ = Average Load (AL)

3) $\dfrac{\text{Average Load}}{\text{LU Eng. CCS}} \times 100$ = % Eng. Cap.

Avg. H. T. — Enter the average holding time used on the study to select quality control limits. The method is outlined in paragraph 2.30 of this section.

#### % Column

+2 — The average CCS will be considered as 100%. Add the quality control limit figure (percent) found in the tables to 100 and enter here.

+1 — Add half the quality control limit figure to 100 and enter here.

0 — The average is considered as 100%.

−1 — Subtract half the quality control limit figure from 100 and enter here.

−2 — Subtract the quality control figure from 100 and enter here.

#### CCS Column

+2 — Multiply the figure in % Column times the average CCS, divide by 100 and round all fractions to the nearest whole number and enter here, e.g. 231.6 would be entered as 232, the upper limit for +2 scores.

+1 — Multiply the figure in % Column times the average CCS, divide by 100 and round fractions to the nearest whole number and enter here.

0 — Divide the total CCS read on the study by the quantity of load units having valid data on the study. Round off to the nearest whole number and enter here.

−1 — Multiply the figure in % Column times the average CCS, divide by 100 and round fractions a whole number and enter here, e.g. 231.2 would be entered as 231.

−2 — Multiply the figure in % Column times the average CCS, divide CCS, divide by 100 and round fractions to a whole number and enter here.

*Note:* Actual 10-hour sample usage readings may be substituted for CCS values if preferred.

---

### LOAD BALANCE SCORE CONTROL RECORD

Form E6615 (5-75)

Building: GARD  Traffic Unit: 532  Page 1 of 1

LOADING DIVISION: LMB   LU's INSTALLED: 20   LU ENG. CCS: 436

| STUDY DATE | 5/3–5/7 | | | | | | |
|---|---|---|---|---|---|---|---|
| STUDY NO. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| TOTAL CCS | 78916 | | | | | | |
| LU's MEAS. | 20 | | | | | | |
| % ENG. CAP. | 90.5 | | | | | | |
| AVG. H.T. | 232 | | | | | | |

| | % | CCS | % | CCS | % | CCS | % | CCS | % | CCS | % | CCS | % | CCS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| +2 | 119 | 4686 | | | | | | | | | | | | |
| +1 | 109.5 | 4321 | | | | | | | | | | | | |
| 0 | AVG. | 3946 | AVG. | | AVG. | | AVG. | | AVG. | | AVG. | | AVG. | |
| −1 | 90.5 | 3571 | | | | | | | | | | | | |
| −2 | 81.0 | 3196 | | | | | | | | | | | | |

LOADING DIVISION: _____   LU's INSTALLED: _____   LU ENG. CCS: _____

| STUDY DATE | | | | | | | |
|---|---|---|---|---|---|---|---|
| STUDY NO. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| TOTAL CCS | | | | | | | |
| LU's MEAS. | | | | | | | |
| % ENG. CAP. | | | | | | | |
| AVG. H.T. | | | | | | | |

| | % | CCS | % | CCS | % | CCS | % | CCS | % | CCS | % | CCS | % | CCS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| +2 | | | | | | | | | | | | | | |
| +1 | | | | | | | | | | | | | | |
| 0 | AVG. | | AVG. | | AVG. | | AVG. | | AVG. | | AVG. | | AVG. | |
| −1 | | | | | | | | | | | | | | |
| −2 | | | | | | | | | | | | | | |

LOADING DIVISION: _____   LU's INSTALLED: _____   LU ENG. CCS: _____

| STUDY DATE | | | | | | | |
|---|---|---|---|---|---|---|---|
| STUDY NO. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| TOTAL CCS | | | | | | | |
| LU's MEAS. | | | | | | | |
| % ENG. CAP. | | | | | | | |
| AVG. H.T. | | | | | | | |

| | % | CCS | % | CCS | % | CCS | % | CCS | % | CCS | % | CCS | % | CCS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| +2 | | | | | | | | | | | | | | |
| +1 | | | | | | | | | | | | | | |
| 0 | AVG. | | AVG. | | AVG. | | AVG. | | AVG. | | AVG. | | AVG. | |
| −1 | | | | | | | | | | | | | | |
| −2 | | | | | | | | | | | | | | |

**Fig. 2—Load Balance Score Control Record Form E-6615 and Instructions for Preparation (2.34, 5.01, 5.06)**

## INSTRUCTIONS FOR PREPARING FORM E-6616

### LOAD UNIT LINE LOAD BALANCE CHART

<u>Loading Division</u> — Identify the loading division.

<u>Traffic Unit</u> — Identify the traffic unit.

<u>LU Installed</u> — Enter quantity of load units installed in the loading division.

<u>Page of</u> — Number each page consecutively beginning with 1 (one) and show total pages to list all load units in the loading division.

<u>Study Date</u> — Enter the beginning and ending dates of the study; eg, 2-9 to 2-13-75.

<u>Study No.</u> — These numbers may be circled to indicate the studies to be indexed when more than one study a month is made.

<u>FR-LLN-LLF</u> — Enter the line link network or frame number when required to distinguish between load units. Cross out the two not applicable.

<u>LG-HG-Conc.</u> — Cross out the two not applicable. Enter the line group, horizontal group or concentrator identification.

<u>CCS</u> — Enter the weeks usage reading for the load unit (LG, HG or Conc.) on the study.

<u>S-P-H</u> — These spaces stand for score (S), penalty (P) and hot spot penalty points (H). Detailed information regarding the development of <u>P</u> and <u>H</u> is found in DFMP Division A, Section 5b, <u>Load Balance Index Plan</u>.

— The <u>S</u> space is for entering the study score for the load unit. The +4 scores for indexed studies may be highlighted for ease of counting penalty points.

— The <u>P</u> space is for entering the total penalty points for the report month. It is suggested these be entered only when the load unit results are to be reported in the index.

— The <u>H</u> space is for entering the total hot spot penalty points for the report month.

<u>CCS</u> — Enter total usage for the study period for each load unit (LG' HG or Conc.) on the study.

*Note:* Actual 10 hour sample usage readings may be substituted for CCS values if preferred. However, this will require the Hot Spot threshold value to be converted to reflect this approach. See Division A, Section 5b.

<u>S-P-H</u> — These spaces stand for score (S), penalty (P) and hot spot penalty points (H). Detailed information regarding the development of <u>P</u> and <u>H</u> is found in DFMP Division A, Section 5b, <u>Load Balance Index Plan</u>.

— The <u>S</u> space is for entering the study score for the load unit. The +4 scores for indexed studies may be highlighted for ease of counting penalty points.

— The <u>P</u> space is for entering the total penalty points for the report month. It is suggested these be entered only when the load unit results are to be reported in the index.

— The <u>H</u> space is for entering the total hot spot penalty points for the report month.

**INSTRUCTIONS FOR PREPARING FORM E-6616**
(5-75)

LOAD UNIT—LOAD BALANCE CHART  Form E-6616 (5-75)

Building: GARD   Traffic Unit: 532   Page 1 of 1
Loading Division: IMB   LU Installed: 20

| ~~LTN~~ ~~LLN~~ (FR) | (LG) ~~HG~~ ~~Conc Grp~~ | STUDY DATE / STUDY NO. | 8/9-8/3  1. | 9/16-9/20  2. | 9/23-9/27  3. | 9/30-9/3  4. | 5. | 6. | 7. |
|---|---|---|---|---|---|---|---|---|---|
| 35 | 80 | CCS | 4696 | 4321 | 3571 | 3196 | | | |
|  |  | S +2 P H | +1 | -1 | -2 | | | | |
| 26 | 63 | CCS | 4623 | 3999 | 3243 | 3097 | | | |
|  |  | S +2 P H | +1 | -1 | -2 | | | | |
| 33 | 77 | CCS | 4931 | 4789 | 3200 | 3001 | | | |
|  |  | S +2 P H | +1 | -1 | -2 | | | | |

S-Study Score

P-Penalty Points

H-Hot Spot Penalty Points

**Fig. 3—Load Unit-Load Balance Chart Form E-6616 and Instructions for Preparation (2.34, 5.01)**

A. WITH SELECTORS IN EACH STAGE

B. WITH DIGIT ABSORBING SELECTORS
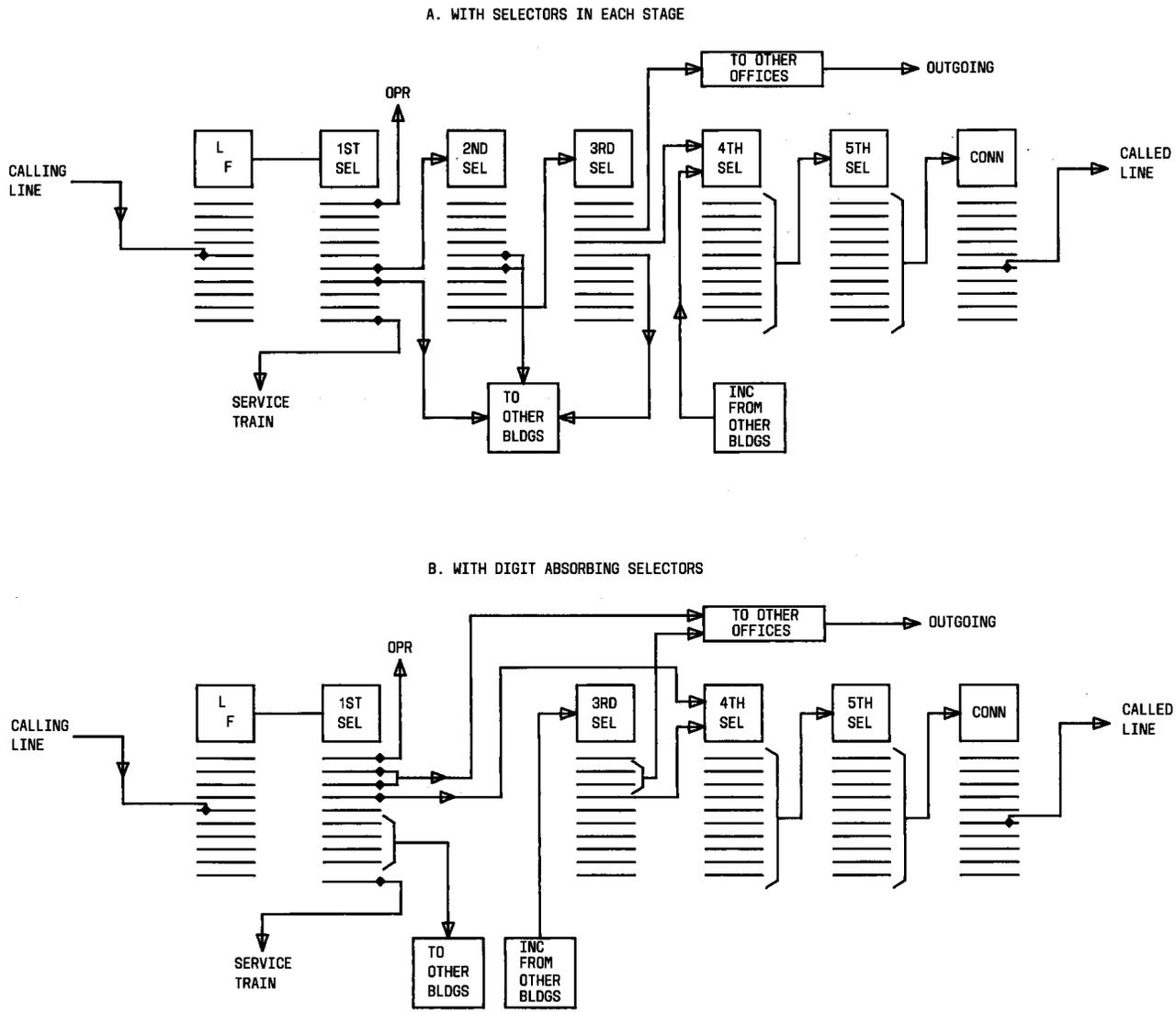
Fig. 4—Non-Automatic Message Accounting Switch Trains (3.02)

**ESTABLISHED LOAD PER CONNECTOR GROUP**

| CLASS OF SERVICE | INSTALLED TERMINALS | PROJECTED CCS PER GRP | TOTAL CCS |
|---|---|---|---|
| Reg 1-ring | 3,600 | 130 | 4,680 |
| Reg 2-ring | 2,200 | 130 | 2,860 |
| Rotary hunting | 700 | 255 | 1,785 |
| Level hunting | 100 | 325 | 325 |
| Rural | 600 | 144 | 864 |
| Coin | 200 | 115 | 330 |
| Official | 100 | 395 | 395 |
| Total | 7,500 | | 11,239 |

**CONNECTOR GROUP CCS CAPACITY TABLE (P.01)**

| NUMBER OF CONNECTORS PER GROUP | CCS CAPACITY |
|---|---|
| 5 | 46 |
| 6 | 64 |
| 7 | 84 |
| 8 | 105 |
| 9 | 126 |
| 10 | 149 |
| 11 | 168 |
| 12 | 187 |
| 13 | 205 |
| 14 | 223 |
| 15 | 241 |
| 16 | 259 |
| 17 | 276 |
| 18 | 294 |
| 19 | 312 |
| 20 | 329 |
| 21 | 347 |
| 23 | 382 |
| 25 | 417 |
| 27 | 451 |
| 29 | 485 |
| 31 | 519 |

**Fig. 5—Connector Group Capacity Table (3.13)**

## INSTRUCTIONS FOR USING LOAD BALANCE GUIDE CONNECTOR GROUPS (FORM E-6899)

Building — Identify the building.

Loading Division — Identify the loading division.

Traffic Unit — Identify the traffic unit.

No. of Connectors per Group — Enter number of connectors in the connector group.

CCS/CALL Capacity Per Group — Enter the engineered CCS/CALL capacity for the connector group multipled by study hours.

Page of — Number each page consecutively beginning with one (1) and show told pages to list all load units in the loading division.

CCS Load Per Group—Weekly — Enter the weeks usage reading for the connector group.

---

Form E — 6899 (9-76)

**LOAD BALANCE GUIDE
CONNECTOR GROUPS**

PAGE *1* OF *1*

BUILDING ___GRDN___

LOADING DIVISION ___1MB___

NO. OF CONNECTORS PER GROUP ___20___

TRAFFIC UNIT ___532___

*Note:* Circle those CG's which are at or exceed the stated capacity.

CCS/CALL CAPACITY PER GROUP ___329___

| CONNECTOR GROUP NO. | 6/28 to 7/2 | 7/5 to 7/9 | 7/12 to 7/16 | 7/19 to 7/23 | 7/26 to 7/30 | 8/2 to 8/6 | 8/9 to 8/13 | 8/16 to 8/20 | 8/23 to 8/27 | 8/30 to 9/3 | 9/6 to 9/10 | 9/13 to 9/17 | 9/20 to 9/24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (8900) | 1779 | 1759 | 1800 | 1667 | 1680 | 1790 | 1690 | 1702 | 1689 | 1798 | 1635 | 1701 | 1688 |
| (3500) | 1760 | 1665 | 1559 | 1619 | 1699 | 1701 | 1689 | 1709 | 1650 | 1715 | 1675 | 1701 | 1750 |
| (4000) | 1801 | 1790 | 1767 | 1793 | 1799 | 1805 | 1760 | 1763 | 1764 | 1811 | 1659 | 1724 | 1740 |
| 4500 | 1499 | 1305 | 1423 | 1480 | 1490 | 1595 | 1478 | 1483 | 1465 | 1597 | 1545 | 1425 | 1495 |

Fig. 6—Load Balance Guide to Connector Groups
Form E-6899 and Instructions for Preparation
(3.15)

## LINE ASSIGNMENT GUIDE — PROCEDURE 1

CCS Capacity      = 436
Type of Frame     = LF*
Estimated CCS/MS = 4

| DESIRED ORDER OF ASSIGNMENT | CCS TO ADD | BAY# | LG# | ASSIGNED TERM. CS | DISCONNECTED TERM. CS |
|---|---|---|---|---|---|
| 1 | 70 | 33 | 76 | 7 | |
| 2 | 66 | 33 | 76 | 12 | |
| 3 | 62 | 33 | 76 | 13 | |
| 4 | 60 | 26 | 63 | 9 | |
| 5 | 58 | 33 | 76 | NA NA | 8 |
| 6 | 56 | 26 | 65 | 12 | |
| 7 | 54 | 33 | 76 | NA NA | |
| 8 | 54 | 13 | 36 | 1 | |
| 9 | 54 | 35 | 80 | NA NA | 5 |
| 10 | 53 | 6 | 16 | 1 | |
| 11 | 52 | 26 | 63 | 18 | |
| 12 | 50 | 33 | 76 | NA NA | |
| 13 | 50 | 13 | 36 | 11 | |
| 14 | 50 | 35 | 80 | NA NA | |
| 15 | 50 | 8 | 23 | 17 | 14 |
| 16 | 49 | 6 | 16 | 10 | |
| 17 | 48 | 26 | 63 | NA NA | |
| 18 | 46 | 33 | 73 | NA NA | |
| 19 | 46 | 13 | 36 | NA NA | 20 |
| 20 | 46 | 35 | 80 | NA NA | |

*Note:* LG# = line finder or line switch group(s).

**Fig. 7—Line Assignment Guide—Procedure 1 (5.28, 5.29)**

LINE ASSIGNMENT GUIDE — PROCEDURE 2

CCS Capacity = 436          LCCS = 3
                            MCCS = 6
Type of Frame = LF          HCCS = 9

| DESIRED ORDER OF ASSIGNMENT | CCS TO ADD | BAY# | LG# | ASSIGNED TERM. CS | | DISCONNECTED TERM. CS |
|---|---|---|---|---|---|---|
| 1 | 70 | 33 | 76 | L | 7 | |
| 2 | 67 | 33 | 76 | ____ | | |
| 3 | 64 | 33 | 76 | M | 12 | |
| 4 | 61 | 33 | 76 | ____ | | |
| 5 | 60 | 26 | 63 | L | 9 | |
| 6 | 58 | 33 | 76 | ____ | | |
| 7 | 57 | 26 | 63 | ____ | | |
| 8 | 55 | 33 | 76 | H | 13 | |
| 9 | 54 | 26 | 63 | M | 12 | |
| 10 | 54 | 13 | 36 | L | 1 | |
| 11 | 54 | 35 | 80 | NA | NA | 5 |
| 12 | 53 | 6 | 16 | L | 1 | |
| 13 | 52 | 33 | 76 | NA | NA | 11 |
| 14 | 51 | 26 | 63 | ____ | | |
| 15 | 51 | 13 | 36 | ____ | | |
| 16 | 51 | 35 | 80 | NA | NA | |
| 17 | 50 | 6 | 16 | ____ | | |
| 18 | 50 | 8 | 23 | L | 17 | 18 |
| 19 | 49 | 33 | 76 | NA | NA | |
| 20 | 48 | 26 | 63 | ____ | | |
| 21 | 48 | 13 | 36 | M | 12 | 14 |

Fig. 8—Line Assignment Guide—Procedure 2 (5.35)

FORM E-6617
(5-75)

## CCS CORRECTION

Page  / of /

| BUILDING: *GRDN* | | | | TRAFFIC UNIT: *532* | | | | LOAD UNITS: *1MB* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | F | STUDY 1 (4-4 to 4-9) | | | | STUDY 2 (4-14 to 4-18) | | | | STUDY 3 (4-21 to 4-25) | | | |
| | | Q/3 X AVG. CCS X F | | | | Q/3 X AVG. CCS X F | | | | Q/3 X AVG. CCS X F | | | |
| | .5 | (.13)(3946)(0.5)=256.5 | | | | 1.13(3946)(0.5)=256.5 | | | | (0.13)(3946)(0.5)=256.5 | | | |
| | 1.0 | (.13)(3946)(1.0)=513.0 | | | | 1.13(3946)(1.0)=513.0 | | | | (0.13)(3946)(1.0)=513.0 | | | |
| | 2.0 | (.13)(3946)(2.0)=1026.0 | | | | (.13)(3946)(2.0)=1026.0 | | | | (0.13)(3946)(2.0)=1026.0 | | | |
| | 3.0 | (0.13)(3946)(3.0)=1539. | | | | (.13)(3946)(3.0)=1539.0 | | | | (0.13)(3946)(3.0)=1539.0 | | | |
| | 4.0 | (0.13)(3946)(4.0)=2052. | | | | (.13)(3946)(4.0)=2052.0 | | | | (0.13)(3946)(4.0)=2052.0 | | | |
| | 5.0 | (0.13)(3946)(5.0)=2565. | | | | (.13)(3946)(5.0)=2565.0 | | | | (0.13)(3946)(5.0)=2565.0 | | | |
| | 6.0 | (0.13)(3946)(6.0)=3078. | | | | 1.13(3946)(6.0)=3078.0 | | | | (0.13)(3946)(6.0)=3078.0 | | | |

| LOAD UNIT | W | SC | WSC | F | CCS CORR. | W | SC | WSC | F | CCS CORR. | W | SC | WSC | F | CCS CORR. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | +4 | | 3.0 | -47 | | +4 | | 3.0 | -47 | | +4 | | 3.0 | -47 |
| 2 | | -2 | | 1.0 | +16 | | -2 | | 1.0 | +16 | | -2 | | 1.0 | +16 |
| 3 | | +1 | | 0.5 | -8 | | +1 | | 0.5 | -8 | | +1 | | 0.5 | -8 |
| 4 | | +2 | | 1.0 | -16 | | +2 | | 1.0 | -16 | | +2 | | 1.0 | -16 |
| 5 | | -4 | | 3.0 | +47 | | -4 | | 3.0 | +47 | | -4 | | 3.0 | +47 |
| 6 | | -1 | | 0.5 | +8 | | -1 | | 0.5 | +8 | | -1 | | 0.5 | +8 |
| 7 | | -2 | | 1.0 | +16 | | -2 | | 1.0 | +16 | | -2 | | 1.0 | +16 |
| 8 | | +1 | | 0.5 | -8 | | +1 | | 0.5 | -8 | | +1 | | 0.5 | -8 |

**Fig. 9—CCS Correction Form E-6617 (5.39)**

| FACTORS (W) & (F) | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WEEKLY | | | | | | BIWEEKLY | | | | | |
| WSC | W | F | WSC | W | F | WSC | W | F | WSC | W | F |
| 0 | 0 | 0 | 3.6 | 1.6 | 1.0 | 0 | 0 | 0 | 3.4 | 1.3 | 2.0 |
| .1 | 0 | 0 | 3.7 | 1.6 | 2.0 | .1 | 0 | 0 | 3.5 | 1.4 | 2.0 |
| .2 | .1 | 0 | 3.8 | 1.7 | 2.0 | .2 | .1 | 0 | 3.6 | 1.4 | 2.0 |
| .3 | .1 | 0 | 3.9 | 1.7 | 2.0 | .3 | .1 | 0 | 3.7 | 1.4 | 2.0 |
| .4 | .2 | 0 | 4.0 | 1.8 | 2.0 | .4 | .2 | 0 | 3.8 | 1.5 | 2.0 |
| .5 | .2 | 0 | 4.1 | 1.8 | 2.0 | .5 | .2 | 0 | 3.9 | 1.5 | 2.0 |
| .6 | .3 | 0 | 4.2 | 1.9 | 2.0 | .6 | .2 | 0 | 4.0 | 1.6 | 2.0 |
| .7 | .3 | 0 | 4.3 | 1.9 | 2.0 | .7 | .3 | 0 | 4.1 | 1.6 | 2.0 |
| .8 | .4 | 0 | 4.4 | 2.0 | 2.0 | .8 | .3 | 0 | 4.2 | 1.6 | 2.0 |
| .9 | .4 | 0 | 4.5 | 2.0 | 2.0 | .9 | .4 | 0 | 4.3 | 1.7 | 2.0 |
| 1.0 | .4 | 0 | 4.6 | 2.0 | 2.0 | 1.0 | .4 | 0 | 4.4 | 1.7 | 2.0 |
| 1.1 | .5 | 0 | 4.7 | 2.1 | 2.0 | 1.1 | .4 | .5 | 4.5 | 1.8 | 2.0 |
| 1.2 | .5 | .5 | 4.8 | 2.1 | 2.0 | 1.2 | .5 | .5 | 4.6 | 1.8 | 2.0 |
| 1.3 | .6 | .5 | 4.9 | 2.2 | 2.0 | 1.3 | .5 | .5 | 4.7 | 1.8 | 2.0 |
| 1.4 | .6 | .5 | 5.0 | 2.2 | 2.0 | 1.4 | .5 | .5 | 4.8 | 1.9 | 2.0 |
| 1.5 | .7 | .5 | 5.1 | 2.3 | 2.0 | 1.5 | .6 | .5 | 4.9 | 1.9 | 3.0 |
| 1.6 | .7 | .5 | 5.2 | 2.3 | 2.0 | 1.6 | .6 | .5 | 5.0 | 2.0 | 3.0 |
| 1.7 | .8 | .5 | 5.3 | 2.4 | 2.0 | 1.7 | .7 | .5 | 5.1 | 2.0 | 3.0 |
| 1.8 | .8 | .5 | 5.4 | 2.4 | 3.0 | 1.8 | .7 | .5 | 5.2 | 2.0 | 3.0 |
| 1.9 | .8 | .5 | 5.5 | 2.4 | 3.0 | 1.9 | .7 | .5 | 5.3 | 2.1 | 3.0 |
| 2.0 | .9 | .5 | 5.6 | 2.5 | 3.0 | 2.0 | .8 | .5 | 5.4 | 2.1 | 3.0 |
| 2.1 | .9 | .5 | 5.7 | 2.5 | 3.0 | 2.1 | .8 | 1.0 | 5.5 | 2.1 | 3.0 |
| 2.2 | 1.0 | .5 | 5.8 | 2.6 | 3.0 | 2.2 | .9 | 1.0 | 5.6 | 2.2 | 3.0 |
| 2.3 | 1.0 | 1.0 | 5.9 | 2.6 | 3.0 | 2.3 | .9 | 1.0 | 5.7 | 2.2 | 4.0 |
| 2.4 | 1.1 | 1.0 | 6.0 | 2.7 | 3.0 | 2.4 | .9 | 1.0 | 5.8 | 2.3 | 4.0 |
| 2.5 | 1.1 | 1.0 | 6.1 | 2.7 | 3.0 | 2.5 | 1.0 | 1.0 | 5.9 | 2.3 | 4.0 |
| 2.6 | 1.2 | 1.0 | 6.2 | 2.8 | 3.0 | 2.6 | 1.0 | 1.0 | 6.0 | 2.3 | 4.0 |
| 2.7 | 1.2 | 1.0 | 6.3 | 2.8 | 4.0 | 2.7 | 1.1 | 1.0 | 6.1 | 2.4 | 4.0 |
| 2.8 | 1.2 | 1.0 | 6.4 | 2.8 | 4.0 | 2.8 | 1.1 | 1.0 | 6.2 | 2.4 | 4.0 |
| 2.9 | 1.3 | 1.0 | 6.5 | 2.9 | 4.0 | 2.9 | 1.1 | 1.0 | 6.3 | 2.5 | 4.0 |
| 3.0 | 1.3 | 1.0 | 6.6 | 2.9 | 4.0 | 3.0 | 1.2 | 1.0 | 6.4 | 2.5 | 5.0 |
| 3.1 | 1.4 | 1.0 | 6.7 | 3.0 | 4.0 | 3.1 | 1.2 | 1.0 | 6.5 | 2.5 | 6.0 |
| 3.2 | 1.4 | 1.0 | 6.8 | 3.0 | 4.0 | 3.2 | 1.2 | 1.0 | 6.6 | 2.6 | 6.0 |
| 3.3 | 1.5 | 1.0 | 6.9 | 3.1 | 4.0 | 3.3 | 1.3 | 1.0 | | | |
| 3.4 | 1.5 | 1.0 | 7.0 | 3.1 | 5.0 | | | | | | |
| 3.5 | 1.6 | 1.0 | 7.1 | 3.2 | 5.0 | | | | | | |
| | | | 7.2 | 3.2 | 6.0 | | | | | | |

**Fig. 10—W- and F-Factors (Sheet 1 of 2) (5.40)**

| FACTORS (W) & (F) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TRIWEEKLY | | | | | | MONTHLY | | | | | |
| WSC | W | F | WSC | W | F | WSC | W | F | WSC | W | F |
| 0 | 0 | 0 | 3.0 | 1.0 | 1.0 | 0 | 0 | 0 | 2.9 | .8 | 2.0 |
| .1 | 0 | 0 | 3.1 | 1.0 | 2.0 | .1 | 0 | 0 | 3.0 | .9 | 2.0 |
| .2 | .1 | 0 | 3.2 | 1.1 | 2.0 | .2 | .1 | 0 | 3.1 | .9 | 2.0 |
| .3 | .1 | 0 | 3.3 | 1.1 | 2.0 | .3 | .1 | 0 | 3.2 | .9 | 2.0 |
| .4 | .1 | 0 | 3.4 | 1.2 | 2.0 | .4 | .1 | 0 | 3.3 | 1.0 | 2.0 |
| .5 | .2 | 0 | 3.5 | 1.2 | 2.0 | .5 | .1 | 0 | 3.4 | 1.0 | 2.0 |
| .6 | .2 | 0 | 3.6 | 1.2 | 2.0 | .6 | .2 | 0 | 3.5 | 1.0 | 2.0 |
| .7 | .2 | 0 | 3.7 | 1.3 | 2.0 | .7 | .2 | 0 | 3.6 | 1.0 | 2.0 |
| .8 | .3 | 0 | 3.8 | 1.3 | 2.0 | .8 | .2 | 0 | 3.7 | 1.1 | 2.0 |
| .9 | .3 | 0 | 3.9 | 1.3 | 2.0 | .9 | .3 | 0 | 3.8 | 1.1 | 2.0 |
| 1.0 | .3 | .5 | 4.0 | 1.4 | 2.0 | 1.0 | .3 | .5 | 3.9 | 1.1 | 2.0 |
| 1.1 | .4 | .5 | 4.1 | 1.4 | 2.0 | 1.1 | .3 | .5 | 4.0 | 1.2 | 2.0 |
| 1.2 | .4 | .5 | 4.2 | 1.4 | 2.0 | 1.2 | .3 | .5 | 4.1 | 1.2 | 2.0 |
| 1.3 | .4 | .5 | 4.3 | 1.5 | 2.0 | 1.3 | .4 | .5 | 4.2 | 1.2 | 3.0 |
| 1.4 | .5 | .5 | 4.4 | 1.5 | 2.0 | 1.4 | .4 | .5 | 4.3 | 1.2 | 3.0 |
| 1.5 | .5 | .5 | 4.5 | 1.5 | 3.0 | 1.5 | .4 | .5 | 4.4 | 1.3 | 3.0 |
| 1.6 | .5 | .5 | 4.6 | 1.6 | 3.0 | 1.6 | .5 | .5 | 4.5 | 1.3 | 3.0 |
| 1.7 | .6 | .5 | 4.7 | 1.6 | 3.0 | 1.7 | .5 | .5 | 4.6 | 1.3 | 3.0 |
| 1.8 | .6 | .5 | 4.8 | 1.6 | 3.0 | 1.8 | .5 | 1.0 | 4.7 | 1.4 | 3.0 |
| 1.9 | .6 | 1.0 | 4.9 | 1.7 | 3.0 | 1.9 | .6 | 1.0 | 4.8 | 1.4 | 3.0 |
| 2.0 | .7 | 1.0 | 5.0 | 1.7 | 3.0 | 2.0 | .6 | 1.0 | 4.9 | 1.4 | 4.0 |
| 2.1 | .7 | 1.0 | 5.1 | 1.7 | 3.0 | 2.1 | .6 | 1.0 | 5.0 | 1.5 | 4.0 |
| 2.2 | .7 | 1.0 | 5.2 | 1.8 | 3.0 | 2.2 | .6 | 1.0 | 5.1 | 1.5 | 4.0 |
| 2.3 | .8 | 1.0 | 5.3 | 1.8 | 4.0 | 2.3 | .7 | 1.0 | 5.2 | 1.5 | 4.0 |
| 2.4 | .8 | 1.0 | 5.4 | 1.8 | 4.0 | 2.4 | .7 | 1.0 | 5.3 | 1.5 | 4.0 |
| 2.5 | .8 | 1.0 | 5.5 | 1.9 | 4.0 | 2.5 | .7 | 1.0 | 5.4 | 1.6 | 4.0 |
| 2.6 | .9 | 1.0 | 5.6 | 1.9 | 4.0 | 2.6 | .8 | 1.0 | 5.5 | 1.6 | 5.0 |
| 2.7 | .9 | 1.0 | 5.7 | 1.9 | 4.0 | 2.7 | .8 | 1.0 | 5.6 | 1.6 | 6.0 |
| 2.8 | .9 | 1.0 | 5.8 | 2.0 | 4.0 | 2.8 | .8 | 1.0 | | | |
| 2.9 | 1.0 | 1.0 | 5.9 | 2.0 | 5.0 | | | | | | |
| | | | 6.0 | 2.6 | 6.0 | | | | | | |

Fig. 10—W- and F-Factors (Sheet 2 of 2) (5.40)

## LINE TRANSFER GUIDE

CCS Capacity    = 436
Type of Frame    = LF
Estimated CCS/MS = 4

| DESIRED ORDER OF ASSIGNMENT | CCS TO REMOVE | BAY# | LG# | SELECTED TERM. CS | DISCONNECTED TERM. CS |
|---|---|---|---|---|---|
| 1 | 70 | 25 | 60 | 37 | |
| 2 | 66 | 25 | 60 | 10 | |
| 3 | 62 | 25 | 60 | 15 | |
| 4 | 60 | 16 | 43 | 8 | |
| 5 | 58 | 25 | 60 | — | 9 |
| 6 | 56 | 16 | 43 | 10 | |
| 7 | 54 | 25 | 60 | — | 2 |
| 8 | 54 | 23 | 56 | 1 | |
| 9 | 54 | 40 | 91 | — | 6 |
| 10 | 53 | 8 | 23 | 1 | |
| 11 | 52 | 16 | 43 | 16 | |
| 12 | 50 | 25 | 60 | — | |
| 13 | 50 | 13 | 36 | 10 | |
| 14 | 50 | 40 | 90 | — | 13 |
| 15 | 50 | 10 | 30 | 16 | |
| 16 | 49 | 8 | 23 | 10 | |
| 17 | 48 | 16 | 43 | 16 | |
| 18 | 46 | 25 | 60 | 5 | |
| 19 | 46 | 23 | 56 | 8 | |
| 20 | 46 | 40 | 91 | 10 | |

*Note:* LG# = line finder or line switch group(s)

**Fig. 11—Line Transfer Guide (5.42)**