

NO. 4 SWITCHING SYSTEMS
METHOD OF PROCEDURE (MOP) PREPARATION

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1.02 Organizational Structures

1.02.1 Since differences in organizational structures exist, specific titles of individuals, groups and departments are avoided. However, general descriptive or functional names are used. This particular format lends itself to identification by an individual company of a particular organizational level (or chain within the organizational level) responsible for the categorical procedure described herein.

1.02.2 The following designations will be used in this practice:

- a. The Telephone Company representative normally responsible for the administration of a 4A/4M machine will be referred to as the *Dial Administrator*.
- b. Additional personnel may be assigned the responsibility of coordinating and utilizing available network switching paths. These persons will be referred to as the *Network Manager*.

Note: In certain locations the 4A/4M Dial Administrator and the Network Manager are one and the same person. However, the functions performed relate to one or the other job.

- c. The Telephone Company representative normally responsible for the maintenance of the 4A/4M machine will be referred to as *Plant*.
- d. The Western Electric Company's Service Division does the majority of equipment installation work for Bell System Companies. *WECO* will be the designation used for these installation forces. In locations where local company installation forces perform the same functions as Western Electric Company, reference to *WECO* shall be assumed to include these Installation Forces.
- e. Engineering refers to that particular department such as, Switching Engineer, Equipment Engineer, Acceptance and/or Maintenance Engineer, as appropriate.

1.03 Continuity of Service

1.03.1 The maintenance of continued machine performance at clearly reliable services

levels during periods of activity connected with installation or modification of equipment by WECO is the joint interest and responsibility of both the Telephone Company and WECO. The ultimate success of this objective depends upon preliminary preparations prior to the operation, and upon how well the outlined plans are followed during the progress of the job.

1.03.2 Preparations made for the purpose of planning service protection depend on several factors. Telephone Company and WECO must fully discuss and clearly understand the following items prior to the start of an activity being performed by WECO:

- a. Service Objectives
 - (1) Machine indexes
 - (2) Ineffective machine attempts
 - (3) Sender Delay
- b. Completion date required
 - (1) Advance turnover (ATO)
 - (2) Date requested by Equipment Engineer
- c. Type of equipment to be added or modified
 - (1) Senders, by type
 - (2) Markers
 - (3) Miscellaneous connectors, etc.
- d. Working equipment likely to be affected by the planned activity
- e. Amount, duration and the selection of time for equipment outages
- f. Emergency restoral plan for equipment
- g. Peak day requirements
- h. Possible changes in working hours or other time frames
- i. Method of accomplishing transition work
- j. Test requirements for acceptance purposes
- k. Assignment and cross-connection information.

1.04 Cutover and Analysis Committee (Coordination Committee)

1.04.1 It is recommended that a working *Cutover and Analysis Committee* (Coordination) be appointed to coordinate the various phases of

the project, and to ensure compliance with paragraph 1.03.2.

1.04.2 The size of the Committee will generally be determined according to the complexity of the project and the number of departments involved. The chairman of the Committee will be selected from the group.

1.04.3 The committee will be composed of representatives from Plant, Engineering, WECO, Dial Administration and Network Management. Other groups such as Traffic Switchboard Operator Units may be included, as necessary.

1.04.4 Activities of this committee will include:

- a. Establish objective service levels to be maintained
- b. Resolve all basic differences on how and when a job is to be done and include instructions in the MOP
- c. Ensure that the Method of Procedure is adequate and is followed by WECO
- d. Draw up a contingency plan to be used during emergency situations
- e. Periodic review of job progress
- f. Review service results before, during and after the job.

1.04.5 It must be noted that this committee will not assume the normal functions of job supervision or acceptance responsibilities which will be assigned to on-site management personnel.

1.04.6 This committee should be formed early in the job to permit sufficient time to prepare and circulate an MOP prior to any work activity.

1.04.7 It is suggested that sub-committees be formed to deal with specific aspects not requiring full project committee attention. Examples might be:

- a. Cross-connect committee
This committee would be responsible for the timely drafting and distribution of all cross-connect forms.
- b. Trunking Committee
This committee would be charged with

the coordination of projects related to facilities, testing of trunks, and overall turn-up of trunks within scheduled completion date.

1.04.8 The frequency of committee and sub-committee meetings should be firmly established and followed for job status reports.

1.04.9 Minutes of all meetings must be kept and distributed as a formal record of inter-departmental and/or inter-company discussions, agreements and commitments.

2. RESPONSIBILITIES

2.01 Responsibilities of the Dial Administrator

2.01.1 It is recommended that the Dial Administrator have the prime administrative responsibility for all areas normally attributed to Traffic or Switching Departments. These responsibilities include:

- a. Having a detailed knowledge of the proposed transitional procedure and ensuring that the MOP document contains in-service requirements, cross-connection lists, time frames in which the work may be done, and plans for equipment restoral during periods of high traffic volumes.
- b. Reviewing service and load results prior to, during and immediately after the work.

2.01.2 Practices concerning prevention of service interruptions should be familiar to the Dial Administrator. These include:

- a. BSP 201-112-001; BSP 201-112-005; BSP 201-112-010 including WECO Handbook 0, Section 10; BSP 201-112-020 containing WECO Handbook 3, Section 13; and BSP 800-614-150, Issue 4D.
- b. BSP 201-114-001 which explains the record of equipment and trunks out of service.
- c. The method of procedure prepared by WECO based upon Installation Engineering Handbook 3, Section 5A should be reviewed by the Dial Administrator and involved departments to ensure service protection as outlined in this practice.

2.02 Network Management Responsibilities

2.02.1 The Network Manager is responsible for directing the activity of the switching network at his disposal on a real time basis. He must evaluate machine and/or facility problems, and effectively direct and control activity until problems are resolved and the network returns to normal.

2.02.2 In order to make suitable recommendations regarding 4A/4M machines under his charge he must understand load service relationships in order to establish equipment in service requirements by time frames.

2.02.3 It is recommended that the Network Manager have the joint responsibility with the Dial Administrator for allowing service affecting equipment releases.

2.02.4 The decision to release or not release equipment will be based on existing conditions at the time of the request.

2.03 Engineering Responsibilities

2.03.1 Many operating companies assign an Engineering Department representative to coordinate WECO installation activities.

2.03.2 The Engineering Department will generally be responsible for:

- a. Scheduling the original Cutover and Analysis Committee meeting;
- b. Signing the MOP as one of the approving authorities;
- c. Acting as a liaison between the Telephone Company and WECO for the initiation and fulfillment of contractual agreements;
- d. Economic aspects of the job; overtime, unusual transition procedures, extra effort to avoid equipment outages;
- e. Arranging for additional Plant or WECO assistance when required;
- f. Ensuring with the Plant, WECO adherence to the MOP;
- g. Arranging for advance turnover of equipment;

h. Coordinating acceptance, turnover and notification procedures;

i. Ensuring that the quality of installation is satisfactory. In many cases, Plant may be delegated as acceptance authority. Engineering will take action on all items brought to their attention relating to satisfactory completion of a project.

2.04 Western Electric Company Responsibilities

2.04.1 WECO is normally responsible for provision of the necessary engineering material and installation in accordance with Bell System standards and the provisions of the installation handbook. The materials shall include various schematic and wiring prints which contain latest equipment configurations.

2.04.2 MOP's shall be prepared by WECO far enough in advance of job start for Plant, Traffic and Engineering to review and approve them.

2.04.3 Adherence to the prescribed MOP by WECO is necessary to ensure proper coordination by all groups.

2.04.4 Removing equipment from service, testing and restoring equipment to service, must be done in accordance with WECO Handbook instructions and established procedures contained in various Bell System Practices and done only with the approval of the appropriate Telephone Company representative.

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

2.05 Plant Department Responsibilities

2.05.1 The Plant Department has the overall responsibility for physically removing equipment from service, testing and restoring equipment to service, during all periods of WECO activity. This must be done as outlined in paragraph 2.04.4.

2.05.2 Plant participates in joint tests with Engineering, and/or WECO as required.

2.05.3 A record of equipment outages is maintained by Plant according to their practices (BSP 201-114-001). This log will include information concerning equipment removed from service for *any reason*.

2.05.4 Plant will inform the Engineering and Traffic representatives of any observed condition which might affect service.

2.05.5 The Network Manager/Dial Administrator should be informed by Plant when out-of-service equipment has been restored to service.

3. METHOD OF PROCEDURE

3.01 General

3.01.1 A Method of Procedure is a written plan concurred in and signed by both the Telephone Company and WECO. It defines, in appropriate detail, the job that has to be done and the steps necessary to do it. It should provide for:

- a. Work to be done:
 - (1) Changes and/or additions involved
 - (2) Sequencing of changes and/or additions.
- b. How the job is to be done with provision for:
 - (1) Continuity and quality of service
 - (2) Minimum interference with normal plant routines
 - (3) Emergency restoral procedures
 - (4) Efficiency in WECO installation effort
 - (5) Safety of all personnel.

3.01.2 A Method of Procedure is required whenever WECO activities involve working equipment.

3.01.3 Methods of Procedure must have approval by Telephone Company representatives for Dial Administration, Plant and Engineering. It is recommended that Dial Administration approval be at District Level or higher.

3.01.4 When an unforeseen circumstance indicates the need for changing the Method of Procedure once the work has started, the revisions should be agreed to and approved *prior to the continuance of the job*. A revised MOP

document, containing appropriate approvals, will normally be prepared.

3.01.5 In general, the sequence of events in the preparation of the MOP document may be:

- a. Plant, Traffic and Engineering, based upon the work required by the job specifications will provide input to the WECO. These inputs will include: (1) in-service requirements, (2) tests to be performed, (3) hours in which the work may be done.
- b. WECO prepares a General MOP with notes containing agreements between WECO and Telco personnel. This General MOP will include references to Detailed MOP which describe the actual work to be done.
- c. The Plant, Traffic and Engineering members of the Coordination committee will review the steps to ensure that service will not be degraded.
- d. Departmental signatures will signify approval of the MOP.
- e. If all steps of the Detailed MOP are not contained in the document, due to the magnitude of the work involved, each detailed MOP must be discussed and approved before any work commences.
- f. The progress of the job and completion of the various steps should be followed closely by the committee and on-site personnel.

3.02 Preliminary Planning

3.02.1 It should be recognized that installation work necessary for 4A/4M machine additions or changes will possibly involve removing trunks and equipment from service for extended periods of time. In order to prevent service impairments during these periods, *additional capacity must be provided far enough in advance to allow equipment turn-downs*.

3.02.2 Planning for an MOP that would protect customer service should begin with the preparation of the Traffic Order. It is necessary that the Traffic or Equipment Engineer responsible for equipment provision along with the Dial Administrator, work closely to see that service requirements are followed, not only by the timely addition of equipment quantities, but also by

proper equipment configurations and workable methods of placing them into service. Appropriate statements regarding any portion of the work involved should be included in the Job Specifications to serve as a guide to the WECO job planner. Items which may be mentioned are:

- a. Identification of equipment needed first;
- b. Where the sequence of steps may affect equipment in-service requirements, the sequence should be stated;
- c. Dates for advance turnover to Telephone Company representatives;
- d. Maximum equipment quantities that may be released for modification (including time of day or day of month when releases may be affected.)

3.02.3 Prior to and during installation activity it is important that machine maintenance be of exceptional high quality. The release of equipment to WECO makes it doubly important that maintenance equipment outages be kept at a minimum. Meeting test requirements along with routine equipment cleaning requirements prior to the release of equipment to WECO will serve to narrow down the trouble clearance analysis involved in returning the equipment to service. Possible review of equipment condition by the *cutover and analysis committee* may be in order.

3.02.4 It is recommended that machine historical data be available for thorough analysis when determining allowable equipment outages on the MOP. Trend charts based on such data as the Machine Load Service Summary (MLSS) can provide valuable information pertaining to switching capacity under load conditions. Maintaining these trends for an extended period of time prior to developing an MOP enhances their value in terms of reliability under varying load conditions.

3.03 Format of the MOP

3.03.1 After consulting with the appropriate Telephone Company representatives, (See paragraph 3.01.5a), the WECO installer prepares the MOP. WECO Handbook 3, Section 5A spells out the installer's responsibility and general guidelines for the MOP. The first four pages of a prepared WECO's MOP Form SD-4-2850, are included as Attachment 1 of this practice.

3.03.2 Page 1 of Attachment 1 identifies the job to be done, the WECO and the Telephone Company supervisors responsible for its completion and provides the authorization for WECO to proceed. Space is provided for authorization by three Telephone Company representatives; Dial Administration, Plant and Engineering. (See paragraph 3.01.3)

3.03.3 Page 2 is a check list of pertinent items to be discussed and agreed upon prior to drafting the final MOP. It may be used as a convenient guide for the first meeting of the cutover and analysis committee (see paragraph 1.04). In addition to this check list, the items listed in paragraph 1.03.2 should not be overlooked.

3.03.4 General Notes followed by the General MOP which lists the work to be done will be shown on Page 3 and continued on succeeding pages. The notes will contain agreements regarding equipment outages, testing, etc. The General MOP will contain a brief description of the work to be done and will give reference to a detailed MOP where required. The detailed MOP will include references to Handbooks, In-Service Requirements, Cross-Connection Lists, etc.

3.03.5 Detailed steps of MOP should also follow a logical sequence based on the following considerations:

- a. Equipment requirements for peak traffic periods;
- b. Provision of advance equipment most urgently needed 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. Time allowed between restoral of one piece of equipment and the removal of another to assure modified equipment is working properly under actual load conditions;
- e. Work that can be done without affecting live equipment such as:
 - (1) Erecting, cabling, wiring, and testing;
- f. Work on critical items that must be done at night or during other light traffic periods. (See paragraph 2.02.3).

- g. The type of test and test equipment including test frames, required during and at the completion of each step;
- h. Steps necessary to restore equipment to service in an emergency.

3.03.6 Attachment 2, pages 1-6 contain an example of a General MOP and a detailed MOP for one step which shows the type of information that should be included.

3.04 Administering the MOP

3.04.1 When the MOP has been authorized and work on any step is in progress, it is the responsibility of the Dial Administrator to see that its provisions are adhered to and continue to be adequate for service requirements. The step-by-step procedure of the MOP should identify the WECO or a Telephone Company responsibility for each step and provide for a check-off of its completion. A proper follow-up procedure should be developed by the Dial Administrator to see that all steps are completed in the required sequence.

3.04.2 The equipment in service should be adequate to meet peak hour load requirements based upon the Dial Administrator's analysis of equipment requirements for the time period involved. Network Management people should monitor the amount of equipment removed from service based upon minimum requirements as determined by this analysis along with the cooperation of Plant. Notification for maintenance outages should be immediately sent to Network Management and the Dial Administrator as appropriate. Conversely, the Dial Administrator should provide adequate feedbacks to Plant, WECO, and Network Management concerning the load and service levels during the project.

3.04.3 When expected loads increase and/or equipment trouble outages make it likely that service objectives may be exceeded, additional equipment should not be released to WECO. Dial Administration, Plant and WECO should jointly discuss the situation and decide on the best means of reducing the equipment outage expeditiously.

4. EQUIPMENT IN-SERVICE REQUIREMENTS

4.01 General

4.01.1 This section briefly discusses the factors

determining the capacity of various 4A/4M machine components and provides a method of establishing in-service guidelines for Senders, Decoders or Decoder channels, controllers, markers, and transverters.

4.01.2 Although Plant is the group with whom the WECO is in direct contact when equipment is released from service, releases should never be determined by vague factors. The decision to release equipment must be based on Network Management's analysis of the "real time" situation and on the Dial Administrator's analysis of equipment needs as stated in the MOP.

4.01.3 *The Network Manager or Dial Administrator, as applicable, is responsible for determining minimum requirements of all "traffic sensitive" equipment for every hour of every day.*

4.01.4 The Dial Administrator's analysis should begin with a thorough check of both Traffic and Equipment Orders for correctness, adequate equipment provision and identification of any possible transitional problems. A complete understanding of the Engineering data and procedures from which the Traffic Order is derived will benefit the Dial Administrator in his own judgement of equipment capacities.

4.01.5 The reference section of this practice lists several sources that may be consulted to acquire this understanding.

4.01.6 Service objectives should be the foundation of all equipment in-service requirements and the determining factor for allowing equipment to be taken out of service during a 4A/4M addition or transition project. Following are service parameters which should be maintained at 4A/4M machines:

a. *Sender Delay*

This measurement reflects incoming blockage or delay of calls into a 4A/4M machine. The service ceiling is no more than .5% Sender Delay of more than 3-seconds for the average busy hour of a machine's 10-high-days. This ceiling of .5% greater than three seconds, should not be exceeded for *any hour during a transition period.*

b. *Ineffective Machine Attempts - IMA*

This is a measurement of attempts accessing

the 4A/4M machine that fail to complete the customer's call to the next switching point satisfactorily. The IMA components are derived from measurements of attempts on the various announcement trunk groups. Service objectives of not more than 2% should be established and maintained for each component of the IMA as well as for the total IMA for each machine.

- (1) Individual component measurements comprising IMA are based on average busy hour performance. During transitional periods these service results should be monitored continually to ensure that service is not adversely affected by equipment outages. Service parameters for the major elements of IMA which should not be exceeded are:

(a) Reorder Announcement (ROA)

.6% - .9%

(b) No Circuit Intertoll plus Final Reorder (NCIT+FRA/NCTC)

.6% - .8%

- (c) Overflow Final Reorder and Sender Overload Announcement (SOA) should not be greater than 0.

- (d) Vacant Code Announcements during transitions should not exceed that figure which is normally experienced.

4.01.7 Service Observing should remain a good source of service indicators through any transition period. The Dial Administrator should maintain frequent contact with the Service Observer for discussions concerning the machine's performance.

4.01.8 Because of the obvious importance of data collection during transition work, the data collection devices *must be kept* in service throughout any WECO activity. These include Sender Attachment Delay Recorder (SADR), Traffic Usage Recorder (TUR), and Traffic Data Recorder (TDR).

4.01.9 In calculating the capacity of any equipment components, interaction of equipment should be kept in mind. High occupancy or turndown of Decoders or Markers for example, can *increase* sender holding time thereby *reducing*

sender capacity. Requirements for individual machine components cannot be accurately calculated independent of the total machine's capacity and occupancy.

4.01.10 For some equipment components, the engineering criteria for new offices differ from that used for existing offices. In the discussion that follows, guidelines for additions to existing offices are used. For additional understanding of factors that might determine a 4A/4M machine's capacity, the Dial Administrator may want to consider engineering criteria for new offices.

4.02 Incoming Senders

4.02.1 The number of 4A/4M incoming senders *required* during a transition period must be calculated *by type impulsing* as well as by time frames.

4.02.2 These calculations will generally be based on High Day requirements. Local traffic conditions and seasonal demands during which WECO activity is to be performed may permit allowances to be made in calculated requirements. Sender Delay of .5% over 3" for 10 high-day average is considered the service ceiling.

4.02.3 In addition to busy hour sender needs, it is important that light hour needs are considered in the event that WECO work during normal business hours must be curtailed due to heavy traffic loads.

4.02.4 The following information should be available when in-service requirements are to be computed:

- a. Number of senders installed (by type impulsing and sender group);
- b. Is Inter-Sender timing working;
- c. Load service curves depicting percentage sender delay over 3 seconds vs. CCS per Sender (by type impulsing).
- d. Required maintenance senders;
- e. Number of working trunks on the Sender Link Frames by Sender group, as well as total, by type impulsing;
- f. Miscellaneous historical data;

- g. Number of senders by type assigned to each Decoder Connector;
 - h. Sender usage by type
 - maintenance
 - service
 - i. Sender peg count by type.
- 4.02.5 The form shown in Appendix 1 (Form MOP-4A) may be used to calculate *projected* sender requirements by type of sender and/or sender group. Appendix 2 shows an example of the form's use. Appendix 3 lists full access and slip multiple grouping tables, and the chart on Appendix 4 indicates full access and slip multiple sender capacity based on 10% sender attachment delay over 7 seconds which is also equivalent to 30% sender Attachment delay over 3 seconds.
- 4.02.6 Sender requirements are determined from a projection of the current usage to the engineering period. By using this projection along with the calculation of a machine percent sender occupancy, determination of sender requirements may be made at any relative point in time based upon traffic estimates.
- 4.02.7 The following paragraphs describe the calculations required when figuring sender in-service requirements (Appendix 2).
- a. *Lines 1-5* — Self explanatory.
 - b. *Line 6A* — Enter the number of senders installed in the group being calculated (by type). If all of the senders of a type are being considered enter on line 6B.
 - c. *Line 7* — Enter the same information as on line 6A or 6B.
 - d. *Line 8* — Enter the total peg count of senders from line 7 for the corresponding time period shown on line 3 (the study date and time).
 - e. *Line 9* — Enter the actual total usage for time period on line 3.
 - f. *Line 10* — Enter the maintenance usage for the time period on line 3.
 - g. *Line 11* — Subtract line 10 from line 9 for traffic usage.
 - h. *Line 12* — Line 7 multiplied by 36 CCS.
 - i. *Line 13* — Divide the Sender traffic usage by sender peg count.
 - j. *Lines 14-16* — Enter as determined by trunks in service during last busy season.
 - k. *Lines 17-19* — Enter figures determined by correlation of list A and B against in-service trunks. (Data should be projected through the intended job for which this information is being calculated).
 - l. *Line 20* — This is estimated on the ten high business day average busy hour marker peg count per train. Projection should extend through the busy season of the future engineering period. This growth percentage is applied to the current adjusted marker attempts to obtain engineering period busy season projected marker attempts. From this the ratio is determined; 1.08 equals 8% growth.
 - m. *Lines 21-22* — Multiply the traffic usage (by type) and the engineering period % MF, DP, or CAMA of equivalent 2-way trunks. Step 2. Multiply the product of step 1 by the ratio of increase of marker attempts. Step 3. Divide the product of step 2 by the current busy season % MF, DP or CAMA of equivalent 2-way trunks.
 - n. *Line 23* — percent occupancy is based upon the calculation made on lines 21-22 (by type). If figure for line 21 is 889 CCS, divide the projected sender usage by the maximum sender capacity to determine projected 62% occupancy.
 - o. *Line 24* — This item is determined by using the tables shown on Appendix 3 according to the type of sender grouping in the specific office involved.
 - p. *Line 25* — Subtract total senders required from the number of senders installed.
 - q. *Line 26* — Enter the sender delay for senders as indicated on line 6B for the period shown on line 3.
- 4.02.8 The suggested form MOP-4A, shown, may be also used to determine projected peak holiday sender requirements using the chart on Appendix 4.

4.02.9 Sender requirements for traffic purposes, as determined by the calculations, may be posted on a form similar to Appendix 6 and included as an appendix to the MOP document. These requirements on a daily and hourly basis must be adhered to by the WECO.

4.02.10 In addition to the entries for Traffic, Plant should have the opportunity to have input for the PLT column. These entries will be based on empirical data (Maintenance Usage) and the number of senders that may be held for tracing purposes under "stuck sender" conditions. The service objective of Sender Attachment Delay (% SADR) of *no more than .5% over three seconds* for the corresponding hour should always obtain.

4.03 Sender Link Frames

4.03.1 When reviewing traffic orders which increase trunk quantities by adding Sender Link Frames the following items should be considered by the Dial Administrator:

- a. There should be a plan for each 16 sender link frame group which is used for assigning trunk relays to the frames.
- b. One-way relays assigned to any one switch on a sender link frame should not exceed 50% of the switch capacity.
- c. One and two way trunks should be assigned alternately on the switch horizontals e.g., two-way relays can be assigned to even numbered horizontals on even numbered frames and to odd numbered horizontals on odd numbered frames. The one-way relays may then be used as fill.
- d. Each type of one-way and two-way relay should be spread over as many switches and frames as possible.

4.03.2 It must be noted that where meeting the 50% requirement of one-way to two-way trunks is impossible, a study should be made to ensure that the total number of attempts do not exceed the capacity of controllers. Attempts may be totalled by considering the following types of traffic:

- a. One-way incoming intertoll trunk connections per circuit per group (CCH).
- b. Two-way intertoll trunk CCH.

- c. TSPS incoming attempts.
- d. Tandem trunk incoming attempts.

4.03.3 Care must be taken during any work associated with the sender link frames not to disable the sender attachment delay recorder. The Traffic Order should specify a SADR assignment for every Sender Link Frame.

4.04 Link Controller and Controller Connector

4.04.1 The Link Controller serves to connect an incoming trunk to an idle incoming sender.

4.04.2 The sender link frames are connected to the link controllers by controller connectors. Four link controllers serve a full access grouping sender group, and six link controllers serve a slip multiple group.

4.04.3 Controller in-service requirements are determined differently for each type of grouping. The following instructions will help in calculating traffic controllers required.

- a. Full Access Grouping (40 Senders of Less)
 - (1) Controller quantities depend upon the number of senders in the group along with the estimated peak business day busy hour holding time.
 - (2) A formula may be used to make the calculation easier:

Computation of Controller Requirements

Controllers Required Per Sender Group (Simplified grouping arrangement)

(a) Controllers Required for Traffic =
$$\frac{(\text{Controller H.T.}^*) (\text{Senders in Group})}{\text{Sender H.T.}^*}$$

(b) Controllers Required for MTCE = 1
Total Controllers Required = (a) + (b)

* Average of 10-High Day Holding Times

- b. Slip Multiple Grouping (41-80 Senders)
 - (1) Controller requirements in offices which have more than 40 senders are based on 2700 controller attempts for an hour with a maximum of 6 controllers in a

controller group (TFP, Div. D, Section 7-b-(5).

4.04.4 In-service requirements may be listed on an hourly and daily basis on a form similar to Appendix 6; it is recommended that any controller outages be avoided during the office busy hour or when traffic volumes are expected due to weather, holiday or unusual conditions.

4.04.5 Controller connectors may only be released to WECO on a sender link frame basis; any reduction will increase trunk to sender attachment interval and will be based on controller requirements.

4.05 Decoders and Card Translators

4.05.1 The decoder, in conjunction with the card translator, performs the function of decoding the code digits recorded in the incoming sender into information for call completion and forwarding it to the marker.

4.05.2 Depending upon the type office, single train units may have a maximum of 10 decoders while a two-train office may have a maximum of 18 decoders provided.

4.05.3 Subgrouping arrangements may also vary from office to office. Some offices having two decoder sub-groups may have maintenance decoders for these sub-groups. Other offices with small sub-groups will possibly have no maintenance spare. The sender arrangement in such offices is very important and should be noted by the Dial Administrator when an addition of senders is made. Items of particular concern would be:

- a. All senders of a group should be served by a single decoder sub-group.
- b. Sender loading of each decoder sub-group should be balanced.

4.05.4 The decoder requirement for WECO transitional work may be based on ten-high criteria to ensure sufficient facilities for normal average business day busy hour. Knowledge of traffic conditions is imperative to ensure adequate facilities are always available.

4.05.5 A suggested method for calculating decoder requirements follows:

- a. Determine present decoder holding time for

reasonableness with engineered CCS (27):

$$\frac{\text{Decoder CCS} \times 100}{\text{Decoder P.C.}} = \text{Dec. H.T.}$$

Decoder P.C.

For example, $\frac{41690}{78064} = .53 \text{ Seconds}$

- b. Determine the card drop ratio:

$$\frac{\text{Total Card Drop PC}}{\text{Decoder PC}} = \text{Card Drop Ratio}$$

For example, $\frac{100111}{78064} = 1.27$

- c. Determine the calculated H.T.

From the following table and formula a holding time may be determined for comparison with actual (a).

Basic decoder holding times are:

	Seconds	
	<u>With Modification</u>	<u>Without Modification</u>
Decoder-Pre translation	—	.27
Decoder Seizure- One Card Drop	.37	.47
Each Additional Card Drop	.26	.30

The formula without modification is:

$$\text{Calculated H.T. (.55)} = .47 + .30 \times (\text{card drop ratio} - 1)$$

This figure (.55) should be within 5% of actual.

- d. The estimated decoder peg count for transitional purposes should reflect current peg count, growth, and ratios to the high day's. This figure may be used with calculated H.T. to develop "Estimated Decoder Usage (CCS)".

For example:

$$\text{Calculated H.T.} \times \text{Estimated Calls} = \text{Calculated CCS or } .55 \times 81400 = 448 \text{ CCS}$$

- e. The number of decoders required for traffic may then be determined by using the engineering criterion of 27 CCS.

For example:

$$\frac{448}{27} = 17 \text{ Decoders Required.}$$

This formula may be used for hourly distribution and the number of decoders required for each day on a hourly basis may then be transcribed onto a form similar to Appendix 6.

4.06 Decoder Connector

4.06.1 The Dial Administrator must be acquainted with the Sender to Decoder Connector arrangements of his office. During modifications and additions affecting senders, Decoders, Decoder channels (ETS), and Decoder Connectors, care should be taken in preparing a method of procedure to ensure adequate senders to left in-service in each group.

4.06.2 Since a Decoder Connector can affect up to nine senders, making a connector busy may have to be avoided during ABD busy periods as determined by the Dial Administrator's calculations of sender requirements. This is very important during the preparation of an MOP for an ETS conversion. (See Paragraph 7).

4.07 Markers

4.07.1 Markers in 4A and 4M offices are engineered on total busy hour attempts per train. The estimate for the engineering period is based on ten-high-day average business day, average busy hour marker peg count per train. This includes all ineffective attempts and cross train routing calls. A minimum of two but never more than ten markers per train may be provided.

4.07.2 Marker in-service requirements for transition preparation must be projected through the busy season of the engineering period. The projected marker attempts for this period must take into consideration:

- a. A change of NC condition. Some estimate of future NC conditions may be made by comparing current trunk requirements with the future trunk provision;

- b. Routing changes affecting in, out and through traffic;
- c. The introduction of CAMA during the engineering period;
- d. Conversion of ring down trunks to dial pulse or MF.

4.07.3 Marker requirements should be calculated on a per train basis.

4.07.4 Since markers may work only one at a time in any trunk link frame or each half of a trunk block connector there is a normal marker queueing expected during busy periods. The lower the ratio of markers to frames, the lower the marker holding time will be and the greater the marker attempt capacity will be. The degree of trunk link frame and trunk block connector congestion is stated in terms of a *frame factor* by the train or for the office in the case of a single train office. The following method is used to compute the frame factor:

$$\text{Frame Factor} = \frac{1}{1.5 \times \text{TBC}} + \frac{.7}{(\text{IN TLF})} + \frac{.7}{(\text{OUT TLF})}$$

Let TBC = number of trunk block connectors
IN TLF = number of incoming trunk link frames
OUT TLF = number of outgoing trunk link frames

4.07.5 After calculating the average ten-high-day busy season busy hour attempts and the frame factor, read these into the Marker Capacity tables on Attachment 4, figures 1, 2 and 3. The figure used should be determined by the following:

- a. Fig. 1 used with Markers not modified for speed up;
- b. Fig. 2 used with Markers modified for speedup of new Markers;
- c. Fig. 3 used with modified Markers and where offices have trunk block connectors with speed up modification.

4.07.6 Regional Centers along with some sectional and primary center bear the effects of network overloads as mentioned in paragraph 4.02.9. The use of the following formula will result in the provision of sufficient markers to handle the decoders provided for peak load days. This should be calculated for each train separately:

$$\text{Markers} = \frac{\text{Marker CCS} \times \text{Decoders Required} \times \text{Marker H.T.}}{\text{Marker CCS} \times 1.5 \times \text{Decoder Engineering H.T.}}$$

This formula allows no provision for maintenance markers since during peak days every effort should be made to prevent maintenance outage.

4.07.7 Since ETS does not utilize Decoders but rather Decoder Channels the peak day marker requirements should be a balance of Senders to Markers. Use of the terms *senders* and *sender holding time plus one second* for decoder and decoder holding time in the formula given in paragraph 4.07.6 will allow proper traffic marker quantities to be identified for method of procedure preparation. The formula would be:

$$\text{Markers} = \frac{\text{Marker CCS} \times \text{Senders Required} \times \text{Marker H.T.}}{\text{Marker CCS} \times \text{Sender Holding Time} + \text{One Second}}$$

This formula must be calculated for each train individually.

4.08 Marker Connectors

4.08.1 Since marker connectors are provided one to each decoder or decoder channel, any required transition work on marker connector would affect the call carrying capacity of the 4A/4M machine. The details of any required marker connector outage should be based on adequate protection of decoder and marker capacity.

4.08.2 At offices converting to ETS it is recommended that a new marker connector frame, equipped with three new marker connectors be provided. These new marker connectors may then be used for the transition to the first three decoder channels with no interruption of working marker connectors. The Dial Administrator should note this during the initial planning stage of the ETS conversion and should ensure that the MOP for the conversion takes this into consideration to cut down on Decoder outage.

4.09 Trunk Block Connectors

4.09.1 In-service requirements for trunk block connectors are based upon a summary of the maximum number of outgoing appearances of all intertoll trunks and terminals required for announcement trunks, tributary trunks, toll switching trunks, operator trunks, and all miscellaneous trunks which appear on the outgoing Link Frames. The total of required trunk block connector terminals is increased by at least 40% for intertoll trunks and at least 25% for toll connecting

trunks. This percentage figure depends upon local growth expectations and/or requirements; i.e., the number of toll connecting groups.

4.09.2 The Dial Administrator must ascertain from the traffic order whether or not adequate terminals are being provided for the engineering period based on trunk forecasts.

4.10 Incoming and Outgoing Trunk Link Frames

4.10.1 The addition of incoming and outgoing trunk link frames in adequate quantities to serve future period growth is based on four categories of junctor usage:

- a. Usage generated by successful outward attempts;
- b. Usage generated by successful inward attempts;
- c. Usage generated by successful through attempts;
- d. Usage generated by unsuccessful attempts connecting to tone or announcement trunks.

The percentage of unsuccessful attempts is normally of small magnitude that it is not considered as a factor in projecting trunk link frame growth.

4.10.2 While the Traffic Engineering is primarily responsible for trunk link frame growth it is the Dial Administrator's responsibility to ensure that during growth jobs and junctor pattern changes, WECO has an MOP which will be workable from the standpoint of an office's particular calling pattern, to keep *matching loss* at or below the service objective of .5% of Incoming Trunk Link Frame peg count for ABD-BS busy hour.

4.10.3 Balance must be maintained on the trunk link switches, bays and frames during a trunk link frame addition. The Dial Administrator must plan trunking rearrangements far enough in advance of the actual frame addition to allow Plant time to secure adequate manpower for the framework involved. WECO should always be asked to mount the blocks on the Trunk Distributing Frame early in the job to enable preliminary jumper work to be accomplished by Plant. This should be discussed at the first Cutover and Analysis Committee meeting.

4.10.4 The addition of incoming and outgoing

trunk link frames may involve a change of the junctor distribution plan. The traffic order will normally indicate the plan to be used. A method of procedure must be written to detail the steps necessary to accomplish this transition. An example of this type of MOP is shown in Attachment 2 of this practice.

4.10.5 Protection of service through a junctor distribution rearrangement is accomplished only through the coordinated efforts of Dial Administration, Plant and WECO. Some safeguards for service protection during junctor transition work include:

- a. As new incoming or outgoing link frames are added, trunks should be deloaded from the existing frames and spread according to Traffic Engineering Practice (TEP) Division K, Section 3-c and 3-d.
- b. The actual cutover to a new junctor distribution plan should be worked during very light load periods in most cases. It must be noted that as trunks are cut onto new link frames, sufficient channels must be available to handle the expected load.
 - (1) In cases where the junctor distribution plan is converted before the new trunk link frames are loaded, preliminary tests should be made during ABD busy hour periods to ensure against matching loss.
 - (2) Channels should be made busy during the heavy load periods on a one at a time basis and the data should be checked on a fifteen minute basis for matching loss. Once a definite number of channels required for *objective* service has been determined a workable method of Procedure can be written by WECO including the allowable busy hour junctor outage.
- c. When a quantity of new trunks is being added at the same time incoming and outgoing link frames are being added, the Dial Administrator should assign the new trunks along with those being deloaded from existing frames keeping in mind all the necessary balance considerations named in Division K, Sections 3-c and 3-d.

4.11 Transverters

4.11.1 The required number of transverters in a

4A/4M office with CAMA is determined by the number of busy hour CAMA attempts per recorder and the type of tape entry (whether 50% or 100% detailed recording). This can be determined prior to any CAMA transition work that might require transverter outage. It would be up to the Dial Administrator to calculate this data and discuss it prior to development of the Method of Procedure.

4.11.2 Excessive transverter outage can lead to CAMA sender delay very quickly. An easy test to determine the reliability of the busy hour attempt method would be to turn down a transverter as traffic begins to build and continue to watch the SADR delay register through the busy hour. If a backup does cause delay, transition work should only be done on the transverter during light load periods.

4.11.3 The tables on Appendix 5 may be used to calculate transverter in-service requirements.

4.12 Recorders

4.12.1 A CAMA recorder may serve a maximum of 100 CAMA trunks and in offices where large numbers of trunks per group are required and recorders may be paired, thus serving 200 trunks. No more than 30 different central office codes can be accommodated in a recorder. Recorders receive the necessary billing information during each call from the transverter and the call identify indexer.

4.12.2 The quantity of recorders required is determined by a trial assignment of trunks to the recorders. A balance of busy hour calls among the recorders is desirable. Sufficient spare terminals should be allowed in each recorder to accommodate all trunk growth through forecasted engineering periods, and to allow for proper balance rearrangements to prevent transverter queueing and the ultimate threat of sender delay (TFP, Division D, Section 7-e).

4.13 Miscellaneous CAMA Equipment

4.13.1 CAMA equipment such as CAMA Positions, Billing Indexers, Call Identity Indexers, Master Timers, Perforators and Trunk Class Translators may require modification or other transition work by WECO from time to time. The Dial Administrator must determine the effect

of any outage, on the service measurements listed in paragraph 4.01.5. If service may presumably be degraded because of WECO activity during the busy hours of the day the Dial Administrator is responsible for determining alternate plans and coordinating them with the WECO and Plant forces (TFP, Division D, Sec. 7-e).

5. TRANSITION DATA REQUIREMENTS

5.01 General

5.01.1 Although continuous data flow is always necessary, it takes on added importance during transitional period. Accurate up-to-date information coming from the various data producing in the 4A/4M office, serve as the main barometer of service.

5.01.2 The principal measuring tools in most 4A/4M offices are the traffic Usage Recorder and the Sender Attachment Delay Recorder. Some offices employ Esterline-Angus Recorders, Alston Call Count Monitors, PCM Scanners and a miscellany of other measuring devices. PBC is not discussed in this section.

5.01.3 Whatever data gathering equipment is in use during transitions, it is imperative that every effort is made by Plant and WECO to keep it in service. Care should be taken during MOP development to provide instructions for TUR and TDR availability. If modification work is to be performed on the data gathering device the work must be done during hours not normally used for ABD or Busy Hour data. It is also important to require in the MOP that this type of work be done outside of required 5 day and 20 day trunk study periods. These days and hours should be accounted for in the MOP.

5.02 Sender Attachment Delay Recorder (SADR)

5.02.1 One of the best sources of locating potential service problems is the Sender Attachment Delay Recorder. It is used to measure sender attachment delay, over 3 or 7 seconds, by type of impulsing.

5.02.2 These data, accumulated during the office busy hour or during days included in the ten-high-day Engineering period may be used in preparing load-service curves as a comparison against usage per sender.

5.02.3 Causes for sender attachment delay at any time must be quickly determined and eliminated. This is even more important during transition work, because of the added danger of maintenance outage occurring while WECO has equipment turned down for modification. Each department along with WECO must cooperate in maintaining the sender delay below the service level of .5% for 3" during the ABD busy hour.

5.03 Machine Load Service Summary (MLSS)

5.03.1 Where it is possible, such as in locations using PCM or Alston scanning equipment, a minimum of two machine load service summaries per week should be produced. No less than one MLSS a week should be produced in those offices with TUR frames with or without the TDRS.

5.03.2 This report will serve to direct the Dial Administrator to unforeseen problems during the transition. A careful analysis of the MLSS will ensure a timely correction of problems such as:

- a. Loss of data due to transition work;
- b. An increase of matching loss;
- c. An increase in any one of the ineffective machine attempt components;
- d. Significant changes in holding times;
- e. Unequal distribution of traffic to various machine components;
- f. Significant changes in Peg Counts;
- g. An inordinate amount of maintenance outages.

5.03.3 It would be impractical to attempt to list the troubles which can be discovered by data analysis. The Dial Administrator is responsible for the service level at which the machine is switching. It behooves the Dial Administrator to be aware of every equipment outage or modification as it is taking place, so that an intelligent and correct analyzation of the available data is possible.

5.03.4 Whenever conditions make the gathering of data by mechanical means impossible, it might be necessary to collect the information from registers manually. The training of people to do this job, the volume of data to be collected and

when it is to be collected should be thoroughly discussed and agreed upon at a Cutover and Analysis Committee meeting early in the project.

6. OTHER DIAL ADMINISTRATIVE FUNCTIONS

6.01.1 The Dial Administrator must pay particular attention to the number of trunks being served (by the trunk group), the times during which these groups are most heavily loaded and the common control facilities serving them during periods of transition.

6.01.2 A special sensitivity to trunking requirements should be developed by the Dial Administrator and he should discuss any problems with Network Management, where applicable, and also with the Trunking Engineer. Should an office be under trunked during a transition project, the regenerated attempts during peak periods could greatly affect the Dial Administrator's or Network Manager's ability to allow common control equipment to be turned down.

6.01.3 Conversely, if an office is trunked too heavily the call carrying capacity of existing 4A/4M equipment may be exceeded greatly, thereby impairing service. This possibility should be considered during the initial planning stage of an addition. New trunks should not be added and cut into service during a major addition until the common control equipment capable of serving them is in service. This is an important responsibility of the Cutover and Analysis Committee.

6.01.4 All cross-connects and records for which the Dial Administrator is responsible must be available to Plant or WECO at the particular interval of the job as determined by the Cutover and Analysis Committee.

6.01.5 There are other load measuring devices available which should be tested for proper operation to any transition project. These are:

- a. Sender Load Meters;
- b. Sender Group Busy Lamps and Registers (one per Sender group);
(1) If these aren't provided, adding them should be considered.
- c. All Marker Busy Lamp Indications;

- d. All Decoder Busy Lamp Indications;
- e. Sender Queue Low and Sender Queue High Indicators;
- f. Decoder Queue Lamp;
- g. Dynamic Overload Control Circuit.

6.01.6 Before placing any new equipment in service, the Dial Administrator must be assured that all load measuring devices are associated with the correct equipment and are functioning properly.

7. ELECTRONIC TRANSLATOR SYSTEM (ETS)

7.01 The Electronic Translator System is a Solid-State System utilizing stored logic which is used in a 4A/4M office in place of the Decoder Card Translators, Foreign Area Translators, Translator Connectors and the Alternate Route Traffic Control Frame. It provides the 4A/4M system with increased translation capabilities and flexibility in terms of changes and rearrangement (Network Management, growth, routing, etc.). The ETS may be installed at the time of a cutover of a new 4A machine or an existing 4A/4M machine may be converted to ETS operation. The latter requires considerable skill and coordination on the part of a Dial Administrator. It is the purpose of this section to aid the Dial Administrator in preparing for an ETS conversion or large addition to an office which already has the ETS.

7.02 The Dial Administrator is responsible for sufficient and timely job planning and preparation leading up to an ETS conversion. General items of particular interest in planning the job would be:

- a. Study traffic orders, equipment specifications, office drawings and wiring lists in order to minimize errors and make changes when required without affecting the job interval.
- b. Identify *all* installation, modification and transition problems so that proper priorities and realistic job intervals can be established and followed so that equipment outages can be coordinated.
- c. Make a thorough and detailed study of all trunking requirements, machine equipment

expected growth, routing pattern changes and rearrangements of equipment due to addition. Utilize this information to provide adequate preprogramming of the software program to eliminate numerous and costly "recent changes".

- d. Coordinate the ETS pre-planning with Plant, WECO and Engineering to assure all departments involved that as problems are identified, decisions will be forthcoming in an expedited manner to prevent delays in job completion.
- e. Arrange for sufficient personnel, material and expertise to handle the questionnaire and cross-connect requirements, adhering to pre-arranged job interval schedules.
- f. Coordinate the receipt of all load maps, data input records and tables by the Dial Administrator from WECO so that as the conversion progresses, recent change needs can be handled as soon as they are required.

7.03 Specific information relative to the Dial Administrators responsibility for planning an ETS conversion can be put into four general categories.

- a. Initial Planning
- b. Program Planning
- c. Program Implementation
- d. Scheduling and Coordination

7.04 Initial Planning should involve the following steps in all ETS conversions:

- a. Determine with the Traffic Engineer:
 - (1) Scheduled "ship" and "complete" dates
 - (2) Availability of office drawings, GB, CBA and sender link frame wiring list, etc.

Should be 8-12 weeks before job start so that proper office load and balance assignments or reassignments can be made. (It is suggested that the volume be kept to a minimum due to the complexities of ETS conversions.)

- b. Check on all available information for ETS:
 - (1) Questionnaire instructions from WECO regarding schedule;
 - (2) Available Traffic Practices and Bell System Practices;

(3) Advance copy of "Traffic Order" if possible;

(4) Trunking requirements:

- (a) List "A" (Intertoll), "B" (Toll Connecting), Miscellaneous toll switching trunks, Test and Operator Trunks;
- (b) Incoming and Outgoing Trunk Group requirements should be determined for 18-24 months beyond "in-service" date.

(5) Routing requirements for cutover and as far beyond as possible should be identified. Such as:

- (a) Homing arrangements;
- (b) Alternate routing;
- (c) 3 digit and 6 digit needs;
- (d) Sufficient quantities of GB relays of all types (1GB, 2GB and 4GB) are provided, liberal spares included.

(6) Check to see if screening is required and determine to what extent it will be done

(7) Store frames are provided based on items 4 through 6. It is recommended that the Dial Administrator confer early in the engineering period with the Traffic Engineer and that six store frames be provided on the initial job. Actual requirements, can be determined using Attachment 3.

(8) Verify Validity of Office Records.

(a) Dial Administration Records (3D, 6D, AR - and RA-) should be checked with Plant's to avoid discrepancies

(b) Sample the sender link frame records for trunk relay assignment especially in offices where trunk relay assignments to sender link frames have been changed.

(c) Review Office Balance Prior to Start of Conversion

Check sender link trunk block connector, and train balance prior to making ETS assignments.

(d) Training for Dial Administration

Dial Administration and Routing people generally collaborate in the preparation of ETS program forms. The personnel involved in their preparation should be trained for this job well in advance of the job "start" date.

(e) Manpower Requirements

- (1) Dial Administration and Routing groups should be adequately staffed during the ETS project.

Note 1: During the conversion period there is always a twofold operation, card translator routing and decoder operation plus the ETS form and cross-connect preparation. Additional time is generally indicated for initial programming, "recent change" handling, and record maintenance for ETS.

all groups Finals, HU, 1F, T.SW, CAMA, LAMA, TSPS, Misc. test codes, ATOC's Spec Acc, Conv. junctors etc.

- (3) The Dial Administrator must coordinate all trunk group information with the Routing group (if they are separate);
- (4) The Routing supervisor will develop alternate routing patterns for HU and Final trunk groups;
- (5) Determine the 6 digit requirements by area and groups;
- (6) Identify screening requirements AC, NAC, overseas, division of revenue requirements;
- (7) Identify and establish proper Inwats requirements, originating thru and terminating;
- (8) Verify that all 2-way and outgoing trunk relays are modified in the 4A/4M office for "GB" relay use where possible (excluding announcement);
- (9) During the conversion to ETS all "recent change" orders and "E-3920" work must be coordinated.

7.05 The Dial Administrator is responsible for planning the program utilized by the ETS. This requires that all available information be used regarding trunking, routing and equipment. This information should extend beyond the conversion date by two years. As a guide for a properly planned ETS conversion the following "Program Preparation" information should be used:

- a. Questionnaire forms should be ordered 4-5 months prior to job start;
- b. All information available should be used to establish long range needs. This would include the use of lists A and B, Long Range Planning Forecast, Traffic Routing Guide, DDD Coordinating Handbook, Traffic Order and specific detailed local area routing information;
- c. Identify adjustments necessary to take care of cutover date and interim routing arrangements. Include this in the method of procedure discussion with the cutover and analyses committee;
- d. Using data previously collected:
- (1) Establish incoming and outgoing trunk groups;
- (2) Provide "Common Language Codes" for

7.06 The ETS program is compiled into several "tables" such as the incoming and outgoing trunk group tables, code grouping tables, code conversion tables, route pattern, etc. The Dial Administrator can minimize massive amounts of recent changes required when Plant must relocate entire tables due to out-growth by following a few suggested programming steps:

- a. Establish additional route patterns and outgoing trunk groups using spare "GB" relays
- b. Establish additional 6 digit areas
- c. Establish additional incoming trunk groups by assigning *equipped* sender link frame appearances to fictitious groups
- d. "Route Pattern Records" of pre-planned groups can be used to add fictitious code conversion spare to the code conversion tables.

7.07 The program information should be ready for the WECO line engineer at the 25% interval of the job. This allows sufficient time for

key punching error checks and compilation of the program tape to meet the 50% interval of the job requirement.

7.08 The Dial Administrator and Routing Supervisor should be available to the WECO Line Engineer for the error check portion of the programming. This will prevent the need for additional error runs by WECO.

7.09 Records must be maintained by the Dial Administrator and the Routing Supervisor of all changes, additions and deletions which have taken place during the interval of an ETS conversion when WECO is responsible for installation, namely: the time from when the tape is loaded, and all tests and checks have been run by WECO, and they can release the ETS equipment to Plant for program updates.

7.10 Several modifications are normally performed preceding a conversion of a 4A to ETS operation. The Dial Administrator should be familiar with each of these since holding times and increased capacities vitally affect the operation of the 4A and can make in-service requirements of almost all components differ from a machine without these modifications. This must therefore be a vital part of transition preparation. A list of all modifications to be made should be tracked for completion by the cutover and analysis committee.

7.11 BSP Section 818-007-153 lists all related component modifications performed on existing equipment as well as the actual installation of ETS frames and finally, several detailed MOP plans for converting decoder connectors to operate with decoder channels. The Dial Administrator should refer to this practice and any planning concerning the development of a method of procedure for the actual conversion should be based upon information contained in this practice.

7.12 4A/4M equipment requirements for an ETS conversion are listed in E.L. 26 dated March 10, 1967 and E.L. 815 dated September 16, 1970, as noted in the reference section. The Dial Administrator should determine early in the engineering period that all equipment provision items have been provided for in the Traffic Order.

7.13 When additions to an existing office are planned to coincide with the ETS conversion they should be scheduled to complete *well ahead* of the planned ETS cutover date.

8. REFERENCES

8.01 Sources

8.01.1 Reference should be made to other sources as necessary for the proper preparation of a Method of Procedure or calculation of in-service equipment requirements. These sources for a 4A/4M office would be as listed under Reference sources.

8.01.2 The WECO Installation Engineering Handbooks are the practices which guide their people in installing central office equipment.

8.01.3 WECO publishes notes regarding Engineering Change Procedures (ECP) which may be required for proper preparation of an MOP. These ECP's are issued for circuit improvements and may be included during an addition. If an ECP would provide substantial circuit changes, the work would not necessarily be done during an addition.

8.02 Attachments

8.02.1 Attachment 1 is a completed Sample of a Method of Procedure Authorization from WECO Handbook 3, Section 5A while Attachment 2 is a copy of the Step-by-Step procedure from the same Handbook. Attachment 3 is a form from E.L. 26 dated March, 1967. Attachment 4 is taken from Traffic Engineering Practice, Division D, Section 7-c-(8).

8.03 Reference Sources

<i>Reference</i>	<i>Subject</i>
DFMP, Div. H, Section 1b(8)	General Administration — MOP
T.F.P. Div. D, Sec. 7-c	4A/4M Additions to existing Offices
T.F.P. Div. D, Sec. 7-c(3)	Additions — In & Out Link Frames
T.F.P. Div. D, Sec. 7-c(4)	Additions — Sender Link Frames
T.F.P. Div. D, Sec. 7-c(5)	Additions — Controllers-Controller
T.F.P. Div. D, Sec. 7-c(6)	Additions — Senders
T.F.P. Div. D, Sec. 7-c(7)	Additions — Decoders & Card Translator
T.F.P. Div. D, Sec. 7-c(8)	Additions — Markers
T.F.P. Div. D, Sec. 7-c(9)	Additions — Trunk Blk. Conn
T.F.P. Div. D, Sec. 7-e	4A/4M — CAMA
E.L. 26	No. 4 Crossbar Electronic Tran. System
E.L. 455	No. 4 — Controllers
E.L. 815	No. 4 Crossbar Electronic Tran. System
WECO Handbook 3, Sec. 5A	Method of Procedure
B.S.P. 818-007-153	Modification of Existing No. 4 type Toll Offices Translator System
WECO Handbook 0, Sec. 10	
B.S.P. 201-112-001	Practices related to prevention of Service Interruption
B.S.P. 201-112-005	
B.S.P. 201-112-010	
B.S.P. 201-112-020	
B.S.P. 201-114-001	
B.S.P. 800-614-150, Issue 4D	General Equipment Requirements
T.E.P. Div. A, Section 1	General Engineering Considerations

8.04 It is proposed that Traffic Facilities Practices dealing with 4A/4M Systems will be revised. The following table of contents is for informational purposes only:

<i>Reference</i>	<i>Subject</i>
T.F.P., Div. D, Sec. 7-a	Traffic Estimates
T.F.P., Div. D, Sec. 7-b	New Offices
T.F.P., Div. D, Sec. 7-c	Additions
T.F.P., Div. D, Sec. 7-d	Electronic translator System
T.F.P., Div. D, Sec. 7-e	CAMA
T.F.P., Div. D, Sec. 7-f	Emergency Call Arrangement
T.F.P., Div. D, Sec. 7-g	Data Collection
T.F.P., Div. D, Sec. 7-h	Network Control Arrangements

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METHOD OF PROCEDURE

AUTHORIZATION

Town "BIGTOWN" USA Office IO#2 Date 8-30-73
 Start-Date 9-18-73 Time - Completion-Date 3-15-74 Time -
 W.E. Co. Order No. 7723456 Tel. Co. Spec. 77936 AA
 Type of Plant # 4A CROSSBAR
 General Description of Work NINTH Addition CONSISTING OF 4 ITG,
4 TC MKRS, 12 ITLF, 12 OTLF, 48 SLF, 120 MF SDRS,
MISC. TK RY EQPT. CONVERT OFFICE JUNCTOR
PATTERN FROM 101G-100G TO 131G-130G

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 J.E. SMITH Title INST. SUPVR

Tel. Co. Supervisor H.W. JONES Title C.O. SUPVR

M.O.P. Prepared by (W.E.Co.) R.J. NOMINE Date 8-30-73

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

J. E. Smith Title INST. SUPVR. Date 8-31-73
 _____ Title _____ Date _____

Approved by Tel. Co. Representative

R.B. Fulkerson Title DIST. PLT. SUPT. Date 9-5-73

S.W. Memison Title DIST. TFC. SUPT Date 9-6-73

A.B. Jacobs Title Senior Eng. Date 9-6-73

TELEPHONE ENGINEERING

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Attachment 1
Page 2Page 2 of 10 Pages
W.E. Order 7723456

METHOD OF PROCEDURE

CHECK LIST OF PERTINENT ITEMS

General NOTES and General MOP contain agreements that detailed MOP must be approved before start.

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.

J. E. Smith
For Western Electric Co.

Date 8-31-73

H. W. Jones
For Telephone Co.

Date 8/31/73

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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.
GENERAL NOTES:		
1. NO WORK IS TO BE PERFORMED UNDER		
A STEP INDICATING THE NEED FOR A		
DETAILED MOP WITHOUT APPROVAL FOR		
THE WORK TO BE PERFORMED. APPROVAL		
MUST BE JOINT WECCO - TELCO PLANT		
AND TRAFFIC		

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W.E. Order 7723456

METHOD OF PROCEDURE (CONTINUED)

STEP #	RESPONSIBILITY	
	TEL. CO.	W.E. CO.
NOTE 2: ALL FACILITIES TO BE MADE BUSY SHOULD BE IN ACCORDANCE WITH IN-SERVICE REQUIREMENTS, ATTACHED HERETO. TIME FRAMES SHOULD BE IN ADHERANCE WITH THESE REQUIREMENTS.	✓	✓
NOTE 3: DETAIL MOP AUTHORIZATION SHALL SPECIFY WORK PERIODS AND EQUIPMENT QUANTITIES TO BE REMOVED FROM SERVICE.	✓	✓
NOTE 4: ALL MEASUREMENT DEVICES SHOULD BE KEPT OPERATIVE. ALL WORK PERFORMED REQUIRES DIAL ADMINISTRATION APPROVAL	✓	
NOTES: ALL EQUIPMENT TO BE MADE BUSY BY TELCO PLANT AND RESTORED BY PLANT AFTER PROPER TESTS ARE COMPLETED.	✓	
NOTE 6: ALL TESTS TO BE PERFORMED PER WECO HANDBOOKS AND DESCRIBED IN DETAILED MOP, ATTACHED		✓

HB 3

Attachment 2
Page 2

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W.E. Order 7723456

METHOD OF PROCEDURE (CONTINUED)

STEP #	RESPONSIBILITY	
	TEL. CO.	W.E. CO.
DETAILED MOP FOR STEP #4		
CONVERT OFFICE JUNCTION		
PATTERN FROM 101G-100G TO		
131G-130G PER STEPS		
SHOWN IN THE FOLLOWING:		
1. PLACE ADEQUATE PROTECTION		
BETWEEN JGF AND ALL		
ADJACENT EQUIPMENT. ALL		
SAFETY PRECAUTIONS MUST		
BE OBSERVED WITH LADDERS,		
LADDER SEATS, ETC.		✓
2. WORK WILL START ON		
FRIDAY NIGHT (9-7-73) AT		
10PM AND WILL CONTINUE		
UNTIL TRANSITION OF ONE		
TRAIN IS COMPLETED		✓

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W.E. Order 7723456

METHOD OF PROCEDURE (CONTINUED)

STEP #	RESPONSIBILITY	
	TEL. CO.	W.E. CO.
3 - EQUIPMENT TO BE MADE BUSY AND FUSES TO BE REMOVED ARE THE PLANT RESPONSIBILITY BASED UPON IN-SERVICE REQUIREMENTS ATT'D.	✓	
4 - ALL HAND TOOLS, ELECTRICALLY DRIVEN, SOLDERING TIPS, ETC., THAT ARE REQ'D FOR THIS MOP SHALL BE INSPECTED, INSULATED, & TESTED per HBO, SECTION 3, PARA. 3; SECT. 12, PARA 6. AND HB 28 FOR SPECIFIC DETAILS		✓
5 - FUNCTION OF ALARMS AND LOCATION OF SPARE FUSES TO BE CHECKED PER HANDBOOK D, SECTION 12, PARA 5.		✓
6 - AS MUCH OF NEW PATTERN WILL BE STRAPPED INTO THE MARKERS ASCAN BE WITHOUT AFFECTING SERVICE. JPO & JPI RELAYS ARE BLOCKED NON-OPER.		✓
7. CONNECT JUMPERS FOR NEW JCTR PATTERN ED-68221-41.TC-4 WILL BE IN AND CONNECTED TO CONTACT A IN JGFs (CONT'D)		

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METHOD OF PROCEDURE (CONTINUED)

STEP #	RESPONSIBILITY	
	TEL. CO.	W.E. CO.
7 - IT & TCGO 3 & 4 TO CONTACT A OF IT & TCGO 2 & 4. A STRAP FROM TERMINAL A TO TERMINAL B WILL BE CONNECTED AT THE INCOMING LINK PORTION OF THE TERMINAL STRIP		✓
8 - TELCO WILL BLOCK THE RTA & RTA' OPERATED IN EACH MARKER IN THE TC TRAIN. THIS WILL FORCE THE MARKER TO LOOK AT THE FIRST SUB-GROUP	✓	
9 - CUT EXISTING JUMPERS BETWEEN TCGO 0, 2, 3, 4 - ED 68221-42 TCS AND DISCONNECT. USING TRANSITION DISCONNECT CUTOVER PLUGS, MAKE THE INITIAL CUT BETWEEN A & B PER ED 68221-41 TC4 PLAN AND THEN MAKE FINAL CUT PER STEP 6		✓
10 - STRAP FROM B TO A ON THE OUT PORTION OF TCGO 2 & 4 PER ED 68221-41 TC4 PLAN		✓

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METHOD OF PROCEDURE (CONTINUED)

STEP #	RESPONSIBILITY	
	TEL. CO.	W.E. CO.
11- TELCO REMOVE HALF OF TC MARKERS FROM SERVICE. (SEE IN-SERVICE REQUIREMENTS FOR TIME PERIOD.) REMOVE X-CONNECTS PER SD 68388-D12-NOTE 414, X-CONNECT PER SD 68388-D12 NOTE 415	✓	
12- REPEAT STEP # 11 ON REMAINING MARKERS AFTER APPROPRIATE TESTS ARE MADE	✓	
13- REMOVE BLOCKING TOOLS FROM RELAYS JPD, JPI, RTA & RTA! USING THE DEC-MKR TEST FR., VERIFY THAT EACH MARKER'S RTA, RTB, RTC, & RTD RELAYS OPERATE AND RELEASE IN SEQUENCE WHEN RTD RELAY OPERATES, THE JPD OR JPI WILL OPERATE. - JPD WITH EVEN OUT LINKS - JPI WITH ODD OUT LINKS	✓	
14- INSURE THAT MARKERS WILL MAKE THREE (3) TRIES AT THE FIRST SUB-GROUP AND THEN-		

(CONT'D)

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METHOD OF PROCEDURE (CONTINUED)

STEP #	RESPONSIBILITY	
	TEL. CO.	W.E. CO.
(14) MOVE TO THE SECOND SUB-GROUP OF JUNCTORS	✓	
15- BLOCK RTD RELAY OPERATED. BY CHANGING CODES, VERIFY THAT EACH MARKER WILL COMPLETE TO EACH OUTGOING LINK GROUP BY USING JPD & JPI FROM ONE INCOMING LINK. VERIFY THAT ONE EVEN & ONE ODD INCOMING LINK GROUP WILL COMPLETE TO EVERY OUT LINK GROUP. - REMOVE BLOCK FROM RTD RELAY		✓
16- USE AVAILABLE JUNCTOR TRACING CARDS	✓	✓
17- USING HB 67, SECTION 902, P 5- VERIFY EACH ADDED JUNCTOR FOR NEW FRAMES AND WITH THE USE OF TRACING CARDS, ALL JUNCTORS IN THE SECOND SUB-GROUP PATTERN		✓
18- REPEAT STEPS 8-17 ON THE IT TRAIN THE FOLLOWING WEEKEND	✓	✓

Attachment 3

SHORT METHOD

(20 Bit Words)

Estimate of ETS Variable Memory (5th Pair Store Frames)

Reserved and Allocated Memory Requirements

Non-Relocatable Data Tables	3,584
Maintenance Tables	<u>1,000</u>
Estimate Buffer and Growth	<u>6,000</u>

Trunk Memory Requirements

App

(B-1) SLFWRDS:	40 x No. of Controller Groups	_____
(B-2) KFWRDS:	20 x No. of Controller Groups using KF Class 0	_____
	80 x No. of Controller Groups using KF Class 1	_____
	160 x No. of Controller Groups using KF Class 2	_____
	240 x No. of Controller Groups using KF Class 3	_____
(B-3) ITKWRDS	Total # of Inc. Trunk Groups + 50	_____
(B-4) TGPWRDS:	50 x No. of Sender Link Frames	_____
(D-1) ØTKWRDS:	7 x No. of Actual and Preplanned Trunk Groups (outgoing)	_____

Routing Memory Requirements

App

(C-1) PRYWRDS:	1000 x No. of Domains	_____
(C-2) SCRWRDS:	16 x No. of Screened Codes	_____
(C-3) CCWRDS:	2 x No. of Code Conversions + 200	_____
(C-4) RPTWRDS:	6 x No. of Outgoing Trunk Groups	_____
(C-5) CGPWRDS:	16 x No. of 6 Digit Areas	_____
(C-6) Grid Table:	200 x No. of 6 Digit Areas	_____

TOTAL VARIABLE MEMORY *

* When this number exceeds 32,768, a sixth pair of store frames is required.

**4A AND 4M TOLL CROSSBAR MARKER CAPACITY TABLE
BEFORE SPEED-UP**

(Note 1)

Busy Hour Attempt Capacities of Traffic Markers

Frame Factor (Note 2)	2	3	4	5	6	7	8	9	10
.35	8,400	11,200	14,000						
.30	8,400	11,500	14,600						
.25	8,400	11,800	15,100	18,000					
.24	8,400	11,800	15,200	18,200					
.23	8,400	11,800	15,200	18,300					
.22	8,400	11,900	15,400	18,500					
.21	8,400	11,900	15,400	18,600	21,000				
.20	8,400	12,000	15,600	18,800	21,300				
.19		12,100	15,700	18,900	21,500				
.18		12,200	15,800	19,100	21,800	24,500			
.17		12,200	15,900	19,200	22,100	24,900			
.16		12,300	16,000	19,400	22,400	25,300			
.15		12,400	16,100	19,600	22,700	25,700	28,000		
.14		12,400	16,200	19,700	22,900	26,100	28,600		
.13		12,500	16,300	19,900	23,200	26,500	29,200	31,500	
.12		12,600	16,400	20,000	23,500	26,900	29,800	32,400	35,000
.11			16,500	20,200	23,800	27,300	30,400	33,300	36,100
.10			16,600	20,300	24,000	27,700	31,000	33,100	37,200
.09			16,700	20,500	24,300	28,100	31,600	35,000	38,300
.08			16,800	20,700	24,600	28,500	32,200	35,800	39,400
.07				20,800	24,800	28,900	32,800	36,700	40,600
.06				20,900	25,100	29,300	33,500	37,600	41,700
.057				21,000	25,200	29,400	33,600	37,800	42,000

Note 1: This table indicates the busy hour attempt capacities of traffic markers. Marker requirements for service protection or maintenance are determined by the Plant and Engineering Departments in consultation with Traffic.

Note 2: Compute Frame Factor for each train separately as follows:

$$\text{Frame Factor} = \frac{1}{(1.5 \times \text{TBC})} + \frac{.7}{(\text{IN TLF})} + \frac{.7}{(\text{OUT TLF})}$$

Where: TBC = Number of trunk block connectors
 IN TLF = Number of incoming trunk link frames
 OUT TLF = Number of outgoing trunk link frames

4A AND 4M TOLL CROSSBAR MARKER CAPACITY TABLE
AFTER SPEED-UP

Frame Factor (Note 2)	(Note 1) Busy Hour Attempt Capacities of Traffic Markers								
	2	3	4	5	6	7	8	9	10
.35	10,400	13,600	16,800						
.30	10,400	13,900	17,300						
.25	10,400	14,100	17,700	21,000	23,800	25,800	27,100	28,100	29,100
.24	10,400	14,300	18,100	21,500	24,100	26,300	27,700	28,800	29,900
.23	10,400	14,500	18,400	21,900	24,500	26,700	28,300	29,600	30,800
.22	10,400	14,600	18,600	22,200	24,800	27,200	29,000	30,300	31,700
.21	10,400	14,700	18,800	22,500	25,200	27,700	29,600	31,000	32,700
.20	10,400	14,800	19,000	22,800	25,600	28,200	30,300	32,000	33,700
.19		14,900	19,200	23,100	26,000	28,800	31,000	32,900	34,700
.18		15,000	19,400	23,400	26,400	29,400	31,700	33,800	35,700
.17		15,100	19,600	23,700	26,800	30,100	32,400	34,700	36,600
.16		15,200	19,800	24,000	27,200	30,800	33,000	35,600	37,700
.15		15,300	20,000	24,300	27,600	31,400	33,600	36,400	38,800
.14		15,400	20,200	24,500	28,000	32,000	34,600	37,000	39,800
.13		15,500	20,300	24,700	28,400	32,600	35,600	37,800	40,800
.12		15,600	20,400	24,900	28,800	33,200	36,500	39,400	42,000
.11			20,500	25,100	29,200	33,800	37,400	40,700	43,600
.10			20,600	25,300	29,600	34,300	38,200	41,800	45,100
.09			20,700	25,500	30,000	34,800	39,000	42,900	46,600
.08			20,800	25,700	30,400	35,300	39,700	44,000	48,000
.07				25,800	30,700	35,700	40,400	45,000	49,400
.06				25,900	31,100	36,100	41,000	45,900	50,700
.057				26,000	31,200	36,400	41,600	46,800	52,000

Note 1: This table indicates the busy hour attempt capacities of traffic markers. Marker requirements for service protection or maintenance are determined by the plant and engineering departments in consultation with traffic

**4A AND 4M TOLL CROSSBAR MARKER CAPACITY TABLE
AFTER SPEED-UP AND WITH NEW FAST TRUNK BLOCK CONNECTORS**

(Note 1)

Frame Factor	Busy Hour Attempt Capacities of Traffic Markers								
	2	3	4	5	6	7	8	9	10
.35	11,600	15,200	18,800						
.30	11,600	15,500	19,300						
.25	11,600	15,800	19,800	23,500	26,600	28,900	30,300	31,400	32,600
.24	11,600	16,000	20,200	24,100	26,900	29,400	31,000	32,200	33,500
.23	11,600	16,200	20,600	24,500	27,400	29,900	31,700	33,100	34,500
.22	11,600	16,300	20,800	24,800	27,800	30,400	32,500	33,900	35,500
.21	11,600	16,400	21,000	25,200	28,200	31,000	33,200	34,700	36,600
.20	11,600	16,500	21,200	25,500	28,600	31,600	33,900	35,800	37,700
.19		16,600	21,500	25,800	29,100	32,200	34,700	36,800	38,800
.18		16,700	21,700	26,200	29,500	32,900	35,400	37,800	39,900
.17		16,800	21,900	26,500	29,900	33,700	36,200	38,800	40,900
.16		17,000	22,100	26,800	30,400	34,500	36,900	39,800	42,200
.15		17,100	22,300	27,200	30,800	35,100	37,600	40,700	43,400
.14		17,200	22,500	27,400	31,300	35,700	38,700	41,400	44,600
.13		17,300	22,600	27,600	31,700	36,400	39,800	42,300	45,800
.12		17,400	22,800	27,800	32,200	37,100	40,800	44,100	47,000
.11			22,900	28,000	32,600	37,700	41,800	45,500	48,800
.10			23,000	28,200	33,000	38,300	42,700	46,700	50,400
.09			23,100	28,400	33,500	38,800	43,500	48,000	52,000
.08			23,200	28,600	33,900	39,400	44,300	49,100	53,600
.07				28,800	34,200	39,800	45,100	50,200	55,100
.06				28,900	34,500	40,200	45,700	51,200	56,500
.057				29,000	34,800	40,600	46,400	52,200	58,000

Note 1: This table indicates the busy hour attempt capacities of traffic markers. Marker requirements for service protection or maintenance are determined by the Plant and Engineering Departments in consultation with Traffic.

**4A/4M TOLL CROSSBAR
SENDER CAPACITY TABLE
(4A/4M SENDER GROUPING CAPACITY .5% SENDER DELAY OVER 3")**

Full Access Grouping				Slip Multiple Grouping					
<u>Senders</u>	<u>CCS</u>	<u>Senders</u>	<u>CCS</u>	<u>Senders</u>	<u>CCS</u>	<u>Senders</u>	<u>CCS</u>	<u>Senders</u>	<u>CCS</u>
2*	5*			3	14	29	697	55	1,543
3	16	22	552	4	29	30	728	56	1,576
4	31	23	554	5	46	31	759	57	1,609
5	50	24	584	6	65	32	790	58	1,641
6	71	25	616	7	85	33	821	59	1,673
7	93	26	646	8	107	34	852	60	1,705
8	118	27	680	9	131	35	883	61	1,737
9	142	28	709	10	156	36	914	62	1,769
10	169	29	741	11	182	37	945	63	1,801
11	198	30	772	12	209	38	976	64	1,833
12	224	31	804	13	236	39	1,008	65	1,865
13	252	32	836	14	253	40	1,040	66	1,897
14	282	33	867	15	290	41	1,072	67	1,929
15	313	34	900	16	317	42	1,105	68	1,961
16	340	35	932	17	345	43	1,138	69	1,993
17	367	36	965	18	373	44	1,172	70	2,025
18	398	37	999	19	401	45	1,206	71	2,057
19	427	38	1,035	20	430	46	1,240	72	2,089
20	460	39	1,071	21	459	47	1,274	73	2,121
21	491	40	1,107	22	488	48	1,308	74	2,153
				23	517	49	1,342	75	2,185
				24	547	50	1,376	76	2,217
				25	577	51	1,410	77	2,249
				26	607	52	1,444	78	2,280
				27	637	53	1,477	79	2,311
				28	667	54	1,510	80	2,342

* Provision of less than three senders per group is not recommended.

Appendix 4

4A AND 4M TOLL CROSSBAR SENDER CAPACITY TABLE

(Based on 10% sender attachment delay over 7 seconds)
(equivalent to 30% Sender Attachment Delay over 3 seconds)

Senders	CCS		Senders	CCS	
	Full Access			Slip Multiple	
	Multiple	Slip Multiple			
			41		1,270
			42		1,305
3	44	39	43		1,340
4	76	68	44		1,376
5	108	97	45		1,411
6	140	127	46		1,446
7	172	157	47		1,491
8	204	188	48		1,527
9	237	219	49		1,562
10	270	250	50		1,597
11	303	281	51		1,632
12	336	312	52		1,668
13	369	343	53		1,703
14	402	374	54		1,738
15	435	405	55		1,773
16	469	437	56		1,809
17	503	469	57		1,844
18	537	501	58		1,879
19	571	533	59		1,914
20	605	566	60		1,950
21	640	599	61		1,986
22	675	632	62		2,022
23	710	665	63		2,058
24	745	698	64		2,094
25	780	731	65		2,130
26	815	765	66		2,166
27	850	799	67		2,202
28	885	833	68		2,238
29	920	867	69		2,274
30	955	901	70		2,310
31	991	935	71		2,346
32	1,027	969	72		2,382
33	1,063	1,003	73		2,418
34	1,099	1,037	74		2,454
35	1,135	1,071	75		2,490
36	1,172	1,105	76		2,526
37	1,209	1,140	77		2,562
38	1,246	1,175	78		2,598
39	1,283	1,210	79		2,634
40	1,320	1,245	80		2,670

APPENDIX 5

TRANSVERTER TABLE FOR 4A AND 4M CAMA

TRAFFIC TRANSVERTERS REQUIRED	<u>TOTAL TRANSVERTER ATTEMPTS</u> <u>50% DETAILED RECORDING</u> <u>ATTEMPTS PER RECORDER</u>		
	<u>800</u>	<u>12000</u>	<u>1600</u>
2	2,800	2,700	2,500
3	5,900	5,600	5,100
4	9,000	8,500	7,800
5	11,800	11,200	10,200
6	14,400	13,600	12,400
7	16,900	15,900	14,500
8	19,300	18,200	16,600
9	21,800	20,600	18,800
10	24,200	22,900	20,900
11	26,700	25,200	23,000

TRAFFIC TRANSVERTERS REQUIRED	<u>100% DETAILED RECORDING</u> <u>ATTEMPTS PER RECORDER</u>		
	<u>800</u>	<u>1200</u>	<u>1600</u>
2	2,700	2,510	2,200
3	5,400	5,100	4,500
4	8,200	7,800	6,900
5	10,800	10,200	9,100
6	13,100	12,400	10,900
7	15,400	14,500	12,900
8	17,600	16,600	14,700
9	19,900	18,800	16,600
10	22,100	20,900	18,500
11	24,400	23,000	20,400

APPENDIX 6

REQUIRED FOR SERVICE
COMMON CONTROL EQUIPMENT

Office: _____

Equipment: _____

No. Installed: _____

	MON		TUES		WED		THURS		FRI		SAT		SUN	
	TFC	PLT	TFC	PLT	TFC	PLT	TFC	PLT	TFC	PLT	TFC	PLT	TFC	PLT
8- 9 AM														
9-10														
10-11														
11-12														
12- 1 PM														
1- 2														
2- 3														
3- 4														
4- 5														
5- 6														
6- 7														
7- 8														
8- 9														
9-10														

Prepared By: _____

Date: _____