SWITCHING SYSTEMS MANAGEMENT
CROSSBAR TANDEM
ADMINISTRATION
TRANSITION MANAGEMENT (METHOD OF PROCEDURE)

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1. GENERAL

PURPOSE

1.01 This section contains procedures to be followed by personnel responsible for the network administration of crossbar tandem offices when additions to existing facilities are required, when certain modifications and/or improvements are planned, or when any changes and/or transitions are anticipated to increase capacity or improve service.

1.02 This section is reissued to update in general and to provide greater details for use in determining in-service requirements for equipment components. This section replaces the previous transition management section which was issued as Division H, Section 12d(7).

1.03 Familiarity with Dial Facilities Management Practices, Division H, Section 1b(8), Method of Procedure, is essential as is a knowledge of network design (traffic engineering), network administrative procedures, and the switching functions of the Crossbar Tandem System.

1.04 Generally, periods of activity involving equipment additions, transitions, and/or modifications require the involvement of groups in other departments. Such areas of mutual responsibility are identified to the extent necessary for network administration personnel to participate effectively in the development of methods of procedure (MOPs).

RECOGNITION OF ORGANIZATION STRUCTURES

1.05 Due to differences in organizational structures, specific titles of individuals, groups, and departments are avoided. Instead, general descriptive or functional names are used. This type of format permits the individual company to identify a particular organizational level (or sequence of organization levels) responsible for the procedures described in this section.

1.06 For the purpose of this section the following designations will be used.

(a) The telephone company representative normally responsible for administration and utilization of switching equipment is referred to as the network administrator.

(b) The telephone company representative normally responsible for requesting the provision of equipment (preparing the traffic order) is referred to as the network designer.

(c) The telephone company representative actually performing the equipment provision function and producing the output (preparing the authorization, placing the order, coordinating the job, etc) is referred to as the equipment engineer.

(d) The telephone company representative normally responsible for the maintenance of the switching equipment is referred to as the maintenance supervisor.

(e) The Western Electric Company (WECo) Service Division does the majority of installation for Bell System companies. The installation force is referred to as WECo.

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

2. OBJECTIVES OF MOP

GENERAL

2.01 An MOP contains a detailed step-by-step plan, with the appropriate references, for

the addition of various facilities to existing crossbar tandem equipment.

2.02 The MOP is normally prepared by WECo, based upon various inputs from telephone company representatives as well as job requirements and specifications. It may be a very formal document or somewhat informal, depending upon the magnitude of the job. WECo Handbook 69B, Section 000, describes the basic work agreement required on all jobs.

2.03 MOPs are required whenever WECo activities involve working equipment, especially when this activity can be service-affecting. The following are examples of work activities which require MOPs.

(a) Sender additions, rearrangements, or modifications

(b) Marker additions, rearrangements, or modifications (eg, speedup, trunk group busy circuits, etc)

(c) Office and/or trunk link work (eg, second extension frames, supplementary trunk link frames, etc)

(d) Automatic message accounting (AMA) recorder rearrangements

(e) Traffic services position (TSP) position link or centralized automatic message accounting (CAMA) position link work

(f) Incoming registers and incoming register link frames.

2.04 A proper MOP involves the following procedures:

(a) WECo ***develops*** and ***proposes*** a plan in advance for departmental review.

(b) The plan is evaluated by the telephone company.

(1) The network administrator ***assesses*** the impact on service.

(2) The maintenance supervisor ***evaluates*** the maintenance effort and test requirements.

(3) The equipment engineer ***examines*** the cost aspect.

(4) Other departments ***are consulted*** as necessary.

(c) Adjustments in procedures are made based upon the participation of the groups involved.

(d) A final MOP is agreed upon.

(e) The MOP is prepared in writing and is signed by management in the three departments involved. District level approval is recommended. See 2.12(c) and attachment to this section.

2.05 The MOP in its final form is a written plan concurred in and signed by WECo and the telephone company defining:

(a) ***What has to be done:***

(1) Changes or additions involved

(2) Sequences of additions or changes.

(b) ***How the job will be done with provision for:***

(1) Continuity and quality of service

(2) Efficiency in WECo installation effort

(3) Minimum interference with normal maintenance routines

(4) Emergency restoral procedures.

CONTINUITY OF SERVICE

2.06 The network administrator is the telephone company representative with the primary responsibility for continuity and reliability of switching service. When there is ***any*** activity in an office, efforts associated with this responsibility must be intensified.

2.07 Both WECo and the telephone company share joint interest and responsibility for assuring continuity and reliability of service during periods of activity connected with installation of equipment by WECo. The attainment of this objective requires full and continued cooperation prior to and during the installation period. A procedure generally

found practical for attaining this objective involves a full discussion of items such as the following prior to any installation activity:

(a) Type of equipment to be added or modified (eg, senders) by type (markers, etc)

(b) Working equipment that may be affected by planned job activity

(c) Selection of periods for taking working equipment out-of-service

(d) Whether a change in working hours may be necessary because of service-affecting work

(e) Method of accomplishing transitional work

(f) Amount and duration of equipment outages

(g) Assignment and cross-connection information required.

2.08 Beginning with the preparation of the traffic order, continuing attention is required to ensure protection of customer service. It is necessary that the network administrator concur not only with the equipment requirements but also with the configuration of equipment and the methods for placing these facilities in service. An appropriate statement regarding any portion of the work involved must be included in the traffic order to serve as a guide to the WECo job planner.

RESPONSIBILITIES OF THE NETWORK ADMINISTRATOR

2.09 The network administrator is basically responsible for ensuring that sufficient equipment is properly arranged to meet the requirements for effective administration over the life of the job while rendering service ***at or better than objective levels.***

2.10 Major contributions to the development of the MOP may be made in the following areas:

(a) Developing load-service charts depicting the percentage of sender attachment delay over 3 seconds versus CCS load per sender (by type of impulsing). These may then be used to determine in-service requirements for MOP purposes with proper applications of recommendations contained in the Traffic Facilities Practices.

(b) Arranging for monitoring the various load-service barometers to ensure that sufficient equipment quantities are available.

(c) Arranging for promp cross-connection lists for traffic registers, traffic usage recorders, sender attachment delay recorders, etc.

(d) Participating in determining and scheduling joint interdepartmental tests in which the network administrator would be a participant.

(e) Planning ahead for trunk transfers from existing trunk link fames and office link frames to newly added ones.

(1) This must include association of load and service measurement devices.

(2) New routings will include certain marker cross-connection work that may require the preparation of orders.

(f) Providing a single contact who will coordinate activities of other departmental groups for TSP, CAMA, etc.

SERVICE PROTECTION FROM EQUIPMENT FAILURES

2.11 The MOP must provide for optimum protection of service. The following items are pertinent:

(a) The specific location of WECo activity.

(b) The specific equipment activity with which WECo is involved. The "down-time" of any facility would be of particular interest.

(c) Service and load devices must be kept in service during WECo activity. Manual readings may be necessary for immediate analysis and corrective actions; therefore, adequate personnel must be trained and provided.

(d) A formalized plan for restoring equipment to service in cases of emergency or unusually high call and/or load volumes.

2.12 The network administrator should be familiar with practices pertaining to prevention of service interruptions. They include the following:

(a) Bell System Practices Sections 201-112-001, 201-112-005, and 201-112-010 which include

WECo Handbook 0, Section 10; Section 201-112-010 which contains WECo Handbook 3, Section 13; and Section 800-614-150, Issue 4D.

(b) Bell System Practices Section 201-114-001 explains the record of equipment and trunks out of service.

(c) The MOP prepared by WECo based upon Installation Engineering Handbook 3, Section 5A should be reviewed by the network administrator and other departments involved to ensure service protection as outlined in this section. The Method of Procedure Authorization, from Handbook 3, Section 5A (see attachment), provides for ***three*** telephone company approvals; it is recommended that the network administrator at district level signify approval of job procedures.

MEETINGS

2.13 Before starting any work, an MOP meeting should be arranged by the telephone company's representative (usually the equipment engineer; see 3.05 and 3.06) to discuss the work involved and assign dates and hours for start and completion of the various operations. These discussions are to be held as frequently as is found necessary in order to protect equipment and service. Those in attendance should be network administration, maintenance, network design, equipment engineering, and WECo (WECo Installation Handbook 3, Section 5A, 1.3) (Attachment 1).

2.14 Proposals for establishing controls and followup on job progress should be determined at the MOP meeting.

2.15 Minutes of all meetings should be kept and distributed as the formal record of interdepartmental or intercompany agreements and decisions.

2.16 It is suggested that subcommittees be formed when necessary to assist the MOP committee. An example of a function for which the subcommittee could be responsible would be the development of a section for traffic usage recorder (TUR) transition and/or addition.

2.17 The frequency of committee and subcommittee meetings should be firmly established and followed for job status reports.

3. RESPONSIBILITIES ASSOCIATED WITH MOP

GENERAL

3.01 The preparation of the MOP is usually handled by WECo, based upon the job factors previously described in this section.

3.02 Service should be placed above all other considerations and it may well be necessary to subordinate departmental routine.

3.03 The departmental general responsibilities of MOP are contained in the following paragraphs.

RESPONSIBILITIES OF NETWORK ADMINISTRATOR

3.04 It is recommended that the network administrator have the prime administrative responsibility for those areas that normally accrue to the network or maintenance departments. These include:

(a) Reviewing the contents of the traffic order to ensure that:

(1) The estimate of equipment requirements reflect the latest view of demand predicated upon dialing and routing arrangements (extended area service [EAS], numbering plan area [NPA] changes, etc.)

(2) The incoming trunk decades are distributed equitably over the trunk link frames and associated sender link frames.

(3) The traffic department representatives responsible for the CAMA or TSP facilities concur in equipment provision and arrangements.

(b) Being familiar with service results (percentage of sender attachment delay over 3 seconds, percentage of ineffective attempts, overflow scorings, etc) since the last job.

(c) The ability to reconcile traffic volumes and loads to service results.

(d) Familiarity with demands other than trunking needs (ie, centrex-CU customers, automatic or operator number identification, rater requirements, etc).

(e) Knowledge of any special studies such as Division of Revenue or trunk base studies.

(f) Arranging for, by providing the appropriate coordination, the following information:

(1) Designation strips and any switchboard assignments.

(2) Cross-connection lists for the following:

- Traffic usage devices
- Sender attachment delay recorder
- Trunk and marker work
- Traffic registers
- Network control devices.

(g) Understanding of load-service relationships so that proper ***in-service requirements*** can be determined by time frames.

(h) Having a detailed knowledge of the proposed transitional procedures.

(i) Having a written transition plan approved by the district level supervisor. This plan may be prepared prior to the first MOP meeting described in 2.13 through 2.17.

(j) Reviewing as soon as possible all equipment configurations to ensure equitable distribution (eg, sender, by type of impulsing, over sender link frames).

(k) Having various documents available for easy reference. These should include the following:

(1) Traffic orders

(2) Job specification

(3) MOP

(4) Various written practices

(5) Trunk estimates

(6) Data summaries.

EQUIPMENT ENGINEER

3.05 Many operating companies assign an equipment engineering department representative to coordinate WECo installation activities.

3.06 The equipment engineering department representative is normally responsible for the following:

(a) Scheduling job meeting between WECo and the telephone company

(b) Providing liaison between WECo and the telephone company

(c) Ensuring WECo adherence to MOP

(d) Economic aspects of the job (overtime, unusual transition methods, additional effort to avoid equipment outages, etc)

(e) Arranging advance turnover of equipment

(f) Coordinating acceptance, turnover, and notification procedures.

WESTERN ELECTRIC COMPANY

3.07 WECo is responsible for preparing the MOP.

3.08 It is necessary that WECo adhere to the prescribed MOP to ensure proper coordination by all groups.

3.09 Removing equipment from service, testing, restoring equipment to service, etc, must be in accordance with WECo Handbook instructions and established procedures contained in various Bell System Practices. These functions must be done only with the approval of the network administrator.

3.10 Transitions, rearrangements, replacements, etc, must be accomplished with a minimum interval of reduced capacity and with a minimum probability of service interruption, but consistent with reasonable job efficiency.

MAINTENANCE DEPARTMENT

3.11 The maintenance department has the overall responsibility for physically removing equipment from service, testing, and restoring to service, etc, during periods of WECo activity. See 3.09.

3.12 A record of equipment outages is maintained by maintenance according to their practices (Bell System Practices Section 201-114-001). This log will include information concerning equipment removed from service for ***any reason.***

3.13 The maintenance department participates in joint tests, as necessary.

3.14 Certain cross-connection work and/or other rearrangements may be done by the maintenance department.

NETWORK DESIGN (TRAFFIC ENGINEER)

3.15 The network design representative is normally responsible for writing the traffic order. The order as prepared reflects traffic engineering based on local and toll current plans, design trunk estimates, trunk engineering, facility plans, and overall network planning.

3.16 Advance turnover of specific equipment and its components is requested with "by dates" by the network engineer in the traffic order. The equipment order (authorization) prepared by the equipment engineer must include this request to assist WECo in planning the job and preparing the MOP.

3.17 The network engineer consults with the network administrator on existing problems such as overloads. The network engineer also holds discussions relating to data, office performance, and the need for obtaining special data, if required.

3.18 The network engineer shares with the network administrator the responsibility for determining allowable equipment and trunk outages based on projected loads.

4. DEVELOPMENT OF MOP

GENERAL

4.01 Proper planning and continuing followup in connection with an MOP is of primary importance in ensuring that service risks are held to a minimum and job efficiency is at a maximum.

4.02 Planning must begin ***before*** the traffic order is prepared. Information regarding transitions, advance turnover, replacement, or rearrangement of any equipment should be included in the traffic order, when possible, because it may affect the way in which the WECo engineer prepares the job specification. Significant information might include:

(a) Dates for advance turnover

(b) Time interval for transition or replacement

(c) Requested procedure for rearrangement

(d) Maximum equipment quantities that may be released for modification (including time-of-day)

(e) Where necessary, a detailed step-by-step procedure for doing a transition or a rearrangement

(f) Traffic and service measurement requirements.

4.03 The traffic order and job specification should be compared so that errors or omissions are corrected before WECo engineering begins.

4.04 The network administrator is responsible for ensuring that any special instructions, dates of advance turnover, or unusual measures are included in the MOP.

FORMAT OF MOP

4.05 The MOP, prepared by WECo as discussed in this section, will include a general outline of the entire equipment affected, work location, major equipment to be added or removed, general notes, special instructions, etc.

4.06 The MOP will contain the dates, the start and complete time, the type of protection, and special precautions of each step of the job.

4.07 All work to be done in a step should follow a logical sequence and should be explained fully with the indication of that portion of the work that will be the responsibility of WECo or maintenance.

4.08 The sequence of progress may be based on the following considerations:

(a) Equipment that will be required first

(b) The sequence of steps that will provide equipment for advance service, if required

(c) The amount of work that can be done and still provide a major margin of safety for returning released equipment to service within the specified time

(d) Work that can be done without affecting working equipment such as erecting, cabling, wiring, etc

(e) Work that must be done during lightly loaded (usually night) hours

(f) Work that must be done on an "in-service" basis

(g) The type of test and test equipment required during and at the completion of each step.

4.09 When a change in the order of procedure of the work is necessary due to unforeseen circumstances, WECo and the telephone company's representatives, principally the network administrator, shall be held responsible for determining the extent of the change and its possible effect on service and the job.

4.10 If changes are necessary and agreement is reached concerning method of implementing the changes, this agreement shall be indicated on a ***revised*** and ***approved*** MOP.

4.11 All copies of the MOP, original or revised, as described in WECo Handbook 3, Section 5A, provide an opportunity for WECo and telephone company representatives to approve and concur in proposals.

4.12 The contents of the MOP are as follows:

(1) General notes

(2) General MOP

(3) Detailed MOP

(4) Approvals

(5) Appendixes.

4.13 The bases of WECo installation as described in WECo Handbook 3, Section 5A, are as follows:

(1) ***In-Service:*** Equipment cannot be removed from service and extreme caution will be taken during work operation.

(2) ***Out-Of-Service:*** Equipment will be removed from service for a period of time that may last through an entire shift or more.

(3) ***Temporarily-Out-Of-Service:*** Equipment will be removed from service for a certain period of time.

5. TRANSITIONS AND REARRANGEMENTS

GENERAL

5.01 The following paragraphs describe the various methods to be employed in completing transitions and rearrangements when adding equipment to existing facilities. These methods should appear in the MOP and adherence to the proposals should be followed by WECo. Any changes would require a revision of the MOP as described in 4.09 and 4.10.

5.02 Service may be affected by transitions and/or rearrangements because the capacities may be reduced somewhat by decreasing team-size of facilities or removing equipment from service. The purpose of the MOP is to provide for the protection of service while the transitions are accomplished.

5.03 MOPs must be designed for minimum equipment outages or capacity reduction for a minimum period of time and ***capacity must not be reduced beyond a point which would result in less than system service standards.***

5.04 The various measurement devices discussed in Parts 7 and 8 must be kept in service during periods of WECo activity. The MOP should contain statements ensuring that these devices not be turned-down during periods of time when data-gathering is imperative.

5.05 The network administrator should be alert to the potential hazards to the equipment and personnel. Familiarity with the work areas involved will permit causes of possible service

degradation to be promptly identified. For instance, work on senders would be reflected in the percentage of sender attachment delay.

5.06 Installation work for the addition of frames and equipment is divided into three categories:

- Preliminary work
- Transitional work
- Cleanup work.

(a) ***Preliminary Work:*** Preliminary work involves the erection of all frameworks, running in and connecting all cables to the added equipments, and installing and connecting miscellaneous apparatus on existing equipment where it will not interfere with working circuits.

(b) ***Transitional Work:*** It is during this phase that the added frames are established in the working circuit pattern.

(c) ***Cleanup Work:*** Transfer of traffic to the new equipments will be effected during this stage. (It will also include removal of abandoned cabling and other related wiring.)

TRUNK LINK FRAME AND OFFICE LINK FRAME ADDITIONS

5.07 The addition of trunk link and office link frames requires a redistribution of the office junctors since the number of junctors per trunk frame per office frame must be correspondingly reduced to provide equal access between all trunk and office link frames.

5.08 When junctor redistribution is involved, it will be necessary to ensure a maximum number of available junctors (see 5.10).

5.09 The addition of office link frames will also require the transfer of working trunks from existing office link frames onto the newly installed pair of office link frames (see 5.13 through 5.21).

5.10 Determination of the next size of the office may decide the number of junctors to be made available following the transition; that is, the number of junctors may meet the requirements of a ***future*** similar addition. During the interim, however, fewer office junctors will carry traffic loads than could be made available with the present job. Any reduction in traffic-carrying capacity should be avoided. Studies will indicate, depending upon office configuration, whether the proposed pattern is satisfactory.

For example, assume that a 10 by 5 tandem office (10 trunk link frames with 5 office link frame pairs) is expanding to a future 14 by 7 office junctor pattern via an interim 12 by 6 office. If the junctor pattern for the interim and ultimate job remains the same, the effect is to compress junctor loads into a smaller quantity of junctors per group with probable deterioration in service levels.

5.11 A rapid reassignment of incoming and outgoing trunking into the new frames, to disperse and balance the traffic loads, becomes ***mandatory.*** The chart in Figure 1 illustrates the junctor group capacity loss as the tandem size increases. These calculations are based on a comparison with a full 20 by 10 tandem.

5.12 Junctor transitions are sensitive to traffic loads and reflect quickly, in the service indexes, any overloads. It is most desirable to perform this work during light traffic load periods such as weekends or nights. The proposed sequence should be part of the MOP based on the day and time period given to WECo.

TRANSFER OF TRUNKS—OUTGOING, 2-WAY, AND INCOMING

5.13 Outgoing trunk groups on the office link frames are the focus of the loads on the tandem. Their movement, among the office link frames, must be carefully planned based on a knowledge of their present and forecasted loads. Balance of office link frames load assists in protecting and minimizing the percentage of matching loss for the tandem.

5.14 There are various methods of transferring outgoing or 2-way trunks to the added office link frames; the suggested method outlined in 5.15 through 5.18 is the most direct and involves a minimum of time and effort. This work will normally be done ***outside*** of the office busy hour.

5.15 This procedure requires that the trunk groups to be transferred are wired to their new

locations (at main distributing frame [MDF] or trunk distributing frame [TDF]) and that all trunks in the marker test group (a maximum of 40) will be reassigned. The percentage of the load transferred to the new pair of office link frames is determined by dividing the existing or planned total office usage by the number of office link frame pairs in the new configuration. The size of the load to be transferred from the existing frames to the new office link frames can now be defined. Table A provides a guide for the distribution of load percentages to deload existing office link frames and load the new for the maintenance of office balance.

5.16 When moving trunks to new frames, if the old office frames are in balance, the group start, (GS) group end (GE), and trunk level (TL) location of the group to be transferred should be retained. This will leave only one wiring change: the start (ST) lead identifying the new office link frames of the trunk group that is to be transferred to that location. Maintenance will do the necessary wiring upon the request of the organization responsible for issuing marker cross-connection orders.

5.17 When the wiring has been accomplished, whether new or as suggested, the following method may be followed.

(a) Trunk groups with alternate routing: the trunks in the group to be moved will be properly made busy by the appropriate personnel in maintenance.

(b) One marker is removed from service ***(not in busy hour)*** and the trunk group wiring is changed to the new location.

(c) The procedure in (b) above is repeated, one marker at a time, until all markers have been changed. During this period, the unchanged markers will complete calls over the alternate routes and the rewired markers will then use the trunks at their new location.

(d) The old locations may then be released for future reassignment.

5.18 Based upon the premise that preliminary wiring has been accomplished as described in 5.15, the following method will be used to transfer trunk groups without alternate routes to the newly added office link frames.

(a) Half of the trunks in the group will be made busy.

(b) These trunks should be the first to be transferred to the added office frames.

(c) The other half of the trunks in the group will be made busy at their new location.

(d) One marker is removed from service ***(not in busy hour)*** and its wiring changed as required to pick the idle trunks in the new location.

(e) After the work described in (d) above is done, the marker is restored to service and (d) is repeated until all markers are completed. During this period the unmodified markers will use the idle trunks at the old location and the modified ones will employ the idle trunks at the new location.

(f) The trunk make busy conditions are removed upon the completion of the marker work.

(g) The remaining trunks at the old locations can then be moved to the new office link frame location.

5.19 Prior to placing load on added office link frames, the network administrator should review loads (CCS per trunk group, trunk link, and office link frames) and service (percentage of ineffective attempts and overflow registrations at the trunk link and pairs of office link frames).

5.20 If imbalances exist which could cause impairment of service, steps should be taken to rebalance the existing frames as well as to efficiently utilize the added office link frames.

5.21 A review of trunk assignments within the GS-GE should be conducted to ensure that load is equitably distributed over ***all*** secondary switches. This is ***imperative*** when primary and secondary extension frames are installed to provide additional trunk terminations.

5.22 In order to assure an equal spread of traffic over each of the frames of the pairs, care should be taken where the number of trunks in a trunk group is uneven (ie; 7, 9, 11, 15, etc) that the trunk that is not needed is busied in the middle of the group.

5.23 For example, 11 trunks are required to a destination. The total number of trunk group terminations ***must*** be a minimum of 12. Assuming GS-0 and GE-11, the trunk termination that should be busied-out is either five or six. Several trunk groups on a pair of office link frames with odd-numbered totals should alternate the middle odd-numbered and middle even-numbered trunk. This will ensure that regardless of which numbered trunk link frame is originating the call the traffic will be equally divided between the frames of the pair. (Even-numbered trunk link frames will cause the marker to prefer even-numbered office link frames; odd-numbered trunk link frames will cause odd-numbered office link frames to be preferred.)

5.24 Two-way trunks require particular caution to prevent disruption of connections in progress and existing conversations. Coordination and protection of both ends of the affected trunking must be established and maintained during relocations.

5.25 Before the transfer of working trunks to new incoming trunk equipments and/or new trunk link frames, the trunks must be made busy at the originating office. Coordination with these offices to ensure that either direct or alternate routings are not adversely affected is imperative and is a network administrator's responsibility. It is advisable to do this work during light traffic periods; ***testing of these trunks following their transfer is mandatory.***

ADDITION OR REARRANGEMENT OF SENDERS

5.26 The addition of senders to the crossbar tandem system will require additional marker connector facilities, as well as distributing the new senders in the sender link frames (either existing and new) in a pattern that will equitably offer attachment to all trunks of a particular type of impulsing.

5.27 There are four basic types of senders for impulsing purposes. These types, however, contain different circuitry for outpulsing, prefixing or omitting digits, connection to CAMA or TSP, etc. The four types of impulsing senders available and in service are:

(1) Multifrequency (MF)

(2) Revertive pulsing (RP)

(3) Dial pulsing (DP)

(4) Panel call indicator (PCI).

5.28 These senders, depending upon their vintage and the terminating facility requirements, may outpulse in a variety of ways. The instructions for properly completing a call will be transmitted to the sender from the marker predicated upon the decoded information.

5.29 Unavailibility of senders is quickly reflected back into the originating offices causing a service deterioration there. It is also reflected in an unfavorable sender attachment delay report percentage in the tandem. All activity involving additional senders or reassignment of senders demands that the traffic requirements for senders be protected and assured. Additional service hazards for the senders are outlined in 5.30 through 5.46 and 6.65 through 6.69.

SENDER LINK FRAMES

5.30 Trunks gain access to the proper type sender at the sender link frames. Trunks are arranged in decades and should be equitably distributed over the sender and trunk link frames.

5.31 Each sender link frame contains terminations for 100 incoming trunks and 40 senders which can be grouped as two varieties of impulsing making a total of a maximum of 80 senders.

5.32 Sender link frames are associated with trunk link frames and trunk frames. Although trunk link frames accommodate 160 trunks, sender link frames only serve 100. As a result, the number of sender link frames outnumber the quantity of trunk link frames. Due to the unique functions and features of tandem trunks, the capacity of trunk frames varies.

5.33 In order to be efficient, senders must be arranged in an equitable fashion. The sender link frame configuration is of ***utmost*** importance and care must be taken during transition periods that the MOP ensures that traffic is offered equally to each subgroup of senders by type, that each subgroup has a reasonably equal number of sender link frame appearances, and that the preference pattern is such that each sender link frame has sender subgroups with proportionate preference positions.

5.34 A multipling arrangement of the sender subgroups is illustrated by Table B. Table B depicts the configuration of 11 sender subgroups (55 senders) over 9 sender link frames. Each sender link frame accommodates, in this case, 40 senders over 8 switches denoted A0, B0, etc, as they pertain to the two controllers for each sender link frame.

5.35 From Table B the total number of appearances of each sender subgroup may be determined.

SDR SUB-GROUP NO.	0	1	2	3	4	5	6	7	8	9	10
NO. OF APPEARANCES	6	6	6	6	6	6	7	8	8	7	6

5.36 As can be seen, sender subgroup number 7 and number 8 each has eight appearances; the preferred arrangement should be as follows:

SDR SUB-GROUP NO.	0	1	2	3	4	5	6	7	8	9	10
NO. OF APPEARANCES	6	6	6	6	7	7	7	7	7	7	6

5.37 The network administrator must be aware that imbalances in sender subgroup appearances and preferences can and will reflect service problems, not only at the originating office but also in the tandem percentage of sender attachment delay report. Improper assignments of incoming trunk groups, as allocated through the sender link frame decades, can also be injurious to service.

5.38 Transitions in sender link frames usually require that affected incoming trunking be made busy at the originating offices. Any restrictions of the work operation in terms of what hours and days must be known by WECo for incorporation into the MOP. The MOP schedule provides a coordinated base for making incoming trunks busy and for restoring them to service during appropriate periods during transitions.

5.39 The arrangement and the preference position may be found on Wiring List Drawing T—XXXX—5840. This drawing is made available when the job specification is prepared; the network administrator should review this drawing to ensure that the best possible sender subgroup preference and distribution are being furnished. It is recommended that distribution tables, as shown herein, be included in the MOP.

ADDITION OF TANDEM MARKER CONNECTORS

5.40 A tandem marker connector provides the paths between five senders and the installed markers for the exchange of certain decoding and pulsing information.

5.41 Three marker connectors serving a maximum of 15 senders are installed on a marker connector frame. A total of 13 such frames may be provided in a crossbar tandem office.

5.42 When senders are added to the tandem office, it will be necessary to provide additional connectors and frames to accommodate the senders.

5.43 Three features provided within connector circuitry are as follows.

(1) In cases of simultaneous demands on a connector by two or more senders, the senders are served in a predetermined order of preference.

(2) To give each connector equal access to markers during periods of heavy traffic, a connector, after handling a call, cannot serve another call until ***all*** connectors waiting for markers have ***each*** handled one call.

(3) Each connector prefers markers in a fixed order which differs in the various connectors for the purpose of distributing calls as evenly as possible over the markers. To accomplish this, the MOP will contain information which will divide the connectors into as many groups as there are markers and assign each marker as a first choice in each connector group. Second-choice, third-choice, etc, markers are assigned similarly in rotation.

5.44 The network administrator should determine if the proper preference orders have been provided by reviewing marker peg count and participating with maintenance in making test calls at the sender test frame during light load hours

to ensure that markers are selected in accordance with (3) in 5.43.

5.45 These tests, which should be stipulated in the MOP, may also uncover troubles in the connectors which may cause any of the following:

(1) Erratic usage of markers by eliminating planned marker preference.

(2) Cancelation of the sender gating between all connectors due to a false indication of occupancy. This loss of gating results in a severe increase of sender holding time causing serious service reaction (percentage of sender attachment delay over 3 seconds [% SAD over 3"]).

5.46 Although marker connectors may be busied out, the normal make-busy procedures for senders and/or markers will usually be followed during transitional periods, based upon the in-service requirements discussed in Part 6.

TANDEM MARKER ADDITIONS

5.47 The marker is one of the major equipment components in the Crossbar Tandem System. Earlier versions employed route relays for decoding information and transmitting it, through the connector, to the sender. Later designs utilize ring translators instead of route relays permitting a maximum of 600 routings and eliminating, for practical purposes, the limitation on the number of outgoing trunk groups per routing.

5.48 Transition work which would require marker work involves any of the following.

(1) Trunk link frames

(2) Office link frame pairs

(3) Marker connectors or frames.

5.49 The need to extend marker multiples to the added frames will require that markers be made busy. Therefore, this type of work must ***not*** be done during busy periods of traffic.

5.50 When markers are added to an existing office, the multiples of the new markers must be extended to the various link frames. ***This work must be accomplished during light load periods.***

5.51 When markers are added to the connector unit, the unit can be made busy but the associated sender subgroup (five senders) must be made busy at the appropriate frame.

5.52 Any marker improvement work (ie, speedup, trunk group busy feature, etc) will require the marker to be removed from service for varying periods of time. The MOP should in all instances of marker involvement contain specific instructions concerning the hours, duration, and method of removing this equipment from service. The network administrator is responsible for calculating in-service marker requirements as discussed in this section.

5.53 It is advisable to include in the MOP a time interval between the time that a marker is restored to service and the time that another marker is made busy to determine if any service reactions occur on the multiple or marker that was worked on.

5.54 Prior to restoral to service, the leads installed should be tested for reversals, crosses, and other continuity checks. The procedure for checking added multiples to existing and new facilities should be stated in the MOP.

INCOMING REGISTERS AND INCOMING REGISTER LINKS

5.55 An incoming register is employed where subscriber dial pulses are expected over the incoming trunk. Two types are available: 3-digit and 10-digit registers.

5.56 A 3-digit incoming register receives only the first three digits; it passes these three digits to a tandem DP sender which, in turn, stores the remaining digits. If the tandem DP sender is not attached before the start of the fourth digit, overflow is given to the calling subscriber.

5.57 A 10-digit incoming register receives all the call digits and transfers these digits to a tandem MF sender.

5.58 Incoming register links include a by-link operation which is used with both types of incoming registers to prevent losing any of the

pulses of the subscriber's dialed digits and to negate the requirement for a second dial tone.

5.59 The same service precautions should be exercised during the addition of trunking and/or registers including connections to the senders via connectors. Light load periods should be known by WECo for inclusion in the MOP schedule.

CENTRALIZED AUTOMATIC MESSAGE ACCOUNTING

5.60 The addition of CAMA features to an existing crossbar tandem or additions to an operating CAMA tandem involves the same elements as a Non-CAMA crossbar tandem, plus equipment necessary for recording call details.

5.61 Where the job requires adding CAMA features to an existing office, new types of senders, new trunking, and CAMA position access circuitry are required.

5.62 The service protection responsibility of the network administrator is further enhanced and requires a knowledge and understanding of the interaction and demands of the CAMA equipment.

5.63 Based on the job and items affected, WECo must be provided with days and time frames for their work to formulate a workable MOP.

100A TRAFFIC SERVICE POSITIONS

5.64 The addition of 100A TSPs to a CAMA tandem extends the CAMA service offered by permitting person-to-person, collect, charge, and coin calls to be processed automatically under the control of an operator.

5.65 The service protection responsibility of the network administrator is covered in 5.62 and 5.63.

6. DETERMINATION OF IN-SERVICE REQUIREMENTS

GENERAL

6.01 The determination of in-service requirements is the prime responsibility of the network administrator.

6.02 The quantities of equipment which may be taken out of service and the times at which they may be removed should be agreed upon by all groups involved in the transitional periods (eg, maintenance, network design, equipment engineering, network administration, and WECo).

6.03 Because the amounts of equipment have a significant effect on service levels not only within the crossbar tandem but on other offices in the network, the recommendations prepared by the network administrator (and agreed to by other groups) should be included in the MOP.

6.04 These quantities and time frames should be discussed at MOP and subcommittee meetings (2.13 to 2.17) and agreement obtained that sufficient work force will be available in order that the MOP proposals can be followed.

6.05 No deviation from miminum equipment requirements should be tolerated; facilities removed from service due to circuit trouble must be included in the total outage; that is, stuck senders held for tracing should be counted as senders removed from service for WECo work.

6.06 The following paragraphs contain suggested methods for calculating required capacity and the means for properly recording these data for MOP purposes.

CROSSBAR TANDEM SENDERS

6.07 Calculation of the number of crossbar tandem senders required to render satisfactory service during transitional periods must be made by type of impulsing and by time frames.

6.08 Generally, these calculations will be predicated upon high-day requirements; local traffic conditions and the season in which the work is performed may permit adjustment in these requirements. In some cases, based upon the judgment of the network administrator, the number of senders required may be based upon busy season requirements (a 10-high-day average service ceiling of 0.5 sender attachment delay over 3 seconds).

6.09 In addition to calculating busy hour sender needs, it is important that light-load-hour requirements be established in the event that traffic loads preclude WECo work during normal business hours.

6.10 Each year key traffic data and the various factors and relationships developed from these data should be recorded chronologically in a history file for each sender group. Commentary supporting the inclusion of "odd" data must be part of the history.

6.11 The following information should be available before in-service requirements are computed for the transition period and the engineering period of the job.

By type of impulsing:

(a) Number of installed senders

(b) Three previous busy season 10-high-day results by day

(c) Traffic CCS of senders per (b) above

(d) Maintenance CCS of senders per (b) above

(e) Average equivalent working one-way incoming trunks for the same days of (b) above

(f) Trunk link frame peg count per (b) above

(g) Sender attachment delay percentage for days of (b) above

(h) Three previous busy seasons.

Note 1: Equivalent working incoming one-way trunks include 2-way trunks and for incoming purposes each is considered as 1/2 trunk.

Note 2: Busy season data should be maintained for calculations relative to factors other than peak days.

Note 3: "Off-hour" data should be available for calculations relative to factors other than busy hour.

6.12 Form MOP-1, Figure 2 (one form per sender type), will be used for recording in-service requirements for crossbar tandem senders. This form also shows out-of-service allowances with both conditions limited to a specific period of days, weeks, or months.

BH=busy hour and, depending on the period of the form, may be for busy season or nonbusy season.

NBP=nonbusy hour period(s) and refers to periods of the day when traffic levels are normal.

OFF PR=off-period and indicates the period when traffic levels are at their lowest, usually night and early morning hours.

The upper part of this form extracts in part data used in traffic engineering worksheet A and provides a summary sheet to reflect sender values for various loads. Sender percentage of occupancy is determined by the formula: sender traffic usage divided by (36 times the number of installed senders minus sender maintenance usage), the quotient of which is multiplied by 100. Equivalent sender outage is expressed in tenths of senders: sender maintenance CCS (50) divided by 36 equals 1.4 senders. A blank form is attached to this section. This form will be attached to the MOP.

6.13 The following paragraphs describe the calculations required to prepare the in-service requirements.

6.14 The calculations described in the following will also assist the network administrator in determining capacity requirements for existing crossbar tandem installations not involved in additions, changes, or rearrangements.

6.15 These data should be transcribed from the historical file onto Form MOP-2, Figure 3 (traffic engineering worksheet A). One form will be prepared for each of three past 10-high-day data periods for each type of sender.

(1) ***Lines 1-4:*** Self-explanatory

(2) ***Lines 5-14:*** 10-high-day data in descending sender traffic CCS order

Column:

(C) TFC CCS (C): Sender traffic CCS high day, second high, etc.

(E) AVG. EQUIV ONE-WAY INC TRKS WORKING (E): For sender type

(U) TFC CCS PER EQUIV ONE-WAY INC TRK (U): (C) divided by (E)

(B) MTC CCS (B): Sender maintenance CCS

(M) SNDRS OUT OF SVC (M): (B) divided by 36 (0.5 or higher, raise to next whole sender)

(S) SNDRS IN SVC (S): Installed (N) minus (M)

(T) TFC CCS PER SNDR (T): (C) divided by (S)

(D) % SD/3" (D): Associated service data

(VN) VARIBILITY NUMBER (VN): Derived from 6.16.

(3) ***Lines 15-19:*** Additional high-day data in continued decending sender traffic CCS order

(4) ***Line 20:*** Sum of column (U)

(5) ***Line 21:*** Line 20 divided by 10

(6) ***Line 22:*** Self-explanatory

(7) ***Line 23:*** Sum of column (VN)

(8) ***Line 24:*** Line 23 divided by number of entries in column (VN) (6.19).

6.16 The variability number (VN) for each day requires reference to Figure 4. To determine the value, locate the developed CCS per sender along the side or bottom of the lower graph and follow the associated curve until it intersects the number of traffic senders from which the CCS/sender was developed. At this point, run a vertical up into the % SADR (D) graph to the horizontal representing the percentage of sender attachment delay experienced. This intersection will be on or in the vicinity of the numbered curved lines (which are the variability numbers). By interpolation the value of the variability number will be obtained. Interpolation will also be required when the CCS/sender is other than a whole number.

6.17 To illustrate, assume that there is 26.9 CCS per sender on 64 traffic senders with a sender attachment delay of 1.4 percent. By interpolation, locate 26.9 CCS/sender delay results and trace its curve to the point at which it intersects the horizontal for 64 senders. Run a vertical into the upper (% SADR [D]) graph to the horizontal intersection at sender attachment delay of 1.4 percent. The variability number, by interpolation between the number 2 and number 3 curved lines, is 2.5.

Note: There are restrictions imposed on the use of the curved numbered (variability number) lines. Refer to 6.20.

6.18 As each day of the 10-high-days exhibits different values for the same items of data, so does traffic measured during each busy hour experience peak during that hour period; that is, each half-hour may present entirely different load/service relationships that are disguised by the one-hour summary. The variability number reflects a load/service relationship with comprehension that these peaks do indeed exist and are more pronounced as the load and service values increase.

6.19 A minimum of six variability numbers is required to complete worksheet A. When % SD/3" (D) is zero, a nominal variability number (NVN) is developed as shown in worksheet A. The value of this equation is included and repeated as many times as necessary in column (VN) to total six entries. Refer also to 6.20.

6.20 Each data point between the two curves designated 1 is assigned a variability number of 1.0. For sender groups of over 40 installed senders (N), each data point between the left curve 1 and curve 5 is assigned a number interpolated to the nearest tenth between the curves adjacent to it. For sender groups of 40 or fewer installed senders (N), all data points in the region between curves 4 and 5 are assigned a variability number of 4.0 and only data points between left curve 1 and curve 4 are interpolated between adjacent curves.

6.21 Points in the diagonally lined area do not provide statistically significant information to characterize a sender group. Likewise, points in the cross-hatched areas are most likely not due to traffic load conditions and are not to be used in this procedure. Only points within the graph proper are valid data points. The unexplained points, particularly those to the left of curve 5,

suggest that they may be due to other causes of sender delay and they should be investigated.

6.22 Form MOP-3 (Fig. 5), traffic engineering worksheet B, gathers the results of worksheet A, summarizes them, and applies factors (Fig. 6 and 6.25) to these summaries. Sender capacity tables (Fig. 7, two sheets) are consulted to develop present sender capacity and sender requirements based on trunking for 10-high-day traffic.

6.23 Sender CCS capacity is determined by application of the variability number to the sender capacity tables as is the quantity of senders required. The interpolation technique is illustrated in Figure 8.

6.24 Part B of Form MOP-3 (Fig. 5) is used to determine the trunk capacity of senders. Part C is used to convert trunk data into sender CCS requirements and is used to define sender requirements presently and upon job completion.

6.25 Figure 6 provides the conversion factor (F) for the ratio (R) developed in the calculation.

6.26 If it is anticipated that sender holding time will change because of routing changes, change in type of tandem, etc, holding times can be estimated using tables provided in Traffic Facilities Practices Division D, Section 6e, Crossbar Tandem Frames.

6.27 Blank copies of the MOP forms are attached to the back of this section. These should be reproduced locally as required.

LOAD/SERVICE CURVES

6.28 Maintenance of load/service curves (percentage of sender attachment delay over 3 seconds) is continuous during normal operation or transitions.

6.29 Interrelationships between capacity determination, sender requirements, and the service rendered are monitored using the load/service graph.

6.30 Monitoring maintains the validity of the calculated requirements and conversely the calculated requirements monitor the load/service graph.

6.31 Any discrepancies should be analyzed to determine their cause and suitable corrections applied.

CROSSBAR TANDEM MARKERS (RING OR ROUTE RELAY TYPES)

6.32 In order to properly calculate tandem marker in-service requirements, it is essential that the network administrator be familiar with Traffic Facilities Practices, Division D, Section 6f, Crossbar Tandem Markers.

6.33 Although no service reaction can be directly attributed to marker unavailability or increased occupancy of accessible markers, an increase in sender attachment delay may result due to increased tandem sender holding time and marker connector blockage. These, in turn, would tend to affect the efficiency of originating end office facilities.

6.34 In order to provide maximum facility accessibility, the calculation of tandem marker in-service requirements should be predicated on marker usage for the highest day anticipated. Obviously, the time-frame in which any marker is removed from service must be considered due to the tandem's sensitivity to overload caused by a rapid accumulation of alternate routed traffic during peak periods.

6.35 In addition to marker work involving speedup or group busy, etc, markers may be required to be turned down during periods when other component configuration is changed (eg, additions of trunk link and office link frames, sender additions, trunk group changes, etc).

6.36 The techniques to be employed in calculating marker needs, as described later in this section, require sufficient, reliable empirical data. These data include:

(a) Marker usage (traffic and maintenance)

(b) Marker peg count

(c) Office link seizure peg count

(d) Office link frame overflow

(e) Second failure to match peg count

(f) Working incoming trunks.

6.37 In addition to these data, other facts are needed to determine marker requirements. These facts include the type of marker (ring or route relay), the number of office link frames, the number of trunk link frames, and what options are provided (eg, speedup, group busy, traffic usage recorder options, etc).

6.38 As stated previously in this section, the sequence of additions and/or changes must be stipulated in the written MOP and agreed to by the telephone company departmental representatives.

6.39 These sequences should be discussed prior to the preparation of the MOP document so that accurate marker in-service requirements may be determined.

6.40 Determination of the sequence and the steps within the sequence may be predicated upon marker requirements because they are the major equipment elements within the tandem system.

6.41 Depending upon the nature of the tandem office work that is involved, markers will be busied-out for varying lengths of time. This down-time should be planned so that no adverse service reaction is experienced. It will be necessary, therefore, to determine the exact days and hours that the work may be performed; this information should be contained in the MOP.

6.42 Of prime importance in determining the duration of the outages is the size and experience level of the WECo force. Vacations and holidays must also be considered in programming the work sequence as they will influence productivity time which affects the completion dates.

6.43 Several in-service requirement calculations may be necessary because of changes in marker holding time during the interval of the job. Factors that will affect holding times are:

(a) Changes in the number of trunk link frames and office link frame pairs

(b) Change in the number of markers

(c) Circuit modifications such as group busy and marker speedup

(d) Change in routing pattern.

6.44 For example, additional trunk and office link frames will, when completed and working, reduce marker holding time by decreasing marker competition at the frames.

6.45 Conversely, the addition of a marker or markers to an existing trunk link frame-office link frame configuration may cause higher holding times due to the queuing of the markers in their bids to the link frames.

6.46 Other work which will necessitate marker outages are trunk group rearrangements and the various circuit modifications such as speedup, group-busy, traffic usage recorder, etc.

6.47 Extensive marker turndown will be experienced for speedup features because the work is complex and extends to the office and trunk link frames.

6.48 The data necessary and the calculations required to make a judgement of in-service marker quantities are as outlined in Figure 9. As a summary sheet, it must be included in the defined MOP.

6.49 The following is an explanation of the items required to determine marker in-service requirements using Form MOP-4, Figure 9.

Item 1: Self-explanatory

Item 2: Identify as ring or route relay markers

Item 3: Insert appropriate factor to reflect marker vintage and type as follows:

(1) Route Relay Marker-W/ "LV" Option (Issue 60D): Add 0.009 Sec/peg count

(2) Route Relay Marker-W/O LV Option: Add 0.022 Sec/peg count

(3) Ring Marker-W/ "XW" Option (Issue 16D): Add Zero

(4) Ring Marker-W/O XW Option: Add 0.022 Sec/peg count

Items 4 and 5: Self-explanatory

Item 6: Applicable season; ie, 1974-1975

Item 7: Traffic usage CCS (total usage [divided by 10] minus maintenance usage) plus missed usage CCS (marker peg count times factor divided by 100)

Item 8: Self-explanatory

Item 9: Item 7 divided by Item 8 times 100

Item 10: Item 7 divided by ([36 times Item 1] minus [Item 15]) times 100

Item 11: Working incoming trunks with 2-way trunks counted as equivalent 1/2 incoming trunk each. Trunks working in two appropriate successive months summed and divided by 2 for average.

Item 12: Item 1 divided by Item 11

Item 13: Standard calculation

Item 14: Office link frame seizure peg count divided by marker peg count

Item 15: Self-explanatory.

6.50 All of the items shown in 6.49 are developed from the historical record maintained for each tandem each day. That record provides an insight into the month-by-month variations in tandem activity and provides a basis for investigation when loading or traffic characteristics change.

6.51 The second portion of Form MOP-4 provides the period, time-frames, and in-service requirements/out-of-service allowances. The additional 0.5 allowance illustrates a volitility of in-service requirement that demands occasional marker augment.

6.52 Several MOP-4s may be necessary to express varying in-service requirements dependent upon length of job and seasons involved. Current data validated but not available at the time of the original estimate may also limit the period of effectiveness of an original MOP-4.

(a) The busy hour and its in-service and out-of-service allowances are indicated by BH. Nonbusy period (NBP) is a nonbusy hour period such as side busy hours, hours during the day or evening that are busy but which do not quality as a busy hour.

(b) OFF P is identified as an off-period, usually the night and early morning hours.

(c) Based on the network administrators' knowledge of traffic and equipment requirements, WECo can format an MOP that will provide a productive job with minimal service reactions.

6.53 ***Planned Changes or Modifications of Markers (ie, Speedup):*** Group busy relays, addition of trunk link frames, and office link frames which tend to shorten marker holding time can be estimated as can additions that add to marker holding time. Holding time changes, either shortened or lengthened, reflect successively in greater or lesser capacity of the markers. Assumptions and calculations are detailed in Traffic Facilities Practices, Division D, Section 6f-2, Crossbar Tandem Markers.

6.54 The maximum Traffic Facilities Practices busy hour loading per marker is given in Table C.

6.55 A theoretical marker holding time may be obtained by using Figures 10 through 14. Each figure (graph) provides the theoretical holding time for its standard configuration, taking into consideration seizure ratios, and is plotted for the quantities of markers working at 100 percent occupancy. This result can be amended by the percentage of occupancy proposed as shown in Figure 15. For example, Figure 13, the graph for an 18 TLF-9 OLFP configuration, with eight nonspeedup markers and a seizure ratio of 1.2, shows a theoretical marker holding time of 0.78 second. Since this represents 100 percent occupancy by the markers, amending that holding time for an 80 percent occupancy rate requires reference to Figure 15. For 80 percent marker occupancy, a theoretical 6.5 percent reduction in holding time would be attained. A 0.78 second holding time would then be reduced to a 0.73 second holding time, for markers occupied at 80 percent of capacity, operating in the proposed or present environment.

6.56 Most theoretical tables are guides and afford a technique for qualifying actual data. Any major deviation experienced should be investigated to ascertain the validity of the data or the process.

6.57 ***Marker Connectors:*** Although marker connectors of themselves have no bearing on marker capacity, any sender or marker additions will require consideration of effect on the markers; that is, the addition of a new marker connector frame because of a sender addition requires marker down-time for connection into the new frame (or group).

INCOMING REGISTER

6.58 Incoming registers are used in crossbar tandem offices to provide step-by-step customers access to the tandem. The provision of these registers, with by-link operation to ensure the reception of the dialed digits, must be of sufficient quantity that one will almost always be immediately available.

6.59 If the number of incoming registers available is insufficient, step-by-step customers will encounter excessive reorder tone which is furnished as a signal for no registers available.

6.60 Incoming register quantities for CAMA or non-CAMA are based on 10-high-day, average-busy-hour usage. The maximum number of 3-digit registers in a group is 10; for 10-digit registers the maximum is 20. Where fewer than the maximum number of registers and/or trunks is installed, the 10-high-day, average-busy-hour usage of the installed register group should be divided by the number of working DP trunks served to obtain a CCS/trunk value. Any proposed increase in the number of working trunks can be translated back into incoming register requirements (at least one incoming register in either type of group is assigned to maintenance). The capacity table for various quantities of incoming registers will be found in Traffic Facilities Practices, Division D, Section 6i, Crossbar Tandem—CAMA.

6.61 Even though engineering provision is based on an average of 10-high-day, equipment in-service requirements would be predicated on the highest day if the work is being accomplished during the busy season. Empirical data, at all times, should be the bases for establishing needs.

6.62 These data would be affected if additional DP trunks are assigned to the tandem. Hence, for MOP purposes, the sequence should provide for the addition and/or rearrangement of incoming registers on incoming register link frames before additional assignments of DP trunks are made.

6.63 Traffic Facilities Practices, Division D, Section 6g, Crossbar Tandem—Incoming Registers, may also be used for reference purposes.

6.64 The quantity of incoming registers needed and the time intervals in which they are needed should be included in the MOP document.

CAMA AND TSP 100A

6.65 CAMA provides a technique for centrally recording and accurately billing calling subscribers. Several equipment elements, transverters, billing indexers, call identity indexers, and recorders are required to accomplish this service. Position link circuitry is also needed to include operator recording of calling subscriber telephone numbers when the automatic identification feature fails.

6.66 Billing indexers, call identity indexers, and recorders are related within their own hierarchy and require little involvement by the network administrator.

6.67 Transverters and position link circuitry do involve tandem senders and the network administrator must be aware of the impact on the senders when additions to these equipment elements are part of the pending job.

6.68 TSP 100A expands the service offered to subscribers. Generally, person-to-person, collect, charge, and coin calls can be processed automatically. Sender involvement is in terms of extended holding times to ensure that call details are complete. Marker attempts may also increase due to the operator's ability to complete delayed calls.

6.69 The network administrator must be familiar with both CAMA and TSP 100A operation to properly assign in-service requirements of senders and markers. Details of these services will be found in Traffic Facilities Practices, Division D, Sections 6i (Crossbar Tandem—CAMA) and 6k (Crossbar Tandem—100A TSP), respectively.

RECORD OF EQUIPMENT OUTAGES

6.70 As specified in Bell System Practices Section 201-114-001, network maintenance will complete

Forms E-4255 (trunk outage) and E-4256 (equipment outage). These outages may be reconciled with determined in-service requirements.

7. SERVICE MEASUREMENTS

GENERAL

7.01 There are several major service barometers which must be monitored before, during, and after transitional work. The devices which produce service results ***must be kept*** in service during periods of WECo activity. These include:

(a) Sender attachment delay recorder

(b) Various peg count registers for:

(1) Trunk group peg count for no circuit-reorder, sender overload announcement, and reorder announcement peg counts

(2) Marker peg counts

(3) Second failure to match peg count

(4) Revertive pulse reorder peg count

(c) Various overflow registers for:

(1) Office link frame overflow

(2) Trunk link overflow

(3) No circuit—reorder trunk group overflow.

SENDER ATTACHMENT DELAY RECORDER

7.02 One of the major service arrangements in a crossbar tandem office is the percentage of sender attachment delay (over 3 seconds) by type of impulsing.

7.03 These data, accumulated during the tandem office busy hour as well as those days to be included in 10-high-day engineering, may be used in the preparation of load-service curves portraying this service versus CCS per sender.

7.04 Any degradation in this service arrangement tends to affect overall service in the originating offices. Poor dial tone, excessive overflows, and inefficient utilization of facilities result when the percentage of attachment delay increases.

INEFFECTIVE ATTEMPTS

7.05 The percentage of ineffective attempts is based upon the number of reorder announcements, reorder tone (120 ipm), no circuit, and sender overload announcements as compared to the total tandem marker attempts.

7.06 The various trunk groups containing announcements or tones should have associated peg count devices so that an accurate compilation of ineffective attempts can be made.

7.07 Where RP tandem senders are employed, matching loss failures will not be routed to no circuit-reorder. Rather, the tandem marker establishes in the sender a condition which permits the originating office to establish the no circuit-reorder state. This condition scores the RPRO register; these scorings must be deducted when computing the percentage of matching loss.

7.08 The formula for calculating the percentage of matching loss is:

$$\frac{\text{Second Failure to Match Peg Count}}{\text{Total Marker PC-OLF Overflows-RPRO}} \times 100$$

7.09 Analysis of all register scorings may assist in identifying potential congestion before matching loss is experienced. The following table describes the various registers which score on matching loss failure. The reconciliation of trunk link overflows and office link overflows may pinpoint the link frames which are congested but those results are diluted when calculated as a office matching loss result.

STAGE OF CALL	TRK GRP PC				OVERFLOW			
					OFFICE LINK FRAME			2ND FTM
	MKR PC	1ST	ALT	OVFL	1ST	2ND	TLF	
1. First of office link frame pair	X	X						
2. Other office link frame of pair					X		X	
3. First of office link frame pair	X		X					
4. Other office link frame of pair						X	X	X
5. No circuit-reorder	X			X				

7.10 In addition, three office link frame seizures peg count registration will be made and a trunk link frame peg count will score when cross-points to the no circuit-reorder trunk group are operated.

7.11 Trunk group assignments, trunk link frame switches made busy, or office link frame switches made busy may be the possible contributors during transitional periods.

7.12 Where marker work has been or is involved, the appropriate channel relays may not be functioning properly. This condition may also cause reduced junctor accessibility which causes matching loss.

OTHER MEASUREMENTS

7.13 In those tandem offices serving step-by-step offices, an additional measurement of the number of permanent signals, partial dials, and no sender attached is obtained as a percentage of the incoming register attempts.

7.14 No-position-attached registers in crossbar tandems equipped for CAMA and/or TSP may indicate blockages or insufficient operator force provision. (In addition to these measurements, provision should be made to record and analyze customer comments to the operators regarding service.)

7.15 Where CAMA and TSP facilities are provided, other devices to determine misrouted non-CAMA (MCA) and unauthorized CAMA announcement (UCA) may assist in correcting dialing irregularities, etc.

SERVICE SUMMARY FORM

7.16 A crossbar tandem service summary (Fig. 16) may be useful for recording daily busy hour results.

7.17 During transitional periods these data should be reviewed by the network administrator and copies should be furnished to WECo, maintenance, and the network designer.

7.18 The network administrator must ensure that all traffic registers are associated properly and functioning accurately before the new equipment is placed in service.

8. LOAD MEASUREMENTS

GENERAL

8.01 In addition to the various traffic (peg count) and service measurements previously discussed, there are others which permit the registration of usage of the crossbar tandem equipment components.

8.02 Although there are many devices that can produce data for network administration purposes (eg, Esterline-Angus recorders, Alston scanners, etc), the principal measurement tool is the traffic usage recorder.

8.03 The traffic usage recorder, together with certain peg counts, produces the necessary ratios and data for ***load-balance*** and ***load-service*** relationships.

8.04 The traffic usage recorder must remain in service during periods of transition. The MOP must contain instructions which ***ensure*** traffic usage recorder availability at all times.

PEG COUNTS

8.05 Various peg count registers which are utilized in determining loads are:

(a) Trunk link frame peg count—total

(b) Trunk link frame sample link peg count

(c) Sender group busy peg count

(d) IST control peg count

(e) ***Office Link Frame Peg Seizures Peg Count:*** In offices where seizures peg count is not available an office link frame peg count is furnished.

USAGE

8.06 Usage measurements from the traffic usage recorder are produced in units of CCS or tenths of CCS (fast scan used with short-holding-time equipment components).

8.07 The various measurements of load are:

(a) Trunk link frame—holding group sample channel usage

(b) Trunk link frame total sample channel usage (detector group usage)

(c) Total sender usage

(d) Total sender maintenance usage

(e) Total marker usage

(f) Total marker maintenance usage

(g) Office link frame—holding group sample channel usage

(h) Office link frame—sample channel usage (detector group usage)

(i) Outgoing trunk usage

(j) Incoming register usage

(k) Incoming register maintenance usage

(l) Transverter usage

(m) Recorder usage

(n) CAMA and TSP usage (FADS).

8.08 Network administration techniques dictate that these usage data, after proper validation, be used to develop meaningful ***load-service*** relationships. The use of these techniques become increasingly important during periods of additions to existing facilities because capacities of equipment may be affected by transition work.

8.09 It is strongly recommended that the usage data be obtained coincident with the service data described in Part 7 for reconciliation purposes.

8.10 Provisions should be made to gather usage data during periods of high-volume traffic. It may be necessary, depending upon conditions, to manually record data. The training of personnel to do this work and the forms for transcription should be planned and discussed at MOP and subcommittee meetings (2.13 through 2.17).

OTHER LOAD INDICATORS

8.11 Measurements of facility inadequacy or unavailability may be provided through the use of overflow registrations. These measurements may well be the earliest indicators of equipment congestion, excessive out-of-service, or improper arrangement.

8.12 As discussed earlier, office link frame and trunk link frame overflows indicate that an idle trunk (at an office link frame) is available but that a channel (trunk link, office junctor, or office link) from the incoming trunk cannot be chosen by the marker. Analysis of these scorings may permit corrective action in time to prevent matching loss failures.

8.13 Outgoing trunk group overflow registrations indicate that an all-trunks-busy condition exists at the time a marker is testing for an idle trunk.

8.14 These registrations must be examined carefully because in many instances high scorings on high usage trunk groups will result as peg counts on final routes. Overflow scorings for final routes result as peg counts for the no circuit-reorder terminations.

8.15 During transitional periods (eg, new office link frame pairs which will require the transfer of existing working trunks), the trunk overflow registrations will give immediate indications of alternate routing which, in turn, increases marker holding time.

8.16 There are other load measurements which describe time frames and percentage of equipment occupied. These are the sender load meters and all markers busy. Associated with the all markers busy is an alarm circuit which notifies network maintenance when this condition exists for a certain duration. This marker busy alarm does not score a register but is a visual and audible signal of load.

8.17 A sender group busy register, provided one per sender group, may also be furnished. These registers may permit analysis which would disclose imbalances between sender groups.

8.18 Before placing any new equipment in service, the network administrator must be assured that all load measuring devices are associated properly and functioning accurately.

8.19 If facilities are made operative without a measuring device capability, load data would be distorted and would prevent sound decisions based upon load-service relationships.

9. OTHER NETWORK ADMINISTRATION FUNCTIONS

9.01 The purpose of a crossbar tandem is to provide network efficiency by serving small-sized incoming trunk groups and making available to them large-sized outgoing trunk fields. The tandem also provides features for centrex-CU, CAMA, TSP, coin zone dialing, code conversion, and prefixing digits as well as 6-digit translation.

9.02 Analogous to local offices where demand is equated to working main stations, tandem office demand can be related to ***working incoming trunks.***

9.03 During periods of transition, the number of trunks being serviced, the time frame in which they are served, and the common control facilities serving them require the attention of the network administrator whose role is intensified during periods of WECo activity.

9.04 Contacts with coordinates will become more frequent. This contact may be either formal or informal contact. Interface with the group responsible for trunking is imperative.

9.05 As previously described, determination of requirements for components in-service is a prime responsibility of the network administrator.

9.06 These requirements can be converted into working incoming trunk capability to ensure that ***during WECo activity,*** the call-carrying capacity of the tandem is not exceeded by adding trunks to the incoming trunk field.

9.07 The use of load distribution tables, as described in Dial Facilities Management Practices, Division H, Section 1b(8), Method of Procedure—General Administration, may assist in relating CCS per incoming trunk during certain time-frames.

9.08 These time-frames should coincide with tandem sender and tandem marker needs as defined by the network administrator.

9.09 The various features discussed in 9.01 may require additional records to be maintained by the networks administrator. For example:

(1) Centrex-CU lines will require line assignment records to be kept in a trunk assignment format.

(2) Translators will necessitate codes (NNX) to be recorded by numbering plan area so that routing information may be rapidly obtained.

(3) Coin zone circuits will require switchboard appearances to be associated with trunk equipments.

9.10 CAMA and TSP functions must be coordinated with the department representative charged with this responsibility.

10. REFERENCES

SOURCES

10.01 Reference should be made to other Traffic Facilities Practices, other sections of the Dial Facilities Management Practices, Bell System

Practices, WECo Handbooks, etc, as necessary, for the proper preparation of an MOP for crossbar tandem. References, as contained in this section, are shown below.

10.02 The WECo Installation Engineering Handbooks are the practices which guide WECo personnel in installing central office equipment.

10.03 There are numerous notes published by WECo which cover Engineering Change Procedures (ECPs) which may require the preparation of an MOP. These Engineering Change Procedures are issued for circuit improvements and may be included during an addition. If the Engineering Change Procedures would provide substantial circuit changes, the work may not necessarily be done in connection with an addition.

ATTACHMENTS

10.04 Attached is WECo Handbook 3, Section 5A, which covers the requirements and format for preparing a written MOP. Also attached are copies of Forms MOP-1, 2, 3, and 4 for local reproduction, as required. Figure 17, an extract from Traffic Facilities Practices, Division D, Section 6f-2, aids in visualizing and anticipating the effect on the basic machine operating time of markers when confronted with different TLP/office link frame configurations and/or office link frame seizure ratios. Figure 17 is self-explanatory.

OTHER PRACTICES

10.05 The following practices contain information which pertains to this section.

(a) ***Dial Facilities Management Practices:***

(1) Division E, Data Administration

(2) Division H, Section 1b(8), General Administration MOP

(3) Division A, Section 1, Traffic Characteristics and Probability Theory

(b) ***Traffic Facilities Practices:***

(1) Division D, Section 6b-1, Crossbar Tandem—Trunk Link Frames

(2) Division D, Section 6b-2, Crossbar Tandem—Office Link Frames

(3) Division D, Section 6c, Crossbar Tandem—Trunks

(4) Division D, Section 6d, Crossbar Tandem—Sender Link Frames

(5) Division D, Section 6e, Crossbar Tandem—Frames

(6) Division D, Section 6f-1, Crossbar Tandem—Markers

(7) Division D, Section 6f-2, Crossbar Tandem—Markers

(8) Division D, Section 6g, Crossbar Tandem—Incoming Registers

(9) Division D, Section 6h, Crossbar Tandem—Network Management Facilities

(10) Division D, Section 6i, Crossbar Tandem—CAMA

(11) Division D, Section 6j, Crossbar Tandem—Traffic Registers

(12) Division D, Section 6k, Crossbar Tandem—100A TSP

(c) ***Bell System Practices:***

(1) Section 201-112-001, Methods of Procedure—Plant

(2) Section 201-114-001, Record of Equipment Out of Service

(d) ***WECo Handbook:***

(1) Handbook 3, Section 5A, Method of Procedure

TABLE A

GUIDE FOR DISTRIBUTION OF LOAD PERCENTAGE

PRESENT OFFICE		NEW OFFICE		PERCENT TANDEM CCS LOAD TO BE TRANSFERRED TO EACH OLF PAIR
NO. OF OFFICE FRAMES	JUNCTORS PER TLF/OLF	NUMBER OF OLF PRS	JUNCTORS PER TLF/OLF	
10	20	6	16	16.6
12	16	7	14	14.3
14	14	8	12	12.5
16	12	9	11	11.1
18	11	10	10	10.0

Note : The total number of office link frames will always equal or be one more than the total number of trunk link frames.

TABLE B

SENDER LINK FRAME NUMBER

CONTROLLER AND SWITCH NO.	0	1	2	3	4	5	6	7	8
	(SENDER SUBGROUP NUMBER)								
A3	0	1	2	3	4	5	6	7	8
A2	1	2	3	4	5	6	7	8	9
A1	2	3	4	5	6	7	8	9	10
A0	3	4	5	6	7	8	9	10	0
B3	4	5	6	7	8	9	10	0	1
B2	5	6	7	8	9	10	0	1	2
B1	6	7	8	9	10	0	1	2	3
B0	7	8	9	10	0	1	2	3	4

TABLE C

BUSY HOUR LOADING PER MARKER

NUMBER OF MARKERS FOR TRAFFIC	HIGHEST DAY		AVERAGE 10 HIGH DAYS		AVERAGE BUSY SEASON	
	OCCU-PANCY	CCS/ MKR	OCCU-PANCY	CCS/ MKR	OCCU-PANCY	CCS/ MKR
1	65%	23.4	55%	19.8	40%	14.4
2	75%	27.0	65%	23.4	50%	18.0
3 or more	80%	28.8	70%	25.2	55%	19.8

CROSSBAR TANDEM
AVERAGE ADDED CCS PER TRUNK LINK OR OFFICE LINK FRAME
@ 0.5% MATCHING LOSS
(to be added to the basic capacity for 20 x 10 office)

	WHERE NO. OF TLFs = NO. OF OLFs		WHERE NO. OF TLFs DOES NOT EQUAL NO. OF OLFs		
	("Additions" Category)		CCS ADDED		
PATTERN	JUNCTORS PER GROUP	ADDED CCS	LESS 2 TLFs OR 2 OLFs	LESS 1 TLF	LESS 1 TLF & 2 OLFs
10 x 5	20	600	780	690	None
12 x 6	16	320	450	385	"
14 x 7	14	220	330	275	"
16 x 8	12	90	180	135	"
18 x 9	11	50	130	90	"
20 x 10	10	0	70	35	"
	("New Office" Category)				
10 x 5	16	160	310	235	None
12 x 6	14	100	220	160	"
14 x 7	12	0	100	50	"

Note 1: No comparable figures are available for offices below the 10 x 5 size, but frame capacity is rarely limiting in these cases. For engineering purposes, it is suggested that the capacity indicated for 10 x 5 size office be used for all but the 4 x 2 "New Office" size. Because of the poor junctor pattern, this combination is not recommended for use.

Note 2: The "CCS added" should be applied to the CCS capacity of the smaller number of frames.

Note 3: The 10 x 5 pattern capacities are for offices with non-split OLF secondaries. For split secondaries, the 20 x 10 pattern capacities are used.

Fig. 1—Example of Junctor Group Capacity Loss With Tandem Size Increase (5.11)

FORM MOP - 1

Sender In-Service Requirements

Type Sender MF (CAMA & NCAMA) Season 1974-1975

No. Senders Installed 76

Sender Type Appears In 26 Sender Link Frames

	High Day	10 High Day Avg.	Busy Season Average
Sender Traffic Usage	1992	1750	1597
Sender Peg Count	25859	24648	22814
Sender Holding Time	7.7	7.1	7.0
Sender % Occupancy	73.8	65.9	61.2
Avg. Working Equivalent Inc. Trks.	2190	2164	2170
CCS/Wkg. Equivalent Inc. Trk.	0.91	0.81	0.74
% SAD	0.7	0.6	0.1
Equivalent Sender Outage	1	2	3

Requirements For Period 5/1/75 To 8/31/75

	Reqd. For Traffic	Mtce. Allowance
BH 10 30 A To 11 30 A	68	6
NBP 9 00 A To 10 30 A	65	9
NBP 11 30 A To 3 00 P	66	8
NBP 3 00 P To 7 00 P	64	10
NBP 7 00 P To 9 30 P	67	7
NBP To		
NBP To		
OFFP 9 30 P To 9 00 A	50	25

Remarks:

Fig. 2—Sender In-Service Requirements (6.12)

FORM MOP - 2

CROSSBAR TANDEM SENDERS — TRAFFIC ENGINEERING WORKSHEET A

1) Tandem Alpha XBT
2) Data Period 1974-75 Busy Season
3) Type of Sender Group MF CAMA + Non-CAMA
4) Number of Senders Installed (N) 76

	TFC CCS (C)	AVG EQUIV INC TRKS WORKING (E)	TFC CCS PER EQUIV INC TRK (U)	MTC CCS (B)	SNDRS OUT OF SVC (M)	SNDRS IN SVC (S)	TFC CCS PER SNDR (T)	%SD/3" (D)	VARIABILITY NUMBER (VN)
5)	1992	2190	.91	36	1	75	26.6	0.7	2.4
6)	1901	2160	.88	133	4	72	26.4	3.8	3.7
7)	1820	2140	.85	72	2	74	24.6	0.0	1.0
8)	1744	2160	.81	61	2	74	23.6	0.0	
9)	1717	2140	.81	108	3	73	23.5	1.9	4.2
10)	1700	2190	.78	0	0	76	22.4	0.0	
11)	1671	2140	.78	144	4	72	23.2	0.0	
12)	1660	2160	.77	65	3	74	22.4	0.0	
13)	1657	2170	.76	50	1	75	22.1	0.0	
14)	1644	2190	.75	141	4	72	22.8	0.0	
15)	1640			144	4	72	22.8	0.4	3.5
16)								NVN ø	2.7
17)									
18)									
19)									

20) TOTAL 10 HI CCS/TRK 8.09
21) AVG 10 HI CCS/TRK (U) .81
22) AVERAGE 10 HI SNDR HOLDING TIME (H) 7.1

23) TOTAL OF VN NUMBERS 17.5
24) AVERAGE OF VN NUMBERS 2.9

ø Determination of Nominal Variability Number (NVN) for Number of Senders Installed (N) and Average Sender Holding Time in Seconds (H):

NVN = 2.1 + .01 N + .05 (H - 10.0)

= 2.1 + .01 (76) + .05 (7.1 - 10.0)
= 2.1 + .76 - .145
= 2.715 USE 2.7

Remarks:

Fig. 3—Crossbar Tandem Senders—Traffic Engineering Worksheet A (6.15)

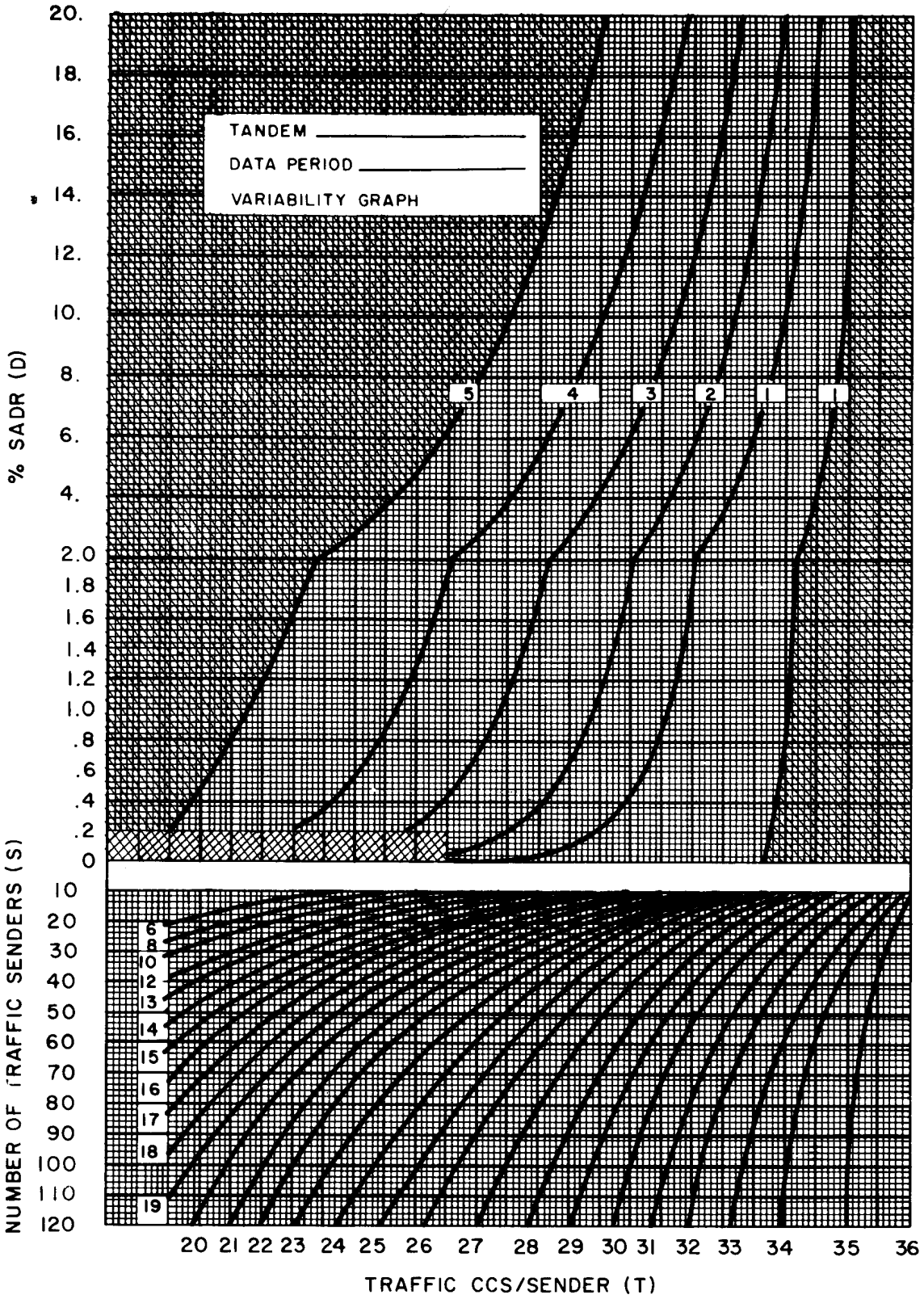


Fig. 4—Traffic Senders/CCS Sender Graph (6.16)

FORM MOP - 3

CROSSBAR TANDEM SENDERS — TRAFFIC ENGINEERING WORKSHEET B

Tandem Alpha

Sender Type
MF CAMA & Non-CAMA

Tabulation of historical data and selection of data for calculations:

(a)

DATA PERIOD	INST. SNDRS (N)	HOLD TIME (H)	VARI-ABILITY NUMBER (VN)	WTG FACTOR X	WEIGHTED VN	TFC CCS PER EQUIV INC TRK HIGHEST DAY	TFC CCS PER EQUIV INC TRK AVERAGE 10 HI	RATIO (R)
Curr. Yr. 74-75	76	7.1	2.9	.5	1.45	.91	.81	1.12
Curr. Yr. (−1) 73-74	64	7.4	2.8	.3	.84	.91	.84	1.08
Curr. Yr. (−2) 72-73	64	7.2	2.2	.2	.44	.96	.82	1.17
						Total	2.47	3.37
			Weighted VN Total		2.73	Avg	.823	1.23
			USE		2.7	USE	.82#	1.12
					(VN′)		(U′)	(R′)

(b) CALCULATION OF TRAFFIC CAPACITY OF INSTALLED SENDERS

76 INST SNDRS - 4 SP SNDRS = 72 TFC SNDRS AT VN′ of 2.7 = 1809 TABLE CCS

CONVERSION FACTOR for TABLE CCS to AVG 10 HI CCS (F, Fig. 17, for R′ = 1.12) = .96

1809 TABLE CCS x .96 (F) = 1737 CCS AVG 10 HI DAY TRAFFIC CAPACITY

TFC CAPY IN EQUIVALENT INCOMING TRUNKS = AVG 10 HI DAY CCS = 1737 = 2118
AVG CCS PER TRK (U′) .82

(c) CALCULATION OF SENDER REQUIREMENTS FOR ENGINEERING PERIOD 5/75 to 8/75

EQUIVALENT INCOMING TRUNKS FORECASTED FOR ENGINEERING PERIOD (P′) 2200

AVG 10 HI DAY TFC CCS FORECASTED FOR ENGINEERING PERIOD (P′ x U′ or EU′ .82) = 1804

CONVERSION FACTOR for AVG 10 HI CCS to TABLE CCS (F, Fig. 17, for R′ = _____)= _____

1804 FORECASTED AVG 10 HI CCS ÷ .96 (F) = 1879 FORECASTED TABLE CCS

Reading TABLE CCS into CAPACITY TABLE, Fig. 7, for VN′ or EVN′ of 2.7

TRAFFIC SENDERS REQUIRED (TFC SNDRS) 75

SERVICE PROTECTION SENDERS (SP SNDRS = TFC SNDRS ÷ 20) 4

TOTAL SENDERS TO BE PROVIDED 79

Remarks

#: For three seasons = As shown
For two seasons = .7 + .3
For one season = 1.0

Fig. 5—Crossbar Tandem Senders—Traffic Engineering Worksheet B (6.22, 6.24)

(R)	(F)			
FOR RATIO (R): H.D. TFC CCS/TRK AVG. 10 H.D. CCS/TRK	FOR VN BETWEEN 2.0 AND 3.0 (SEE NOTE) TO CONVERT TO: AVG. 10 HIGH DAY CCS; MULTIPLY TABLE CCS BY (F) TABLE CCS; DIVIDE AVG. 10 HIGH DAY CCS BY (F) AS INDICATED FOR SENDER GROUP SIZE.			
	UP TO 24	25 - 39	40 - 59	60 OR MORE
1.00 TO 1.07	1.00	1.00	1.00	1.00
1.08 TO 1.11	1.00	.99	.99	.98
1.12 TO 1.15	.99	.98	.97	.96
1.16 TO 1.19	.98	.96	.95	.94
1.20 TO 1.23	.97	.95	.93	.92
1.24 TO 1.27	.96	.94	.92	.90
1.28 TO 1.31	.95	.92	.90	.88
1.32 & UP	.94	.91	.88	.85

Note: FOR VN UNDER 2.0 USE FACTOR FOR NEXT ***HIGHER*** RANGE OF RATIOS IN SENDER GROUP SIZE.

EXAMPLE: For 20 senders and RATIO (R) of 1.21, when VN = 1.5, use FACTOR (F) of .96 instead of .97

FOR VN OVER 3.0 USE FACTOR FOR NEXT ***LOWER*** RANGE OF RATIOS IN SENDER GROUP SIZE.

EXAMPLE: For 20 senders and RATIO (R) of 1.21, when V = 3.5, use FACTOR (F) of .98 instead of .97

Fig. 6—Table of Conversion Factors Between Average 10-High-Day CCS and Capacity Table CCS (Sender Single-Hour CCS Capacity (6.22, 6.25)

NO. OF SNDRS	VARIABILITY NUMBER 1	2	3	4	5
6	68	48	29	11	
7	88	64	41	17	
8	112	84	57	27	
9	138	107	75	41	
10	166	132	95	59	
11	196	159	117	79	
12	226	186	139	99	
13	256	213	161	119	
14	286	240	183	139	
15	316	267	205	159	
16	346	294	227	179	
17	376	321	250	199	
18	406	348	273	219	
19	436	375	296	239	
20	466	402	320	259	
21	496	429	344	279	
22	526	456	369	299	
23	556	483	394	319	
24	586	510	420	339	
25	616	527	446	359	
26	646	565	472	380	
27	676	593	498	401	
28	706	621	524	423	
29	736	650	550	445	
30	766	679	576	467	
31	797	709	603	490	
32	828	739	630	513	
33	859	769	657	537	
34	890	799	684	561	
35	921	829	711	585	
36	952	859	739	609	
37	983	889	767	633	
38	1014	919	795	657	
39	1045	949	823	681	
40	1076	979	851	705	
41	1107	1009	879	730	720
42	1138	1039	907	755	740
43	1169	1069	935	780	760
44	1200	1099	963	805	780
45	1231	1129	991	830	800

NO. OF SNDRS	VARIABILITY NUMBER 1	2	3	4	5
46	1262	1159	1019	856	820
47	1293	1189	1047	882	840
48	1324	1219	1075	908	861
49	1355	1249	1103	934	881
50	1387	1279	1131	960	902
51	1419	1309	1159	987	922
52	1451	1339	1187	1014	943
53	1483	1369	1215	1041	964
54	1515	1399	1243	1068	985
55	1547	1429	1271	1095	1006
56	1579	1459	1299	1122	1026
57	1611	1489	1327	1149	1047
58	1643	1519	1355	1176	1068
59	1675	1549	1383	1203	1089
60	1707	1579	1411	1230	1110
61	1739	1609	1439	1257	1130
62	1771	1639	1467	1284	1151
63	1803	1669	1495	1311	1172
64	1835	1699	1523	1338	1193
65	1867	1729	1551	1365	1214
66	1899	1759	1579	1392	1234
67	1931	1789	1608	1419	1255
68	1963	1819	1637	1446	1276
69	1995	1849	1666	1473	1297
70	2027	1879	1695	1500	1318
71	2059	1909	1724	1527	1338
72	2091	1939	1753	1554	1359
73	2123	1969	1782	1581	1380
74	2155	1999	1811	1608	1401
75	2187	2029	1840	1635	1422
76	2219	2059	1869	1662	1442
77	2251	2089	1898	1689	1463
78	2283	2119	1927	1716	1484
79	2316	2149	1956	1743	1505
80	2349	2179	1985	1770	1527

Fig. 7—Sender Single-Hour Capacity Tables for 0.5 Percent Sender Attachment Delay Over 3 Seconds (Sheet 1 of 2) (6.22)

NO. OF SNDRS	VARIABILITY NUMBER 1	2	3	4	5
81	2382	2210	2014	1797	1548
82	2415	2241	2044	1824	1570
83	2448	2272	2074	1851	1591
84	2481	2303	2104	1878	1613
85	2514	2334	2134	1905	1634
86	2547	2365	2164	1932	1656
87	2580	2396	2194	1959	1677
88	2613	2427	2224	1986	1698
89	2646	2458	2254	2013	1720
90	2679	2489	2284	2040	1741
91	2712	2520	2314	2068	1763
92	2745	2551	2344	2096	1784
93	2778	2582	2374	2124	1806
94	2811	2613	2404	2152	1827
95	2844	2644	2434	2180	1849
96	2877	2675	2464	2208	1870
97	2910	2706	2494	2236	1892
98	2943	2737	2524	2264	1913
99	2976	2768	2554	2292	1934
100	3009	2799	2584	2320	1956
101	3042	2830	2614	2348	1977
102	3075	2861	2644	2376	1999
103	3108	2892	2674	2404	2020
104	3141	2923	2704	2432	2042
105	3174	2954	2734	2460	2063
106	3207	2985	2764	2489	2085
107	3240	3016	2794	2518	2106
108	3273	3047	2824	2547	2127
109	3306	3078	2854	2576	2149
110	3339	3109	2884	2605	2170
111	3372	3140	2914	2634	2192
112	3405	3171	2944	2664	2213
113	3438	3202	2974	2694	2235
114	3471	3233	3004	2724	2256
115	3504	3264	3034	2754	2278

NO. OF SNDRS	VARIABILITY NUMBER 1	2	3	4	5
116	3537	3295	3064	2784	2299
117	3570	3326	3094	2814	2321
118	3603	3357	3124	2844	2342
119	3636	3388	3154	2874	2363
120	3669	3419	3184	2904	2385
121	3702	3450	3214	2934	2406
122	3735	3481	3244	2964	2428
123	3768	3512	3274	2994	2449
124	3801	3543	3304	3024	2471
125	3834	3574	3334	3054	2492
126	3867	3605	3364	3084	2514
127	3900	3636	3394	3114	2535
128	3933	3667	3424	3144	2556
129	3966	3698	3454	3174	2578
130	3999	3729	3484	3204	2599
131	4032	3760	3514	3234	2621
132	4065	3791	3544	3264	2642
133	4098	3822	3574	3294	2664
134	4131	3853	3604	3324	2685
135	4164	3884	3634	3354	2707
136	4197	3915	3664	3384	2728
137	4230	3946	3694	3414	2750
138	4263	3977	3724	3444	2771
139	4296	4008	3754	3474	2792
140	4329	4039	3784	3504	2814
141	4362	4070	3814	3534	2835
142	4395	4101	3844	3564	2857
143	4428	4132	3874	3594	2878
144	4461	4163	3904	3624	2900
145	4494	4194	3934	3654	2921
146	4527	4225	3964	3684	2943
147	4560	4256	3994	3714	2964
148	4593	4287	4024	3744	2985
149	4626	4318	4054	3774	3007
150	4659	4349	4084	3804	3028

Fig. 7—Sender Single-Hour Capacity Tables for 0.5 Percent Sender Attachment Delay Over 3 Seconds (Sheet 2 of 2) (6.22)

Total installed senders 76

Service protection margin senders 4 (76 ÷ 20)

Traffic senders 72

Interpolation of table CCS at VN′of 2.7:

72 senders at VN′ of 2 = 1939 CCS
72 senders at VN′ of 3 = 1753 CCS
Difference = 186 CCS

186 difference CCS x .7 = 130.2, use 130

VN′ of 2 = 1939, minus 130 CCS difference = 1809 CCS

Interpolation of VN′ at 2 for 1879 Table CCS:

1879 CCS on Table 2 = 70 senders (next larger number of senders).

1879 CCS on Table 3 = 77 senders (next larger number of senders).

Difference in senders = 7

.7 x 7 senders = 4.9, use 5 senders

Table 2 senders (70) plus 0.7 interpolated (5) = 75 traffic senders required.

Service protection margin senders = 75 ÷ 20 = 4

Total senders provided = 79

Fig. 8—Application of Variability Number to Sender Capacity Tables (6.23)

FORM MOP - 4

Marker In-Service Requirements

1) No. Markers Installed 7 4 / 5) No. Trk. Lk. Frms. 15 OLF Prs 8

2) Marker Type Route relay

3) Missed Usage Factor .022 "/PC 6) Season 1974-1975

	High Day	10 High Day Avg.	Busy Season Average
7) Marker Adjusted Traffic Usage	214.2	188.2	171.7
8) Marker Peg Count	30174	28761	27701
9) Marker Holding Time	.71	.65	.62
10) Marker % Occupancy	85%	74.7%	75.6%
11) Avg. Working Equivalent Inc. Trks.	2190	2164	2170
12) CCS/Wkg. Equivalent Inc. Trk.	.098	.087	.079
13) Matching Loss Percent	1.0	.5	.1
14) Office Link Frame Seizure Ratio	1.10	1.11	1.05
15) Equivalent Marker Outage	0	0	.7

Requirements for Period 5/1/75 To 8/31/75

	Reqd. For Traffic	Mtce. Allowance
BH 10:30 A To 11:30 A	7	0
NBP 9:00 A To 10:30 A	7	0
NBP 11:30 A To 3:00 P	6	.5
NBP 3:00 P To 7:00 P	6	.5
NBP 7:00 P To 9:30 P	7	0
NBP _____ To _____		
NBP _____ To _____		
OFFP 9:30 P To 9:00 A	4	2

Remarks:

Fig. 9—Marker In-Service Requirements (6.48, 6.49)

CALCULATED MARKER HOLDING TIME CHART
100% OCCUPANCY

TLF-OLFP
12-6

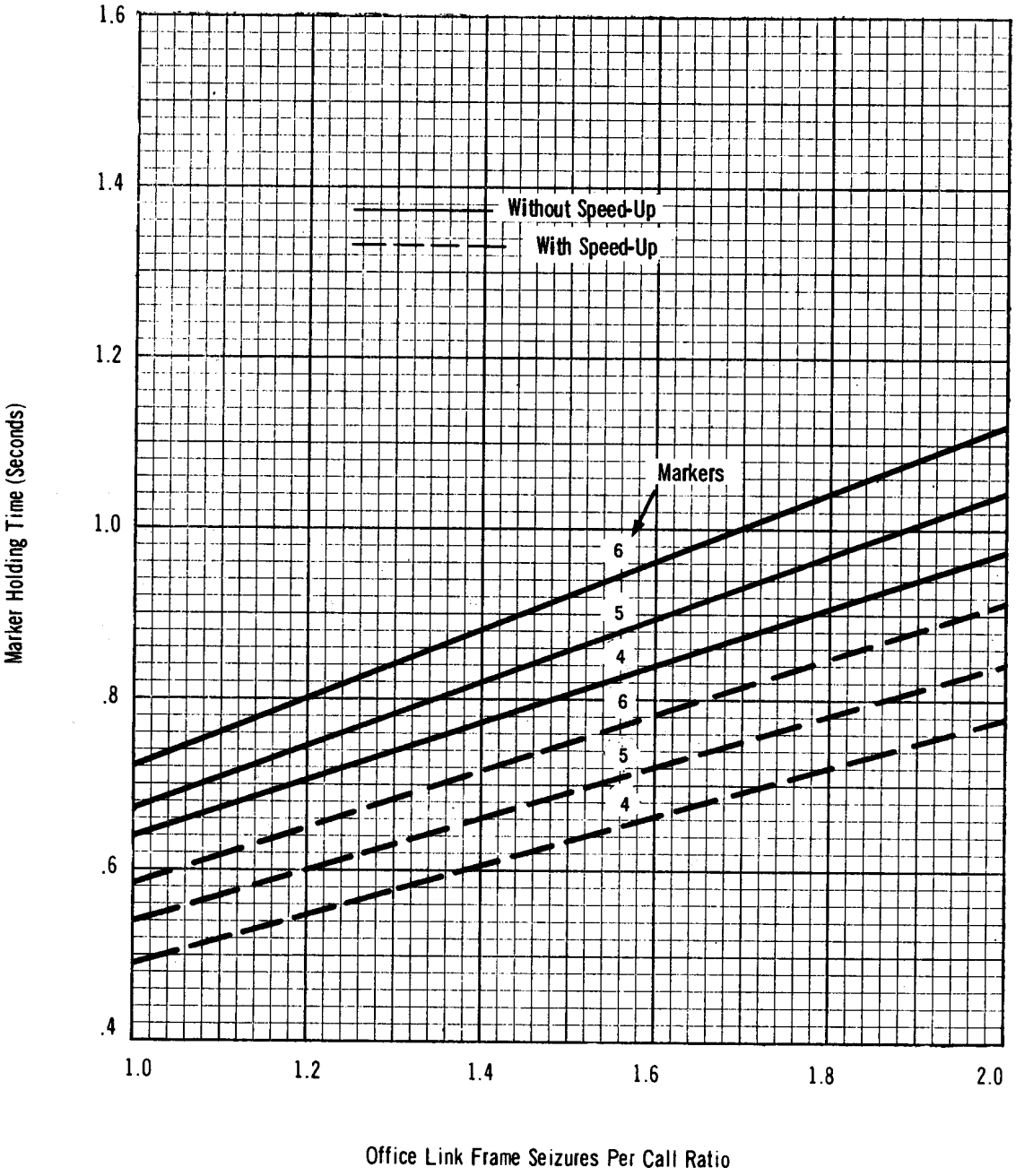


Fig. 10—Calculated Marker Holding Time Chart—100 Percent Occupancy (TLF-OLFP 12-6) (6.55)

CALCULATED MARKER HOLDING TIME CHART
100% OCCUPANCY

TLF-OLFP
14-7

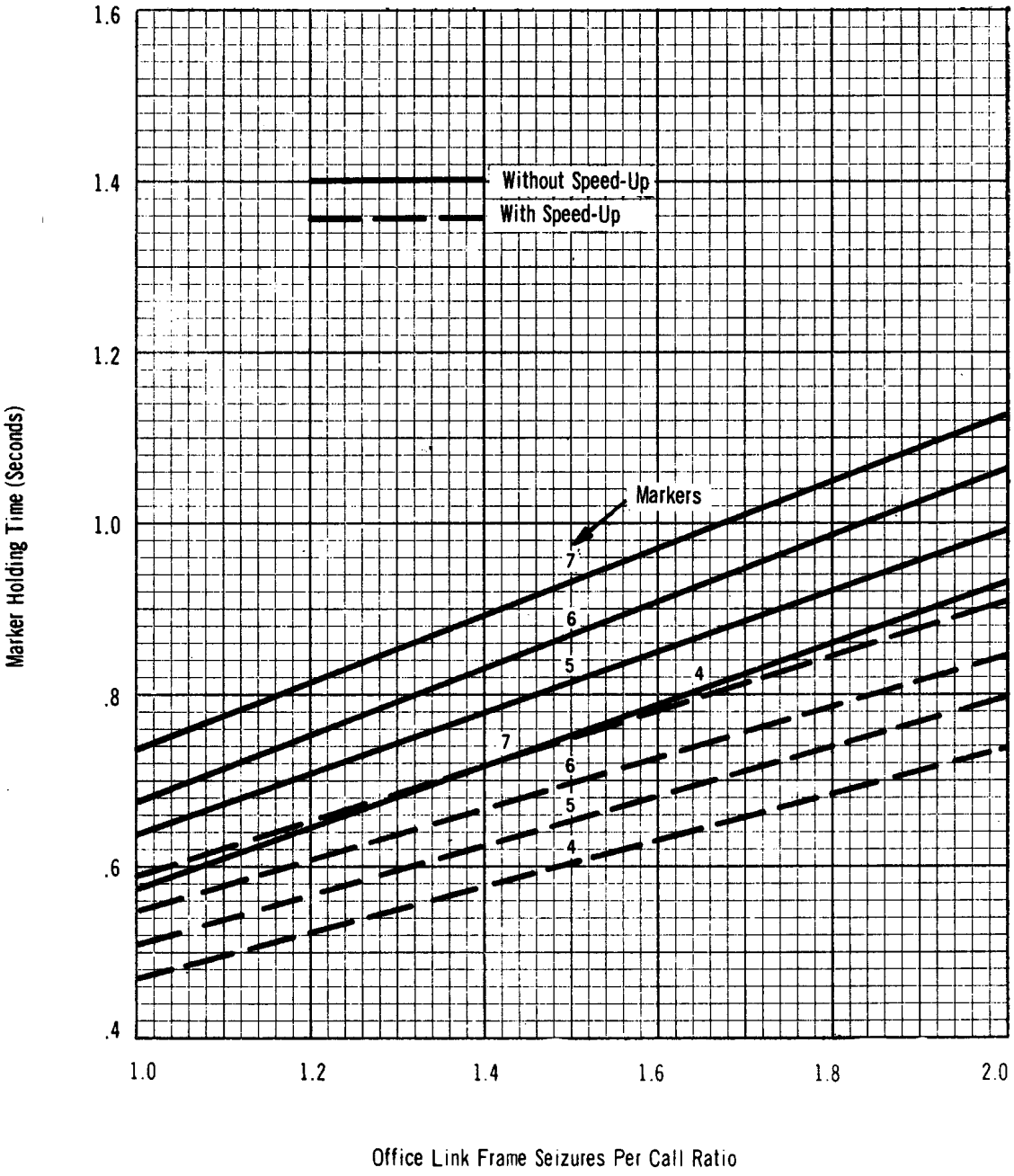


Fig. 11—Calculated Marker Holding Time Chart—100 Percent Occupancy (TLF-OLFP 14-7) (6.55)

CALCULATED MARKER HOLDING TIME CHART
100% OCCUPANCY

TLF-OLFP
16-8

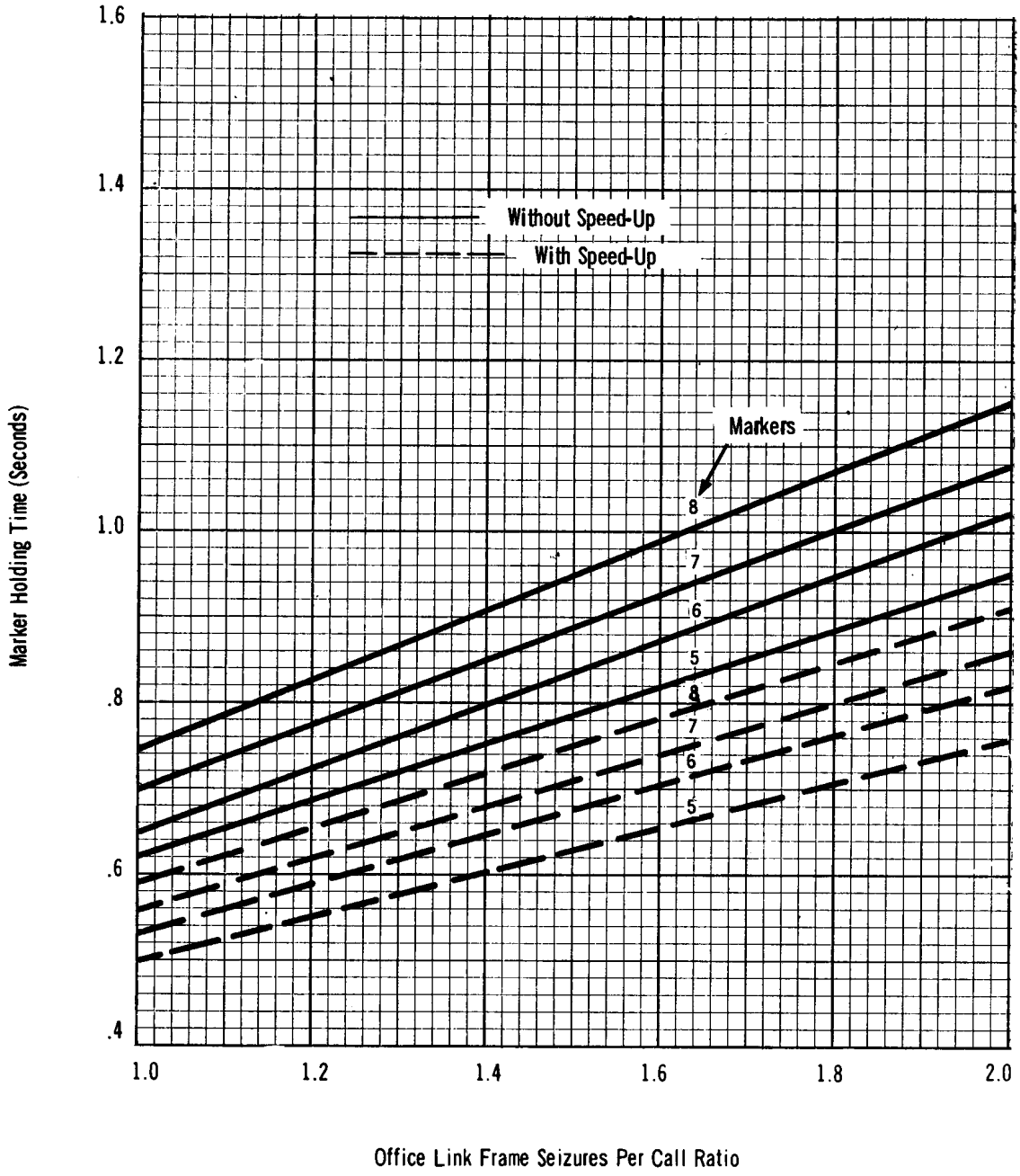


Fig. 12—Calculated Marker Holding Time Chart—100 Percent Occupancy (TLF-OLFP 16-8) (6.55)

CALCULATED MARKER HOLDING TIME CHART
100% OCCUPANCY

TLF-DLFP
18-9

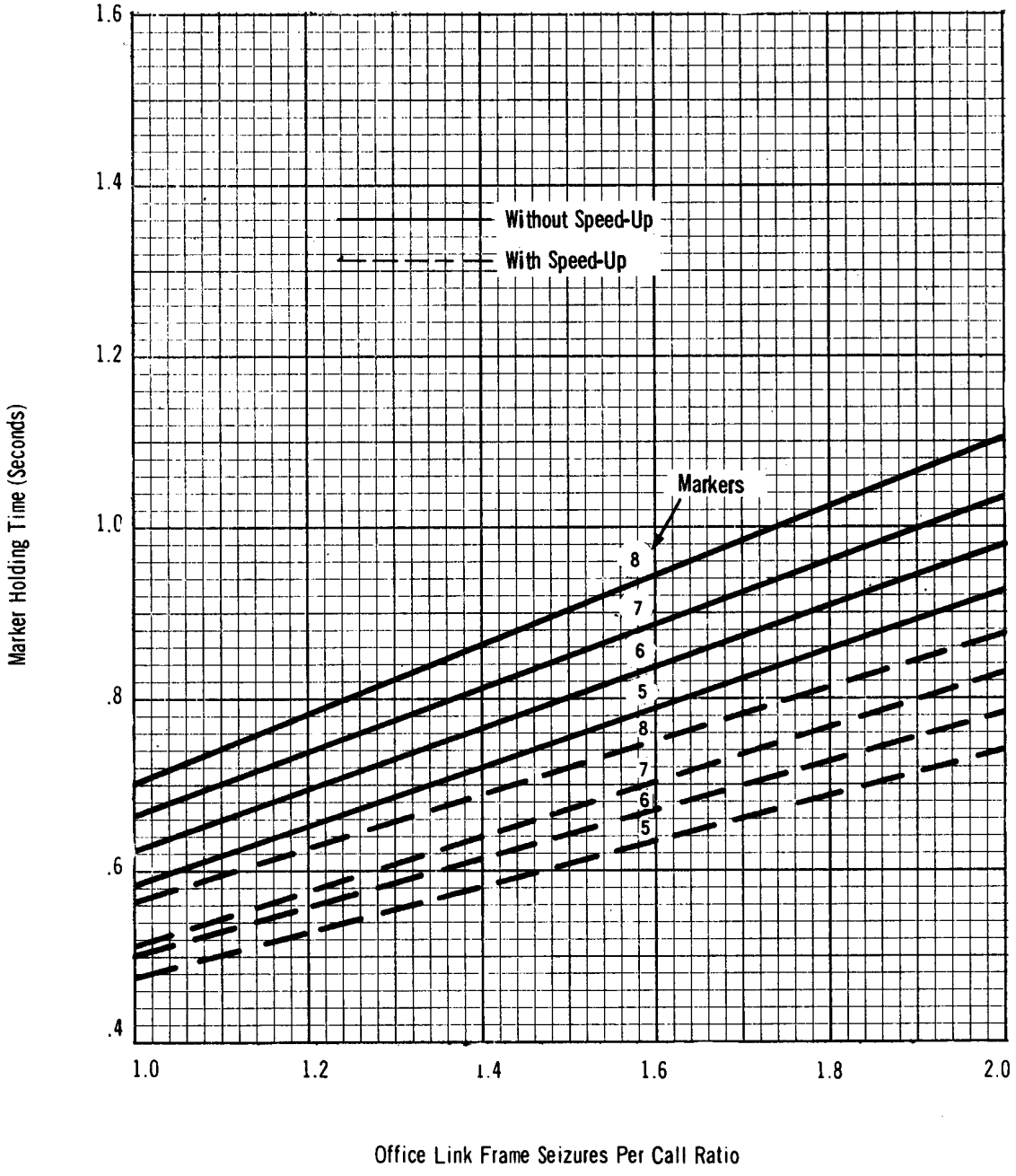


Fig. 13—Calculated Marker Holding Time Chart—100 Percent Occupancy (TLF-OLFP 18-9) (6.55)

CALCULATED MARKER HOLDING TIME CHART
100% OCCUPANCY

TLF-OLFP
20-10

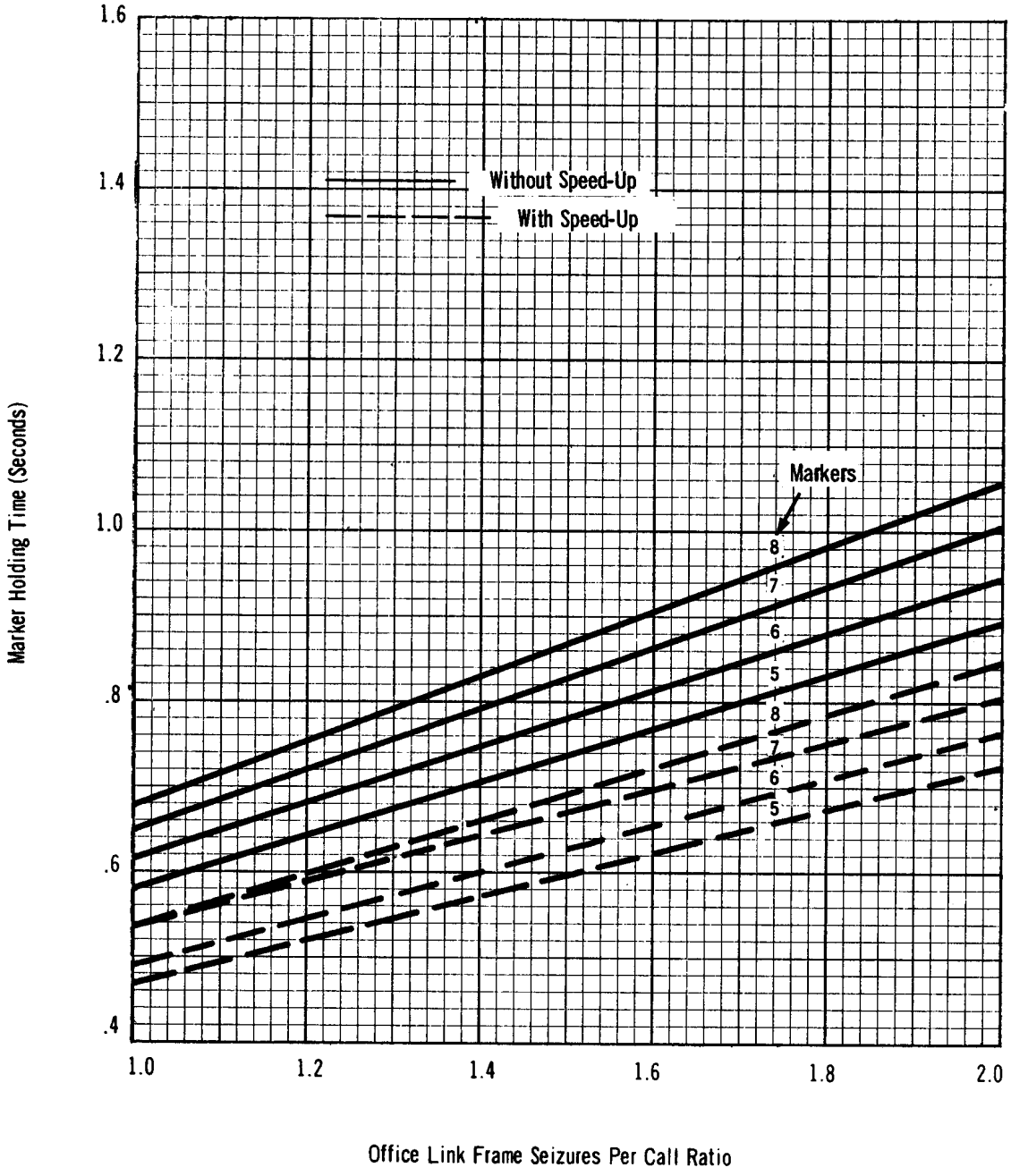
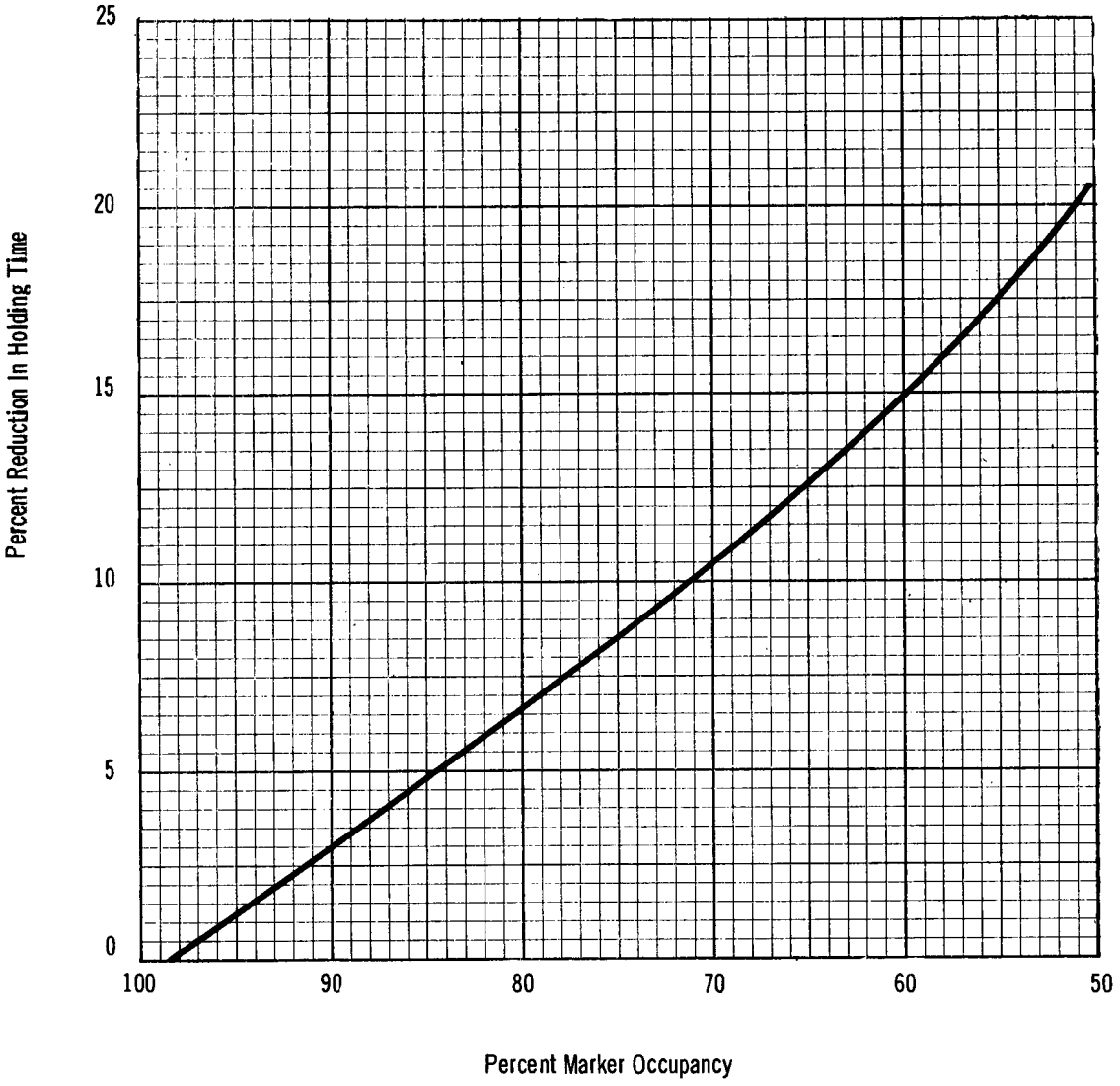


Fig. 14—Calculated Marker Holding Time Chart—100 Percent Occupancy (TLF-OLFP 20-10) (6.55)

MARKER HOLDING TIME OCCUPANCY



This Chart provides the approximate percent change in Marker Holdings, in relation to Change in occupancy for the following office sizes:

Mkrs	TLF 5	OLFP
8	20	10
7	18	9
6	16	8
5	14	7
4	10	5
3	6	3

Fig. 15—Marker Holding Time Occupancy (6.55)

CROSSBAR TANDEM SERVICE SUMMARY

BUILDING:_____ BUSY HOUR:_____

TANDEM: _____

			TOTAL BH COUNT	% FAILURE
1	MARKER ATTEMPTS (000)			
2	% OF MARKER ATTEMPTS	REORDER		
3		VACANT CODE ANNOUNCEMENT		
4		SENDER OVERLOAD ANNOUNCEMENT		
5		NC INTERTOLL		
6		NC TOLL CONNECTING		
7		TOTAL		
8		FINAL HI AND DRY		
9	TRANSVERTER ATTEMPTS			
10	% MISROUTED NON-CAMA CALLS			
11	INCOMING REGISTER ATTEMPTS			
12	% OF INCOMING REG ATT	PERMANENT SIGNALS		
13		PARTIAL DIAL		
14		NO SENDER ATTACHED		
15	TRANSVERTER ONI ATTEMPTS			
16		WRONG CALLING CODE		
17		NO POSITION ATTACHED		
18		POSITION DISCONNECT		
19	BUSY HOUR % SENDER DELAY OVER 3 SEC-M.F.			
20	-D.P.			
21	-R.P.			
22	-P.C.I.			
23	TRUNK LINK FRAME OVERFLOWS			
24	OFFICE LINK FRAME OVERFLOWS			
25	BUSY HOUR % MATCHING LOSS			

Fig. 16—Crossbar Tandem Service Summary (7.16)

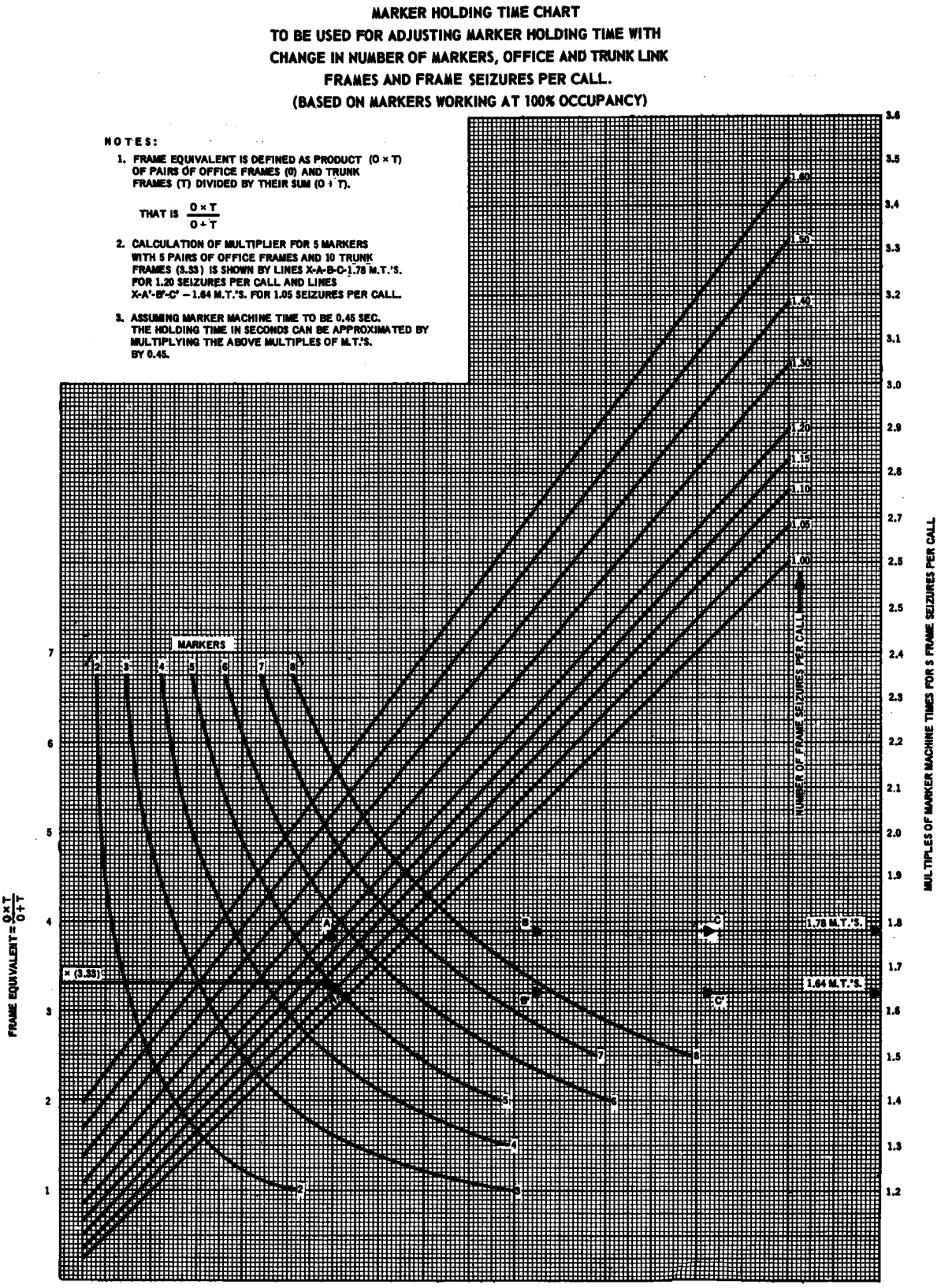


Fig. 17—Marker Holding Time Chart for Adjusting Marker Holding Time With Change in Number of Markers, Office and Trunk Link Frames, and Seizures Per Call (10.04)

Installation Engineering Handbook 3
Western Electric Company, Incorporated
Engineering Division

Section 5A
7-23-71
Replaces: Section 5A
dated 4-30-71

METHOD OF PROCEDURE

CONTENTS

1. GENERAL

1.1 Scope of Section
1.2 Purpose and Responsibility
1.3 Requirements
1.4 Installers Preliminary Work
1.5 Work Intervals

2. BASIS OF INSTALLATION

2.1 In-Service
2.2 Out-of-Service
2.3 Temporary-Out-of-Service

3. PRELIMINARY PREPARATIONS

3.1 General Information

4. FORMAT AND DETAILS OF PREPARATION

5. DISTRIBUTION

6. CHANGE IN PROCEDURE AFTER WORK HAS STARTED

1. GENERAL

1.1 Scope of Section

1.11 This section covers the requirement and suggested format for preparing a written Method of Procedure which is a detailed step-by-step procedure for a particular job which has been agreed upon and signed by both the Telephone Company and Western Electric Company representatives.

1.2 Purpose and Responsibility

1.21 The purpose is to record all installing operations on any live equipment and to establish a detailed method of procedure. The installer shall have the responsibility of preparing this document in writing. A form of this document may be prepared by the PECC in which case the installer shall verify that all items have been covered according to this section.

1.3 Requirements

1.31 Before starting any work the Western Electric Company, installer shall contact the Telephone Company's representative, who will arrange with the plant and traffic representative, to discuss the work involved and assign dates and hours for start and completion of the various operations. These discussions are to be held as frequently as it is found necessary in order to protect the equipment and to assure the progress of the installation.

1.4 Installers Preliminary Work

1.41 The installer shall do as much work as possible, such as removing or placing cables as required, fan and connect cable ends where practicable without causing interference with live equipment. In some cases certain preliminary operations essential for a step may be outlined in connection with a step. However, this is not to be interpreted as meaning that any additional preliminary work found necessary or feasible should not be done.

1.5 Work Intervals

1.51 All work will be done between the hours covered in the procedure as agreed upon at the time of discussion with the Telephone Company. Work on common current supply should be performed between midnight and 6 A.M. Common current supply equipment is that equipment such as Batteries, Motor generator sets, Ringing machines, Rectifiers, Power Boards, Distributing Panels, Fuse Panels, Bus Bars, Power Cables, and Carrier Supplies.

2. BASIS OF INSTALLATION

2.1 In-Service

2.11 In those cases where the Western Electric Company can work on the equipment that is kept in service, the work is done on what is known as an "in-service" basis.

2.111 In some cases the working equipment can be made busy permitting the Western Electric Company to make changes.

2.112 When it is found necessary to have working equipment made busy, it will first be made busy in the standard manner by a representative of the Telephone Company.

2.113 When the work involved removes the busy condition, placed by the Telephone Company, the installer shall supplement this condition in a nonstandard manner.

2.114 When equipment is made busy, and held busy by a temporary nonstandard arrangement only, the installer will not remove busy condition or return equipment to service without the approval of the Telephone Company.

2.115 Upon completion of a step or a portion of a step, the installer will remove all busy conditions as required, except those that are placed by the Telephone Company.

2.116 It is the Telephone Company's responsibility to remove the busy conditions placed by them when returning equipment to service.

2.2 Out-of-Service

2.21 In those cases where the Western Electric Company can work on the equipment only when it is removed from service, the work is done on what is known as an "out-of-service" basis.

2.3 Temporary-Out-of-Service

2.31 In those cases where the Western Electric Company can work on the equipment during certain periods of time, due to the release of equipment by temporary routings, etc., the work is done on what is known as a "temporary-out-of-service" basis.

3. PRELIMINARY PREPARATIONS

3.1 General Information

3.11 The installer shall assemble all available information associated with the job. Job papers should be analyzed and new and old drawings compared to learn the extent of the modification or addition. He should specify Handbook 0, Section 10, 11, 12, 13 and 14 (safety precautions and protection), and Handbook 22 Section 10, 11, 20, 40 and 60 (if power work is involved) to prevent a possible service interruption.

3.12 All locations involved should be verified and marked in a temporary manner for easy identification.

4. FORMAT AND DETAILS OF PREPARATION

4.1 All information will then be recorded using Forms SD-4-2850 or local forms if available. (Ordering information is included in Handbook 250, Section 0.) If local forms are used due to unusual circumstances, all items in the standard SD-4 Forms must be covered including levels of Operating Company approvals. See Exhibits A, B, C, D and E. A copy shall be available to the installer at all times.

4.2 General Information

4.21 Include a general outline of the entire equipment affected, work location, major equipment to be added or removed, general notes and other information as required.

4.3 Detailed Steps

4.31 For each step or group of steps show the dates, the start and complete time, the type of protection and where it will be used and any special precautions that must be observed. Next explain in detail all the work to be done in the step, how it will be done and indicate that portion of the work that will be the responsibility of the installer or the operating company.

4.32 The detailed step should follow a logical sequence of process based on the following considerations:

(a) Equipment that will be required first.

(b) The sequence of steps that will provide advance equipment for service.

(c) The amount of work that can be done and still provide a margin of safety for returning released equipment to service within the specified time.

(d) Work that can be done without affecting live equipment such as erecting, cabling, wiring, connecting, adjusting and testing.

(e) Work that must be done at night within the specified hours.

(f) ECP's or DCS's associated with live equipment.

(g) Work done on an "in-service" basis.

(h) The type of test and test equipment required during and at the completion of each step.

4.4 Items Not Specifically Mentioned

4.41 Rearrangement of auxiliary equipment (Testing, monitoring and alarm circuits) not specifically outlined, shall be taken care of, in general, as part of the step covering the associated major circuit. Exceptions to this are noted under the step affected.

5. DISTRIBUTION

5.1 Sufficient copies should be distributed to Telephone Company engineer and Plant and Traffic representative personnel or per Local Agreement for their information. When agreement has been reached signed copies shall be returned to the installer for the job and area supervisor files.

6. CHANGE IN PROCEDURE AFTER WORK HAS STARTED

6.1 When a change in the orderly procedure of the work is necessary due to unforeseen circumstances, a conference with the Telephone Company's representative shall be held at once to determine the extent of the change and its possible effect on service and job.

6.2 If it is agreed to continue the work on a changed basis, this agreement shall be indicated on a revised Method of Procedure.

→ Arrowed lines indicate new or changed information.

Manager, Engineering Practices

ATTACHMENT
Exhibits A, B, C, D and E on pages 3, 4, 5, 6 and 7.

SD-4-2850 (5-69)

Page 1 of _____ Pages

METHOD OF PROCEDURE

AUTHORIZATION

Town_____ Office_____ Date_____

Start-Date_____ Time_____ Completion-Date_____ Time_____

W.E. Co. Order No._____ Tel. Co. Spec._____

Type of Plant_____

General Description of Work_____

_____

_____

_____

_____

This job has been reviewed and agreement reached on items listed on Page 2 of this Method of Procedure.

Responsibility for supervision of this job is assigned to ---

W.E. Co. Supervisor_____ Title_____

Tel. Co. Supervisor_____ Title_____

M.O.P. Prepared by (W.E.Co.)_____ Date_____

The undersigned approve this step by step procedure starting with Page 3. No changes shall be made without the approval of the Telephone Co. Plant Manager and the Western Electric Company Supervisor.

Concurred in by W.E. Co. Supervision

_____ Title_____ Date_____

_____ Title_____ Date_____

Approved by Tel. Co. Representative

_____ Title_____ Date_____
PLANT DEPT.

_____ Title_____ Date_____
TRAFFIC DEPT.

_____ Title_____ Date_____
TELEPHONE ENGINEERING

EXHIBIT A

Page 2 of_____Pages
W.E. Order_____

METHOD OF PROCEDURE

CHECK LIST OF PERTINENT ITEMS

Work should not start on this order until this form and the M.O.P. have been signed by the Telephone Company representative.

Place a check in brackets as each of the following items are discussed and agreed upon:

( ) 1. Equipment to be installed or removed.
( ) 2. Compatibility of the proposed equipment with existing equipment.
( ) 3. What working equipment might be affected.
( ) 4. When working equipment may be taken out of service.
( ) 5. Proximity of power plants and distributing systems.
( ) 6. Who shall remove fuses.
( ) 7. Portion of job that will require detailed Method of Procedure.
( ) 8. Steps requiring the presence of a Telephone Company supervisor.
( ) 9. Alarms to be disconnected, and when.
( ) 10. Records and drawings to be corrected.
( ) 11. Protection of equipment; floors, walls, etc.
( ) 12. Storage of tools and material.
( ) 13. Safety precautions.
( ) 14. Service restoration procedure and responsibilities in the event of an interruption.
( ) 15. Locations of select and government circuits.
( ) 16. Other pertinent factors.
( ) 17. Detailed step-by-step procedure Is ( ), Is Not ( ) required.

Western Electric Handbook "O", Sections 10, 11, 12, 13 and 14, Handbook 3, Section 9.2, Handbook 22, Sections 10, 11, 20, 40 and 60 (if power work is involved) and BSP-201-112-001 outline requirements, practices, precautions and procedures to be followed by Western Electric installer during the installation period.

We, the undersigned, have discussed the details on this page and have reached agreement on those applying to this installation.

_____Date_____ _____Date_____
For Western Electric Co. For Telephone Co.

EXHIBIT B

Page 3 of_____Pages
W.E. Order_____

METHOD OF PROCEDURE

STEP-BY-STEP PROCEDURE

The following steps in doing this job must be followed in the order listed. Deviations from the procedure shall not be made without the approval of the Telephone Company supervisor who signed Page 1.

The following important items must be specifically included as steps in this procedure:

1. Special safety precautions required.
2. The restricted hours (period) that work may be done.
3. Service releases required - - when and by whom released. When and by whom restored.
4. Insulated tools required.
5. Location of spare fuses.
6. Check operation of associated fuse alarms prior to start of the job.
7. Fuses and leads to be removed, tagged and verified, and by whom.

General Information, Precautions, Notes, Check Lists, Reference to Instructions and Drawings, and the Step-by-Step Procedure follows. Each Item must be checked off as completed and initialled by the Telephone Company representative before proceeding to the next item.

If, after completing Page 1 and 2, the Telephone Company Plant Manager and the Western Electric Company Supervisor agree that a detailed step-by-step procedure is not required to prevent a service failure, a statement, below, to that effect will complete this M.O.P.

STEP #	RESPONSIBILITY	
	TEL. CO.	W.E. CO.

EXHIBIT C

Page_____of _____Pages
W.E. Order_____

METHOD OF PROCEDURE (CONTINUED)

STEP #	RESPONSIBILITY	
	TEL. CO.	W.E. CO.

EXHIBIT D

Page_____of _____Pages
W.E. Order_____

METHOD OF PROCEDURE (CONTINUED)

STEP #	RESPONSIBILITY	
	TEL. CO.	W.E. CO.

EXHIBIT E

Sender In-Service Requirements

Type Sender_____ Season_____

No. Senders Installed_____

Sender Type Appears In_____ Sender Link Frames

	High Day	10 High Day Avg.	Busy Season Average
Sender Traffic Usage			
Sender Peg Count			
Sender Holding Time			
Sender % Occupancy			
Avg. Working Equivalent Inc. Trks.			
CCS/Wkg. Equivalent Inc. Trk.			
% SAD			
Equivalent Sender Outage			

Requirements For Period_____ To_____

	Reqd. For Traffic	Mtce. Allowance
BH _____To_____		
NBP _____To_____		
NBP _____To_____		
NBP _____To_____		
NBP _____To_____		
NBP _____To_____		
NBP _____To_____		
OFFP_____To_____		

Remarks:

CROSSBAR TANDEM SENDERS — TRAFFIC ENGINEERING WORKSHEET A

1) Tandem _____

2) Data Period _____

3) Type of Sender Group _____

4) Number of Senders Installed (N) _____

	TFC CCS (C)	AVG EQUIV INC TRKS WORKING (E)	TFC CCS PER EQUIV INC TRK (U)	MTC CCS (B)	SNDRS OUT OF SVC (M)	SNDRS IN SVC (S)	TFC CCS PER SNDR (T)	%SD/3" (D)	VARI-ABILITY NUMBER (VN)
5)									
6)									
7)									
8)									
9)									
10)									
11)									
12)									
13)									
14)									
15)									
16)									
17)									
18)									
19)									

20) TOTAL 10 HI CCS/TRK _____

21) AVG 10 HI CCS/TRK (U) _____

22) AVERAGE 10 HI SNDR HOLDING TIME (H) _____

23) TOTAL OF VN NUMBERS _____

24) AVERAGE OF VN NUMBERS _____

Ø Determination of Nominal Variability Number (NVN) for Number of Senders Installed (N) and Average Sender Holding Time in Seconds (H):

$$NVN = 2.1 + .01\,N + .05\,(H - 10.0)$$

Remarks:

CROSSBAR TANDEM SENDERS — TRAFFIC ENGINEERING WORKSHEET B

Tandem _____ Sender Type _____

Tabulation of historical data and selection of data for calculations:

DATA PERIOD	INST. SNDRS (N)	HOLD TIME (H)	VARI-ABILITY NUMBER (VN)	WTG FACTOR X	WEIGHTED VN	TFC CCS PER EQUIV INC TRK HIGHEST DAY	AVERAGE 10 HI	RATIO (R)
(a) Curr. Yr.								
Curr. Yr. (—1)								
Curr. Yr. (—2)								
						Total		
			Weighted VN Total			Avg		
				USE		USE		
					(VN′)		(U′)	(R′)

(b) CALCULATION OF TRAFFIC CAPACITY OF INSTALLED SENDERS _____ to _____

_____ INST SNDRS - _____ SP SNDRS = _____ TFC SNDRS AT VN′ of _____ = _____ TABLE CCS

CONVERSION FACTOR for TABLE CCS to AVG 10 HI CCS (F, Fig. 17, for R′ = _____) = _____

_____ TABLE CCS x _____ (F) = _____ CCS AVG 10 HI DAY TRAFFIC CAPACITY

TFC CAPY IN EQUIVALENT INCOMING TRUNKS = $\frac{\text{AVG 10 HI DAY CCS}}{\text{AVG CCS PER TRK (U′)}}$ = _____ = _____

(c) CALCULATION OF SENDER REQUIREMENTS FOR ENGINEERING PERIOD

EQUIVALENT INCOMING TRUNKS FORECASTED FOR ENGINEERING PERIOD (P′) _____

AVG 10 HI DAY TFC CCS FORECASTED FOR ENGINEERING PERIOD (P′ x U′ or EU′ _____) = _____

CONVERSION FACTOR for AVG 10 HI CCS to TABLE CCS (F, Fig. 17, for R′ = _____) = _____

_____ FORECASTED AVG 10 HI CCS ÷ _____ (F) = _____ FORECASTED TABLE CCS

Reading TABLE CCS into CAPACITY TABLE, Fig. 7, for VN′ or EVN′ of _____

TRAFFIC SENDERS REQUIRED (TFC SNDRS) _____

SERVICE PROTECTION SENDERS (SP SNDRS = TFC SNDRS ÷ 20) _____

TOTAL SENDERS TO BE PROVIDED _____

REMARKS

Marker In-Service Requirements

1) No. Markers Installed _____

2) Marker Type _____

3) Missed Usage Factor _____ "/PC

4/5) No. Trk. Lk. Frms. ____OLF Prs_____

6) Season_____

	High Day	10 High Day Avg.	Busy Season Average
7) Marker Adjusted Traffic Usage			
8) Marker Peg Count			
9) Marker Holding Time			
10) Marker % Occupancy			
11) Avg. Working Equivalent Inc. Trks.			
12) CCS/Wkg. Equivalent Inc. Trk.			
13) Matching Loss Percent			
14) Office Link Frame Seizure Ratio			
15) Equivalent Marker Outage			

Requirements for Period _____ To_____

	Reqd. For Traffic	Mtce. Allowance
BH _____ To_____		
NBP _____ To_____		
NBP _____ To_____		
NBP _____ To_____		
NBP _____ To_____		
NBP _____ To_____		
NBP _____ To_____		
OFFP _____ To_____		

Remarks: