

[66 FR 43327, Aug. 17, 2001]

§§ 1755.511–1755.521 [Reserved]

**§ 1755.522 RUS general specification for digital, stored program controlled central office equipment.**

(a) *General.* (1) This section covers general requirements for a digital tele-

phone central office switching system, which is fully electronic and controlled by stored program processors. A digital switching system transfers information which is digitally encoded from any input port to a temporarily addressed exit port. The information may enter

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the system in either analog or digital form and may or may not be converted to analog at the exit port depending on the facility beyond. The switching system shall operate properly as an integral part of the telephone network when connected to physical and carrier derived circuits meeting RUS specifications and other generally accepted telecommunications practices.

(2) The output of a digital-to-digital port shall be Pulse Code Modulation (PCM), encoded in eight-bit words using the mu-255 encoding law and D3 encoding format, and arranged to interface with a T1 span line.

(3) American National Standards Institute (ANSI) Standard S1.4–1983, Specification for Sound Level Meters, is incorporated by reference by RUS. This includes S1.4A–1985 that is also incorporated by reference. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies may be obtained from ANSI Inc., 11 West 42nd Street, 13th Floor, New York, NY 10036, telephone 212–642–4900. Copies may be inspected during normal business hours at RUS, room 2838-S, U.S. Department of Agriculture, Washington, DC 20250, or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202–741–6030, or go to: [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html).

(4) American Society for Testing Materials (ASTM) Specification B 33–91, Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes, is incorporated by reference by RUS. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies may be obtained from ASTM, 1916 Race Street, Philadelphia, PA, telephone 215–299–5400. Copies may be inspected during normal business hours at RUS, room 2838-S, U.S. Department of Agriculture, Washington, DC 20250, or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202–741–6030, or

go to: [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html).

(5) Bell Communications Research (Bellcore) document SR-TSV-002275, BOC Notes on the LEC Networks—1990, March 1991, is incorporated by reference by RUS. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR Part 51. Copies may be obtained from Bellcore Customer Service, 60 New England Avenue, Piscataway, NJ 08854, telephone 1–800–521–2673. Copies may be inspected during normal business hours at RUS, room 2838-S, U.S. Department of Agriculture, Washington, DC 20250, or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202–741–6030, or go to: [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html).

(6) Bellcore TR-TSY-000508, Automatic Message Accounting, July 1987, is incorporated by reference by RUS. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies may be obtained from Bellcore Customer Service, 60 New England Avenue, Piscataway, NJ 08854, telephone 1–800–521–2673. Copies may be inspected during normal business hours at RUS, room 2838-S, U.S. Department of Agriculture, Washington, DC 20250, or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202–741–6030, or go to: [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html).

(7) Federal Standard H28, Screw-Thread Standards for Federal Services, March 31, 1978, is incorporated by reference by RUS. This includes: Change Notice 1, Federal Standard, Screw-Thread Standards for Federal Services, May 28, 1986; Change Notice 2, Federal Standard, Screw-Thread Standards for Federal Services, January 20, 1989; and Change Notice 3, Federal Standard, Screw-Thread Standards for Federal

Services, March 12, 1990. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies may be obtained from the General Services Administration, Specification Section, 490 East L'Enfant Plaza SW, Washington, DC 20407, telephone 202-755-0325. Copies may be inspected during normal business hours at RUS, room 2838-S, U.S. Department of Agriculture, Washington, DC 20250, or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to: [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html).

(8) Institute of Electrical and Electronics Engineers (IEEE) Std 455-1985, IEEE Standard Test Procedure for Measuring Longitudinal Balance of Telephone Equipment Operating in the Voice Band, is incorporated by reference by RUS. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies may be obtained from IEEE Service Center, 445 Hoes Lane, P. O. Box 1331, Piscataway, NJ 08854, telephone (201) 981-0060. Copies may be inspected during normal business hours at RUS, room 2838-S, U.S. Department of Agriculture, Washington, DC 20250, or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to: [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html).

(9) Institute of Electrical and Electronics Engineers (IEEE) Std 730-1989, IEEE Standard for Software Quality Assurance Plans, is incorporated by reference by RUS. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies may be obtained from IEEE Service Center, 445 Hoes Lane, P. O. Box 1331, Piscataway, NJ 08854, telephone (201) 981-0060. Copies may be inspected during normal business hours at RUS, room 2838-S, U.S. Department

of Agriculture, Washington, DC 20250, or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to: [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html).

(10) RUS Bulletin 345-50, PE-60, RUS Specification for Trunk Carrier Systems, September 1979, is incorporated by reference by RUS. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552 (a) and 1 CFR part 51. Copies may be obtained from the Rural Utilities Service, Administrative Services Division, room 0175-S, Washington, DC 20250. The bulletin may be inspected at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to: [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html).

(11) RUS Bulletin 345-55, PE-61, Central Office Loop Extenders and Loop Extender Voice Frequency Repeater Combinations, December 1973, is incorporated by reference by RUS. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552 (a) and 1 CFR part 51. Copies may be obtained from the Rural Utilities Service, Administrative Services Division, room 0175-S, Washington, DC 20250. The bulletin may be inspected at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to: [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html).

(12) RUS Bulletin 345-87, PE-87, RUS Specification for Terminating (TIP) Cable, December 1983, is incorporated by reference by RUS. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552 (a) and 1 CFR part 51. Copies may be obtained from the Rural Utilities Service, Administrative Services Division, room

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0175-S, Washington, DC 20250. The bulletin may be inspected at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to: [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html).

(b) *Reliability.* (1) Quality control and burn-in procedures shall be sufficient so the failure rate of printed circuit boards does not exceed an average of 1.0 percent per month of all equipped cards in the central office during the first three months after cutover, and an average of 0.5 percent per month of all equipped cards in the central office during any 6-month period thereafter. A failure is considered to be the failure of a component on the PC board which requires it to be repaired or replaced.

(2) The central office switching system shall be designed such that the expected individual line downtime does not exceed 30 minutes per year. This is the interval that the customer is out of service as a result of all failure types, excluding dispatch and travel time, i.e., hardware, software, and procedural errors.

(3) The central office switching system shall be designed such that there will be no more than 1 hour of total outages in 20 years, excluding dispatch and travel time for unattended offices.

(c) *System type acceptance tests.* (1) System type acceptance tests (general acceptance tests) are performed for the purpose of determining whether or not a type of switching system should be added or retained as an RUS accepted system. While general acceptance tests will be required on each system type, they will not be expected to cover every requirement in this section. However, any installation of a system provided in accordance with this section shall be capable of meeting any requirement in this section on a spot-check basis.

(2) A "completed call" test shall be made part of these system type acceptance tests. There shall be no more than two in 10,000 locally originating and incoming calls misdirected, unsuccessfully terminated, prematurely disconnected or otherwise failing as a result of equipment malfunction and/or equip-

ment failures, or as a result of transients, noise or design deficiencies. This test shall be made with a load box with no less than 10 lines access and 10 subscriber numbers for completion, or equivalent, with no other traffic in the system. If there is a failure in the equipment during this test, the cause shall be repaired and the test restarted at zero calls.

(3) System type acceptance testing applies basically to factory type testing, and not to owner acceptance testing for individual installations. The overall installed and operating system shall also meet these requirements, except for unusual circumstances or where specifically excluded by this or other RUS requirements.

(d) *Types of requirements.* (1) Unless otherwise indicated, the requirements listed in this section are fixed requirements.

(2) Optional requirements are those which may not be needed for every office and are identifiable by a phrase such as, "when specified by the owner," or, "as specified by the owner."

(3) In some cases where an optional feature specified in paragraph (e) of this section will not be required by an owner, either now or in the future, a system which does not provide this feature will be considered to be in compliance with this section for the specific installation under consideration, but not in compliance with the entire section.

(4) The owner may request bids from any RUS accepted supplier whose system provides all the features which will be required for a specific installation.

(5) The Application Guide, RUS TE&CM 322, provides information about the economic and service factors involved in all optional features, as well as instructions for the completion of appendices A and B of this section.

(e) *General requirements.* (1) The equipment shall provide for terminating and automatically interconnecting subscriber lines and trunks in response to dial pulses (or push-button dialing signals, if specified) without the aid of an operator.

(2) Complete flexibility shall be provided for assigning any subscriber directory number to any central office line equipment by the use of internal programmed memory. Thus, any subscriber line and/or directory number may be moved to another terminal to distribute traffic loads, if the line equipment hardware is compatible with the service provided.

(3) The system shall be arranged to interface with interexchange carrier trunks and networks using single digit or multi-digit access codes. The system shall be equipped to handle at least 20-digit subscriber dialed numbers. All subscriber directory numbers in the office shall be seven-digit numbers.

(4) The network and the control equipment shall be comprised of solid-state and integrated circuitry components. Peripheral equipment shall be comprised of solid-state and integrated circuitry components as far as practical and consistent with the state-of-the-art and economics of the subject system.

(5) The basic switching system shall include the provision of software programming and necessary hardware, including memory, for optional custom calling services such as call waiting, call forwarding, three-way calling, and abbreviated dialing. It shall be possible to provide these services to any individual line (single-party) subscriber. The addition of these services shall not reduce the anticipated ultimate engineered line, trunk, and traffic capacity of the switching system as specified in appendix A of this section.

(6) The requirements in this specification apply only to single party lines. Although only single frequency ringing is required, other types may be requested in appendix A of this section.

(7) Provision shall be made for local automatic message accounting (LAMA), and for traffic service position system (TSPS) trunks, or equivalent, to the operator's office when required either initially or in the future.

(8) Tandem switching features shall be provided if specified in appendix A of this section.

(9) The system shall be arranged to serve a minimum of eight All Number Calling (ANC) office codes per office, with discrimination on terminating

calls by trunk group, numbering plan, or programmed memory and class mark, if specified in appendix A of this section.

(10) Busy hour load handling capacity is an important feature when an office approaches capacity. The delays which may occur in call completion during busy hour periods may prove to be excessive in some system designs. Accordingly, each bidder shall provide, in appendix C of this section, data satisfactory to RUS regarding the busy hour load handling capacity and traffic delays of the system.

(11) Provision shall be made for hotel-motel arrangements, as required by the owner, to permit the operation of message registers at the subscriber's premises to record local outdial calls by guests (see Item 10.5, appendix A of this section).

(12) Provision shall be made to identify the calling line or incoming trunk on nuisance calls (see paragraph (g)(10) of this section for details).

(13) Full access from every subscriber line to every interoffice trunk shall be provided.

(14) Facilities shall be provided to implement service orders, make traffic studies, and perform switching and transmission tests by means of remote control devices if such operations are specified in Items 11.2 and 11.3 of appendix A of this section.

(15) Provision shall be made for the addition of facilities to record all subscriber originated calls based on dialed directory number, time of day, and duration of conversation. They shall be such that the additional equipment (if any is required) may be added to an in-service system without interruption of service and a minimum of equipment, wiring and software modifications.

(16) The system shall be capable of distributed switching operation where groups of subscriber lines can be remotely located from the central office. The remotely situated units are known as "Remote Switching Terminals" (RST's) (see paragraph (w) of this section). This does not eliminate the use of pair gain devices such as direct digitally connected concentrators, regular concentrators or subscriber carrier equipment, where specifically ordered by the owner and its engineer.

(17) The switching system shall have means to synchronize its clock with switches above it in the network hierarchy, when specified by the owner in item 3, appendix A of this section (see paragraph (j) of this section).

(18) Consistent with system arrangements and ease of maintenance, space shall be provided on the floor plan for an orderly layout of future equipment bays that will be required for anticipated traffic when the office reaches its ultimate size. Readily accessible terminals shall be provided for connection to interbay and frame cables to future bays. All cables, interbay and intrabay (excluding power), if technically feasible, shall be terminated at both ends by use of connectors.

(19) When specified in appendix A of this section, the system shall be capable of processing emergency calls to a 911 service bureau connected either by a group of one-way 911 lines or a trunk group.

(i) It shall be possible to reach the service bureau by dialing 911, 1+911, or a 7-digit number.

(ii) The system shall select an idle 911 line or trunk.

(iii) The system shall provide usual ringing and ringback signal until the called 911 line answers.

(iv) If the calling line goes on-hook first, the system shall hold the connection from the called 911 line and return steady low tone to the service bureau. The system shall then begin a 45-minute timeout, after which the calling line is disconnected and an alarm message is printed on a TTY. If the calling line goes off-hook before timeout, the system shall reestablish the conversation path.

(v) If the calling line does not disconnect, the service bureau attendant shall have the ability to force a disconnect of the established connection with the calling party.

(vi) When the 911 call is answered, the equipment shall be arranged so that coin lines are not charged for the call. Similarly, if some form of local call charging is used, there shall be no charge for the 911 call.

(vii) If the 911 service bureau is holding a calling line, it shall be possible for the 911 line to cause the equipment to ring back the calling line. This is

done by providing a flash of on-hook signal from the 911 line lasting from 200 to 1,100 milliseconds. The signal to the calling line shall be ringing current if the line is on-hook, or receiver off-hook (ROH) tone if the line is off-hook.

(viii) Calls shall not be originated from the service bureau via the dedicated 911 lines. If an attempt is made to originate a call, it shall receive reorder tone. After 6 minutes, the system shall print an alarm message.

(ix) If 911 calls pass through intermediate switching, the forced-hold control, emergency ringback, and calling line status monitoring capabilities are lost.

(f) *Line circuit requirements*—(1) *General*. (i) The range of direct current (dc) resistances of subscriber loops, measured from the main frame in the central office and including the telephone set shall be at least 0-1900 ohms without loop extension and 1900-3600 ohms with loop extenders, or equivalent. The range when using extension equipment may be significantly reduced for straight line ringers. These limits apply under maximum adverse environmental and manufacturing variation tolerance conditions. Central office voltage shall be stabilized at a value necessary to provide at least a nominal 21 milliamperes current with a non-treated loop of at least 1900 ohms. Minimum loop insulation resistance without loop extenders shall be 25,000 ohms between conductors or from either conductor or both conductors in parallel to ground. Loop insulation resistance for loop extension devices may be 100,000 ohms minimum between conductors or from either conductor or both conductors in parallel to ground.

(ii) In addition to operating on non-loaded cable pairs and subscriber carrier, the equipment shall function properly with D-66 and H-88 loaded cable pairs, including any provisions the equipment must control for the purposes of proper transmission.

(2) *Dialing*—(i) *Subscriber dial speed*. The line equipment and central office equipment (COE) in tandem shall operate satisfactorily when used with subscriber dials having a speed of operation between eight and twelve impulses per second and a break period of

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55 to 65 percent of the total impulse period.

(ii) *Subscriber dial interdigital time.* The line equipment and central office equipment shall operate satisfactorily with subscriber rotary dial interdigital times of 200 milliseconds minimum, and with pushbutton dialing interdigital times of 50 milliseconds minimum.

(iii) *Subscriber line pushbutton dialing frequencies.* (A) The frequency pairs assigned for pushbutton dialing shall be as follows, with an allowable variation of ±1.5 percent:

Low Group Frequencies (Hz)	High Group Frequencies (Hz)			
	1209	1336	1477	1633
697 .....	1	2	3	Spare
770 .....	4	5	6	Spare
852 .....	7	8	9	Spare
941 .....	*	0	#	Spare

(B) The receiver shall comply with the operating parameters of the dual-tone multifrequency (DTMF) central office receiver as described in section 6 of Bell Communications Research (Bellcore) document SR-TSV-002275, BOC Notes on the LEC Networks—1990.

(3) *Impedance.* For the purpose of this section, the input impedance of all subscriber loops served by the equipment is arbitrarily considered to be 900 ohms at voice frequencies.

(4) *Lockout.* (i) All line circuits shall be arranged for line lockout. When a permanent condition occurs prior to placing a line into lockout, a timed low level warning followed by a timed high level receiver off-hook (ROH) tone (see paragraph (i)(2)(xi) of this section) or a howler circuit (see paragraph (o)(2)(iii)(C) of this section) shall be applied to the line.

(ii) The line on lockout shall be reconnected automatically to the central office when the permanent off-hook condition is cleared.

(5) *Pay stations.* Pay stations may be prepay, or semi-postpay, as specified by the owner.

(6) *Loop extension.* (i) The number of lines which exceed 1900 ohms will be specified by the owner. When requested by the owner, the bidder shall furnish equipment to guarantee satisfactory operation of all lines.

(ii) Working limits for subscriber lines with loop extenders are covered in RUS Bulletin 345-55, PE-61, Central Of-

fice Loop Extenders and Loop Extender Voice Frequency Repeater Combinations.

(iii) Ringing from RUS accepted loop extenders, or their equivalent, shall be cut off from the called line when the handset at the called station is removed during the ringing or the silent interval.

(7) *Private branch exchange (PBX) lines.* PBX trunk hunting shall be available. It will not be necessary to segregate PBX lines to certain line groups.

(8) *Quantity.* A sufficient number of terminations shall be provided, in addition to the quantity specified by the owner for subscriber line service, to meet the requirements of the system for equipment testing, alarm checking, tone transfer, loop around test and other features.

(9) *Types.* There shall be provisions for types of lines such as ground start, loop start, regular subscriber, pay stations, etc.

(g) *Intraoffice switching requirements.*

(1) The switching system shall:

(i) Provide dial tone in response to origination of a call by a subscriber, except on special lines where the application of dial tone is not applicable, such as manual and hot lines;

(ii) Remove dial tone immediately after the first digit has been dialed;

(iii) Recognize the class of service of the calling subscriber;

(iv) Register the digits dialed by the calling subscriber where the rotary dial or pushbutton dialing characteristics and the minimum interdigital times are as specified;

(v) Perform the necessary translation functions when the required number of digits have been registered, and select a channel to a proper outgoing trunk, if one is available, to the designated interexchange carrier;

(vi) Provide a transmission path from the calling subscriber line to the selected trunk, if an idle one is found;

(vii) Provide for more than one alternate route to the desired destination when specified by the owner, select an idle outgoing trunk in the first or second choice alternate route trunk group, if all trunks in the higher choice groups are busy, and provide a reorder signal (see paragraph (i)(2)(iv) of this

section) to the subscriber if no trunks are available in the last choice alternate route;

(viii) Translate the proper part of the registered incoming routing data on tandem calls into an identification of an outgoing trunk group, select an idle trunk in that group, initiate the connection of the incoming trunk to the outgoing trunk, set the trunks in the proper configuration for tandem operation, and transmit information as required to permit completion to the desired destination in the distant office;

(ix) Transmit the proper stored information over the selected trunk to permit completion of outgoing calls to the desired destination by the distant office or offices, and provide multifrequency (MF) outpulsing when specified;

(x) Register all the digital information on calls incoming from a distant office, when dial or MF pulsing characteristics and interdigital times are as specified;

(xi) Translate internally a registered directory number into line equipment location, ringing code and terminating class (such as "PBX hunting") on incoming or intraoffice calls;

(xii) Test the called line for a busy condition;

(xiii) Connect the incoming trunk or locally originated call to the called line if the called line is idle;

(xiv) Permit any type of ringing voltage available in the central office to be associated with any Subscriber Directory Number (SDN), cause the proper type of ringing voltage to be connected to the called line, and remove ringing from the line upon answer whether in the ringing or silent period; and

(xv) Test and monitor the switching system continually during periods of low traffic using the maintenance and diagnostic subsystem.

(2) The switching system shall offer at least the following originating and terminating class-of-service indications on a per-line basis to subscribers, as specified by the owner:

(i) Flat rate individual line, bridged ringing;

(ii) Flat rate PBX and trunk hunting numbers, bridged ringing;

(iii) Pay station;

(iv) Message rate subscriber line;

(v) Wide Area Telephone Service (WATS);

(vi) Extended Area Service (EAS);

(vii) Data service;

(viii) Hotel-Motel capability;

(ix) Denied originating;

(x) Denied terminating;

(xi) Custom calling features;

(xii) Special interexchange carrier accesses; and

(xiii) Presubscription to designated interexchange carrier.

(3) The switching system shall provide PBX hunting.

(i) At least one trunk hunting group in each 100 SDN's equipped shall be provided. More may be provided as specified by the owner.

(ii) PBX groups shall be of a reasonable size commensurate with the ultimate size of the switching system.

(iii) Any available SDN may be used for PBX trunk hunting.

(iv) Each PBX group shall have the capability of being assigned one or more nonhunting SDN's for night service.

(v) If the called line is a PBX hunting line, the switching system shall test all assigned lines in the hunting group for a busy condition.

(vi) If the called PBX group is busy, line busy tone, as specified in paragraph (i)(2)(iii) of this section, shall be returned to the originating end of the connection.

(4) The switching system shall provide pay stations which may be prepay or semi-postpay. The system shall be arranged so that an operator and emergency service (911) may be reached from prepay or semi-postpay coin lines without the use of a coin, when the proper pay station equipment is provided.

(5) To meet dialing requirements, the switching system shall:

(i) Initiate the line lockout function after a delay, as specified in paragraph (r)(3) of this section, if dial or push-button dialing pulses are not received after initiation of a call, preferably routing the subscriber line to a holding circuit for tones and then automatically to lockout;

(ii) Connect 120 interruptions per minute (IPM) paths busy tone, recorded message, or other distinctive



tone to the calling subscriber if an interval longer than that specified in paragraph (r)(4) of this section elapses between dialed digits;

(iii) Register the standard tone calling signals received from a subscriber station arranged for pushbutton dialing if specified by the owner, provide arrangements to function properly with 12-button pushbutton dialing sets, and return a reorder signal to the subscriber upon receipt of signal from the 11th or 12th buttons if neither of these buttons is assigned functions; and

(iv) Connect the incoming trunk to the digit register equipment within 120 milliseconds after seizure where direct dialing is received on calls from a distant office, cancel the bid for a register, and return reorder tone to the calling end if dial pulses are received before a register is attached.

(6) The switching system shall provide for appropriate circuit usage.

(i) To avoid inefficient utilization of the switching network, that portion of the common equipment that establishes the connection on intramachine calls shall not require more than 500 milliseconds, exclusive of ringing and ring trip, to complete its function under no-delay conditions.

(ii) The switching system shall provide for duplication in a load sharing or redundant configuration any circuit elements or components, the failure of which would reduce the grade of service of 100 or more lines by more than 25 percent of the traffic carrying capacity.

(iii) The switching system shall ensure that failure of access to a high choice circuit will not prevent subsequent calls from being served by lower choice circuits, wherever possible.

(iv) Where only two circuits of a type are provided, circuits shall be designed so that failure of one circuit will not permanently block any portion of the system for the duration of the failure.

(v) Where more than two circuits of a type are provided, successive usages should be on a rotational or random basis rather than the step-up selection with the possible exception of a last choice trunk.

(vi) The system shall be designed so that, in the event of a network failure, the system shall immediately or simul-

taneously use a redundant portion of the network to complete the call.

(7) The switching system shall provide busy verification facilities with the method of access specified by the owner.

(i) Only an operator or a switchman shall be able to override a busy line condition.

(ii) If the called line is busy, off-hook supervision shall be given the operator or switchman.

(iii) The responsibility of restricting subscribers in distant offices from having access to busy verification shall be on the distant office personnel when the toll trunks are used for both toll connecting and verification traffic.

(iv) When a verification code is used, all digits of the code must be dialed before cut-through to the called line can be accomplished.

(8) The switching system shall provide intercept facilities.

(i) All unused numbering plan area codes, home numbering plan area office codes, service codes and subscriber directory numbers (SDN's) shall be routed to intercept. All intercept administration shall be by changes in memory administrable by telephone company personnel. Maximum machine time to place a subscriber on intercept shall be 15 seconds.

(ii) Unequipped SDN's intercept shall be effective if the processor memory does not have information concerning the SDN in question.

(iii) The intercept equipment shall be arranged so that specific SDN's can be routed to a separate intercept circuit for changed numbers.

(iv) When an intercept call is answered, either by an operator or by a recorded announcement, an off-hook or charge supervision signal shall not be returned, even momentarily, to the originating end.

(v) When intercepting service is to be handled over the regular interoffice toll trunks, a distinctive identifying tone shall be transmitted when the operator answers. This tone shall be of the frequency and duration specified in paragraph (i)(2)(x) of this section.

(9) The switching system shall provide nuisance call trap facilities which, when activated, provide a permanent

record of the calling and called numbers complete with date and time of day. Where the call originates over an interoffice trunk, the actual trunk number shall be recorded. There shall be provision for the called subscriber to hold the connection and for the positive trace of the call from origination to termination within the office.

(10) The switching system shall follow appropriate release procedures.

(i) The office shall be arranged so a connection to a terminating channel other than assistance operator shall be released under control of the calling party so that the channel can be re-seized, unless the call is to emergency 911 service or other termination arranged for called party control.

(ii) If the called party disconnects first, the channel used in the originally established connection shall be held until the calling party disconnects or until the timing interval specified in paragraph (r)(7) of this section has elapsed. This feature shall not interfere with the normal operation of calls to intercept, fire alarm, or other special services.

(11) The switching system shall provide line load control facilities, when specified by the owner, to give preference for originating service to a limited group of subscribers during emergencies.

(i) These facilities may be activated manually by input-output (I/O) device or automatically after a manual setting of a key (or equivalent) to put line load control into effect, as determined by the bidder. The automatic procedure is preferable.

(ii) Procedures shall be established to avoid the unauthorized use of the line load control facilities.

(iii) Where automatic activation is provided, service may be provided to small groups of nonemergency subscribers on limited grade of service whenever the office load becomes low enough to permit this to be done safely.

(h) *Interoffice trunk circuit requirements*—(1) *General.* (i) The bidder shall supply, as requested by the owner, solid-state technology type trunk and signaling circuits of any of the types described in RUS TE&CM 319, Interoffice Trunking and Signaling, or, with

the approval of RUS, any other more recent and desirable types not as yet covered in the manual. For dc signaling, the duplex (DX) and loop types of signaling are preferred.

(ii) Trunks shall not be directly driven from the subscriber's dial on outward calls.

(iii) In order to reduce the spares inventory and minimize incidence of improper maintenance replacement of circuit assemblies, the types of trunk circuits shall be kept to a minimum. Variation in assemblies should be mainly limited to variation in signaling modes.

(iv) Trunk circuits which connect with carrier or 4-wire transmission facilities shall be arranged for 4-wire transmission to avoid an intermediate 2-wire interface between a 4-wire switching system and trunk facilities.

(2) *Quantity.* Trunk quantities shall be as specified in appendix A of this section. Sufficient space shall be provided for an orderly layout of trunks. Trunks of a certain type going to the same destination may be grouped together on the original installation.

(3) *Requirements for interoffice connections.* (i) When operator trunks are used in common for both coin and noncoin lines, they shall be arranged to provide an indication to the operator by means of a visual signal or tone when calls are from pay stations. When a tone is used, it shall be of the type specified in paragraph (i)(2)(v) of this section and shall be connected to be heard only by the operator upon answer. It shall be possible to repeat the tone signal.

(ii) There are no requirements for trunks arranged for manual re-ring by a toll operator, either with the receiver on or off the hook, except to coin stations with the receiver on the hook.

(iii) On calls from subscribers to the assistance operator, the release of the connection shall be under control of the last party to disconnect. An exception is operator control of disconnect that is used on outgoing trunks to a TSP/TSPS system.

(iv) On calls originated by an operator, the release of the connection shall be under control of the operator.

(v) Where trunks with E and M lead signaling are used, the trunk circuits for Type I signaling shall be arranged

to place ground on the M lead during the on-hook condition and battery on the M lead in the off-hook condition. For E and M Type II, only a make contact between the MA and MB lead will be required. In either type, current limiting shall be provided in the E lead of the trunk circuit itself, as required for proper operation. It shall be assumed that connection equipment in the form of trunk carrier, multiplex, or associated signaling apparatus furnishes only a contact closure to ground (Type I) or to a signal ground lead (Type II) for an off-hook condition on the E lead.

(vi) Where answer supervision is used to determine the initiation of the charging interval for a call, such answer supervision shall not be effective for charging until after the elapse of the timing interval listed in paragraph (r)(5) of this section.

(vii) When necessary, provision shall be made for reception of start and stop dial signals on toll trunk equipment.

(viii) When trunks arranged for automatic message accounting (AMA), toll ticketing, or centralized automatic message accounting (CAMA) are specified by the owner, these trunks shall provide the pertinent features described in paragraph (k) of this section applicable to such functions.

(4) *Requirements for direct digital connections.* (i) Interface units which will permit direct digital connection to other digital switches, channel banks and remote line and/or trunk circuits over digital facilities shall be provided when specified by the owner. The digital transmission system shall be compatible with T1 type span lines using a DS1 interface and other digital interfaces that may be specified by the owner. The RUS specification for the span line equipment is Bulletin 345-50, PE-60, RUS Specification for Trunk Carrier Systems.

(ii) Each interface circuit shall connect 24 voice channels to the switching system from a 1.544 megabit per second DS1 bit stream. The DS1 bit stream entering or exiting the system shall be in the D3 format and the voice signals shall be encoded in 8 bit mu-255 PCM. The format and processing of the bit stream must be compatible with characteristics of the D3 channel bank such

as alarm and maintenance characteristics. Loss of receive signal (DS1) shall be detected and the equivalent of a carrier group alarm shall be executed in  $2.5 \pm 0.5$  seconds. Loss of synchronization shall be detected by slips, timing jitter, and wander in accordance with industry standards.

(iii) Signaling shall be by means of MF or dial pulse (DP) and the system which is inherent in the A and B bits of the D3 format. In the case where they are not used for signaling, the A and B bits shall be used only for normal voice and data transmission.

(i) *Tone requirements—(1) General.* Tones shall be provided to indicate the progress of a call through the office. Tone generators should be an integral part of the switching systems. The tones should be introduced digitally by the application of the appropriate bit stream to the line or trunk circuit via the digital switching network. The necessary precautions shall be made to ensure tone sources automatically if the primary sources fail.

(2) *Tone specifications.* (i) Dial tone shall consist of 350 Hz plus 440 Hz at a composite level of  $-10$  dBm0 which equates to  $-13$  dBm0 per frequency. This is the precise tone suitable for use with pushbutton dialing.

(ii) Low tone shall consist of 480 Hz plus 620 Hz at a composite level of  $-21$  dBm0 which equates to  $-24$  dBm0 per frequency.

(iii) Line busy tone shall be low tone interrupted at 60 IPM, with tone on 0.5 seconds and off 0.5 seconds.

(iv) Reorder, all paths busy, and no circuit tone shall be low tone interrupted at 120 IPM, with tone on 0.25 seconds and off 0.25 seconds.

(v) Identifying tone on calls from coin lines shall be uninterrupted low tone.

(vi) High tone shall consist of 480 Hz at  $-17$  dBm0.

(vii) Audible ringback tone shall consist of 440 plus 480 Hz at a composite level of  $-16$  dBm0 which equates to  $-19$  dBm0 per frequency.

(viii) The call progress tones listed in this section are described in Bellcore document SR-TSV-002275, BOC Notes on the LEC Networks—1990, section 6. The 350, 440, 480, and 620 Hz tones shall

be held at  $\pm 0.5$  percent frequency tolerance and  $\pm 3$  dB amplitude variation. The amplitude levels specified are to be measured at the main distributing frame, excluding cable loss.

(ix) Distinctive tone, when required for alarm calls, or other features, shall consist of high tone interrupted at 200 IPM with tone on 150 ms and off 150 ms.

(x) Identifying tone on intercepted calls shall consist of uninterrupted high tone impressed on the trunk circuit 300 to 600 milliseconds following the operator's answer of intercepted calls.

(xi) An ROH circuit shall have output tones which do not interfere with the pushbutton or multifrequency signaling tones. The ROH tone may be introduced digitally internal to the system near the overload level of +3 dBm0. No power adjustment will be required. The frequency of the output shall be distinctive and urgent in order to attract the subscriber's attention to an off-hook situation. (Warning: In order to determine the signal level, a frequency selective voltmeter must be used to determine the level of each signal component and mathematical power addition used to combine these measurements into a single level value.)

(xii) During application of tones, office longitudinal balance shall be maintained within 15 dB of that specified in paragraph (q)(8) of this section.

(j) *System clock.* (1) The central office clock and network synchronization system shall have the ability to be synchronized with external clocks for network synchronization, including detection of slips, timing, jitter and wander, in a digital-to-digital environment or operate initially in an independent network (refer to Bellcore document SR-TSV-002275, BOC Notes on the LEC Networks—1990, section 11).

(2) The end office central office system clock shall be a Stratum 3 clock with:

(i) A minimum long-term accuracy of  $\pm 4.6 \times 10^{-6}$  ( $\pm 7$  Hz @ 1.544 MHz);

(ii) A minimum stability of  $3.7 \times 10^{-7}$ /day upon loss of all frequency references; and

(iii) A "Pull-In Range" for the capability of synchronizing to a clock with accuracy of  $\pm 4.6 \times 10^{-6}$ .

(3) The access tandem central office system clock shall be a Stratum 2 clock with:

(i) A minimum long-term accuracy of  $\pm 1.6 \times 10^{-8}$  ( $\pm 0.025$  Hz @ 1.544 MHz);

(ii) A minimum stability of  $1 \times 10^{-10}$ /day upon loss of all frequency references; and

(iii) A "Pull-In Range" for the capability of synchronization to a clock with accuracy of  $\pm 1.6 \times 10^{-8}$ .

(k) *Switched access service arrangements*—(1) *General.* The equipment shall be capable of providing Feature Group A, Feature Group B, Feature Group C, and Feature Group D switched access service arrangements, as described in Bellcore document SR-TSV-002275, BOC Notes on the LEC Networks—1990, section 6 and section 15, including arrangements for automatic number identification (ANI).

(2) *Operation.* (i) All equipment shall be arranged for Feature Group A (Line Side Connection).

(ii) All equipment shall be arranged for Feature Group B given that appendix A of this section requires the equipment of the necessary trunks (Trunk Side Connection).

(iii) The equipment shall be arranged for Feature Group C on the trunk groups specified in appendix A of this section. Even though appendix A of this section specifies Feature Group D or some other trunk group, it shall be possible through software commands available to the owner to use Feature Group C signaling protocols on a trunk group basis until such time that the trunk group in question converts to Feature Group D signaling protocols.

(iv) The equipment shall be arranged for Feature Group D on the trunk groups specified in appendix A of this section.

(v) Calls originating from coin lines toward switched access service shall be arranged either to provide signaling protocols for TSPS, or in the absence of TSPS-type service, such calls shall be blocked.

(vi) The equipment shall be arranged for forwarding routing information, calling party identification, and called party numbers in the proper feature group protocols, by trunk group as specified in appendix A of this section.

(vii) The equipment shall be arranged for AMA data collection as specified in appendix A of this section by trunk group. Unless otherwise specified by the owner, the equipment shall be arranged to collect the billing data in the Bellcore AMA format as described in Bellcore document TR-TSY-000508, Automatic Message Accounting.

(viii) If specified in Item 9.4, appendix A of this section, the equipment shall be arranged to store the billing data in a pollable system. If specified in Item 9.5, appendix A of this section, equipment shall be furnished to poll the pollable systems associated with the contract.

(1) *Fusing and protection requirements*—(1) *General.* (i) The equipment shall be completely wired and equipped with fuses, trouble signals, and arranged for printout of fault conditions, with all associated equipment for the wired capacity of the frames or cabinets provided.

(ii) Design precautions shall be taken to prevent the possibility of equipment damage arising from the insertion of an electronic package into the wrong connector, the removal of a package from any connector, or the improper insertion of the correct card in its connector.

(2) *Fuses.* Fuses and circuit breakers shall be of an alarm and indicator type, except where the fuses or breaker location is indicated on the alarm printout. Their rating shall be designated by numerals or color code on the fuse panel, where feasible.

(3) *Components.* (i) Insofar as possible, all components shall be capable of being continuously energized at rated voltage without injurious results. Insofar as possible, design precautions shall be taken to prevent damage to other equipment and components when a particular component fails.

(ii) Printed circuit boards or similar equipment employing electronic components shall be self-protecting against external grounds applied to the connector terminals, where feasible. Board components and coatings applied to finished products shall be of such material or treated so they will not support combustion.

(iii) Every precaution shall be taken to protect electrostatically sensitive

components from damage during handling. This shall include written instructions and recommendations (see Item 6.1,h of appendix C of this section).

(m) *Switching network requirements*—(1) *The network.* (i) All networks shall be comprised of solid-state components.

(ii) The switching network shall employ time division digital switching and be compatible for connection to D3 type PCM channel banks without conversion to analog.

(iii) Equipment shall be available as required to connect analog lines and trunks, analog or digital service circuits, digital carriers to RST's, D3 channel banks or other digital switching units.

(2) *Network quantity.* Where the number of stages in the switching network and their control varies with the capacity of the system, sufficient equipment and wiring shall be supplied initially in order that there will be no service interruptions when additions are made up to the ultimate capacity as specified in appendix A of this section. This does not imply the necessity of supplying empty cabinets unless this is the only way the necessary wiring can be accomplished.

(n) *Stored program control (SPC) equipment requirements.* (1) The system shall provide redundancy in call processing such that the failure of a call processing unit does not degrade the call processing capabilities of the switching system nor result in the loss of established calls.

(2) Programs shall be modular, flexible and structured. In the interest of more dependable and more easily read programs, it is desirable to use a language which is more person-oriented leaving the detailed machine-oriented problems to a compiler program. Quality assurance of all software programs shall be in accordance with IEEE Std 730-1989, IEEE Standard for Software Quality Assurance Plans, or equivalent.

(3) The office administration program shall have checks within it to

prevent failure due to erroneous or inconsistent input data. It shall safeguard against the possibility of upsetting machine performance with improper instructions or information. In addition, modular structure shall allow the use of a variety of human-engineered service order formats. Service changes may be performed remotely if so desired. Average machine time for service change shall be 15 seconds or less. Service changes shall not be registered in permanent memory until verified. The access to the service change shall not have access to generic program.

(4) The switching system shall be able to offer, by request, at least the following printouts of its routine stored data for administrative purposes:

- (i) A list of all assigned directory numbers, in numerical order, with their assigned class of service and line terminal numbers;
- (ii) A list of all directory numbers, in numerical order, associated with a class of service;
- (iii) A list of all unassigned line terminals;
- (iv) Traffic data in proper form for separation studies in accordance with the revenue separations procedures current at the time of the contract;
- (v) All lines on lockout;
- (vi) All lines assigned to intercept;
- (vii) All available (unassigned) directory numbers in the working thousands group; and
- (viii) A list of equipment busied out for maintenance.

(5) The printouts in paragraph (n)(4) of this section may be delayed to times of light traffic.

(6) Maintenance diagnostics shall be performed by a fault recognition system utilizing both software and hardware, each being used where they are most effective for maintenance and reliability. In the economic interests of providing early and efficient fault detection and accurate pinpointing of faulty areas, it is desirable to have a comprehensive person-machine interface supported by extensive automatic fault detection and analysis, involving diagnostic software for fault resolution and automatic recovery mechanisms to maintain continuous service. Maintenance

messages may be channeled to a remote maintenance center if so desired.

(7) Information in memory, having no requirement for changes to be introduced in the maintenance or operation of the system, may be stored in memory devices such as programmable read-only memory (PROM) or other devices that cannot be reprogrammed in the field.

(o) *Maintenance facilities*—(1) *Alarm features, including alarm sending.* (i) The equipment shall be arranged to provide audible and visual alarms indicating fuse operation or other circuit malfunctions resulting from component failure, crosses or open wiring, or any other conditions affecting service which can be detected economically.

(ii) The alarms shall be classified in accordance with their effect on the system.

(A) Catastrophic alarms demand immediate attention and require notification of the highest level of supervisory personnel. Conditions such as loss of service, loss of one or more remote line switches or line concentrators connected through Direct Digital Interface, loss of network control, and loss of computer program in all processors shall produce catastrophic alarms.

(B) Major alarms demand rapid action. Conditions such as loss of one or more groups of subscribers or trunk ports, blown fuses for common groups of channels, loss of control to groups of channels, failure of one or both redundant units, and total loss of battery charging current for more than 15 minutes shall produce major alarms.

(C) Minor alarms indicate non-emergency conditions which cause degraded service or fault conditions which causes the system to operate within less-than-optimum performance. Conditions discovered in automatic routing which have not shown in the operation of the equipment but require attention and cumulative line lockout (level adjustable) are examples of minor alarm conditions.

(iii) When the office is arranged for unattended operation, facilities shall be provided for extending the alarm indications to an attended point.

(iv) When the use of a separate outside plant facility for alarm sending is

specified, the nature of the alarm may be indicated to the distant point by machine printout or other display device.

(v) When alarm sending is accomplished over a regular operator office trunk, the operator shall be apprised that the call is an alarm indication by a distinctive tone, as specified by the owner in appendix A of this section. It shall be possible for the operator to determine at any time the presence of a trouble condition by dialing a number set aside for that purpose. This number shall also be accessible from lines classmarked for this feature.

(vi) When the alarm sending circuit seizes an interoffice operator trunk, the operator must dial the alarm checking code over another trunk before the first trunk can be released except where the alarm condition has disappeared first.

(vii) The alarm sending circuit shall have access to two or more trunks if the trunks are used for subscriber traffic.

(viii) An alarm indication of higher priority shall supersede an original alarm indication and re seize an interoffice operator trunk.

(ix) In any group of offices purchased under one contract, the same codes shall be used in each office for alarm checking and test.

(x) When the alarm checking number is dialed, the alarm indications received shall be as follows:

(A) Catastrophic alarm—No tone.

(B) Major alarm—Continuous busy tone 60 IPM, unless alarm is overridden.

(C) Minor alarm—Continuous 1-ring code ringback tone, unless alarm is overridden.

(D) No trouble—Continuous 2-ring code ringback tone, unless alarm is overridden.

(xi) Audible and visual local alarms and transmitted alarms shall be provided as follows:

Classification	Delay Interval	
	Local Alarms	Alarms Transmitted
Catastrophic	0	0
Major	0	0 <sup>1</sup>
Minor	0	0-30 Min.

<sup>1</sup>Except no charge alarm delayed 15 minutes.

(xii) The central office alarm circuits shall be arranged to provide optional wiring to transmit either a minor alarm or a major alarm and a printout to accommodate various types of trunk and subscriber carrier systems, microwave, mobile radio, other transmission systems, and environmental protection systems with different priorities when a set of contacts is closed in the equipment of such systems and the alarm checking code is dialed. The alarm relay shall be furnished by the supplier of the carrier multiplex and/or mobile radio equipment. The option or options shall be specified by the owner.

(2) *Trouble location and test.* (i) *Equipment.* (A) A maintenance center shall be provided with a fault recorder (printer and/or display) for troubles. Here, system and sub-system visual trouble indications are shown for maintenance aid.

(B) The fault recorder shall provide a permanent or semi-permanent record of the circuit elements involved whenever a trouble is encountered. It shall be arranged to recognize an existing fault condition and not cause multiple printouts of the same fault, except during test routine.

(ii) *Maintenance system.* (A) The maintenance system shall monitor and maintain the system operation without interruption of call processing, except for major failures.

(B) The maintenance system shall provide both specialized maintenance hardware circuits and an extensive software package to enable maintenance to determine trouble to an individual card or functional group of cards.

(C) Maintenance programs may be both on-line and off-line. On-line maintenance programs are activated by system errors and shall be scheduled to execute call tests during low traffic periods and periodic hardware tests at specific time intervals. Programs shall provide diagnostic tools for the maintenance personnel and be initiated by them.

(D) Scheduled periodic hardware tests shall automatically detect faults and alert maintenance personnel via alarm or appropriate input/output device(s) at local and/or remote locations.

(E) Facilities shall be provided so that test calls can be set up using pre-selected items of switching equipment.

(F) The maintenance personnel shall be able to make tests to determine if every trunk and every item of switching equipment are functioning properly. Also, it shall be possible to make each trunk and each SPC equipment, or part thereof, busy to service calls. Where possible, equipment which is made busy to service calls shall still be accessible for test calls.

(iii) *Outside plant and subscriber stations.* (A) A subscriber loop test set or equivalent shall be provided either as a separate set or as a part of the maintenance center, as specified in item 11.2 of appendix A of this section. This circuit shall include a high resistance volt-ohm meter, wiring to tip and ring terminals to permit a portable wheatstone bridge to be used, an operator's telephone circuit, a dial circuit (and pushbutton dialing keys, if specified), outgoing trunks to dial equipment for access to lines under test without use of the main distributing frame (MDF) test shoe and the necessary test keys. No dry cell batteries shall be accepted for test potentials. Circuits shall be designed so that alternating current (ac) induction on the line will have no effect on dc measurements. All functions shall be under control of lever or pushbutton keys. As a minimum the test system shall:

- (1) Test for bridged foreign electromotive force (EMF);
- (2) Test for regular line battery;
- (3) Test for booster battery voltage and polarity using the test shoe;
- (4) Test for open circuits, short, tip ground, and ring ground;
- (5) Test for tip or ring negative potential;
- (6) Test for capacitance of a subscriber's line;
- (7) Supply talking battery to the line with and without booster battery;
- (8) Ring the subscriber through the test access circuit or through a test shoe;
- (9) Test in and out of the central office; and
- (10) Supply a reverse polarity key for voltage readings, except when positive or negative values are displayed directly.

(B) An acceptable arrangement for making the tests shown in paragraph (o)(2)(iii)(A) of this section is to have them under software control with results displayed at one of the system's I/O ports.

(C) A howler circuit for maintenance purposes, if ordered by the owner, shall have output tones which do not interfere with the pushbutton or multifrequency signaling tones. The harmonics of the output tones shall be attenuated at least 26 dB below the fundamental frequency for all load conditions. The frequency stability shall be 2 percent or less for all output tones when the unit is operated in the specified load and environmental range. It shall be possible to vary the output voltage (power) of the howler circuit. It shall remove tone and restore the line to service when the telephone instrument receiver is placed on-hook. The frequency of the output shall be chosen to be distinctive and urgent in order to attract the subscriber's attention to an off-hook situation.

(D) When a dial speed test facility is specified by the owner, it shall be accessed by dialing a special code and shall return to the calling station readily identifiable signals to indicate that the dial speed is slow, normal, or fast.

(E) When the office is arranged for pushbutton dialing, optional facilities shall be provided for testing the pushbutton dialing equipment at the subscriber station.

(F) When a system for testing subscriber lines in remote offices from a test position in a centrally located office is specified by the owner, it shall be capable of working with all the central offices and RST's in the remote areas. This testing equipment shall preferably be solid-state with a minimum of electromechanical devices and shall operate from central office battery. It shall be capable of working over any voice grade telephone circuit and shall not require a dedicated trunk. There shall be no interference to or from "in-band" voice channel tones. When used over a network, the verification or access shall be guarded to prevent unauthorized access by subscribers. Access to this system shall only be available to the test operator in all cases.



(3) *Transmission testing.* (i) When transmission test circuits are specified in Item 11.3 of appendix A of this section, they shall permit testing of trunks by a distant office without any assistance in the local dial office. Analog test ports shall meet appropriate trunk requirements. If Centralized Automatic Reporting on Trunks (CAROT), or equivalent, is to be used, the equipment at the end office shall comply with Bellcore document SR-TSV-002275, BOC Notes on the LEC Networks—1990, section 8, Item 2.

(ii) Transmission test circuits are available with a variety of options. These include single frequency and multifrequency tone generators with one or more generator output terminals, quiet terminations, and loop around test arrangements for both one-way and two-way trunks.

(iii) Where multifrequency generators are used, they are usually arranged to provide a minimum of three frequencies. With some equipment, up to seven additional frequencies may be provided if needed. No industry standardization of test frequencies is as yet provided. Therefore, it is important that the selection of frequencies, the order in which they are applied and the time interval for application of each frequency be agreed upon by the connecting company and the RUS borrower and listed in appendix A of this section in those situations where connecting companies request the installation of multifrequency generators in borrowers' central offices.

(iv) The milliwatt generator shall be solid-state and generate the analog or digital equivalent of 1004 Hz. The milliwatt generator shall be assigned to a 4-wire analog test port or be digitally generated. All 2-wire and 4-wire voice frequency ports are at a nominal 0 dBm<sub>0</sub> level. The level of the 1004 Hz tone generator shall appear at outgoing 2-wire and 4-wire ports at 0 dBm ±0.5 dB. For direct digital connections, the encoded output shall be the digital equivalent of a 0 dBm<sub>0</sub> ±0.5 dB signal.

(v) Reference tone generators can be used individually or they can be part of a loop around test arrangement. If both single frequency and multifrequency

reference tone generators are to be provided, only one can be arranged as part of a loop around test. Where a loop around arrangement is provided, the generator output can be obtained by dialing singly one of the two line terminals. By dialing the other line terminal singly, usually a 900 ohm resistor in series with a 2.16 microfarad capacitor is connected to the circuit under test to act as a "quiet termination" for noise measurements and other tests. Whenever both line terminals are held simultaneously, both the milliwatt supply and the quiet termination shall be lifted off and a "loop around" condition established. This permits the overall loss to be determined from the distant office by going out over one trunk, looping around in the end office and returning over the other trunk. The insertion loss of this test arrangement when used in a loop around configuration should not exceed 0.1 dB at the frequencies specified for the milliwatt supply. Unless otherwise specified, continuous off-hook supervision is to be provided on both line terminals to prevent collusive calling without charge. It will be permissible to accomplish the quiet termination by opening the 4-wire path internally and to accomplish the loop around by digital switching.

(vi) Provision shall be made so that the milliwatt supply can be manually patched to circuits.

(vii) Test jack access shall be provided for all interoffice trunks of the voice frequency type. The jack access shall be properly designated for line, drop, monitor, and signaling leads plus any other jacks as requested by the owner. This may be accomplished by a set of jacks located at the maintenance center which have access to each trunk on a switching basis.

(p) *Traffic—(1) General engineering guidelines.* (i) The Traffic Table, based on the Erlang Lost-Calls-Cleared Formula, shall be used for determining the quantity of intraoffice paths, registers, and senders where full availability conditions apply. The following table shows the traffic capacity in CCS for 1 to 200 trunks at nine grades of service.

TRAFFIC TABLE  
 Full Availability for Random Traffic  
 LOST-CALLS-CLEARED  
 Offered Traffic Expressed in CCS

Number of Trunks	B-.001	.002	.005	.01	.02	.05	.1	.2	.5	Number of Trunks
1	0	0	0	0	1	2	4	9	36	1
2	2	3	4	5	8	14	22	36	98	2
3	7	9	13	17	22	32	46	69	165	3
4	16	19	25	31	39	55	74	106	234	4
5	27	32	41	49	60	80	104	144	304	5
6	41	48	58	69	82	107	135	184	374	6
7	57	65	78	90	106	135	168	224	445	7
8	74	83	98	113	131	163	202	265	516	8
9	92	103	120	136	156	193	236	307	586	9
10	111	123	143	161	183	224	270	348	656	10
11	131	145	166	186	210	255	306	391	729	11
12	152	167	190	212	238	286	341	433	801	12
13	174	190	215	238	266	318	377	476	872	13
14	196	213	240	265	295	350	413	519	944	14
15	219	237	266	292	324	383	449	562	1015	15
16	242	261	292	320	354	415	486	605	1087	16
17	266	286	318	347	384	449	523	648	1158	17
18	290	311	345	376	414	482	560	692	1230	18
19	314	337	372	404	444	515	597	735	1302	19
20	339	363	399	433	474	549	634	779	1374	20
21	364	388	427	462	505	583	671	823	1445	21
22	389	415	455	491	536	617	709	866	1517	22
23	415	441	483	521	567	651	747	910	1589	23
24	441	468	511	551	599	685	784	954	1661	24
25	467	495	540	580	630	720	822	998	1733	25
26	493	523	568	611	662	754	860	1042	1805	26
27	520	550	598	641	693	788	898	1086	1876	27
28	546	578	627	671	725	823	936	1130	1948	28
29	573	606	656	702	757	858	974	1174	2020	29
30	600	634	685	732	789	893	1012	1218	2092	30
31	628	662	715	763	822	928	1050	1263	2164	31
32	655	690	744	794	854	963	1089	1307	2236	32
33	683	719	774	825	887	998	1127	1351	2308	33
34	711	747	804	856	919	1033	1165	1395	2380	34
35	739	776	834	887	951	1068	1203	1439	2452	35
36	767	805	864	918	984	1104	1242	1484	2524	36
37	795	834	895	950	1017	1139	1281	1528	2595	37
38	823	863	925	981	1050	1174	1319	1572	2667	38
39	851	892	955	1013	1083	1210	1358	1617	2739	39
40	880	922	986	1044	1116	1246	1396	1661	2811	40
41	909	951	1016	1076	1149	1281	1435	1706	2883	41
42	937	980	1047	1108	1182	1317	1474	1750	2955	42
43	966	1010	1078	1140	1215	1352	1512	1795	3027	43
44	995	1040	1109	1171	1248	1388	1551	1839	3099	44
45	1024	1070	1140	1203	1282	1424	1590	1884	3171	45
46	1053	1099	1171	1236	1315	1459	1629	1928	3243	46
47	1083	1129	1202	1268	1349	1495	1668	1973	3315	47
48	1112	1159	1233	1300	1382	1531	1706	2017	3387	48
49	1141	1189	1264	1332	1416	1567	1745	2062	3459	49
50	1170	1220	1295	1364	1449	1603	1784	2106	3531	50
51	1200	1250	1327	1397	1483	1639	1823	2151	3603	51
52	1229	1280	1358	1429	1516	1675	1862	2195	3675	52
53	1259	1310	1390	1462	1550	1711	1901	2240	3747	53
54	1289	1341	1421	1494	1584	1747	1940	2285	3819	54
55	1319	1371	1453	1527	1618	1783	1979	2329	3891	55
56	1349	1402	1484	1559	1652	1819	2018	2374	3962	56
57	1378	1432	1516	1592	1686	1856	2057	2418	4034	57
58	1408	1463	1548	1625	1719	1892	2096	2463	4106	58
59	1439	1494	1579	1657	1753	1928	2136	2508	4178	59
60	1468	1525	1611	1690	1787	1965	2174	2552	4250	60
61	1499	1556	1643	1723	1821	2001	2214	2597	4322	61

TRAFFIC TABLE—Continued  
 Full Availability for Random Traffic  
 LOST-CALLS-CLEARED  
 Offered Traffic Expressed in CCS

Number of Trunks	B-.001	.002	.005	.01	.02	.05	.1	.2	.5	Number of Trunks
62	1529	1587	1675	1756	1855	2037	2253	2642	4394	62
63	1559	1617	1707	1789	1889	2073	2292	2687	4466	63
64	1590	1648	1739	1822	1923	2110	2331	2731	4538	64
65	1620	1679	1771	1855	1958	2146	2370	2776	4610	65
66	1650	1710	1803	1888	1992	2182	2409	2821	4682	66
67	1681	1742	1835	1921	2026	2219	2449	2865	4754	67
68	1711	1773	1867	1954	2060	2255	2488	2910	4826	68
69	1742	1804	1900	1987	2094	2291	2527	2955	4898	69
70	1773	1835	1932	2020	2129	2328	2566	3000	4970	70
71	1803	1867	1964	2053	2163	2364	2606	3044	5042	71
72	1834	1898	1997	2087	2197	2401	2645	3089	5114	72
73	1865	1929	2029	2120	2232	2438	2684	3134	5186	73
74	1895	1961	2061	2153	2266	2474	2723	3178	5258	74
75	1926	1992	2093	2186	2300	2511	2763	3223	5330	75
76	1957	2024	2126	2219	2335	2547	2802	3268	5402	76
77	1988	2055	2159	2253	2369	2584	2841	3313	5474	77
78	2019	2087	2191	2286	2404	2620	2881	3357	5546	78
79	2050	2118	2223	2319	2438	2657	2920	3402	5618	79
80	2081	2150	2256	2353	2473	2694	2959	3447	5690	80
81	2112	2182	2289	2386	2507	2730	2999	3492	5762	81
82	2143	2213	2321	2420	2542	2767	3038	3537	5834	82
83	2174	2245	2354	2453	2577	2803	3077	3581	5906	83
84	2206	2277	2386	2487	2611	2840	3117	3626	5977	84
85	2237	2309	2419	2521	2646	2877	3156	3671	6049	85
86	2268	2340	2452	2554	2680	2913	3196	3716	6121	86
87	2299	2372	2485	2588	2715	2950	3235	3761	6193	87
88	2331	2404	2517	2621	2750	2987	3275	3805	6265	88
89	2362	2436	2550	2655	2784	3024	3314	3850	6337	89
90	2393	2468	2583	2688	2819	3060	3353	3895	6409	90
91	2425	2500	2616	2722	2854	3097	3393	3940	6481	91
92	2456	2532	2649	2756	2889	3134	3432	3984	6553	92
93	2488	2564	2682	2790	2923	3171	3471	4029	6625	93
94	2519	2596	2715	2823	2958	3208	3511	4074	6697	94
95	2551	2628	2748	2857	2993	3244	3551	4119	6769	95
96	2582	2660	2781	2891	3028	3281	3590	4164	6841	96
97	2614	2692	2814	2925	3063	3318	3630	4209	6913	97
98	2645	2724	2847	2958	3097	3355	3669	4253	6985	98
99	2677	2757	2880	2992	3132	3392	3708	4298	7057	99
100	2709	2789	2913	3026	3167	3429	3748	4343	7129	100
105	2867	2950	3078	3196	3342	3613	3946	4567	7489	105
110	3027	3112	3244	3366	3516	3798	4143	4792	7849	110
115	3186	3275	3411	3536	3691	3983	4341	5016	8209	115
120	3347	3437	3578	3707	3867	4168	4539	5241	8569	120
125	3507	3601	3745	3878	4043	4353	4737	5465	8929	125
130	3669	3765	3912	4049	4219	4539	4935	5689	9289	130
135	3830	3929	4081	4221	4395	4724	5133	5914	9649	135
140	3992	4093	4249	4392	4571	4910	5332	6138	10009	140
145	4155	4258	4418	4564	4748	5095	5530	6363	10369	145
150	4318	4423	4586	4737	4925	5282	5728	6587	10729	150
155	4481	4589	4755	4909	5102	5467	5927	6812	11089	155
160	4644	4755	4925	5082	5279	5654	6125	7037	11449	160
165	4808	4920	5094	5255	5457	5840	6324	7261	11809	165
170	4972	5087	5264	5428	5634	6026	6523	7486	12169	170
175	5137	5253	5434	5602	5811	6213	6722	7710	12529	175
180	5301	5420	5604	5775	5989	6399	6920	7935	12889	180
185	5466	5587	5775	5949	6167	6586	7119	8160	13249	185
190	5631	5754	5945	6123	6345	6773	7318	8384	13609	190
195	5797	5922	6116	6296	6524	6960	7517	8609	13969	195
200	5962	6089	6287	6471	6702	7146	7716	8834	14329	200

(ii) The traffic capacity for all inter-office trunks shall be based on full availability, even though the distant office itself is not engineered to provide full availability access.

(iii) The Traffic Table may also be used to determine the approximate traffic capacity of high-usage intertoll trunks. The traffic offered to high-usage groups may be read at B.10, signifying that 10 percent of the traffic overflows to the alternate route. This approximates the HU12 table used by AT&T.

(iv) In reading the trunk quantity from the table, the higher quantity shall be used when the CCS load is three or more CCS over the lower quantity. For example, the number of trunks justified for 294 CCS at B.005 is 16, but for 295 CCS 17 trunks are justified.

(v) Limited availability is not permitted.

(vi) The traffic capacity in the following table should be used for small trunk groups such as pay station, special service trunks, intercept, and PBX trunks, unless otherwise specified in appendix A of this section:

Number of Circuits	Permissible CCS
1	10
2	20
3	30
4	40

(vii) The percentage of lines equipped for pushbutton dialing is to be used to determine the number of tone receivers. Local registers, if required, shall be supplied on the basis of all dial pulse.

(2) *Grade of service.* (i) Grade of service specifies the expected performance when there are adequate service facilities for an assumed volume of traffic. It is expressed as a portion of the total traffic during a busy hour that cannot be terminated immediately or within a predetermined time period due to congestion. This places responsibility on the traffic engineers to specify facilities which will be entirely satisfactory to the users and which can be equipped at a price which will be accepted as reasonable.

(ii) The number of calls encountering dial tone delay in excess of 3 seconds, measured over the busy hour of the

four high-consecutive week (4HW) period, shall not be more than 1.5 percent.

(iii) The average post dialing delay objective for an intraoffice call shall not exceed 1 second. This includes all connect, operate, and translation time.

(iv) The line to line (intraoffice) network matching loss objective shall be 0.02 or less.

(v) The blocking probabilities related to trunks include both "mismatch" probability and probability of "all trunks busy." It is likely that the "mismatch" will be negligible in that many digital central offices have essentially nonblocking switching characteristics. The objectives for trunk connections are as follows:

(A) Subscriber to outgoing trunk objective 0.01 or less;

(B) Incoming trunk to subscriber objective 0.02 or less; and

(C) Local trunk tandem objective 0.01 or less.

(vi) Groups of common service circuits are to be engineered utilizing the full availability traffic tables that appear in paragraph (p)(1)(i) of this section at the following stipulated probabilities:

(A) Outgoing trunks to 2/6 MF or dial pulse senders at B.001;

(B) Incoming trunks to 2/6 MF receivers at B.001;

(C) Incoming nondelay dial trunks to receivers at B.001; and

(D) Incoming trunks with start dial at B.01.

(vii) Remote Switching Terminals (RST's) shall meet the same grade of service objectives as the host.

(3) *Holding times.* For the purpose of estimating the quantity of common control circuits, the following average holding times may be used. These holding times are conservative and represent the average effective and ineffective call. If these holding times are to be used, it must be so stated in appendix A of this section.

(i) The following average call holding times (HT) may be used.

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Type of Call	HT—Sec- onds
Intraoffice	120
EAS	150
Special Service, Intercept, Verification	60
Toll, CLR	300
Toll, S-S	24
Toll, PPCS	270

(ii) The following average subscriber dialing holding times may be used (times used to dial digits do not include machine time).

	Digits Dialed	DP Sec.	Push-button Sec.
Operator, Non-Pay Station	1	4.7	3.4
Special Service	3	7.7	5.0
Local	7	13.7	8.2
EAS	7	13.7	8.2
DDD: 1/0+7	8	15.2	9.0
DDD: 1/0+10	11	19.7	11.4
Dialing Time Per Digit	-	1.5	0.8
Dial Tone Response	-	3.2	2.6

(iii) The following average incoming register holding times may be used (times for digit registrations do not include machine time).

	Basic		Additional Per Digit
	Hold-ing Time (Sec.)	Digits	
MF Receiver from:			
No. 5 Crossbar—Non-LAMA	1.4	4	0.14
No. 5 Crossbar—LAMA	2.3	4	0.14
Crossbar Tandem & 4A Toll	3.1	4	0.14
No. 1 ESS	1.4	4	0.14
Key Pulsing Switchboard	5.2	4	0.60
DP Receivers—10 PPS from:			
SxS	6.0	4	1.5
Dialing Switchboard	6.6	4	1.3
4A Toll	5.6	5 <sup>1</sup>	-
Crossbar Tandem	4.9	4	1.2

<sup>1</sup>No reduction for fewer digits.

(iv) The following average sender holding times may be used (does not include machine setup and release time).

	Basic		Additional Per Digit
	Hold-ing Time (Sec.)	Digits	
MF Senders:			
No. 5 Crossbar	1.5	4	0.14
Crossbar Tandem & 4A Toll <sup>1</sup>	2.0	4	0.14
TSP/TSPS	2.4	7	0.14
SxS—CAMA, Called Number	3.7	7	0.14
SxS—CAMA, Calling Number	1.3	7	-

	Basic		Additional Per Digit
	Hold-ing Time (Sec.)	Digits	
DP Senders—10 PPS:			
With Overlap Pulsing <sup>2</sup>	9.1	Up to 6	1.8
Without Overlap Pulsing	4.6	4	1.2

<sup>1</sup>Add 1.3 seconds for ANI outpulsing on special toll (0+) calls and on DDD calls if AMA is not provided.

<sup>2</sup>Assumes overlap outpulsing starting on receiving of third digit; applies only to calls handled on direct trunk groups.

(4) *Traffic data requirements.* (i) Traffic measurements are composed of primarily two types—counts and usage. The following types of traffic data recording are required:

(A) *Peg count* registers shall be incremented when a successful network connection is established to a particular circuit group such as trunks, senders, digital receivers, etc.

(B) *Overflow count* registers shall be incremented when access to a particular circuit group is denied due to all resource busy condition.

(C) *Network blockage count* registers shall be incremented due to an unavailability of a path in an access or switching matrix network.

(D) *Usage* measurements of the length of time associated with a particular setup event or network connection shall be made. Usage data measurements are normally collected by scanning circuit groups resources every 10 or 100 seconds to determine busy/idle states. Measurements are accumulated and read directly in CCS (hundred call seconds).

(E) *Service delay* measurements shall provide percentage counts of the calls for a particular service that are delayed beyond a specified interval of time, e.g., calls not receiving dial tone within 3 seconds after call origination.

(ii) Traffic data shall be stored in electronic storage registers or block of memory consisting of one or more traffic counters for each item to be measured. The registers listed in paragraph (p)(4)(i) of this section shall be associated with the interoffice trunks, switching network and central control equipment in such a manner that the register readings can be used to determine the traffic load and flow to, from and within the system. Two-way

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trunks shall be metered to indicate inward and outward seizures. The bidder shall indicate what registers are to be supplied and their purpose.

(iii) The measured data shall be shown on a printout. It should be possible to have local or remote printout, or both. Arrangement shall be made for automatic data printout on command for 15-, 30-, or 60-minute intervals as required, and be arranged for automatic start-stop and in accordance with revenue separation procedures current at the time of contract.

(iv) All traffic records shall have dates and times and office identification.

(q) *Transmission*—(1) *General*. The transmission characteristics will be governed by the fact that the switching matrix will be based on digital operation. Unless otherwise stated, the requirements are in terms of analog measurements made from Main Distributing Frame (MDF) to MDF terminals, excluding cabling loss.

(2) *Impedance*. For the purpose of this section, the nominal input impedance of analog ports in an end office shall be 900 ohms for 2-wire ports and 600 ohms for 4-wire ports. Where the connecting facility or equipment is other than this impedance, suitable impedance matching shall be provided by the bidder when specified by the owner.

(3) *Insertion loss*. The insertion loss in both directions of transmission at 1004 Hz shall meet the following requirements when measured with a 0 dBm input signal at 900 ohms (or 600 ohms, when required) at a temperature of 77 °F ±9 °F (25 °C ±5 °C).

(i) *Trunk-to-trunk or trunk-to-line*. The loss shall be set between 0 and 0.5 dB for 2-wire to 2-wire, 2-wire to 4-wire, or 4-wire to 4-wire voice frequency connections.

(ii) *Line-to-line*. The loss shall be set between 0 and 2 dB.

(iii) *Direct digital interface*. On a direct digital interface, the loss through the office shall be adjusted to the proper level in the receive side.

(iv) *Stability*. The long-term allowable variation in loss through the office shall be ±0.5 dB from the loss specified by the bidder.

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(4) *Frequency response (loss relative to 1004 Hz)* shall meet the following requirements.

(i) *Trunk-to-trunk*.

Frequency (Hz)	Loss at 0 dBm0 Input <sup>1</sup>	
	2-Wire to 2-Wire	4-Wire to 4-Wire
60	20 dB Min. <sup>2</sup>	16 dB Min. <sup>2</sup>
200	0 to 5 dB	0 to 3 dB
300-3000	-0.5 dB to 1 dB	-0.3 to +0.3 dB
3300	1.5 dB Max.	1.5 dB Max.
3400	0 to 3 dB	0 to 3 dB

<sup>1</sup>(-) means less loss and (+) means more loss.  
<sup>2</sup>Transmit End

(ii) *Line-to-line*.

Frequency (Hz)	Loss at 0 dBm0 Input <sup>1</sup>
60	20 dB Min. <sup>2</sup>
300	-1 to +3 dB
600-2400	±1 dB
3200	-1 to +3 dB

<sup>1</sup>(-) means less loss and (+) means more loss.  
<sup>2</sup>Transmit End

(iii) *Trunk-to-line*. The trunk-to-line frequency response requirements shall be a compromise between those values specified in paragraphs (q)(4)(i) and (q)(4)(ii) of this section.

(5) *Overload level*. The overload level at 900 ohm impedance shall be +3 dBm0.

(6) *Gain tracking (linearity)* shall meet the following requirements.

Input Signal Level <sup>1</sup>	Maximum Gain Deviation
+3 to -37 dBm0	±0.5 dB
-37 to -50 dBm0	±1 dB

<sup>1</sup>1004 Hz reference at 0 dBm0.

(7) *Return loss*. (i) The specified return loss values are determined by the service and type of port at the measuring (near) end. Two-wire ports are measured (near end) at 900 ohms in series with 2.16 microfarads and 4-wire ports are measured at 600 ohms resistive.

(ii) Far end test terminations shall be as follows:

(A) Loaded line circuit—1650 ohms in parallel with the series combination of .005 microfarads and 100 ohms;

(B) Nonloaded line circuit—800 ohms in parallel with the series combination of .05 microfarads and 100 ohms;

(C) Special service line circuit including electronic lines and carrier lines—900 ohms in series with 2.16 microfarads;

(D) Two-wire trunk—900 ohms in series with 2.16 microfarads; and

(E) Four-wire trunk—600 ohms.

(iii) For trunk-to-trunk (2-wire or 4-wire) connections the echo return loss (ERL) shall be 27 dB, minimum and the singing return loss (SRL) shall be 20 dB, minimum low and 23 dB, minimum high.

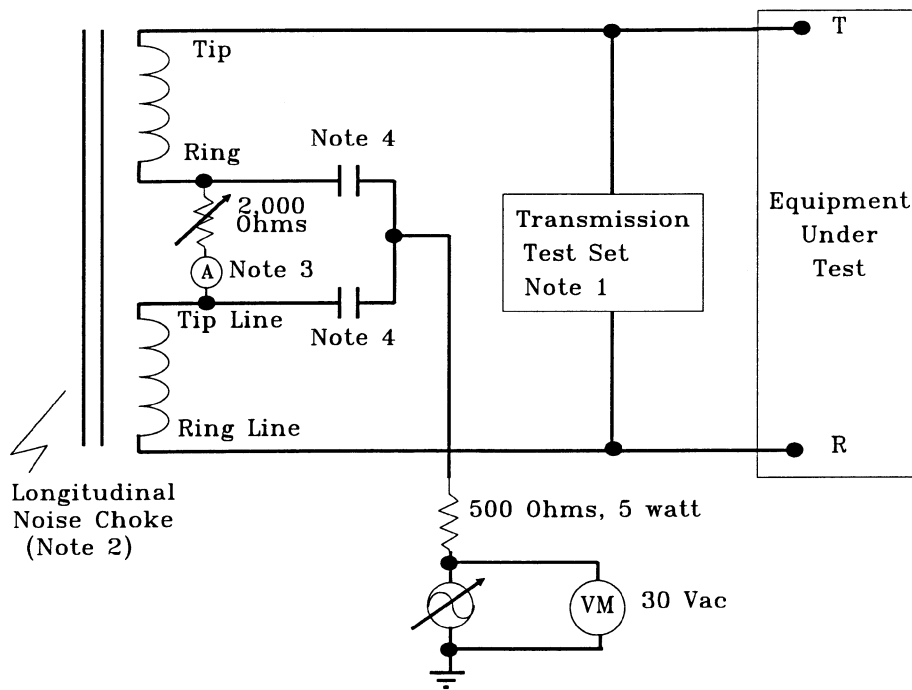
(iv) For trunk-to-line (2-wire or 4-wire) connections the ERL shall be 24 dB, minimum and the SRL shall be 17 dB, minimum low and 20 dB, minimum high.

(v) For line-to-line or line-to-trunk (2-wire or 4-wire) connections the ERL shall be 18 dB, minimum and the SRL shall be 12 dB, minimum low and 15 dB, minimum high.

(8) *Longitudinal balance.* The minimum longitudinal balance, with dc loop currents of 20 to 70 mA, shall be 60 dB at all frequencies between 60 and 2000 Hz, 55 dB at 2700 Hz and 50 dB at 3400 Hz. The method of measurement shall be as specified in the IEEE Std 455-1985, IEEE Standard Test Procedure for Measuring Longitudinal Balance of Telephone Equipment Operating in the Voice Band. Source voltage level shall be 10 volts root-mean-square (rms).

(9) *60 hz longitudinal current immunity.* Under test conditions with 60 Hz, the system noise shall be no greater than 23 dB<sub>BrnC0</sub> as measured using the configuration in Figure 1.

FIGURE 1—MEASURING THE EFFECTS OF LOW FREQUENCY INDUCTION



- NOTES:
1. 900 ohm termination, C-message weighting, hold coil off
  2. SNC Noise Choke 35 W, or equivalent
  3. Test at 0.020 Adc and 0.070 Adc

4.  $2 \pm 0.001$  microfarad, 150 Vdc
- (10) *Steady noise* (idle channel at 900 ohms impedance) measured on a terminated call shall be 23 dB<sub>BrnC0</sub> maximum

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and average 18 dBrnC0 or less. The 3K Hz Flat noise should be less than 35 dBrnC0 as an objective.

(11) *Impulse noise.* The central office switching equipment shall be capable of meeting an impulse noise limit of not more than five counts exceeding 54 dBrnC0 voice band weighted in a 5-minute period on six such measurements made during the busy hour. A Northeast Electronics Company TTS 4002 Impulse Noise Counter, Wilcom T194C, Hewlett Packard 4945, or equivalent, should be used for the measurements. The measurement shall be made by establishing a normal connection from the noise counter through the switching equipment in its off-hook condition to a quiet termination of 900 ohms impedance. Office battery and signaling circuit wiring shall be suitably segregated from voice and carrier circuit wiring, and frame talking battery filters provided, if and as required, in order to meet these impulse noise limits.

(12) *Crosstalk coupling.* Worst case equal level crosstalk is to be 75 dB minimum in the range 200-3400 Hz. This is to be measured between any two paths through the system connecting a 0 dBm0 level tone to the disturbing pair.

(13) *Quantizing distortion.* (i) The switching system shall meet the following requirements.

Input Level (dBm0) 1004 or 1020 Hz	Minimum Signal to Distortion with C-Message Weighting
0 to -30	33 dB
-30 to -40	27 dB
-40 to -45	22 dB

(ii) Due to the possible loss of the least significant bit on direct digital connections, a signal to distortion degradation of up to 2 dB may be allowed where adequately justified by the bidder.

(14) *Absolute delay.* The absolute one-way delay through the switching system, excluding delays associated with RST switching, shall not exceed 1000 microseconds analog-to-analog measured at 1800 Hz.

(15) *Envelope delay distortion.* On any properly established connection, the envelope delay distortion shall not exceed the following limits.

Frequency Range (Hz)	Microseconds
1000 to 2600	190
800 to 2800	350
600 to 3000	500
400 to 3200	700

(16) *Digital error rate.* The digital switching system shall not introduce an error into digital connections which is worse than one error in 10<sup>8</sup> bits averaged over a 5-minute period.

(17) *Battery noise.* Noise across battery at power board distribution bus terminals shall not exceed 35 dBrnC during the busy hour.

(18) Radio and television interference. The central office switching equipment shall be designed and installed so that radiation of high frequency noise will be limited so as not to interfere with radio and television receivers.

(r) *Timing intervals*—(1) *Type of equipment required.* The equipment for providing the specified timing intervals shall be solid-state.

(2) *Tolerance.* Where a range of time is specified as minimum and maximum, the lower limits shall be considered as controlling and the variation between this minimum and the actual maximum shall be kept as small as practicable. In no case shall the quoted upper limit be exceeded.

(3) *Permanent signal timing.* Lockout shall occur after an interval of 20 to 30 seconds after receipt of dial tone if a “permanent” condition occurs prior to the transmission of dial pulses or push-button dialing signals. This interval may be reduced appreciably during periods of heavy traffic.

(4) *Partial dial timing.* Partial dial timing shall be within 15 to 37 seconds. This timing may be reduced appreciably during periods of heavy traffic.

(5) *Charge delay timing.* Charge delay timing shall be within 2 seconds.

(6) *Called party disconnect timing.* Timed disconnect of a terminating path under control of the called party shall be 10 to 32 seconds.

(7) *Timing intervals for signals involved in distance dialing.* Timing intervals shall be provided to meet the requirements for distance dialing equipment, which have been established in Bellcore document SR-TSV-002275, BOC Notes on the LEC Networks—1990.



Some of the more important times which this document specifies are for:

- (i) Disconnect signal;
- (ii) Wink signal;
- (iii) Start dialing signal;
- (iv) Pulse delay signal;
- (v) Go signal;
- (vi) Digit timing; and
- (vii) Sender, register, and link attachment timing.

(s) *Power requirements and equipment—*

(1) *Operating voltage.* The nominal operating voltage of the central office shall be 48 volts dc, provided by a battery with the positive side tied to system ground.

(2) *Batteries.* (i) When battery cells of the lead antimony type are specified, the pasted plate type shall be considered adequate.

(ii) When lead calcium cells are specified, no cell shall differ from the average voltage of the string of fully charged cells by more than  $\pm 0.03$  volt when measured at a charging rate in amperes equivalent to 10 percent of the ampere hour capacity of the cells. Similarly, when cells are fully charged and floating between 2.30 and 2.33 volts per cell, the cell voltage of any cell in a given string shall not differ more than  $\pm 0.03$  volt from the average. These requirements are for test purposes only and do not apply to operating conditions.

(iii) Voltage readings shall be corrected by a temperature coefficient of 0.0033 volt per degree F (0.006 per degree C), whenever temperature variations exist between cells in a given string. This correction factor shall also be applied when comparing cell voltages taken at different times and at different temperatures. The correction factor shall be added to the measured voltage when the temperature is above 77 °F (25 °C) and subtracted when the temperature is below 77 °F (25 °C).

(iv) The specific gravity readings of lead antimony cells at full charge shall be  $1.210 \pm 0.010$  at 77 °F (25 °C) at maximum electrolyte height.

(v) When counter cells are supplied by the bidder, they shall be the dry counter electromotive force (CEMF) type.

(vi) When lead antimony batteries are specified, they shall be designed to last a minimum of 10 years when maintained on a full float operation between 2.15 and 2.17 volts per cell. When lead calcium batteries are specified, they shall be designed to last a minimum of 20 years when maintained on full float operation between 2.17 and 2.25 volts per cell. The battery shall be clearly designated as “antimony” or “calcium” by means of stencils, decals or other devices.

(vii) Each battery cell shall be equipped with an explosion control device.

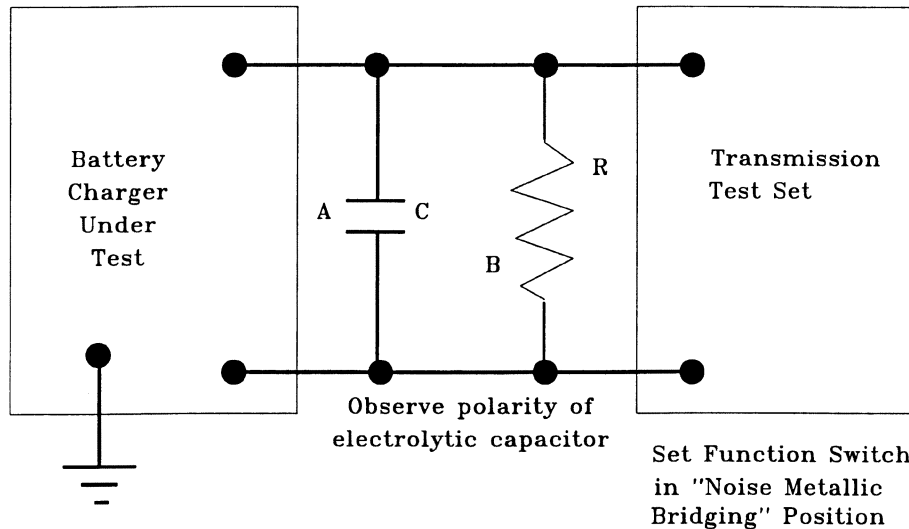
(viii) The battery size shall be calculated in accordance with standard procedures. The battery in no case shall have a reserve capacity in ampere hours less than four times the current capacity of the largest charger.

(3) *Charging equipment.* (i) Charging shall be on a full float basis. The rectifiers shall be of the full wave, self-regulating, constant voltage, solid-state type and shall be capable of being turned on and off manually.

(ii) When charging batteries, the voltage at the battery terminals shall be adjustable and shall be set at the value recommended for the particular battery being charged, providing it is not above the maximum operating voltage of the switching system equipment. The voltage shall not vary more than plus or minus 0.02 volt per cell between 10 percent load and 100 percent load. Between 3 percent and 10 percent load, the output voltage shall not vary more than plus or minus 0.04 volt per cell. Beyond full load current, the output voltage shall drop sharply. The output voltage shall be maintained with the line voltage variations of plus or minus 10 percent. Provision shall be made to change the output voltage of the rectifier manually to 2.25 volts per cell to provide an equalization charge on the battery.

(iii) The charger noise shall not exceed 22 dBrnC when measured with a suitable noise measuring set and under the rated battery capacitance and load conditions as determined in Figure 2.

FIGURE 2—CHARGER NOISE TEST



The manufacturer may elect to eliminate the capacitor C from the measurement.

A. Capacitance in  $\mu\text{F} = 30,000 \mu\text{F}$  per ampere-hour per cell. For example, 25 cells at 100 ampere-hour would be equivalent to a capacitance of:

$$(30,000 \times 100) / 25 = 120,000 \mu\text{F}$$

B. The value of the resistive load R is determined by the nominal battery voltage in volts divided by the full load rating in amperes. For example, for a 48 volt battery and a full load current of 24 amperes, the load resistance R is  $48 / 24 = 2$  ohms of appropriate power handling capacity.

(iv) The charging equipment shall indicate a failure of charging current, whether due to ac power failure, an internal failure in the charger, or to other circumstances which might cause the output voltage of the charger to drop below the battery voltage. Where a supplementary constant current charger is used, an alarm shall be provided to indicate a failure of the charger.

(v) Audible noise developed by the charging equipment shall be kept to a minimum. Acoustic noise resulting from operation of the rectifier shall be expressed in terms of dB indicated on a sound level meter conforming to ANSI S1.4-1983, Specification for Sound Level

Meters, and shall not exceed 65 dB (A-weighting) measured at any point 5 feet (152.4 cm) from any vertical surface of the rectifier.

(vi) The charging equipment shall be designed so that neither the charger nor the central office switching equipment is subject to damage in case the battery circuit is opened for any value of load within the normal limits.

(vii) The charging equipment shall have a capacity to meet the requirements of central office size and special requirements of the owner in appendix A of this section.

(viii) Minimum equipment requirement for chargers is one of the following:

(A) Two chargers either capable of carrying the full office load as specified in Item 12 of appendix A of this section; or

(B) Three chargers each capable of carrying half the office load as specified in Item 12 of appendix A of this section.

(4) *Miscellaneous voltage supplies.* (i) Any power supply required for voltages other than the primary battery voltage shall be provided by either a solid-state dc-to-dc converter or dc-to-ac inverter,

operating from the central office battery or from a separate battery and charger. These power supplies shall meet the noise limit specified for chargers in paragraph (s)(3)(iii) of this section, except the capacitor "C" shall be eliminated and the resistive load "R" shall be determined by the nominal output voltage in volts divided by the full load current rating in amperes. This requirement does not preclude the use of commercial ac power to operate input/output devices.

(ii) Power converters required for the purpose of providing various operating voltages to printed circuit boards or similar equipment employing electronic components shall be provided in duplicate with each unit capable of immediately assuming the full operating load upon failure of a unit. An exception to the duplicate power converter requirement permits nonduplicated power converter(s) to be utilized where there is full compliance with the following criteria.

(A) The failure of any single nonduplicated power converter shall not reduce the grade of service of common control and service circuits to any individual line or trunk by more than 50 percent.

(B) The failure of any single nonduplicated power converter shall not reduce the traffic carrying capacity of any interoffice trunk group by more than 50 percent.

(C) In central office switching systems of 400 or more equipped lines, any single nonduplicated power converter failure shall not cause a complete loss of service to more than 100 equipped lines.

(D) In central office switching systems of less than 400 equipped lines, any single nonduplicated power converter failure shall not cause a complete loss of service to more than 25 percent of the total equipped lines.

(5) *Ringling generators.* Ringling generators supplied on an ancillary basis shall be selected from RUS Bulletin 1755L-100, List of Materials Acceptable for Use on Telephone Systems of RUS Borrowers. Regardless of whether the ringling is generated on an ancillary basis or is generated integrally to the switching system, the ringling equip-

ment shall meet the requirements of this section.

(i) *Ringling equipment provisioning.* (A) Redundant ringling equipment shall be provided. There shall be automatic transfer to the redundant equipment within the period of one ringling cycle, in case of failure of the equipment in use (either regular or standby). Automatic transfer shall not take place under any other conditions. Manual transfer in each direction shall be provided.

(B) An exception to the redundant ringling equipment requirement permits nonredundant ringling equipment to be utilized where there is full compliance with the following service criteria.

(1) In a central office switching system of 400 or more equipped lines, a single nonduplicated ringling source failure shall not cause the complete loss of ringling capability to more than 100 lines.

(2) In a central office switching system of less than 400 equipped lines, a single nonredundant ringling source failure shall not cause the complete loss of ringling capability to more than 25 percent of the total equipped lines.

(ii) *Output voltage.* (A) The ringling generators shall have an output voltage which approximates a sine wave and, as a minimum, shall be suitable for ringling straight-line ringers. Although not a requirement for RUS listing, decimonic, synchromonic, or harmonic ringling may also be specified in appendix A of this section.

(B) The ringling generator shall obtain its energy from the nominal 48-volt office battery.

(C) The output of each generator shall have three or more voltage taps or a single tap with associated variable control. Taps or control shall be easily accessible as installed in the field. Software control of ringling generator outputs via I/O devices may be provided in lieu of taps. The taps, or equivalent, shall be designated L, M, and H. The variable control shall have a locking device to prevent accidental readjustment. The outputs at the terminals of the generators with a voltage input of 52.1 volts and rated full resistive load shall be as follows for the ringling frequencies provided:

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Frequency Range (Hz)	Output Volts rms (Tolerance 3 Volts)		
	L	M	H
16½ through 20 .....	90	105	120
21 through 30 .....	95	110	120
31 through 42 .....	100	115	130
43 through 54 .....	110	125	140

(D) No voltages in excess of the values in column H of the table in paragraph (s)(5)(ii)(C) of this section shall be provided at the output taps. Additional intermediate and/or lower taps may be provided without restriction.

(iii) *Voltage regulation.* (A) The output voltage for resistive, capacitive power factor of 0.8, and inductive power factor of 0.5 loads from no load to full rated output with 52.1 volts input battery shall not vary more than ±3 percent from the output voltage measured at ½ rated output, 1.0 power factor with 52.1 volts dc input applied.

(B) The output voltage for resistive, capacitive power factor of 0.8, and inductive power factor of 0.5 from no load to full rated output with input battery variations between 48-56 volts dc shall not vary more than ±10 percent from the output voltage measured at ½ rated output and 1.0 power factor with 52.1 volts dc input applied.

(C) The output voltage for resistive, capacitive power factor of 0.8, and inductive power factor of 0.5 loads from no load to full rated output and with input battery variations between 44-56 volts dc shall not vary more than +10/-15 percent from the output voltage measured at ½ rated output and 1.0 power factor with 52.1 volts dc input applied.

(iv) *Cross ringing.* Unwanted voltage caused by harmonic distortion or intermodulation distortion shall not exceed 15 volts rms when measured within ±5 Hz of any other assigned ringing frequency under any condition of load or input battery specified by paragraph (s)(5)(iii) of this section.

(v) *Frequency stability.* At ambient temperature of 70 ° ±5 °F (21 ° ±0.3 °C), for any combination of capacitive power factor of 0.8, inductive power factor of 0.5, and resistive loads with variations in input battery ranging from 44 to 56 volts, the output frequency shall not vary more than ±1/3 Hz or ±1 percent, whichever is less

stringent. At temperatures between 15 °F (4 °C) to 130 °F (54 °C), and for any combination of resistive load and variations in input battery ranging from 44-56 volts, the output frequency shall not vary more than ±1/3 Hz or ±1 percent, whichever is less stringent.

(vi) *Self-protection on overloads.* The ringing generator equipment shall be capable of withstanding a short circuit across any pair of output terminals for a period of 5 minutes without fuse operation or damage.

(6) *Interrupter equipment.* (i) The interrupter shall be an integral part of the switching system and shall be controlled by any call processor or equivalent.

(ii) The ringing cycle provided by the interrupter equipment shall not exceed 6 seconds in length. The ringing period shall be 2 seconds.

(7) *Power panels.* (i) Battery and charger control switches, dc voltmeters, dc ammeters, fuses and circuit breakers, supervisory and timer circuits shall be provided as required. Voltmeters shall be provided as specified by the owner.

(ii) Portable or panel mounted frequency meters shall be provided as specified by the owner unless the system is equipped to measure actual ringing generator voltage and frequency outputs internally. If the system is equipped to make such measurements and print the results, the bidder is not required to provide a frequency meter.

(iii) Power panels, cabinets and shelves, and associated wiring shall be designed initially to handle the exchange when it reaches its ultimate capacity as specified by the owner.

(iv) The power panel shall be of the "dead front" type.

(t) *Main distributing frames.* (1) The main distributing frame shall provide terminals for terminating all incoming cable pairs. Arresters shall be provided for all incoming cable pairs, or for a smaller number of pairs if specified, provided an acceptable means of temporarily grounding all terminated pairs which are not equipped with arresters is furnished.

(2) The current carrying capacity of each arrester and its associated mounting shall coordinate with a #22 gauge

copper conductor without causing a self-sustaining fire or permanently damaging other arrester positions. Where all cable pairs entering the central office are #24 gauge or finer, the arresters and mountings need only coordinate with #24 gauge cable conductors. Item 13 of appendix A of this section designates the gauge of the cable conductors serving the host office. Item 7 of appendix B of this section designates the gauge of the cable conductors serving the RST(s).

(3) Central office protectors shall be mounted and arranged so that outside cable pairs may be terminated on the left side of protectors (when facing the vertical side of the MDF) or on the back surface of the protectors. Means for easy identification of pairs shall be provided.

(4) Protectors shall have a "dead front" (either insulated or grounded) whereby live metal parts are not readily accessible.

(5) Protectors shall be provided with an accessible terminal of each incoming conductor which is suitable for the attachment of a temporary test lead. They shall also be constructed so that auxiliary test fixtures may be applied to open and test the subscriber's circuit in either direction. Terminals shall be tinned or plated and shall be suitable for wire wrapped, insulation displacement or connectorized connections.

(6) If specified in appendix A of this section, each protector group shall be furnished with a factory assembled tip cable for splicing to the entrance cable; the tip cable to be 20 feet (610 cm) in length unless otherwise specified. Factory assembled tip cable shall be #22 gauge and selected from RUS Bulletin 1755I-100, List of Materials Acceptable for Use on Telephone Systems of RUS Borrowers. Tip cable requirements are provided in RUS Bulletin 345-87, PE-87, RUS Specification for Terminating (TIP) Cable. Cables having other kinds of insulation and jackets which have equivalent resistance to fire and which produce less smoke and toxic fumes may be used if specifically approved by RUS.

(7) Protectors shall be mounted on vertical supports, with centers not exceeding 9 inches (22.9 cm). The space

between protector units shall be adequate for terminating conductors.

(8) Cable supporting framework shall be provided between the cable entrance and the MDF when overhead cable entrance is specified in Item 14.3.3 of appendix A of this section.

(9) The main distributing frame shall be equipped with a copper ground bus bar having the conductivity of a #6 American Wire Gauge (AWG) copper conductor or a greater conductivity, or may consist of another metal if specifically approved, provided it has adequate cross-sectional area to provide conductivity equivalent to, or better than, bare copper. A guardrail or equivalent shall also be furnished.

(10) Other features not specified in paragraph (t) of this section may be required at the option of the owner, if checked in Item 13.4 of appendix A of this section.

(11) Main frame protector makes and types shall be selected only from RUS Bulletin 1755I-100, List of Materials Acceptable for Use on Telephone Systems of RUS Borrowers. Protectors shall be capable of easy removal.

(u) *Electrical protection*—(1) *Surge protection*. (i) Adequate electrical protection of central office switching equipment shall be included in the design of the system. The characteristics and application of protection devices shall be such that they enable the central office switching equipment to withstand, without damage or excessive protector maintenance, the dielectric stresses and currents that are produced in line-to-ground and tip-to-ring circuits through the equipment as a result of induced or conducted lightning or power system fault-related surges. All wire terminals connected to outside plant wire or cable pairs shall be protected from voltage and current surges.

(ii) Central office switching equipment shall pass laboratory tests, simulating the hostile electrical environment, before being placed in the field for the purpose of obtaining field experience. There are five basic types of laboratory tests which shall be applied to exposed terminals in an effort to determine if the equipment will survive. Figure 3 summarizes these tests and the minimum acceptable levels of protection for equipment to pass them.

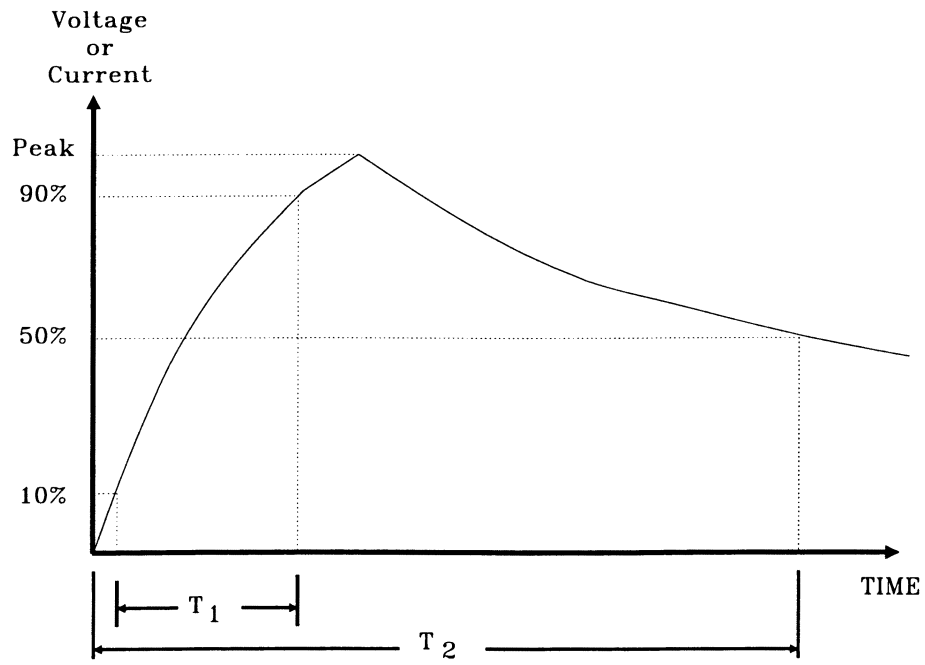
FIGURE 3—SUMMARY OF ELECTRICAL REQUIREMENTS AND TESTS

Test	Application Criteria	Peak Voltage or Current	Surge Waveshape	No. of Applications & Max. Time Between	Comments
Current Surge	Low Impedance Paths Exposed to Surges	500A or Lesser Current (See Fig. 5)	10×1000 μs	5 each Polarity at 1 minute intervals	
60 Hz Current Carrying	High or Low Impedance paths Exposed to Surges	10A rms or Lesser Current (See Fig. 6)	11 Cycles of 60 Hz (0.183 Sec.)	3 each Polarity at 1 minute intervals	
AC Power Service Surge Voltage	AC Power Service Connection	2500V or +3 σ clamping V of arrester employed at 10kV/μs	1.2×50 μs	5 each Polarity at 1 minute intervals	AC arrester, if used, must be removed. Communications line arresters, if used, remain in place.
Voltage Surge	High Impedance Paths Exposed to Surges	1000V or +3 σ dc breakdown of arrester employed	10×000 μs	Same	All primary arresters, if used, must be removed.
Arrester Response Delay	Paths protected by arresters, such as gas tubes, with breakdown dependent on V. rate of rise.	+3 σ breakdown of arrester employed at 100V/μs of rise	100V/μs rise decay to 1/2 V. in tube's delay time	Same	Same

(iii) *Two categories of surge tests.* (A) Current surge tests simulate the stress to which a relatively low impedance path may be subjected before main frame protectors break down. Paths with a 100 Hz impedance of 50 ohms or less shall be subjected to current surges, employing a 10 × 1000 microseconds waveshape as defined in Figure 4. For the purpose of determining this impedance, arresters which are mount-

ed within the equipment are to be considered zero impedance. The crest current shall not exceed 500A; however, depending on the impedance of the test specimen this value of current may be lower. The crest current through the sample, multiplied by the sample's 100 Hz impedance, shall not exceed 1000 volts (V). Where sample impedance is less than two ohms, crest current shall be limited to 500A as shown in Figure 5.

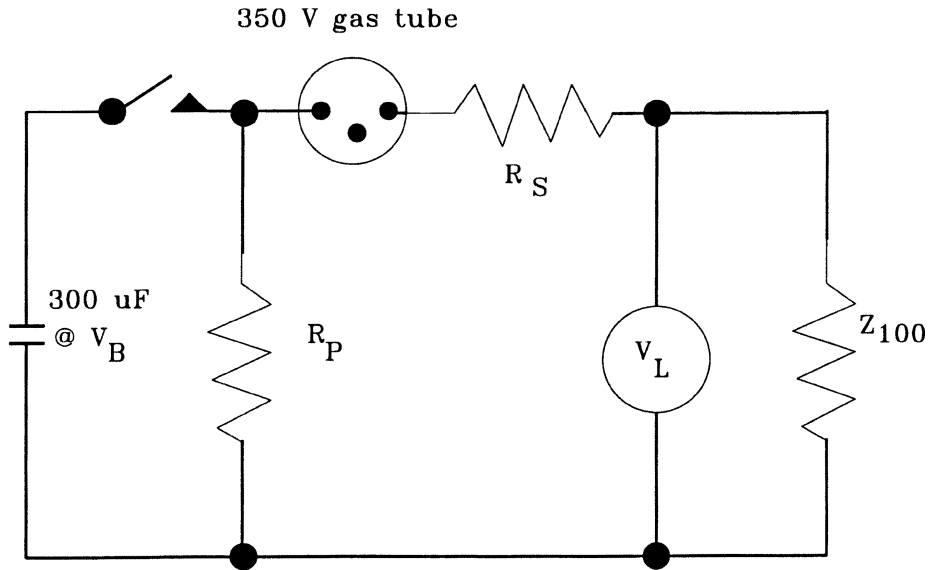
FIGURE 4—EXPLANATION OF SURGE WAVESHAVE



Surge Waveshape is defined as follows:  
 Rise Time  $\times$  Time to Decay to Half Crest  
 Value  
 (For example,  $10 \times 1000 \mu\text{s}$ )  
 Notes:

$T_1$  = Time to determine the rate of rise.  
 The rate of rise is determined as the  
 slope between 10% and 90% of peak volt-  
 age or current.  
 $T_2$  = Time to 50% of peak voltage (decay to  
 half value).

FIGURE 5—EXPLANATION OF SURGE WAVESHAPE



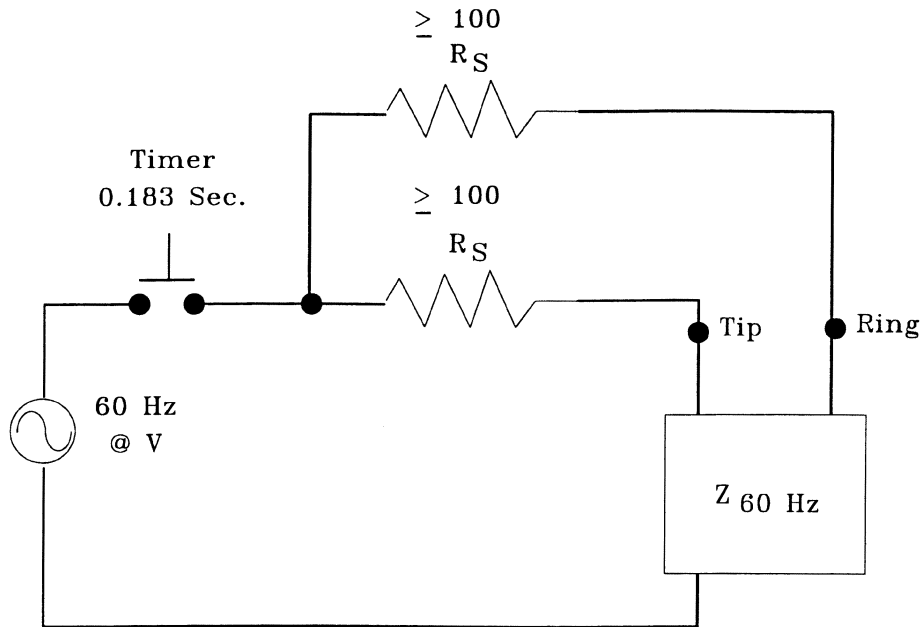
$V_L$  = Not to exceed 1000V  
 $V_B$  = Charging Voltage  
 $Z_{100}$  = Test Specimen Impedance to be measured at 100 Hz.  
 $R_P$  = Parallel Resistance (Waveshape)  
 $R_S$  = Series Resistance (Current Limiting)

$Z_{100}$	$R_S$	$R_P$	$V_B$
0	5	$\infty$	2500
1	4	$\infty$	2500
2	3	$\infty$	2500
3	2	$\infty$	1670
4	1	$\infty$	1250
5	0	$\infty$	1000
7.5	0	15	1000
10	0	10	1000
15	0	7.5	1000
20	0	6.7	1000
25	0	6.25	1000
30	0	6	1000
40	0	5.7	1000
50	0	5.5	1000

(B) Sixty Hertz (60 Hz) current-carrying tests should be applied to simulate an ac power fault which is conducted to the unit over the cable pairs. The test should be limited to 10 amperes rms at 60 Hz for a period of 11 cycles (0.1835 seconds) and should be applied longitudinally from line to ground (see Figures 3 and 6 of this section).



FIGURE 6—60 HZ CURRENT SURGE TEST



V—700 Volts RMS (Approximately 1000V Peak).

Z<sub>60</sub>—Test specimen impedance to be measured at 60 Hz.

R<sub>S</sub>—Series Resistance (current limiting) in each side of line. (Source impedance never less than 50 Ω longitudinal.)

Z <sub>60</sub> Hz	R <sub>S</sub>
0	140
10	120
20	100
50	100
Over 50	100

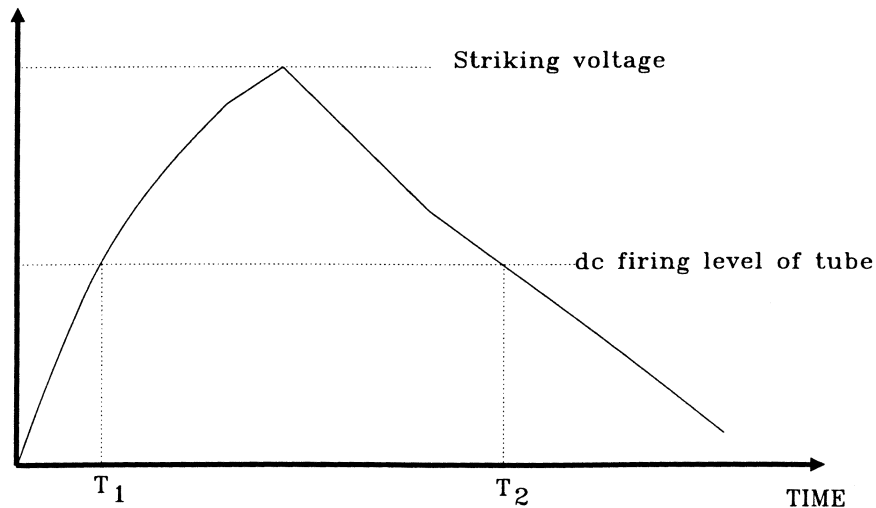
(C) AC power service surge voltage tests should be applied to the power input terminals of ac powered devices to simulate switching surges or lightning-induced transients on the ac power system. The test shall employ a 1.2 × 50 microseconds waveshape with a crest voltage of 2500V. Communications line protectors may be left in place for this test. Borrowers are urged to install commercially available surge protectors at the ac service entrance as part of their COE building program.

(D) Voltage surge tests simulate the voltage stress to which a relatively

high impedance path may be subjected before primary protectors break down and protect the circuit. To assure coordination with the primary protection while reducing testing to the minimum, voltage surge tests should be conducted at a 1000 volts with primary arresters removed for devices protected by carbon blocks, or the +3 sigma dc breakdown of other primary arresters. Surge waveshape should be 10 × 1000 microseconds.

(E) Arrester response delay tests are designed to stress the equipment in a manner similar to that caused by the delayed breakdown of gap type arresters when subjected to rapidly rising voltages. Arresters shall be removed for these tests, the peak surge voltage should be the +3 sigma breakdown of the arrester in question on a voltage rising at 100V per microsecond and the time for the surge to decay to half voltage shall equal at least the delay time of the tube, as explained in Figure 7.

FIGURE 7—EXPLANATION OF ARRESTER RESPONSE DELAY TIME



$$D = T_2 - T_1 = \text{Delay time of tube}$$

The delay time is that period of time when the potential across an arrester exceeds its dc firing level.

(iv) Five applications of each polarity for the surge tests and three for the 60 Hz Current Carrying Test are the minimum required. All tests should be conducted with not more than 1 minute between consecutive applications in each series of three or five to a specific configuration so that heating effects will be cumulative. As not all tests are required in every application, non-applicable tests should be omitted. Tests should be conducted in the following sequence.

- (A) Current Impulse Test.
- (B) Sixty Hertz (60 Hz) Current Carrying Test.
- (C) AC Power Service Impulse Voltage Test.
- (D) Voltage Impulse Test.
- (E) Arrester Response Delay Test.
- (v) Tests should be applied between each of the following terminal combinations for all line operating conditions.
  - (A) Line tip to ring.
  - (B) Line ring to ground.
  - (C) Line tip to ground.
  - (D) Line tip to ring tied together to ground.

- (2) *Extraordinary surge protection.* A central office or RST may be located in an area where ground conditions prevent the reasonable economic achievement of a low resistance to ground and/or there exists a greater than average probability of surge damage. Such an unusually hostile operating environment shall be recognized and taken into consideration by the bidder in the engineering and specification of the central office switching system and line protection. This subject of operating environment, ground conditions, etc., should be discussed at the time of technical presentation to assure the owner that adequate system protection will be provided by the bidder.
- (3) *Dielectric strength.* Arresters shall be removed for all dielectric strength tests. The duration of all dielectric strength tests shall be at least 1 second. The applied potential shall equal or exceed the +3 sigma dc breakdown voltage of the arrester, provided by the

COE manufacturer. Direct current potentials shall be applied between all line terminals and equipment chassis and between these terminals and grounded equipment housings in all instances where the circuitry is dc open circuit from the chassis, or connected to the chassis through a capacitor.

(4) *Insulation resistance.* Following the dielectric tests, the insulation resistance of the installed electrical circuits between wires and ground, with the normal equipment grounds removed, shall not be less than 10 megohms at 500 volts dc at approximately room temperature (68 °F (20 °C)) and at a relative humidity of approximately 50 percent. The measurement shall be made after the meter stabilizes, unless the requirement is met sooner. Arresters shall be removed for these tests.

(5) *Self-protection.* (i) All components shall be of the self-protecting type, capable of being continuously energized at rated voltage without injurious results.

(ii) The unit equipment shall not be permanently damaged by accidental short circuits of any duration across either the central office side tip and ring or the line side tip and ring. A test is to be made with the unit energized at the highest recommended voltages.

(6) *Static discharge.* Assemblies subject to damage by static discharge shall be identified and special handling instructions shall be supplied.

(v) *Miscellaneous—(1) Office wire.* All office wire shall be of soft annealed tinned copper wire meeting the requirements of ASTM Specification B 33-91, Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes, and of suitable cross-section to provide safe current carrying capacity and mechanical strength. The insulation of installed wire, connected to its equipment and frames, shall be capable of withstanding the same insulation resistance and dielectric strength requirements as given in paragraphs (u)(3) and (u)(4) of this section at a temperature of 120 °F (49 °C) and a relative humidity of 90 percent.

(2) *Wire wrapped terminals.* These terminals are preferred and where used shall be of a material suitable for wire wrapping. The connections to them

shall be made with a wire wrapping tool with the following minimum number of successive nonoverlapping turns of bare tinned copper wire in contact with each terminal.

(i) 6 Turns of 30 Gauge.

(ii) 6 Turns of 26 Gauge.

(iii) 6 Turns of 24 Gauge.

(iv) 5 Turns of 22 Gauge.

(3) *Protection against corrosion.* All metal parts of equipment frames, distributing frames, cable supporting framework, and other exposed metal parts shall be constructed of corrosion resistant materials or materials plated or painted to render them adequately corrosion resistant.

(4) *Screws and bolts.* Screw threads for all threaded securing devices shall be of American National Standard form in accordance with Federal Standard H28, Screw-Thread Standards for Federal Services, unless exceptions are granted to the manufacturer of the switching equipment. All bolts, nuts, screws, and washers shall be of nickel-copper alloy, steel, brass or bronze.

(5) *Temperature and humidity range.* The supplier shall furnish the operating temperature and humidity ranges of the equipment being provided in order that adequate heating and cooling may be supplied (see Items 5.2.1 and 5.2.2 of appendix C of this section).

(6) *Stenciling.* Equipment units and terminal jacks shall be adequately designated and numbered. They shall be stenciled so that identification of equipment units and leads for testing or traffic analysis can be made without unnecessary reference to prints or descriptive literature.

(7) *Equipment frame design.* For newly designed systems, consideration should be given to the desirability of providing frames which can be installed in rooms of normal ceiling height [up to 10 feet (305 cm)]. Where feasible, frames and equipment units shall be designed for ready portability and high salvage value.

(8) *Quantity of equipment bays.* Consistent with system arrangements and ease of maintenance, space shall be provided on the floor plan for an orderly layout of future equipment bays that will be required for anticipated traffic when the office reaches its ultimate size. Readily accessible terminals

shall be provided for connection to interbay and frame cables to future bays. All cables, interbay and intrabay (excluding power), if technically feasible, shall be terminated at both ends by use of connectors.

(w) *Remote switching terminal (RST)*—

(1) *General.* The RST is a remotely located digital switching terminal which is placed at a subordinate wire center for subscriber lines and is a part of the host central office from a switching standpoint, and has hardware interchangeable with the host office, except for items that are applicable only to RST control and associated peripheral equipment. This does not preclude the use of existing in-service remote units on a new or upgraded host central office of the latest series generic or release.

(2) *Span line.* The RST is to be connected to the host central office via a means compatible with T1 type span lines using a DS-1 interface. This connection will be for control supervision and subscriber communication. The RUS equipment specification for a span line is PE-60.

(3) *Switching.* (i) The RST may have its switching functions controlled either by the host central office stored program control processors or by local subordinate processors which communicate with the host office processors.

(ii) As long as the connecting span line is intact, the subscribers served by the RST shall have all features, traffic capacity, and services including busy verification, available to all other subscribers in the system.

(iii) The RST shall have available an emergency call processing option which permits calling among all subscribers and from subscribers to emergency numbers within the RST if control link connections to the host central office are severed or otherwise disabled. The RST shall be capable of re-routing normally used emergency numbers, such as 911, to predetermined line terminations in this emergency stand-alone operating condition. This RST emergency call processing option shall be provided only when specified by the owner in Item 6.1 of appendix B of this section.

(4) *Subscriber line test.* (i) Means shall be available on an optional basis to the

maintenance personnel to make subscriber line tests from a common location for all subscriber lines including the RST.

(ii) If tests in paragraph (w)(4)(i) of this section are not requested by the owner for a particular installation, a subscriber loop test set (see paragraph (o)(2)(iii)(A) of this section) shall be supplied at the RST with a means to access all lines.

(5) *Housing.* When housed in a building supplied by the owner, a complete floor plan including ceiling height, power outlets, cable entrances, equipment entry and travel, type of construction, and other pertinent dimensions shall be supplied with this section.

(6) *Power*—(i) *Chargers.* A single charger meeting the requirements of paragraph (s)(3) of this section (with the exception of paragraph (s)(3)(viii) of this section) is required. An additional charger capable of carrying the full load or a combination of three chargers each capable of carrying half the load shall be supplied if redundant chargers are specified in appendix B of this section.

(ii) *Ringling equipment provisioning.* (A) Ringling sources shall be supplied in duplicate.

(B) An exception to the duplicated ringling source requirement permits nonduplicated ringling source(s) to be utilized where there is full compliance with the following service criteria.

(1) In a remote switching terminal (RST) of 400 or more equipped lines, a single nonduplicated ringling source failure shall not cause the complete loss of ringling capability to more than 100 lines.

(2) In a remote switching terminal (RST) of less than 400 equipped lines, a single nonredundant ringling source failure shall not cause the complete loss of ringling capability to more than 25 percent of the total equipped lines.

(iii) *Power converter.* (A) Power converters required for the purpose of providing various operating voltages to printed circuit boards or similar equipment employing electronic components shall be provided in duplicate with each unit capable of immediately assuming the full operating load upon failure of a unit.

(B) An exception to the duplicate power converter requirement permits nonduplicated power converter(s) to be utilized where there is full compliance with the following criteria.

(1) The failure of any single nonduplicated power converter shall not reduce the grade of service of common control and service circuits to any individual line or trunk by more than 50 percent.

(2) The failure of any single nonduplicated power converter shall not reduce the traffic carrying capacity of any trunk group or service links to a host office by more than 50 percent.

(3) In a remote switching terminal (RST) of 400 or more equipped lines, any single nonduplicated power converter failure shall not cause a complete loss of service to more than 100 equipped lines.

(4) In a remote switching terminal (RST) of less than 400 equipped lines, any single nonduplicated power converter failure shall not cause a complete loss of service to more than 25 percent of the total equipped lines.

(7) *Alarm.* Sufficient system alarm points shall be provided from the RST to report conditions to the host alarm system.

(x) *Responsibilities of the bidder*—(1) *Central office layout.* (i) The successful bidder shall furnish tentative floor plan layout drawings showing the arrangement of the equipment and the dimensions of major equipment units. These drawings shall include minimum door dimensions and ceiling heights required for installation, maintenance and ventilation. If requested by the owner, the floor plan shall be such that the battery, charger, power board, main distributing frame and wire chief's test equipment are isolated from the other equipment by a partition.

(ii) The layout drawings shall also show provision for the ultimate capacity of the central office as specified by the owner.

(iii) After approval by the owner of the tentative floor plan, and within 10 calendar days after approval of the contract by the Administrator, the owner shall furnish the bidder the necessary data on the actual floor plan. Within 20 calendar days after receiving the necessary building data, the bidder

shall then supply floor plan drawings showing exact locations of all equipment, both initial and ultimate, including points where connection to commercial power are required, with voltage and wattage indicated at each point. Within 20 calendar days after receiving the floor plan drawings from the bidder, the owner shall approve these drawings or take the necessary steps to have the drawings changed to meet his approval. The layout planning must be so coordinated between the owner and the bidder as not to delay the scheduled equipment installation date.

(2) *Shipment of main distributing frame (MDF).* The bidder shall ship the MDF equipment, with all necessary instructions to permit its installation by the owner, at the time requested by the owner in writing, provided such time is not earlier than 90 days prior to the date specified for the shipment of the rest of the central office equipment. If the owner or the owner's agent installs the main distributing frame, the owner shall assume the responsibility and the expense of proper installation according to information furnished by the bidder.

(3) *Drawings and printed material.* (i) The bidder shall supply instructional material for each exchange involved at the time of delivery of the equipment. It is not the intent of this section to require system documentation necessary for the repair of individual circuit boards. The bidder shall supply three complete sets of legible drawings, each set to include all of the following drawings and documentation:

(A) A floor plan showing exact dimensions and location of each equipment frame or item to a convenient scale;

(B) A block schematic drawing showing the various equipment components in the system, and their identifying circuit number (e.g., MDF, line circuits, memory, trunks, etc.);

(C) Drawings of major equipment items such as frames, with the location of major component items of equipment shown;

(D) Individual functional drawings for electrical circuits in the system;

(E) A detailed description of the operation of each circuit down to a circuit package level;

(F) Wiring diagrams indicating the specific method of wiring used on each item of equipment and interconnection wiring between items of equipment;

(G) Sufficient software documentation to maintain and service the system, including drawings showing principal aspects of the software architecture;

(H) Individual maintenance drawings covering each equipment item that contains replaceable parts, appropriately identifying each part by name and part number, or, complete ordering instructions for all replaceable parts if individual item drawings are not provided; and

(I) Job drawings including all drawings that are individual to the particular office involved, such as main frame, power panel, test board, etc.

(ii) The following information shall also be furnished:

(A) Complete index of the required drawings;

(B) Explanation of electrical principles that are individual to the overall switching system;

(C) List of tests which can be performed with each piece of test equipment furnished, and explanation of the method of performing each test;

(D) Sample of each form recommended for use in keeping records of tests;

(E) Criteria for analyzing results of tests and determining appropriate corrective action;

(F) General notes on the methods of isolating equipment faults to specific printed circuit cards in the equipment;

(G) List of typical troubles which might be encountered, together with general indications as to the probable location of each trouble;

(H) Special office grounding requirements;

(I) A site specific central office ground system acceptance checklist that is consistent with industry practice; and

(J) A site specific layout of the master ground bar (MGB) showing assignment of P, A, N, and I equipment areas.

(4) *Distributing frame wire.* The bidder shall provide sufficient tinned copper

conductor distributing frame wire for the initial installation. The insulation of this wire shall be such that it will not support combustion. The insulation shall have good abrasion resistance and cut-through properties, exhibit good solder heat resistance, and be suitable for wire wrap connections or insulation displacement connections.

(5) *Technical assistance service.* A technical assistance service shall be made available to assist the owner and its maintenance personnel on a 24-hour, 7 days a week basis. There is to be assistance available for both hardware and software problems. The necessary interface devices shall be supplied by the bidder.

(6) *Spare parts.* (i) The spare parts bid price shall be based upon the required quantities of spares shown in Item 6.2 of appendix C of this section, and shall be added to the base bid for comparison purposes in awarding the bid. It is the supplier's responsibility to provide all spares required by this section. If the supplier neglects to list certain spare parts in Item 6.2 of appendix C of this section, but they are necessary to comply with this section, they shall be provided by the supplier at no additional cost to the owner.

(A) "Units" are defined as user replaceable components used in the central office equipment. "Spare Parts" are direct replacements for units. Spare parts are necessary for the maintenance and diagnostic operations where the suspected faulty unit may be removed and a spare part substituted in anticipation that the trouble will be cleared.

(B) Examples of units for which spare parts should be furnished are printed circuit cards; circuit pack assemblies; fuses; and power supplies.

(C) Spare parts are not required as part of this addendum for items such as connectorized cables, nuts, bolts, and similar hardware; nor for items which can be obtained from sources other than the bidder such as battery cells, chargers, powerboards, magnetic tape transport assemblies, disk drives, ringing machines, recorded announcement machines, loop extenders and voice frequency repeaters, fire bars, teletype-writers, and video monitors.

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(D) When 100 or more like units are used in the hosts and RST's to be bid, the quantity of spares to be furnished is determined by multiplying the total number of like units in the contract by .05 or .03, as applicable, and rounding off to the next lowest integer. For example, 119 Class 1 units require five spares; 120 require six.

(E) When alternates are required, the price of the spare parts for the alternates shall be included with the price of the alternate.

(F) For equipment in which the line cards consist of a number of plug-in "daughter" boards on a "mother" board, the line card is defined as the "daughter" board unit. In a similar manner for those designs which have line cards backed up by a "control card," the "control card" is not, by definition, a line card.

(G) The quantities of spare parts determined in paragraph (x)(6)(vi) of this section are a minimum quantity. The bidder may add quantities of spare parts to bring the number of spare parts up to the bidder's list of spare parts necessary for proper operation in the field.

(ii) A Class 1 unit does not have automatic transfer to a redundant or standby pool of identical units, and provides any function for 24 or more lines or trunks or for all trunks in a group. Nonredundant digital trunk interfaces are included in this category.

(iii) A Class 2 unit has automatic transfer to a redundant or standby pool of identical units, and provides any function for 24 or more lines or trunks or for all trunks in a group. Redundant digital trunk interfaces and units of a redundant stored program processor are included in this category.

(iv) A Class 3 unit does not have automatic transfer to a redundant or standby pool of identical units and provides any function for no more than 23 lines or trunks or for less than all trunks in a group. Nonredundant analog trunks are included in this category. Excluded from this category are line cards, which are in Class 4.

(v) A Class 4 unit has automatic transfer to a redundant or standby pool of identical units and provides any function for no more than 23 lines or trunks or for less than all trunks in a

group. Also, any line cards are in Class 4.

(vi) The spare parts for all of the hosts and the RST's included in this contract shall be provided as follows:

Quantity of Units used in the CO's & RST's To Be Bid	Required Quantity of Spares By Class of Unit			
	1	2	3	4
Class —>				
1 through 9	1	1	0	0
10 through 24	2	2	1	0
25 through 49	3	2	2	0
50 through 99	4	3	2	0
100 or More	5%	3%	3%	0

(vii) As a part of the response to the bid, the supplier shall furnish a list of units used by class and a list of spare parts to be furnished with this contract. This list shall be placed in Item 6.2 of appendix C of this section for only one of the host specifications included in the entire contract.

(7) *Environmental requirements.* The bidder shall specify the environmental conditions necessary for safe storage and satisfactory operation of the equipment being bid. If requested, the bidder shall assist the owner in planning how to provide the necessary environment for the equipment.

(8) *Unit costs for cost separation purposes.* The successful bidder shall present a cost breakdown of the central office equipment on a discrete element basis 90 days after installation completion. This shall include the various frames, switching and transmission components, and software.

(9) *Single-point grounding system acceptance.* Qualified representatives of the central office system supplier and the owner are to conduct a thorough joint acceptance audit of the grounding system prior to the central office being placed into service. A grounding system acceptance checklist provided by RUS, which is consistent with standard industry practice, will be used in conducting this audit. All required grounding system corrections are to be made prior to placing the central office system into full service operation. The successful completion of this grounding system audit will constitute an acceptance on the part of both parties, the owner and the central office supplier (refer to paragraph (y)(5) of this

section, and appendix D of this section).

(y) *Installation.* The following responsibilities apply to the central office equipment installation and Remote Switching Terminal (RST) installations, unless otherwise noted.

(1) *Responsibilities of owner.* The owner shall:

(i) Allow the bidder and its employees free access to the premises and facilities at all hours during the progress of the installation;

(ii) Take such action as necessary to ensure that the premises are dry and free from dust and in such condition as not to be hazardous to the installation personnel or the material to be installed (not required for an RST installed in a self-contained environmentally controlled cabinet);

(iii) Provide heat or air conditioning when required and general illumination in rooms in which work is to be performed or materials stored (not required for an RST installed in a self-contained environmentally controlled cabinet);

(iv) Provide suitable openings in buildings to allow material to be placed in position (not required for an RST installed in a self-contained environmentally controlled cabinet);

(v) Provide the necessary conduit and commercial and dc-ac inverter output power to the locations shown on the approved floor plan drawings; provide 120 volts, 60 Hz commercial power equipped with a secondary arrester and a reasonable number of outlets for test, maintenance and installation equipment; provide suitable openings or channels and ducts for cables and conductors, from floor to floor and from room to room; provide an acceptable central office grounding system and at a ground resistance level that is reasonable for office site conditions (not required for an RST installed in a self-contained environmentally controlled cabinet);

(vi) Provide the necessary wiring, central office grade ground and commercial power service, with a secondary arrester, to the location of an exterior RST installation based on the voltage and load requirements furnished by the bidder;

(vii) Test at the owner's own expense all lines and trunks for continuity, leakage and loop resistance and ensure that all lines and trunks are suitable for operation with the central office equipment specified;

(viii) Make alterations and repairs to buildings necessary for proper installation of material, except to repair damage for which the bidder or its employees are responsible;

(ix) Connect outside cable pairs on the distributing frame and run all line and trunk jumpers (those connected to protectors);

(x) Furnish all trunk, line, and party assignment information to permit the bidder to program the data base memory within a reasonable time prior to final testing;

(xi) Release for the bidder's use such portions of the existing plant as are necessary for the proper completion of such tests as require coordination with existing facilities including facilities for T1 span lines with properly installed repeaters between the central office and the RST installations;

(xii) Make prompt inspections as it deems necessary when notified by the bidder that the equipment, or any part of the equipment, is ready for acceptance;

(xiii) Provide and install adequate fire protection apparatus, including one or more fire extinguishers or fire extinguishing systems of the gaseous type that has low toxicity and effect on equipment; and

(xiv) Provide necessary access ports for cable, if underfloor cable is selected.

(2) *Responsibilities of bidder.* The bidder shall:

(i) Allow the owner and its representatives access to all parts of the buildings at all times during the installation;

(ii) Obtain the owner's permission before cutting into or through any part of the building structure such as girders, beams, concrete or tile floors, partitions or ceilings (not applicable to the installation of lag screws, expansion bolts, and similar devices used for fastening equipment to floors, columns, walls and ceilings);

(iii) Be responsible for reporting to the owner any damage to the building



which may exist or may occur during its occupancy of the building, repairing all damage to the building due to carelessness of the bidder's workforce, and exercising reasonable care to avoid any damage to the owner's property;

(iv) Consult with the owner before cutting into or through any part of the building structure where the fireproofing or moisture proofing may be impaired;

(v) Take necessary steps to ensure that all fire fighting apparatus is accessible at all times and all flammable materials are kept in suitable places outside the building;

(vi) Not use gasoline, benzene, alcohol, naphtha, carbon tetrachloride or turpentine for cleaning any part of the equipment;

(vii) Install the equipment in accordance with the specifications for the office;

(viii) Run all jumpers, except line and trunk jumpers (those connected to protectors);

(ix) Establish and update all data base memories with subscriber and trunk information as supplied by the owner until an agreed turnover time;

(x) Give the owner notice of completion of the installation at least 1 week prior to completion;

(xi) Permit the owner or its representative to conduct tests and inspections after installation has been completed in order that the owner may be assured that the requirements for installation are met;

(xii) Allow access, before turnover, by the owner or its representative, upon request, to the test equipment which is to be turned over as a part of the office equipment, to permit the checking of the circuit features which are being tested and to permit the checking of the amount of connected equipment to which the test circuits have access;

(xiii) Make final charger adjustments using the manufacturer's recommended procedure;

(xiv) Notify the owner promptly of the completion of work of the central office, or such portions as are ready for inspection;

(xv) Correct promptly all defects for which the bidder is responsible;

(xvi) Provide the owner with one set of marked prints, or strapping prints, showing which of the various options and figures are in use on each switching system as specified in paragraph (x)(3)(i) of this section;

(xvii) Place the battery in service in compliance with the recommendations of the battery manufacturer; and

(xviii) Furnish the owner with a record of the cell voltages and specific gravity readings made at the completion of the installation of the switching system and before it is placed in commercial service.

(3) *Installation requirements.* (i) All work shall be done in a neat, workmanlike manner. Equipment frames or cabinets shall be correctly located, carefully aligned, anchored and firmly braced. Cables shall be carefully laid with sufficient radius of curvature and protected at corners and bends to ensure against damage from handling or vibration. Exterior cabinet installations for RST's shall be made in a permanent, eye-pleasing manner.

(ii) All multiple and associated wiring shall be continuous, free from crosses, reverses and grounds and shall be correctly wired at all points.

(iii) An inspection shall be made by the owner or its representatives prior to performing operational and performance tests on the equipment. However, this inspection shall be made after all installing operations which might disturb apparatus adjustments have been completed. The inspection shall be of such character and extent as to disclose with reasonable certainty any unsatisfactory condition of apparatus or equipment. During these inspections, or inspections for apparatus adjustments, or soldering, or in testing of equipment, a sufficiently detailed examination shall be made throughout the portion of the equipment within which such condition is observed, or is likely to occur, to disclose the full extent of its existence, where any of the following conditions are observed:

(A) Apparatus or equipment units failing to compare in quantity and code with that specified for the installation;

(B) Apparatus or equipment units damaged or incomplete;

(C) Apparatus or equipment affected by rust, corrosion or marred finish; or

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(D) Other adverse conditions resulting from failure to meet generally accepted standards of good workmanship.

(4) Operational test requirements. (i) Operational tests shall be performed on all circuits and circuit components to ensure their proper functioning in accordance with appropriate applicable documents supplied by the bidder.

(ii) A sufficient quantity of overall tests shall be made to ensure proper operation of all specified features.

(iii) A sufficient quantity of locally originating and incoming calls shall be made to prove the switching system can accept and process calls to completion.

(5) Grounding system audit. (i) A grounding system audit shall be performed to ensure that a viable single-point grounding system is in place prior to the time the switching system is placed into full service operation. It is suggested that such an audit be conducted at the time the switching system is ready for turnover to the owner.

(ii) This single-point grounding system audit is to be conducted by authorized representatives of the supplier and owner, and with the RUS general field representative participating at his discretion.

(iii) The single-point grounding system audit is to be conducted using the checklist contained in appendix D of this section.

(iv) Appendix D of this section shall be the principal single-point grounding system audit guideline document. A supplemental checklist may be prepared and provided by the switching system supplier which recognizes unique grounding requirements related to their particular switching system. The scope of this supplier checklist is to be confined to unique and specific switching system requirements only. Acceptable supplier supplemental grounding checklist must have prior approval of and be on file with the Central Office Equipment Branch of the Telecommunications Standards Division of RUS.

(v) It is the responsibility of the central office supplier to ensure that the grounding system evaluation criteria contained in the combination of the appendix D checklist of this section and their optional supplemental checklist

adequately fulfill requirements for warranty coverage.

(vi) All deficiencies in the single-point grounding system are to be corrected prior to the switching system being placed into full service operation. Exceptions are permitted only by mutual agreement of the owner and supplier and with written approval of the RUS general field representative.

(vii) The acceptance statement facesheet of the audit checklist in appendix D of this section shall be signed by authorized representatives of the supplier and owner to indicate mutual approval of the single-point grounding system. Copies of all completed grounding system audit documents are to be provided to the supplier, owner and appropriate RUS telephone program regional offices.

(The information and recordkeeping requirements of this section have been approved by the Office of Management and Budget (OMB) under the control number 0572-0059)

APPENDIX A TO §1755.522—SPECIFICATION FOR DIGITAL, STORED PROGRAM CONTROLLED CENTRAL OFFICE EQUIPMENT DETAILED REQUIREMENTS (HOST)

(INFORMATION TO BE SUPPLIED BY OWNER)

Telephone Company Name \_\_\_\_\_
Location \_\_\_\_\_
Central Office Name (By Location) \_\_\_\_\_
Town \_\_\_\_\_
County \_\_\_\_\_
State \_\_\_\_\_
Attended \_\_\_\_\_
Unattended \_\_\_\_\_
Remotes \_\_\_\_\_

1. General

1.1 Notwithstanding the bidder's equipment lists, the equipment and materials furnished by the bidder must meet the requirements of paragraphs (a) through (x), Appendix A and Appendix B of §1755.522.

1.2 Paragraphs (a) through (x) of §1755.522 cover the minimum general requirements for digital, stored program controlled central office switching equipment.

1.3 Paragraph (y) of §1755.522 covers requirements for installation, inspection, and testing when such service is included as part of the contract.

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1.4 Appendices A and B of §1755.522 cover the technical data for application engineering and detailed equipment requirements insofar as they can be established by the owner. These appendices are to be filled in by the owner.

1.5 Appendix C of §1755.522 covers detailed information on the switching network equipment and the common control equipment, and information as to system reliability and heavy traffic delays as proposed by the bidder. This appendix is to be filled in by the bidder and must be presented with the bid.

1.6 Appendix D of §1755.522 is the single-point grounding system audit checklist.

**2. Numbering Scheme**

2.1 This office shall be arranged to serve the following area and office code(s):


If more than one code is to be served, discrimination shall be determined by the following:

Number Translation \_\_\_\_\_  
 Separate Trunk Groups \_\_\_\_\_  
 Both (Explain in Item 16, Appendix A) \_\_\_\_\_

2.2 This office shall be arranged to provide EAS service to the following:

Connecting office	Code	Connecting office	Code

2.2.1 Seven digits shall be dialed for all local and EAS calls.

2.3 Additional dialing procedures to be provided include the following:

Feature	Required
Station Paid Toll (Including Coin):	
Home Numbering Plan Area (HNPA):	
"1" + 7 Digits .....	
"1" + 10 Digits .....	
Other (Explain in Item 16, Appendix A) .....	
Foreign Numbering Plan Area (FNPA):	
"1" + 10 Digits .....	
Other (Explain in Item 16, Appendix A) .....	

10XXX Dialing to Interexchange Carriers:

Name	Access code

Name	Access code

Feature	Required
Person, Special (Including Coin):	
HNPA—"0" + 7 Digits.	
"0" + 10 Digits.	
FNPA "0" + 10 Digits.	
Other (Explain in Item 16, Appendix A).	
Directory Assistance:	
HNPA Local—411.	
"1" + 411.	
HNPA Toll "1" + 555-1212.	
FNPA Toll "1" + NPA + 555-1212.	
IDDD:	
Operator Serviced 01.	
Station-Station 011.	

Other service codes	No. to be dialed
Wire Chief.	
Repair Service.	
Business Office.	
Emergency Calls to 911 Lines.	
Emergency Calls to 911 Trunks.	
Time.	
Weather.	
100 Test Line.	
102 Test Line.	
105 Test Line.	
Other (Explain in Item 16, Appendix A).	

2.4 Assistance calls are answered: (Check appropriate items)

2.4.1 At the operator office in \_\_\_\_\_

2.4.1.1 By means of the regular interoffice toll trunks \_\_\_\_\_

2.4.1.2 By means of the regular interoffice EAS trunks \_\_\_\_\_

2.4.1.3 By means of a separate special service trunk group \_\_\_\_\_

2.4.1.4 Locally \_\_\_\_\_

Explain:

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3. Office Clock

3.1 This office is to be slave clock synchronized with another office:

\_\_\_\_\_ Yes \_\_\_\_\_ No

(Explain details in Appendix A, Item 16 if "Yes".)

3.2 This office is to be a master clock office to provide synchronization timing for other offices:

\_\_\_\_\_ Yes \_\_\_\_\_ No

(Explain details in Appendix A, Item 16 if "Yes".)

4. Interoffice Trunking Diagram

4.1 A sketch showing relative location of exchanges, RST's, and number of circuits shall be included, also the office and area codes of the direct trunk points. The diagram should indicate whether toll or EAS trunk groups are "High Usage" or "Final." Alternate routes should be included. Indicate whether the trunk termination is direct digital or analog.

5. Translator Function Chart

Called point	Subscriber dials	First route			Alternate routes		
		Translator action	Send		Translator action	Send	
		Deletes	Prefixes		Deletes	Prefixes	

6. Line Circuit Requirements (Includes all lines associated with RST's.)

6.1 Types of Lines

	No. of lines		No. of EAS areas	Total No. of lines required
	Local service only	both local and EAS service		
6.1.1 Individual—Flat Rate .....	_____	_____	_____	_____
6.1.2 Individual—Message Rate .....	_____	_____	_____	_____
6.1.3 Pay Station .....	_____	_____	_____	_____
6.1.4 Telephone Company Official Lines ...	_____	_____	_____	_____
6.1.5 Wire Chief .....	_____	_____	_____	_____
6.1.6 911 Emergency Service Bureau Lines.	_____	_____	_____	_____
6.1.7 Number Hunting PBX Groups: .....	_____	_____	_____	_____

No. of lines in group	No. of groups	Direct in dial *	Re-stricted service at COE	Type		No. of lines		No. of EAS areas	Total No. of lines required
				Ground start	Loop start	Local service only	Both local and EAS service		
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____

\*Furnish translation information under Item 5.

6.1.8 WATS Lines (Give details in Appendix A, Item 16)

Number of Inward WATS Lines \_\_\_\_\_

Number of Outward WATS Lines \_\_\_\_\_

6.1.9 Special Lines Required \_\_\_\_\_ (Explain in Item 16, Appendix A)

6.1.10 Total Number of Lines Required

Host \_\_\_\_\_ (Incl. DDI Concentrator Lines)

RST 1 \_\_\_\_\_

RST 2 \_\_\_\_\_

RST 3 \_\_\_\_\_

Total \_\_\_\_\_

6.1.11 Total Director Numbers Required

(Including RST's) (see Item 7.1, Appendix A)

6.1.12 Pay Station

Type \_\_\_\_\_

New \_\_\_\_\_ Reused \_\_\_\_\_

(Describe in Item 16, Appendix A)

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- 6.1.13 Line Concentrator
  - 6.1.13.1 Supplied by Owner (see Item 16, Appendix A, for details)
    - Yes  No
  - 6.1.13.2 Supplied by Bidder (If "Yes", attach REA Form 397g, Performance Specification for Line Concentrators)
    - Yes  No

6.2. Data on Lines Required Range Extension

6.2.1 Number of non-pay station lines having a loop resistance, including the telephone set, as follows:

	No. of lines
1901-3200 ohms .....	_____
3201-3600 ohms .....	_____

6.2.2 Number of pay station lines having loop resistance, excluding the telephone set, greater than:

	No. of lines
1200 ohms (For Prepay) .....	_____
1000 ohms (For Semi-Postpay Operation).	_____

6.2.3 Range extension equipment is to be provided:

6.2.3.1 Loop Extenders: Total Quantity

By Bidder—Quantity \_\_\_\_\_  
 By Owner—Quantity \_\_\_\_\_  
 (Explain in Item 16, Appendix A)

6.2.3.2 VF Repeaters: Total Quantity \_\_\_\_\_

By Bidder—Quantity \_\_\_\_\_  
 (Bidder must have information on loading and cable size.)

By Owner—Quantity \_\_\_\_\_  
 (Explain in Item 16, Appendix A)

6.2.3.3 Range extension may be furnished as an extended range line circuit at the option of the supplier. If this option is used, the quantities of loop extenders and VF repeaters will be different from the quantities listed above (see Item 6.1.a, Appendix C).

Yes  No

**7. Traffic Data-Line Originating and Terminating Traffic**

7.1 Originating Line Traffic—Estimated per Busy Hour (Includes all Lines Associated With RST's):

	(a) CCS per Main Station	(b) No. of Main Stations	(axb) Total CCS	No. of Lines Re- quired <sup>1</sup>
Ind.—Res .....	_____	_____	_____	_____
Ind.—Bus .....	_____	_____	_____	_____
Special Lines .....	_____	_____	_____	_____
Pay Station .....	_____	_____	_____	_____
Telco Official .....	_____	_____	_____	_____
Wire Chief .....	_____	_____	_____	_____
No. Htg. or PBX .....	_____ (2)	_____ (3)	_____	_____
WATS .....	_____	_____	_____	_____
Data Service .....	_____	_____	_____	_____
911 Emerg. Service .....	_____	_____	_____	_____ (4)
Total .....	_____	_____	_____	_____
		(c)	(d)	(e)

<sup>1</sup> See Appendix A, Item 6.1.  
<sup>2</sup> This figure is the CCS per PBX trunk.  
<sup>3</sup> This figure is the number of PBX trunks.  
<sup>4</sup> This is the total number of line equipments required. The number to be provided will be determined by the equipment design of the system of the selected bidder. See Appendix C, Item 3.1.1.2.

7.2 Average Originating CCS per Line per Busy Hour

(d)/(e) = \_\_\_\_\_ / \_\_\_\_\_ = \_\_\_\_\_ CCS/Line

This office shall be engineered to handle an initial average originating busy hour traffic of \_\_\_\_\_ CCS per line. It is anticipated that the average originating busy hour traffic will increase to \_\_\_\_\_ CCS per line.

Originating Traffic Attributed to Host Only \_\_\_\_\_ CCS/Line

7.3 Terminating Traffic—Estimated CCS per Busy Hour

It is assumed that the total CCS for terminating traffic is the same as for originating traffic. Since digital switch networks are on a terminal per line basis,

the terminating CCS per line will be the same as the originating CCS per line as shown in Item 7.2, Appendix A.

Terminating Traffic Attributed to Host Only \_\_\_\_\_ CCS/Line

7.4 Percent of Pushbutton Lines \_\_\_\_\_

7.5 Anticipated Ultimate Capacity (20 years)

7.5.1 Subscriber Lines

Host \_\_\_\_\_ (Incl. DDI Concentrator Lines)

RST 1 \_\_\_\_\_

RST 2 \_\_\_\_\_

RST 3 \_\_\_\_\_

Total \_\_\_\_\_

8. Trunk Circuit Requirements

8.1 Interoffice Trunking

8.1.1 Trunking Requirements

1. Connecting Office .....	.....	.....	.....	.....
2. Use of Trunk .....	.....	.....	.....	.....
3. Trk. Grp. Ntwk. Connection <sup>1</sup> .....	.....	.....	.....	.....
4. Quantity Equipped .....	.....	.....	.....	.....
5. Ultimate % Growth .....	.....	.....	.....	.....
6. CCS Capacity .....	.....	.....	.....	.....
7. Direction .....	.....	.....	.....	.....
8. No. Digits Dialed .....	.....	.....	.....	.....
9. No. Digits Outpulsed .....	.....	.....	.....	.....
10. No. Digits Impulsed .....	.....	.....	.....	.....
11. Type Signaling .....	.....	.....	.....	.....
12. Type Pulsing .....	.....	.....	.....	.....
13. Carrier Type (2-Wire) .....	.....	.....	.....	.....
14. Carrier Type (4-Wire) .....	.....	.....	.....	.....
15. Physical .....	.....	.....	.....	.....
16. Repeat Coils <sup>2</sup> .....	.....	.....	.....	.....
17. DX Signaling Set .....	.....	.....	.....	.....
18. Other Type Signaling .....	.....	.....	.....	.....
19. Delay Dial .....	.....	.....	.....	.....
20. Direct Digital Interface .....	.....	.....	.....	.....
21. a. Feature Group B .....	.....	.....	.....	.....
b. Feature Group C .....	.....	.....	.....	.....
c. Feature Group D .....	.....	.....	.....	.....

<sup>1</sup> Designation of trunk group network connection involves the following categories:  
 IC—Direct Inter-LATA Connecting Trunk=(IC/POP)  
 TC—Tandem Connecting Trunks  
 IT—Intertandem Connecting Trunks  
 IL—Intra-LATA Connecting Trunks  
 TIC—Tandem Inter-LATA Connecting Trunks  
 Misc.—Intercept, Busy Verification, etc.  
<sup>2</sup> Omit repeating coils for carrier derived trunks.

8.1.2 Pads for 4-Wire Carrier (7dB and 16dB)

Total Quantity \_\_\_\_\_  
 By Bidder Quantity \_\_\_\_\_  
 By Owner Quantity \_\_\_\_\_

Refer to the attached information regarding connecting company trunk circuit drawing numbers and name of manufacturer.

8.2 Switched Traffic Data

8.2.1 Originating Traffic

Type	CCS	H.T. secs.	BHC	No. of digits out-pulsed	Sender sig. mode	Remarks
Toll "0" - 1 .....	.....	.....	.....	.....	.....	.....
Toll "0"+7 <sup>1,2</sup> .....	.....	.....	.....	.....	.....	.....
Toll "0"+10 <sup>1,2</sup> .....	.....	.....	.....	.....	.....	.....
Toll S-S "1"+7 <sup>2</sup> .....	.....	.....	.....	.....	.....	.....
Toll S-S "1"+10 <sup>2</sup> .....	.....	.....	.....	.....	.....	.....
Toll Other .....	.....	.....	.....	.....	.....	.....
Special Service .....	.....	.....	.....	.....	.....	.....
Intercept .....	.....	.....	.....	.....	.....	.....
Intraoffice .....	.....	.....	.....	XXXXXXX	XXXXXXX	.....
EAS .....	.....	.....	.....	.....	.....	.....
EAS .....	.....	.....	.....	.....	.....	.....
Tandem .....	.....	.....	.....	.....	.....	.....
Tandem .....	.....	.....	.....	.....	.....	.....
Tandem .....	.....	.....	.....	.....	.....	.....
911 Emerg. Service .....	.....	.....	.....	.....	.....	.....
Total .....	.....	.....	.....	.....	.....	.....

<sup>1</sup> PPCS traffic assumed to be divided 20 percent "0"- and 80 percent "0"+ if unknown.  
<sup>2</sup> Toll calls assumed to be divided two-thirds 7 digits and one-third 10 digits.

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Busy Hour Attempts=BHC Total × 1.4=\_\_\_\_  
 8.2.2 Terminating Traffic

Type	CCS	H.T. secs.	BHC	No. of digits impulsed	Receiver sig. mode	Remarks
Toll Compl. ....	.....	.....	.....	.....	.....	.....
Test & Ver. ....	.....	.....	.....	.....	.....	.....
Intraoffice ....	.....	.....	.....	.....	.....	.....
EAS .....	.....	.....	.....	.....	.....	.....
EAS .....	.....	.....	.....	.....	.....	.....
Tandem .....	.....	.....	.....	.....	.....	.....
Tandem .....	.....	.....	.....	.....	.....	.....
Tandem .....	.....	.....	.....	.....	.....	.....
Total .....	.....	.....	.....	.....	.....	.....

9. Checklist of Features Required
- 9.1 *Alternate Routing* ..... (Explain in Item 16, Appendix A)
  - 9.2 *Data Service* ..... (Explain in Item 16, Appendix A)
  - 9.3 This office shall be:
    - 9.3.1 End Office Only .....
    - 9.3.2 End Office and Intermediate Tandem ..... (Explain in Item 16, Appendix A)
    - 9.3.3 End Office and Access Tandem ... (Explain in Item 16, Appendix A)
  - 9.4 Billing Data

	Trunk group	Send ANI feature group			Store billing data	
		B	C	D	AMA system	Pollable system
9.4.1 This office only .....	.....	.....	.....	.....	.....	.....
9.4.2 Trunks from Tributaries .....	.....	.....	.....	.....	.....	.....
9.4.3 Local Message Detail Recording:						

- 9.5 *Pollable Systems*
  - 9.5.1 Polling device to be provided on this contract
    - \_\_\_ Required
    - \_\_\_ Not Required
 (Provide details in Item 16, Appendix A)
  - 9.5.2 Pollable system to be backed up by tape or disc standby
    - \_\_\_ Required
    - \_\_\_ Not Required

- 9.6 *AMA Format*
  - 9.6.1 Bellcore Format
    - \_\_\_ Required
    - \_\_\_ Not Required
 (Provide details in Item 16, Appendix A)

- 10. Miscellaneous Operating Features
  - 10.1 *Busy Verification*
    - 10.1.1 By dedicated trunk from toll operator: \_\_\_
      - 10.1.1.1 One-Way, Inward \_\_\_
      - 10.1.1.2 Two-Way (Busy verification inward, intercept outward) \_\_\_
    - 10.1.2 By prefix digit over intertoll trunk \_\_\_
      - (Indicate digit(s) dialed) \_\_\_
  - 10.1.3 Access by Switchman
    - 10.1.3.1 Dedicated Trunk \_\_\_

- 10.1.3.2 Multiple of Operator Trunk \_\_\_
- 10.2 *Intercept Facilities*
  - 10.2.1 Vacant code, disconnected number, and unassigned number intercept shall be: (Check One)
    - By recorded announcement:
      - Without cut-through to operator \_\_\_
      - With cut-through to operator \_\_\_
    - By operator \_\_\_
  - 10.2.2 Changed number intercept shall be: (Check One)
    - By recorded announcement:
      - Without cut-through to operator \_\_\_
      - With cut-through to operator \_\_\_
    - By operator \_\_\_
  - By automatic intercept system (AIS) in distant office \_\_\_
- 10.2.3 Method of Reaching Operator, if required:
  - Separate trunk group \_\_\_
  - Regular interoffice toll trunks with idle trunk selecting over at least three trunks when three or more toll trunks are equipped \_\_\_
- 10.2.4 Number of separate intercept trunk circuits \_\_\_
- 10.3 *Line Load Control*
  - 10.3.1 Line load control facilities are:
    - \_\_\_ Required \_\_\_ Not Required
    - (Explain in Item 16, Appendix A)
- 10.4 *Service Observing Facilities*

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- 10.4.1 Service observing facilities are:  
 Required  Not Required  
 (Explain in Item 16, Appendix A)
- 10.5 *Hotel-Motel Arrangements*
- 10.5.1 Hotel-motel arrangements for operation of message registers at the subscriber's premises are:  
 Required  Not Required  
 (Explain in Item 16, Appendix A)
- 10.5.1.1 How are message registers to be activated?

- Line Reversal
- Third Wire
- Other   
 (Explain in Item 16, Appendix A)
- 10.6 *Nailed-Up Connections*  
 Required  Not Required  
 (Explain in Item 16, Appendix A)
- 10.7 *Vertical Services*: (RST Lines are Included)

	<i>Initially</i>	<i>Ultimate</i>
10.7.1 Call Waiting—No. of Lines .....	_____	_____
10.7.2 Call Forwarding—No. of Lines .....	_____	_____
Local <input type="checkbox"/> Remote <input type="checkbox"/>		
(Explain in Item 16, Appendix A).		
10.7.3 Abbreviated Dialing No. of Lines .....	_____	_____
No. of Codes per Line <input type="checkbox"/> for <input type="checkbox"/> Lines		
No. of Codes per Line <input type="checkbox"/> for <input type="checkbox"/> Lines		
10.7.4 Three-Way Calling—No. of Lines .....	_____	_____
CCS Per Line .....	_____	_____

- 10.7.5 Other   
 (Explain in Item 16, Appendix A)

11. Maintenance Facility Requirements

- 11.1 *Alarm Signals*
- 11.1.1 Handled locally   
 Explain in Detail: \_\_\_\_\_

- 11.1.2 Transmitted to attended point
- 11.1.2.1 Via operator office trunks \_\_\_\_\_
- 11.1.2.2 Via printout or other display service   
 Explain in Detail: \_\_\_\_\_

- 11.1.2.3 Type of tone to operator
- 11.1.2.3.1 Distinctive tone (see (i)(2)(ix) of § 1755.522) \_\_\_\_\_
- 11.1.2.3.2 Other \_\_\_\_\_  
 Explain in Detail: \_\_\_\_\_

- 11.1.3 Alarm checking signals for carrier and mobile radio systems

- 11.1.3.1 Minor Alarm .....
- 11.1.3.2 Major Alarm .....
- 11.1.3.3 Terminals for both .....
- 11.2 *Trouble Location and Test*
- 11.2.1 Outside plant and stations (check desired items)
- 11.2.1.1 Subscriber's loop test circuit:
- 11.2.1.1.1 As part of the maintenance center .....
- 11.2.1.1.2 Separately .....
- 11.2.1.2 Remote test set (Explain in Item 16, Appendix A) .....
- 11.2.1.3 Dial speed test circuit (Explain in Item 16, Appendix A) .....
- 11.2.1.4 Pushbutton dialing test circuit .....

- 11.2.1.5 Howler (per (o)(2)(iii)(C) of § 1755.522) .....
- 11.2.1.6 Hand test sets, number required  (Explain in Item 16, Appendix A).

11.3 *Transmission Tests*

- 11.3.1 Furnish reference tone  
 Yes   
 No

Frequencies and order in which applied	Time interval for application of each frequency
_____ Hz .....	_____ Seconds
_____ Hz .....	_____ Seconds
_____ Hz .....	_____ Seconds
_____ Hz .....	_____ Seconds

11.3.2 *Test Lines*

- 11.3.2.1 Test Line 100 \_\_\_\_\_
- 11.3.2.2 Test Line 102 \_\_\_\_\_
- 11.3.2.3 Test Line 104 \_\_\_\_\_
- 11.3.2.4 Test Line 105 \_\_\_\_\_  
 (Explain in Item 16, Appendix A)
- 11.3.2.5 Test Line 107 \_\_\_\_\_
- 11.3.2.6 Remote Office Test Line \_\_\_\_\_  
 (Explain in Item 16, Appendix A)
- 11.4 *Line Testing*
- 11.4.1 Automatic line insulation testing  
 Yes   
 No
- 11.4.2 Owner supplied equipment  
 Yes   
 No
- 11.4.2.1 Vendor supplied interface only  
 Yes   
 No   
 If supplied by owner, explain in Item 16, Appendix A, including manufacturer, model, location.
- 11.5 *Remote Control*



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11.5.1 Remote control of the system shall be provided.

Yes \_\_\_  
No \_\_\_

If required, explain in Item 16, Appendix A, including number, type and location.

**12. Power Equipment Requirements (Host Office Only)**

**12.1 Central Office Battery**

12.1.1 A battery reserve of \_\_\_ busy hours shall be provided for this office when it reaches \_\_\_ lines at the ultimate anticipated traffic rates specified in Item 7.2, Appendix A.

12.1.1.1 The owner will furnish a standby generator, permanently installed in this office, with capacity sufficient to power air conditioning equipment required for cooling of the central office equipment and to maintain an adequate dc supply in the event of a failure of the commercial ac supply.

Yes \_\_\_  
No \_\_\_

**12.1.2 Type of battery: (Check One)**

Lead Calcium \_\_\_  
Lead Antimony \_\_\_

12.1.3 Voltmeter (portable 3-60-150 volt scale, 1% accuracy) shall be furnished.

Yes \_\_\_  
No \_\_\_

12.1.4 Hydrometer in a hydrometer holder with glass or plastic drop cup shall be furnished.

Yes \_\_\_  
No \_\_\_ 12.1.5 Type of battery rack required: (Check One)

Two Tier \_\_\_  
Other \_\_\_

Explain:

12.1.6 Special equipment power requirements (carrier, voice frequency repeaters, etc.). Drain in amperes \_\_\_

12.1.6.1 Supply all necessary equipment to provide the following 48-volt battery taps:

Number of circuits	Fuse (or circuit breaker) size
.....	
.....	
.....	

**12.2 Charging Equipment**

12.2.1 Charging equipment shall be provided capable of charging the office battery on a full float basis when the office reaches \_\_\_ lines at the ultimate anticipated traffic rates specified in Item 7.2, Appendix A.

12.2.2 Charger input rating shall be:

3-Phase Connection:	
Voltage ___	3-Wire ___
Phase ___	4-Wire ___

3-Phase Connection:	
Frequency ___	Delta ___
.....	Y ___

**12.3 Ringing Equipment**

12.3.1 Solid-state ringing equipment in accordance with paragraph (s)(5)(i) of §1755.522 shall be provided for generating the frequencies specified by check marks in the following table. Ringing generator sets serving the entire office shall each be sized to carry the full office ringing load when the office size reaches \_\_\_ lines at the ultimate anticipated traffic rates specified in Item 7.2, Appendix A.

12.3.2 Ringing frequencies to be supplied:

	Frequency in Hz		Maximum No. of tele-phones
Single Frequency .....	20	.....	.....
Decimonic .....	20	.....	.....
	30	.....	.....
	40	.....	.....
	50	.....	.....
Harmonic .....	16⅔	.....	.....
	25	.....	.....
	33⅓	.....	.....
	50	.....	.....
Synchromonic .....	20	.....	.....
	30	.....	.....
	42	.....	.....
	54	.....	.....

12.3.3 Furnish frequency meter (accurate within 1.3 Hz) and voltmeter (5% accuracy) for ringing measurements (see paragraph (s)(7)(ii) of §1755.522). Check One:

Panel Mounted \_\_\_  
Portable \_\_\_  
Not Required \_\_\_

**12.4 Power Board**

The power panel and associated wiring shall be of ample size to meet the load requirements when this office reaches \_\_\_ lines at the ultimate anticipated traffic rates specified in Item 7.2, Appendix A.

**13. Distributing Frame Requirements (Host Office Only)**

13.1 Total number of outside plant cable pairs to be terminated .....

13.1.1 Gauge of outside plant cable pairs .....

13.2 Number of outside plant cable pairs to be protected .....

13.3 Number of additional protector pair units to be provided on MDF .....

Explain:

**13.4 Main Frame Details**

Is present MDF to be reused?

Yes \_\_\_  
No \_\_\_

If "Yes," Type \_\_\_

Reused protectors are:

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\_\_\_\_ (Mfgr.)  
 \_\_\_\_ (Type)  
 13.4.1 Number of pairs of arrester units (switching equipment) \_\_\_\_  
 13.4.2 Number of pairs of gas tube arrester units (special equipment) \_\_\_\_  
 13.4.2.1 Gas tubes to be:  
 \_\_\_\_ light,  
 \_\_\_\_ medium,  
 \_\_\_\_ heavy,  
 \_\_\_\_ max. duty units  
 13.4.2.2 Fail shorted/low breakdown failure mode required  
 Yes \_\_\_\_  
 No \_\_\_\_  
 13.4.2.3 Breakdown voltage of gas tube arresters \_\_\_\_  
 13.4.3 Number of terminated pairs to be grounded \_\_\_\_  
 13.4.4 Factory assembled tip cable  
 Yes \_\_\_\_  
 No \_\_\_\_  
 13.4.4.1 Tip cable length [if other than 20 feet (610 cm)]  
 \_\_\_\_  
 13.4.4.2 Tip cable formed  
 Up \_\_\_\_  
 Down \_\_\_\_  
 13.4.5 Pairs per vertical \_\_\_\_  
 13.4.6 Height of vertical \_\_\_\_ feet \_\_\_\_ inches

14. Building and Floor Plan Information (Host Office Only)

14.1 Equipment is to be installed in an existing building (Attach detailed plan.) \_\_\_\_  
 14.2 A new building is planned \_\_\_\_  
 14.2.1 Tentative plan (Note to Engineer: Show sketch without dimensions.)  
 14.3 Detailed Arrangements  
 14.3.1 Partition required (to isolate space containing battery, charger, power board, test panel, main distributing frame and subscriber's loop test circuit (wire chief's test desk) from that of the remaining equipment).  
 Yes \_\_\_\_  
 No \_\_\_\_  
 14.3.2 Vestibule required  
 Yes \_\_\_\_  
 No \_\_\_\_  
 14.3.3 Cable entrance  
 Overhead \_\_\_\_  
 Underground \_\_\_\_  
 14.3.4 Additional floor space will be required for the following equipment which is being furnished by the owner or by the connecting company:  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 14.3.5 The office will be arranged for Overhead Interbay Cabling \_\_\_\_  
 Underfloor (Computer Room Type) Interbay Cabling \_\_\_\_  
 14.3.6 Is earthquake bracing required?  
 Yes \_\_\_\_

No \_\_\_\_  
 (If "Yes," explain zone and criteria used for zone in Item 16, Appendix A.)  
 14.3.7 Office ground will be \_\_\_\_ ohms or less (Refer to Item 4.6.3 of RUS TE&CM 810.)  
 14.3.8 The office is considered to be in the following category for lightning damage probability based on the Figure 1 map of RUS TE&CM 823 (see paragraph (u)(2) of 1755.522).  
 \_\_\_\_ Very High  
 \_\_\_\_ Higher than Average  
 \_\_\_\_ Average  
 \_\_\_\_ Lower than Average  
 \_\_\_\_ Very Low  
 14.3.9 The following is additional information regarding operating environment conditions which should be considered in determining system protection requirements (tower in vicinity, high exposure, etc.):

15. Alternate Requests

16. Explanatory Notes (Include a detailed description of any equipment to be reused, or otherwise supplied by the owner, loop extenders, subscriber carrier, VF repeaters, etc.)

APPENDIX B TO 7 CFR 1755.522—DETAILED INFORMATION ON REMOTE SWITCHING TERMINALS (RST'S)

(Complete One Form For Each RST)

1. Number of Subscriber Lines (These lines included in totals in Item 6, Appendix A).  
 1.1 Single-Party: \_\_\_\_\_ Flat Rate  
 \_\_\_\_\_ Message Rate.  
 1.2 Semi-Postpay Pay Station \_\_\_\_\_.  
 1.3 Prepay Pay Station \_\_\_\_\_.  
 1.4 PABX Lines \_\_\_\_\_ Loop  
 Start \_\_\_\_\_ Ground Start \_\_\_\_\_ Re-  
 stricted at Office \_\_\_\_\_ Other \_\_\_\_\_  
 (Describe in Item 12, Appendix B)  
 1.5 Number of lines to be pushbutton  
 \_\_\_\_\_  
 1.6 911 Emergency Lines \_\_\_\_\_  
 1.7 Anticipated ultimate capacity (20-  
 Year) \_\_\_\_\_

2. Traffic

2.1 Originating traffic per line—CCS/BH:  
 \_\_\_\_\_ Initial \_\_\_\_\_ Ultimate.  
 2.2 Terminating traffic per line—CCS/BH:  
 \_\_\_\_\_ Initial \_\_\_\_\_ Ultimate  
 2.2.1 Terminating will be made equal to originating if it is not known to be different.

3. Subscriber Loop Resistance

3.1 Number of subscriber lines having loop resistance, including the telephone set of:  
 No. of Lines  
 1501-1900 Ohms \_\_\_\_\_  
 1901-3200 Ohms \_\_\_\_\_

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3.2 Number of pay station lines having loop resistance, excluding the telephone set, greater than:

No. of Lines  
1200 Ohms (For Prepay) \_\_\_\_\_  
1000 Ohms (For Semi-Post Pay Operation) \_\_\_\_\_

**4. Range Extension**

4.1 If no standby power is available at the site, loop extenders may be required on 1501 to 1900 ohms loops.

4.2 Loop extenders: Total Quantity  
By Bidder—Quantity \_\_\_\_\_ By Owner—Quantity \_\_\_\_\_  
(Explain in Item 12, Appendix B)

4.3 VF repeaters: Total Quantity \_\_\_\_\_  
By Bidder—Quantity \_\_\_\_\_ By Owner—Quantity \_\_\_\_\_  
(Explain in Item 12, Appendix B)

**5. Power Supply**

**5.1 Power Board.**

5.1.1 The power board and associated wiring shall be of ample size to meet the load requirements when this RST reaches \_\_\_\_\_ lines at the ultimate anticipated traffic rates specified in Item 2, Appendix B.

5.2 Charger input rating shall be: Voltage \_\_\_\_\_ Phase \_\_\_\_\_ Frequency \_\_\_\_\_

**3-Phase Connection:**

3-Wire \_\_\_\_\_  
4-Wire \_\_\_\_\_  
Delta \_\_\_\_\_  
Y \_\_\_\_\_

5.2.1 Charger shall be capable of charging the RST battery on a full float basis when the RST reaches \_\_\_\_\_ lines at ultimate traffic rate specified in Item 2, Appendix B.

5.2.2 Charger shall be redundant \_\_\_\_\_.

5.3 Battery reserve shall be \_\_\_\_\_ busy hours when the RST reaches \_\_\_\_\_ lines at the ultimate anticipated traffic specified in Item 2, Appendix B.

5.4 Standby power is available. Yes \_\_\_\_\_ No \_\_\_\_\_.

5.5 Special equipment power requirements \_\_\_\_\_ amps.

**5.6 Ringing.**

5.6.1 Type of Ringing.

5.6.2 Frequency  
No. .... 1. 2. 3. 4.  
Frequency HZ .....  
Max. No. Phones/  
Frequency .....

5.6.3 Wattage to be sized for \_\_\_\_\_ lines.

5.6.4 Frequency Meter (see Item 12.3.3, Appendix A). Panel Mounted \_\_\_\_\_ Not Required \_\_\_\_\_.

**6. Emergency Operation**

6.1 If path to central office is opened, the RST shall be able to complete calls between

subscribers in its own system: Yes \_\_\_\_\_ No \_\_\_\_\_

Further requirements should be listed under Item 12, Appendix B.

**7. RST Distribution Frame Requirements**

7.1 Total number of outside plant cable pairs to be terminated \_\_\_\_\_.

7.1.1 Gauge of outside plant cable pairs \_\_\_\_\_.

7.2 Number of outside plant cable pairs to be protected \_\_\_\_\_.

7.3 Number of additional protector pair units to be provided on MDF \_\_\_\_\_.

Explain:

**7.4 Main Frame Details**

7.4.1 Present MDF to be reused Yes \_\_\_\_\_ No \_\_\_\_\_.

If "Yes", Type \_\_\_\_\_.

Reused protectors are: \_\_\_\_\_ (Mfr.) \_\_\_\_\_ (Type).

7.4.2 Number of pairs of arrester units (switching equipment) \_\_\_\_\_.

7.4.3 Number of pairs of gas tube arrester units (special equipment) \_\_\_\_\_.

7.4.3.1 Gas tubes to be: \_\_\_\_\_ light, \_\_\_\_\_ medium, \_\_\_\_\_ heavy, \_\_\_\_\_ maximum duty units.

7.4.3.2 Fail shorted/low breakdown failure mode required Yes \_\_\_\_\_ No \_\_\_\_\_.

7.4.3.3 Breakdown voltage of gas tube arresters \_\_\_\_\_.

7.4.4 Number of terminated pairs to be grounded \_\_\_\_\_.

7.4.5 Factory assembled tip cable Yes \_\_\_\_\_ No \_\_\_\_\_.

7.4.5.1 Tip cable length [if other than 20 feet (610 cm)] \_\_\_\_\_.

7.4.5.2 Tip cable formed Up \_\_\_\_\_ Down \_\_\_\_\_.

7.4.6 Pairs per vertical \_\_\_\_\_.

7.4.7 Height of vertical \_\_\_\_\_ feet \_\_\_\_\_ inches.

**8. Building and Floor Plan Information**

8.1 RST to be mounted in building \_\_\_\_\_.

8.1.1 Earthquake bracing required Yes \_\_\_\_\_ No \_\_\_\_\_ (see Item 14.3.6, Appendix A).

8.1.2 Supply building floor plan.

8.2 RST to be mounted in cabinet out of doors \_\_\_\_\_.

8.2.1 Cabinet to be mounted \_\_\_\_\_ on pole \_\_\_\_\_ on ground.

**9. Subscriber Line Test**

9.1 Remote testing of subscriber lines is required Yes \_\_\_\_\_ No \_\_\_\_\_.

9.2 Subscriber loop test set \_\_\_\_\_.

**10. Span Lines to Host Central Office**

10.1 To be supplied by Owner \_\_\_\_\_.

10.2 To be supplied by Bidder \_\_\_\_\_.

10.2.1 When the bidder is to supply the span lines, an RUS Form 397b, Trunk Carrier

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Systems, with the applicable parts completed must be attached with a physical layout of the span line.

11. Grounding Considerations

11.1 The RST ground will be \_\_\_\_\_ ohms or less. (Refer to Item 4.6.3 of RUS TE&CM 810.)

11.2 This RST is considered to be in the following category for lightning damage probability based on the Figure 1 map of RUS TE&CM 823. \_\_\_\_\_ Very High \_\_\_\_\_ Higher than Average \_\_\_\_\_ Average \_\_\_\_\_ Lower than Average \_\_\_\_\_ Very Low

11.3 The following is additional information regarding operating environment conditions which should be considered in determining system protection requirements (tower in vicinity, high exposure, etc.):

12. Explanatory Notes

APPENDIX C TO 7 CFR 1755.522—SPECIFICATIONS FOR DIGITAL, STORED PROGRAM CONTROLLED CENTRAL OFFICE EQUIPMENT DETAILED REQUIREMENTS—BIDDER SUPPLIED INFORMATION

Telephone Company Name \_\_\_\_\_ Location \_\_\_\_\_

Central Office Name (By Location) Town \_\_\_\_\_ County \_\_\_\_\_ State \_\_\_\_\_

Attended \_\_\_\_\_ Unattended \_\_\_\_\_

1. General

1.1 The equipment and materials furnished by the bidder must meet the requirements of paragraphs (a) through (x), Appendix A, and Appendix B of §1755.522.

1.2 Paragraphs (a) through (x) of §1755.522 cover the minimum general requirements for digital, stored program controlled central office switching equipment.

1.3 Paragraph (y) of §1755.522 covers requirements for installation, inspection, and testing when such service is included as part of the contract.

1.4 Appendices A and B of §1755.522 cover the technical data for application engineering and detailed equipment requirements insofar as they can be established by the owner. These appendices are to be filled in by the owner.

1.5 Appendix C of §1755.522 covers detailed information on the switching network equipment and the stored program controlled equipment, and information as to system reliability and heavy traffic delays as proposed by the bidder. This appendix is to be filled in

by the bidder and must be presented with the bid.

1.6 Appendix D of §1755.522 is the single-point grounding system audit checklist.

2. Performance Objectives

2.1 Reliability (see paragraph (b) of §1755.522).

2.2 Busy Hour Load Capacity and Traffic Delay (see paragraph (e)(10) of §1755.522. Describe basis for traffic analysis).

3. Equipment Quantities Dependent on System Design

3.1 Switch Frames and Circuits.

3.1.1 Number of Lines.

3.1.1.1 The number of lines to be provided shall include the number required for the termination of subscriber lines, Item 7, Appendix A, plus the number required for routine testing plus any additional to meet the minimum switch increment of the selected system.

3.1.1.2 The number of lines provided for this office will be \_\_\_\_\_

3.1.2 Number of Ports Used for Trunks

3.1.2.1 The number of trunk ports to be provided shall be based on the trunk quantities required (Item 8, Appendix A) as modified by the minimum increment of the selected system. Provision shall be made for at least 5 percent additional inlet and outlet ports over those required initially. The additional ports shall be used for connecting additional trunks that may be required in the future.

3.1.2.2 The number of trunk ports provided for this office will be \_\_\_\_\_

3.1.3 Number of Subscriber Directory Numbers

3.1.3.1 The number of directory numbers provided shall be based on the total directory numbers required (Item 6.1.11, appendix A), as modified by the memory increment of the proposed system.

3.1.3.2 The number of subscriber directory numbers provided for this office will be \_\_\_\_\_

4. RST

4.1 Information for RST's must be supplied for each RST to be furnished.

4.2 Number of line terminals for this RST will be \_\_\_\_\_.

4.3 Number of span line terminations to the central office being supplied \_\_\_\_\_.

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4.4 If the emergency operation option is required, it will provide the following service when connection to the main office is severed:

\_\_\_\_\_  
 \_\_\_\_\_

4.5 The ac power drain at the remote end will be:

Initial \_\_\_\_\_ Ultimate \_\_\_\_\_  
 Voltage: Single-Phase \_\_\_\_\_ Three-Phase \_\_\_\_\_

4.6 Special environmental requirements for the remote end:

\_\_\_\_\_  
 \_\_\_\_\_

**5. Power**

5.1 AC Power Drain Watts

Initial \_\_\_\_\_ Ultimate \_\_\_\_\_

5.2 Heat Dissipation Watts

Provide the initial and ultimate equipment dissipation for each equipment room.

5.2.1 Operating Temperature Range

Minimum \_\_\_\_\_ Maximum \_\_\_\_\_

5.2.2 Operating Humidity Range

Minimum \_\_\_\_\_ Maximum \_\_\_\_\_

**6. Additional Information to be Furnished by Bidder**

6.1 The bidder shall accompany its bid with the following information:

a. Two copies of the equipment list and the calculations from which the quantities in the equipment list are determined;

b. Two copies of the traffic tables from which the quantities are determined, other than the full availability tables shown in paragraph (p)(1)(i) of §1755.522;

c. Two copies of detailed switching diagram showing the traffic on each route, the grade of service, the quantity of circuits, and main distributing frames;

d. Block diagram of stored program control and associated maintenance equipment;

e. A prescribed method and criteria for acceptance of the completed central office, which is subject to review;

f. Location of technical assistance service with 24-hour maintenance, and conditions when owner will be charged for access to the service;

g. Calculations showing the method by which ringing machine sizes were derived;

h. Precautions to be taken against static discharge;

i. Details of central office grounding requirements, recognizing local grounding conditions;

j. Details concerning traffic measurement capabilities and formats; and

k. Details concerning AMA features and formats to be provided.

6.2 As a part of the response to the bid, the bidder must also list information concerning the types and quantities of spare parts to be furnished. All units, excluding those units described in paragraph (x)(6)(i)(C) of §1755.522, must fall into one of the four classes. The information must be in the following format:

Unit No.	Unit name	Quantity of units in the CO's and RST's which are bid				Quantity of spare parts furnished with this bid			
		Class 1	Class 2	Class 3	Class 4	Class 1	Class 2	Class 3	Class 4

**7. Explanatory Notes**

APPENDIX D TO 7 CFR 1755.522—ACCEPTANCE CHECKLIST—SINGLE-POINT GROUNDING SYSTEM

**1. Approval Statement**

Telephone Company: \_\_\_\_\_

RUS Borrower Designation: \_\_\_\_\_

RUS Contract Number: \_\_\_\_\_

N/A \_\_\_\_\_

Name: \_\_\_\_\_

Central Office: \_\_\_\_\_

Remote: \_\_\_\_\_

Date of Inspection: \_\_\_\_\_

Names of Inspectors: \_\_\_\_\_

Owner Representative \_\_\_\_\_

Central Office Supplies \_\_\_\_\_

Consulting Engineer \_\_\_\_\_

Mutually Approved Exceptions:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Grounding System Approval:

Name (Owner Representative) \_\_\_\_\_

Signature \_\_\_\_\_

Title \_\_\_\_\_

Date \_\_\_\_\_

Name (Supplier Representative) \_\_\_\_\_

Signature \_\_\_\_\_

Title \_\_\_\_\_

Date \_\_\_\_\_

2. General Survey

2.1 This office is considered to be in the following category for probability of lightning damage based on the Figure 1 map in RUS TE&CM 823 (also refer to paragraph (u)(2) of §1755.522)

\_\_\_ Very High \_\_\_ Higher than Average
\_\_\_ Average \_\_\_ Lower than Average
\_\_\_ Very low

2.2 Central office ground field (COGF) to be inspected for proper bonding of conductors to ground rods, etc. COGF to earth grounding reading is \_\_\_ ohms. (Refer to RUS TE&CM 802, Appendices C and D, Measurement Techniques.) Is this resistance reading acceptable? (Refer to RUS TE&CM 810, Items 1.6, 4.6.2 and 4.6.3 for protection considerations.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

2.3 Ground connection to be inspected from the master ground bar (MGB) to the central office ground field (COGF) to ensure it is properly sized and installed by most direct route with no sharp bends. (Refer to RUS TE&CM 810, Item 4.3.2 and section 8.1.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

2.4 Building structure grounds (steel rebar in footings, ironwork, etc.) are to be properly bonded and connected to the MGB. (Refer to RUS TE&CM 810, Item 4.3.4.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

2.5 Metallic central office door(s) are to be painted with metallic paint with door-knobs left bare. Door(s) and frames are to be grounded to the building structural ground or the MGB.

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

2.6 Metallic fences within 6 feet (183 cm) of the exchange building, storage facilities ground field, etc. are to be properly bonded to the COGF outside of the central office building. Handhole enclosure is to be used for the COGF connection to permit inspection and disconnect for earth resistance testing. (Refer to RUS TE&CM 810, Appendix C, Item 4.6.1.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

2.7 Lightning rod systems are to be grounded by a separate dedicated ground field. A bond should be provided between the COGF and the lightning rod ground field. Handhole enclosure is to be used for the COGF connection to permit inspection and disconnect for earth resistance testing. (Refer to RUS TE&CM 810, Item 4.3.2.1.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

2.8 Radio/microwave tower ground grid is to be properly bonded to the COGF by a direct outside connection. Handhole enclosure is to be used for the COGF connection to permit inspection and disconnect for earth resistance testing. (Refer to RUS TE&CM 810, Item 4.3.2 and section 10.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

2.9 If a qualified metallic water system is present, inspect the MGB connecting conductor to ensure that it is properly sized and installed by the most direct route with no sharp bends and that it is clamped solidly on the water pipes. (Refer to RUS TE&CM 810, Item 4.3.3 for details on metallic water system grounding.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

2.10 All power and grounding conductors are to be continuous, end to end, with no splices, size discontinuity or intermediate terminations. If an exception is necessary, unusual care must be taken to assure proper bonding between the two sections. (Refer to RUS TE&CM 810, Appendix C, section 5.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

2.11 All ground conductors should be void of sharp bends along their entire lengths. (Refer to RUS TE&CM 810, Item 8.2.2.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

2.12 Ground conductors should only be placed in nonmetallic conduit. Those routed through metallic conduit require that both ends of the conduit be bonded to the ground conductor. (Refer to RUS TE&CM 810, Item 8.2.4.)

Acceptable: \_\_\_ Yes \_\_\_ No

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Comments: \_\_\_\_\_  
\_\_\_\_\_

2.13 Ground conductors should not be encircled by metallic clamp. Metallic straps are to be removed and replaced with non-metallic clamps. (Refer to RUS TE&CM 810, Item 8.2.4.)

Acceptable:  Yes  No  
Comments: \_\_\_\_\_

2.14 If metallic conduit is used, it is to be insulated from all ironwork.

Acceptable:  Yes  No  
Comments: \_\_\_\_\_

2.15 Inspect to determine if the required central office supplier electrostatic discharge plates, wrist wraps, antistatic floor mats, etc. are available and properly installed. (Refer to RUS TE&CM 810, Item 12.3.)

Acceptable:  Yes  No  
Comments: \_\_\_\_\_

2.16 Ground conductors, except green wires, should not be routed close and parallel to other conductors so as to minimize induction on surges into equipment wiring. It is also better not to route these ground conductors through cable racks or troughs, or within the confines of any iron work. (Refer to RUS TE&CM 810, Item 8.2.3.)

Acceptable:  Yes  No  
Comments: \_\_\_\_\_

3. Master Ground Bar (MGB)

3.1 The designated P, A, N, and I segments of the master ground bar (MGB) should be clearly identified. (Refer to RUS TE&CM 810, Figure 1 for MGB segmentation arrangement.)

Acceptable:  Yes  No  
Comments: \_\_\_\_\_

3.2 Check for appearance and proper location of following on MGB:

- (a) R—Interior radio equipment<sup>1</sup>
- (b) C—Cable entrance ground bar<sup>1</sup>
- (c) M—MDF ground bar<sup>1</sup>
- (d) G—Standby power equipment frame ground<sup>1</sup>

<sup>1</sup>Surge Producer—(P)

- (e) N—Commercial power MGN<sup>2</sup>
- (f) B—Building structure ground<sup>2</sup>
- (g) L—Central office ground field<sup>2</sup>
- (h) W—Water pipe system<sup>2</sup>
- (i) N<sup>1</sup>—Battery Return<sup>3</sup>
- (j) N<sup>2</sup>—Outside IGZ: \_\_\_\_\_<sup>3</sup>
- (k) N<sup>3</sup>—Outside IGZ: \_\_\_\_\_<sup>3</sup>
- (l) I<sup>1</sup>—Ground window bar<sup>4</sup>
- (m) I<sup>2</sup>—Ground window bar<sup>4</sup>

Acceptable:  Yes  No  
Comments: \_\_\_\_\_

3.3 All connections to MGB are to be two-hole bolted down copper crimped or compression type terminal lugs. (NOTE: No solder connections are permitted.)

Acceptable:  Yes  No  
Comments: \_\_\_\_\_

3.4 MGB is to be properly insulated from the mounting surface.

Acceptable:  Yes  No  
Comments: \_\_\_\_\_

3.5 All connections are to be tight.

Acceptable:  Yes  No  
Comments: \_\_\_\_\_

3.6 The MGB is to have an anticorrosion coating of the type which enhances conductivity.

Acceptable:  Yes  No  
Comments: \_\_\_\_\_

3.7 Bar is to be clearly stenciled or legibly labeled "MGB."

Acceptable:  Yes  No  
Comments: \_\_\_\_\_

3.8 All ground leads are to be properly sized and labeled as to point of origin. (Refer to RUS TE&CM 810, Item 8.3.1 and section 8.1.)

Acceptable:  Yes  No  
Comments: \_\_\_\_\_

<sup>2</sup>Surge Absorber—(A)  
<sup>3</sup>Grounds to non-IGZ Equipment—(N)  
<sup>4</sup>Grounds to IGZ Equipment (GWB's)—(I)

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4. Ground Window Bar (GWB)

4.1 All equipment grounds that originate inside of an Isolated Ground Zone (IGZ) are to be terminated on the GWB which is preferably located physically inside the IGZ and insulated from its support. (Refer to RUS TE&CM 810, Item 5.1.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

4.2 Each GWB is to be connected to the MGB by the most direct route with a conductor of 2/0-gauge or coarser, or resistance of less than 0.005 ohms. Parallel conductors for redundancy if required by the supplier. (Refer to RUS TE&CM 810, Item 8.1.2.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

4.3 The metal framework grounds of only that switching equipment and associated electrical equipment located inside of the IGZ should be connected to the GWB as required by the central office equipment supplier. (Refer to RUS TE&CM 810, Item 5.5.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

4.4 GWB is to be clearly stenciled or labeled "GWB."

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

4.5 All connections are to be tight.

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

5. Isolated Ground Zone (IGZ)

5.1 IGZ areas are to be clearly marked on the floor or in some other easily recognizable manner. (Refer to RUS TE&CM 810, Item 6.1.1)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

5.2 Confirm that all framework, cabinets, etc., within the IGZ are ground connected only to the GWB. (Refer to RUS TE&CM 810, Item 5.5.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

5.3 All cable racks, ground mats, switching and transmission equipment within the IGZ are to have ground leads only to the GWB. (Refer to RUS TE&CM 810, Item 5.5.2.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

5.4 Review ac power feed arrangement within the IGZ for acceptable receptacle type and confirm that all green wires are properly connected. (Refer to RUS TE&CM 810, Item 5.5.4.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

5.5 All ironwork, metallic conduit, and other equipment associated with the switch are to be properly insulated at the IGZ boundary as stipulated by the supplier. (Refer to RUS TE&CM 810, Item 6.2.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

5.6 With the GWB disconnected from the MGB, the resistance reading of \_\_\_ ohms between the GWB and the MGB indicates adequate isolation. (CAUTION: Test is to be conducted only with the approval and under the direction of the central office supplier.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

6. Entrance and Tip Cables

6.1 When neither a cable vault nor a splicing trough exists, the outside plant cable should be brought into the central office and spliced to tip cables with a PVC outer jacket (ALVYN®) or equivalent as close as practical to the cable entrance. (Refer to RUS TE&CM 810, Item 7.3.4.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

6.2 All outside entrance cables and all tip cable shields are to be separated by at least a 3-inch (7.6 cm) gap between shield ends.

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

6.3 All entrance cable shields are to be bonded separately to #6 AWG or larger insulated wire or bonding ribbon and connected



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to the Cable Entrance Ground Bar (CEGB) by most direct route with minimum bends.

Acceptable:  Yes  No

Comments: \_\_\_\_\_  
\_\_\_\_\_

6.4 Outside plant cable shields are to be connected only to the CEGB, and the tip cable shields are to be connected only to the Main Distributing Frame Bar (MDFB).

Acceptable:  Yes  No

Comments: \_\_\_\_\_  
\_\_\_\_\_

**7. Cable Entrance Ground Bar (CEGB)**

7.1 The CEGB is to be properly insulated from the mounting surface. (Refer to TE&CM 810, Item 4.2.1.)

Acceptable:  Yes  No

Comments: \_\_\_\_\_  
\_\_\_\_\_

7.2 The CEGB is to be located as close as possible to the physical ends of the entrance cable shields.

Acceptable:  Yes  No

Comments: \_\_\_\_\_  
\_\_\_\_\_

7.3 All connections are to use two-hole bolted down copper crimped or compression type terminal lugs. (NOTE: No solder connections are permitted.)

Acceptable:  Yes  No

Comments: \_\_\_\_\_  
\_\_\_\_\_

7.4 All connections are to be tight.

Acceptable:  Yes  No

Comments: \_\_\_\_\_  
\_\_\_\_\_

7.5 Bar is to be clearly stenciled or legibly labeled "CEGB."

Acceptable:  Yes  No

Comments: \_\_\_\_\_  
\_\_\_\_\_

7.6 All ground leads are to be properly sized and labeled.

Acceptable:  Yes  No

Comments: \_\_\_\_\_  
\_\_\_\_\_

7.7 The CEGB is to have an anticorrosion coating of the type which enhances conductivity.

Acceptable:  Yes  No

Comments: \_\_\_\_\_  
\_\_\_\_\_

7.8 The CEGB is to be connected to the MGB by a properly sized conductor and by the most direct route. (Refer to RUS TE&CM 810, section 8.1.)

Acceptable:  Yes  No

Comments: \_\_\_\_\_  
\_\_\_\_\_

**8. Main Distributing Frame (MDF)**

8.1 RUS strongly recommends that MDF protectors be furnished without heat coils. (Refer to RUS TE&CM 810, section 7.6.)

Acceptable:  Yes  No

Comments: \_\_\_\_\_  
\_\_\_\_\_

8.2 Incoming cable pairs terminated on MDF protector assemblies should be protected with protector modules. These modules should contain white coded carbon blocks or orange coded gas tube arrestors that are included in the RUS List of Materials. (Refer to RUS TE&CM 810, Item 7.4)

Acceptable:  Yes  No

Comments: \_\_\_\_\_  
\_\_\_\_\_

7.8.3 All incoming subscriber cable pairs are to be properly terminated at either a protector equipped terminal or connected to ground.

Acceptable:  Yes  No

Comments: \_\_\_\_\_  
\_\_\_\_\_

8.4 MDF protector assemblies may be mounted directly on the vertical frame ironwork. Protector assemblies on each vertical are interconnected with each other and the Main Distributing Frame Bar (MDFB) with a #6 copper grounding conductor. Alternative means of connecting to the MDFB are also acceptable which do not rely on the frame ironwork for conducting surge currents to ground. (Refer to RUS TE&CM 810, section 7.)

Acceptable:  Yes  No

Comments: \_\_\_\_\_  
\_\_\_\_\_

8.5 Protective "ground connections" should be provided between the MDFB and the frame ironwork for personnel protection regardless of the type of protector assembly used. Protective ground leads should be 14-gauge, less than 12 inches (30.5 cm) in length with paint thoroughly removed at point of

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connection to the ironwork. (Refer to RUS TE&CM 810, Item 7.1.3.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments \_\_\_\_\_

8.6 The MDFB should be insulated from the frame ironwork in all cases where it is used as a Master Ground Bar (MGB). (Refer to RUS TE&CM 810, Item 7.1.2.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments \_\_\_\_\_

8.7 Where the MDFB is used as the MGB in very small offices the protective "ground connections" should be connected on the N section of the bar. The MDF line protector assembly grounds should be connected to the P section of the bar. (Refer to RUS TE&CM 810, Item 7.1.4.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments \_\_\_\_\_

8.8 The MDFB is to be connected to the MGB by the most direct path with minimum bends and proper conductor size. (Refer to RUS TE&CM 810, Item 8.1.4.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments \_\_\_\_\_

8.9 The MDFB should be free of all other ground leads when not used as an MGB.

Acceptable: \_\_\_ Yes \_\_\_ No
Comments \_\_\_\_\_

8.10 Alternative arrangements which insulate the line protector assemblies and MDFB from the frame ironwork may require a direct ground connection of the frame ironwork to the MGB for personnel protection. Conductor is properly sized and tightened with paint removal on main frame ironwork at point of connection.

Acceptable: \_\_\_ Yes \_\_\_ No
Comments \_\_\_\_\_

9. Power Service Protection and Grounding

9.1 The ground conductor between the ac power system multigrounded neutral (MGN) at the main ac disconnect panel and the master ground bar (MGB) is to be properly sized and connected. (Refer to RUS TE&CM 810, Items 2.19, 4.3.1 and 8.1.3.)

Acceptable: \_\_\_ Yes \_\_\_ No

Comments: \_\_\_\_\_

9.2 If there is a non-MGN ac power system, there is to be a properly sized and connected insulated conductor bond between the power service ground electrode and the MGB. (Refer to RUS TE&CM 810, Item 4.3.1.1.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

9.3 AC conductors including ground conductors serving 120-volt ac electric convenience receptacles and all direct wire peripheral equipment, located in the IGZ, should be sized in accordance with normal "green wire" criteria. (Refer to RUS TE&CM 810, Items 5.5.4, 5.5.5, and 5.5.6.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

9.4 Minimum protection for ac power serving the central office buildings should consist of an RUS accepted secondary arrester at the service entrance. (Refer to RUS TE&CM 810, section 9.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

9.5 A properly sized conductor for ground bonding between the standby power plant framework (not separately derived) and the MGB is to be provided to equalize framework voltages for personnel safety reasons. (Refer to RUS TE&CM 810, Item 4.2.4.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

10. Miscellaneous

10.1 All non-IGZ equipment frames, relay racks, cable racks and other ironwork are to be properly connected to the MGB. (Refer to TE&CM 810, Item 4.4.)

Acceptable: \_\_\_ Yes \_\_\_ No
Comments: \_\_\_\_\_

10.2 Shields on high frequency intra-office cables are to be properly isolated and connected only to an isolation ground bar in the relay rack. All shielded cables entering the IGZ should only be referenced at the IGZ termination point as given by the manufacturer. (Refer to RUS TE&CM 810, Item 7.2.1.2.)

Acceptable: \_\_\_ Yes \_\_\_ No

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Comments: \_\_\_\_\_  
\_\_\_\_\_

10.3 Isolation ground bars in the relay racks are to be properly connected to the MGB with appropriate sized conductor with no sharp bends.

Acceptable: \_\_\_ Yes \_\_\_ No

Comments: \_\_\_\_\_  
\_\_\_\_\_

10.4 All radio equipment cabinet(s) are to be at least 10 feet (305 cm) from the IGZ.

Acceptable: \_\_\_ Yes \_\_\_ No

Comments: \_\_\_\_\_  
\_\_\_\_\_

10.5 The metal spare parts cabinet is to be grounded with a #6 AWG or larger insulated wire to non-IGZ cable rack, etc. or directly to the MGB.

Acceptable: \_\_\_ Yes \_\_\_ No

Comments: \_\_\_\_\_  
\_\_\_\_\_

[58 FR 30938, May 28, 1993; 58 FR 36252, July 6, 1993, as amended at 60 FR 1711, Jan. 5, 1995, 60 FR 64312, 64314, Dec. 15, 1995; 69 FR 18803, Apr. 9, 2004]

**§§ 1755.523–1755.699 [Reserved]**

**§ 1755.700 RUS specification for aerial service wires.**

§§ 1755.701 through 1755.704 cover the requirements for aerial service wires.

[61 FR 26074, May 24, 1996]

**§ 1755.701 Scope.**

(a) This section covers the requirements for aerial service wires intended for aerial subscriber drops.

(b) The aerial service wires can be either copper coated steel reinforced or nonmetallic reinforced designs.

(c) For the copper coated steel reinforced design, the reinforcing members are the conductors.

(1) The conductors are solid copper-covered steel wires.

(2) The wire structure is completed by insulating the conductors with an overall extruded plastic insulating compound.

(d) For the nonmetallic reinforced design, the conductors are solid copper individually insulated with an extruded solid insulating compound.

(1) The insulated conductors are either laid parallel (two conductor design only) or twisted into pairs (a star-quad configuration is permitted for two pair wires).

(2) The wire structure is completed by the application of nonmetallic reinforcing members and an overall plastic jacket.

(e) All wires sold to RUS borrowers for projects involving RUS loan funds under §§1755.700 through 1755.704 must be accepted by RUS Technical Standards Committee “A” (Telecommunications). For wires manufactured to the specification of §§1755.700 through 1755.704, all design changes to an accepted design must be submitted for acceptance. RUS will be the sole authority on what constitutes a design change.

(f) Materials, manufacturing techniques, or wire designs not specifically addressed by §§1755.700 through 1755.704 may be allowed if accepted by RUS. Justification for acceptance of modified materials, manufacturing techniques, or wire designs must be provided to substantiate product utility and long term stability and endurance.

[61 FR 26074, May 24, 1996]

**§ 1755.702 Copper coated steel reinforced (CCSR) aerial service wire.**

(a) *Conductors.* (1) Each conductor shall comply with the requirements specified in the American National Standard Institute/Insulated Cable Engineers Association, Inc. (ANSI/ICEA) S-89-648-1993, paragraphs 2.1 through 2.1.5. The ANSI/ICEA S-89-648-1993 Standard For Telecommunications Aerial Service Wire, Technical Requirements (approved by ANSI July 11, 1994) is incorporated by reference in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies of ANSI/ICEA S-89-648-1993 are available for inspection during normal business hours at RUS, room 2845, U.S. Department of Agriculture, Washington, DC 20250-1500, or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to: [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html). Copies are available