

ORIGINATING AND TERMINATING LOAD CONTROL NO. 1 CROSSBAR OFFICES

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1. GENERAL

1.01 This section covers the procedures to be followed in determining when to apply load control measures in No. 1 crossbar offices.

1.02 This section is reissued to make reference to additional load control features, to delete line link overload control which is replaced by line load control, to include additional information for recognizing overloads, and to rearrange the text. Since this is a general revision, the arrows ordinarily used to indicate changes have been omitted.

1.03 The general objective of load control is to safeguard service by employment of load control features which will most effectively counteract service reaction from sustained overloads on certain equipment units. A sustained equipment overload may be due to large traffic volumes, a major disaster, etc, such as air attacks, tornadoes, hurricanes, and floods.

1.04 When it becomes necessary to use any form of load control, the employment of the load control feature shall conform to local administrative practices and procedures.

1.05 There may be occasions when the originating traffic exceeds the capacity of the subscriber sender group, causing a backup of calls which results in dial tone delays. With this sit-

uation, if all the subscribers waited for dial tone before dialing, it would not be necessary to furnish load control features. Specifically it has been found by experience that any significant increase in the interval between removal of the receiver from the hook and hearing dial tone will be accompanied by a large number of cases in which the subscriber will dial before dial tone, resulting in subscriber senders tied up in a partial dial condition and thereby decreasing the call carrying capacity of the group. This situation may be encountered when something of unusual interest occurs in the community and also when calls fail to complete on the first attempt because of equipment failure.

Note: The reserve sender test feature of the subscriber sender link and controller circuit has been eliminated in later installations since the reserve test feature tends to double the controller holding time in periods of heavy traffic, thus resulting in a delay in selecting an originating sender.

1.06 With crossbar equipment, a further source of possible reaction to the originating traffic is contributed to connections terminating in a crossbar office when all terminating senders or markers are busy for a period of time. Under this condition the subscriber sender is held awaiting a stuck sender time-out until a terminating sender becomes available.

Note: The reserve sender test feature or the terminating sender link and controller circuit has been eliminated in later installations since the reserve test feature tends to double the controller holding time in periods of heavy traffic, thus resulting in a delay in selecting a terminating sender.

2. GENERAL OPERATION OF EQUIPMENT ARRANGED FOR LOAD CONTROL

2.01 Load control is a feature whereby in periods of overloads on the subscriber or full selector terminating sender groups, some of the calls will automatically be given a special rout-

ing by the originating marker during the overload period. This special routing may be to overflow, to an operator, or to an announcement trunk.

A. Originating Load Control

2.02 Intersender Timing: Intersender timing protects originating offices from the effects of the connecting office overloads by reducing, under heavy traffic conditions, the time that a subscriber sender will wait for a terminating or tandem sender attachment signal. This feature causes delayed subscriber senders to be released and restored to service quickly, thus maintaining originating office handling capacity while at the same time removing some of the overload from the congested connecting office. Intersender timing goes into effect when 90 per cent of the subscriber senders in an office are busy (controlled by sender load register) and a 3- to 6-second delay is encountered while attempting to seize a terminating or tandem sender. If a distant sender is not attached before the end of this interval, the subscriber sender functions to route the call to overflow or to an announcement trunk where the announcement trunk feature is provided.

2.03 Subscriber Sender Load Control: Where subscriber sender load control is provided, one sender in each sender subgroup is equipped with the load control feature. During an overload period, calls using these senders will immediately be routed to overflow or to an operator. On these calls the subscriber receives no dial tone; the routing being entirely automatic and independent of dialing. This feature, in effect, reduces the holding time of the senders arranged for load control from an average of 14 seconds to 2 seconds per call thereby increasing the call carrying capacity of the sender group. Before the feature can be effective during the overload period, an LC key common to the special sender in the sender group must be operated. In other words, two conditions must prevail to obtain the automatic routing: (1) the sender load register circuit must be operated, and (2) the load control key must be operated. Once the feature has become effective it will be maintained until the sender load register circuit has remained inoperative for a sustained period of from 12 to 19 seconds (see note) after which the senders equipped for load control operation function in the normal manner.

Note: Provision is made for shortening this interval to 5 to 12 seconds if experience indicates a shorter time period is desirable.

2.04 Fundamentally, the scheme is to transmit a signal from the sender load register circuit to each of the senders equipped for load control, the signal being accepted by any such sender only when it is in a normal condition. When seized on a call, the sender immediately seeks a marker and transmits this signal to the marker for a special routing, either to overflow or to an operator trunk group as desired.

2.05 Radio and Television Programs: An overload condition resulting from certain radio or television programs may reach such proportions on the central office equipment as to require a special routing. Such a routing will be engineered to conform to an area distribution plan.

2.06 Outgoing Trunk Group Control: When an originating overload becomes evident by an abnormal amount of stuck senders, it may be due to a distant office or tandem overload or a trunk group trouble condition. The method of control is effected by removing trunks from service in the outgoing direction.

2.07 Line Load Control: An originating overload condition may reach such proportions that it cannot be controlled by the other load control features and it may become necessary as a last resort to temporarily deny originating service to some subscriber lines in order to reduce the traffic to an amount within the capacity of the equipment. *In this case line load control shall be employed in accordance with Section 216-105-301.*

B. Terminating Load Control

2.08 Terminating Sender Load Control: Terminating sender load control is a means of providing load control when traffic to a terminating unit is so great that all of the calls offered cannot be completed within normal holding times and is effective only when an all senders or an all markers busy condition has prevailed for a predetermined interval. This feature may include any or all three of the following arrangements.

- (a) To cause the terminating sender to return an overflow signal to the subscriber sender after incoming brush selection.

(b) To cause interdigital time-out in the terminating sender (terminating sender returns an overflow signal to the subscriber sender if a selection registration is not completed within 3 to 6 seconds).

(c) To cause calls handled by the originating markers and directed to the particular terminating sender group to be diverted to overflow. In this connection, it is to be noted that the originating markers must be in the same building with the terminating sender group, and therefore, terminating load control is limited to intrabuilding traffic. As a result, this arrangement is most effective in offices having a large amount of intrabuilding terminating traffic. It may, however, be used even though the intrabuilding terminating traffic is small as it may divert sufficient traffic to satisfactorily control an overload. The arrangement is based on diverting calls on a code basis, that is, after the terminating sender group to which the call is to be directed has been established. This arrangement also provides flexibility in the amount of incoming traffic to be routed to overflow by the installation of a manually operated load control key per originating marker which permits the call to be diverted on a marker basis. In this way, all or a part of the traffic to a terminating sender group can be diverted to overflow.

2.09 In order to avoid diverting calls to overflow unnecessarily, a timing circuit per terminating sender group is provided to control the terminating sender load control feature which is made effective by a sustained all senders or markers busy condition of 12 to 19 seconds (see note). After the timing circuit has made the feature effective, it requires a continuous period of 28 to 58 seconds where senders and markers have been available before the feature is released. During the period that the timing circuit is locked in, the routing of calls to overflow will occur only when an all senders or markers busy condition exists. If, after the period of 28 to 58 seconds, all senders or markers become busy for 12 to 19 seconds, the feature again becomes operative.

Note: Provision is made for shortening this interval to 5 to 12 seconds if experience indicates a shorter time period is desirable.

2.10 Incoming Trunk Load Control: An overload condition may reach such proportion on the terminating equipment that it may become necessary to reduce the traffic offered to an amount within the capacity of the equipment.

2.11 Under this overload condition, stuck senders will result in a number of offices in the area and this method of control should be effected by having incoming trunks from these offices made busy in the originating office. These trunks should be restored to service as soon as the terminating load control feature can handle the overload.

2.12 Line Overload Control: An overflow condition to a frequently called busy line may reach such proportions as to develop an excessive holding time on the terminating equipment of a No. 1 crossbar unit. When the line overload control feature is used, the holding time is reduced by returning a busy signal as soon as the called number is registered in the terminating marker. This feature is made operative when a make-busy plug is inserted into the N or P jack at the terminating marker frame.

3. RECOGNIZING OVERLOAD CONDITIONS

3.01 An overload condition exists when the volume of traffic exceeds the capacity of the central office equipment. An overload may be due to trouble in the originating equipment, trouble in outside plant, or a sudden increase of originating traffic due to major catastrophes such as fires, floods, or air raids. It may also result from a terminating overload in the local office or in a connecting office (insufficient terminating equipment to serve originating office demands can cause a backup of originating traffic). It is important to determine quickly the source and cause of an overload so that the appropriate action may be taken promptly (such as making trunks busy because of cable failure or distant office overloads, or application of line load control).

3.02 An overload of central office equipment may be recognized by one or more of the following:

- (a) Large number of stuck senders, partial dials, or both; an alarm accompanied by excessively high readings on PD (partial dial) and SC (slow completion) meters.

- (b) All originating and/or terminating markers busy alarm.
- (c) Originating and/or terminating marker connector time alarm.
- (d) Subscriber sender LR lamp.
- (e) Terminating sender FSB lamp.
- (f) A calls-waiting condition on the line link frames indicated by the lighting of the (red) G lamps (if provided) at the line load control cabinet.
- (g) A large number of permanent signals indicated by the lighting of the following lamps:
 - (1) PS lamps on district link frames in non-AMA offices.
 - (2) NT lamp at the maintenance recorder frame in AMA offices.
 - (3) TB5 lamp in displays at the originating trouble indicator.
 - (4) PS lamp at the "A" switchboard.
 - (5) Numerous NC, PB, or C lamps of permanent signal trunks.
- (h) Heavy battery drain indicated by the office load meter and sounding of the major alarm.

3.03 *The existence of one or more of the conditions described in 3.02, although indicative of an overload, should not be interpreted as a directive for the application of load control. Local instructions should govern the actual application of load control.*

4. LOAD CONTROL OPERATION

4.01 Since the terminating senders work most efficiently with calls waiting to be served, no action need be taken when the FSB alarm occurs, unless the delay in selecting an idle terminating sender reflects on the call carrying capacity of the subscriber senders resulting in partial dial or stuck sender timing.

4.02 In general, when an overload condition occurs, it is most desirable to attempt to control it by the terminating load control, if possible, because it is in operation only when all

terminating senders or markers are busy and also because it furnishes a more satisfactory indication to the subscriber as it permits him to receive dial tone and dial at least two or three digits before receiving overflow.

4.03 Where subscriber sender load control is provided, its use must be closely coordinated with the call carrying capacity of the originating markers. If the CT (connector time alarm) or MBA (marker busy alarm) lamps are lighted continuously, it is desirable to refrain from operating (or to release if operated) the subscriber sender load control key.

4.04 In order that the subscribers may receive normal service, all control measures should be restored as soon as the subscriber senders will serve the traffic offered without any indication of excessive delays.

A. Originating Load Control

4.05 *Intersender Timing:* When an overload exists as a result of a backup of originating traffic, the intersender timing feature may be placed under control of a make-busy plug inserted into the IT jack at the originating trouble indicator frame. This allows the intersender timing feature to be effective continuously instead of waiting until 90 per cent of the subscriber senders become busy. Originating senders that are delayed more than 3 to 6 seconds in waiting for a distant office sender will release quickly (routing calls to an overflow trunk or an announcement trunk), thus making more senders available for service. Remove the make-busy plug from the IT jack as soon as the condition causing the overload has cleared.

4.06 *Subscriber Sender Load Control:* Where this feature is provided and an overload exists as a result of a backup of originating traffic and the CT lamp or the MBA lamp is not lighted, operate the LC key at the originating trouble indicator frame.

4.07 When the LC key is operated and the LR lamp is lighted, the O-RTA lamp will light and the major alarm will be sounded as an indication that calls are being diverted to overflow or to an operator. The audible alarm should be silenced by operating the O-RTA key. During the time this key is operated the O-RTG lamp is lighted.

4.08 When the equipment is arranged to direct these calls to an operator, the Traffic Department should be notified so that suitable measures can be taken to serve this traffic.

4.09 Carefully check the result of the load control operation in respect to reduction of the number of subscriber senders in partial dial or stuck sender condition and the delay resulting from excessive marker usage. When the CT lamp or the MBA lamp is lighted continuously the LC key should be restored. A careful balance must be kept between these two conditions by the operation and release of this key to obtain the maximum benefit of load control.

4.10 The load control feature should be released as soon as possible after the condition causing the overload has cleared.

4.11 *Radio and Television Programs:* Certain radio or television programs which designate a telephone number to be called have an adverse influence on service calls. This type of overload is neutralized by use of a special central office code designation. This code will be routed to conform to an area-routing plan which is usually coordinated by Traffic Engineering Department.

4.12 *Outgoing Trunk Group Control:* It may be necessary to busy out, in the outgoing direction, trunks that terminate in overloaded distant offices experiencing a severe delay in attaching senders. Calls directed to such a point may cause an all trunks busy condition when all idle trunks have been seized by subscriber senders which will time out when the distant sender awaiting time becomes excessive. Warning indications that this action may be necessary are an unusual number of stuck senders or senders timing out due to the reduced timing interval (interdigital and/or intersender timing) and an all senders busy condition. Should it become necessary to remove outgoing trunks from service, checks must be made to determine when the sender delay condition is alleviated so that trunks may be restored to service as rapidly as possible.

4.13 When an originating overload becomes evident by an abnormal amount of stuck subscriber senders, it may be due to a trunk group trouble condition. Stuck senders associated with this condition may release after a brief interval. If stuck senders fail to hold,

steps should be taken to note routings of codes associated with these stuck senders. Station men at several sender locations for obtaining the necessary codes. After the trunk group is located, make test calls simulating service calls to locate nature of trouble. Remove from service trunks which fail to function satisfactorily. Report and clear trouble according to local operating practice.

4.14 *Care should be exercised when making trunks busy as an adverse service condition could develop:*

(a) One code or a few codes could fail in all of their associated ground supplies serving tandem trunk groups and these trunk groups could work satisfactorily with many other codes.

(b) A tandem trunk group associated with a final ground supply could fail with a few codes and serve many other codes satisfactorily — resulting in a high amount of overflow terminations if its trunks were made busy.

4.15 *Line Load Control:* When an abnormal overload condition exists of such a nature that even with the use of the intersender timing or the originating load control feature, the equipment cannot handle the offered load, it may be necessary to resort to line load control. Such an overload condition may result because of a catastrophe in the community or some reason within the office which would reduce the call carrying capacity of the equipment.

Caution: This control should be exercised only after all other originating load control measures have failed to control the situation. This shall be done in accordance with Section 216-105-301.

B. Terminating Load Control

4.16 *Terminating Sender Load Control:* The interdigital timing feature and the feature where the terminating sender returns an overflow signal to the subscriber sender after incoming brush registration are automatically controlled by the terminating sender timing control circuit as described in 2.08(a), 2.08(b), and 2.09. The feature where calls to the overloaded terminating unit are routed to overflow by originating markers located in the same building is described in 2.08(c) and 2.09.

4.17 When it is obvious that an overload condition exists as a result of a backup of terminating traffic, as indicated by a continuous FSB or AMB alarm, operate the RT keys at the originating trouble indicator frame associated with all the originating markers.

Note: When it is known that an overload on the terminating sender group will occur as the result of a scheduled event, it may be desirable to operate all RT keys in advance in order that the subscriber senders may not become overloaded and deny service on calls to the other offices.

4.18 When one or more RT keys are operated and the terminating sender load control timing has functioned the T-RTA (terminating route transfer alarm) lamp is lighted and the major alarm is sounded to indicate that the load control feature is operating. The audible alarm should be silenced by operation of the T-RTA key. During the time this key is operated the T-RTG (terminating reroute guard) lamp is lighted.

4.19 As soon as the number of subscriber senders timing out in partial dial or stuck sender condition is satisfactorily reduced, or the terminating sender busy or all markers busy alarm is retired, the RT keys should be released one at a time until a balance is obtained which will permit as many calls as possible to be completed without causing a partial dial or a stuck sender condition in subscriber senders.

4.20 **Incoming Trunk Load Control:** When it is obvious that an overload exists on the terminating equipment of such proportion that the use of terminating load control is not effective, it may be necessary to reduce the traffic offered. This type of overload may be controlled by having trunks incoming to the overloaded terminating unit made busy at the originating office.

Note: This type of control may be especially useful in offices which have a very small percentage of intrabuilding traffic.

4.21 For efficient use of this type of load control it should be applied on several large trunk groups, as small trunk groups tend to automatically turn back excessive calls by testing busy. Consult the schedule prepared by the Traffic Department for information on the trunks to be made busy.

Caution: *This control should be exercised only after all other terminating load control measures have failed to control the situation.*

4.22 The incoming trunk load control feature should be released as soon as the terminating load control can handle the overload.

4.23 **Line Overload Control:** Where this feature is provided, it is used to reduce the holding time of markers and number groups when an overload of traffic to a particular number results in a high percentage of busy signals.

4.24 Twenty block method — When this arrangement is provided, it permits the control of traffic to a preselected subscriber served by an entire twenty block which must be reached by a split-hundreds SH relay in the marker. To make the overload control feature effective, insert make-busy plugs into either the N (normal) or the P (pre-emptory) jacks at the terminating marker frames. When there are plugs in the N jacks, any terminating marker circuit encountering a busy condition on the preselected number will signal all other terminating marker circuits, which have the same number registered and are awaiting their turn at the number group connector circuit, to give an immediate busy signal. When there are plugs in the P jacks, any marker connecting to the particular number cross connected will be given a busy signal without testing the line.

4.25 Plug and jack method — When this arrangement is provided, it permits the control of traffic to any one number of the 10,000 directory numbers of either office A or office B. One make-busy plug should be inserted into each of the thousands, hundreds, tens, and units jack strips corresponding to the subscriber number. If there is a multioffice arrangement, a make-busy plug should be inserted into the OA or OB jack, as the case may be. This feature is made operative by the insertion of a make-busy plug into the N or the P jacks as described in 4.24.