GTE FLORIDA INCORPORATED

ORIGINAL

FLORIDA PUBLIC SERVICE COMMISSION

DOCKET NO. 990649-TP

Investigation Into Pricing Of Unbundled Network Elements

BINDER 15
TABS 30 - 31

APRIL 17, 2000

DOCUMENT NUMBER-DATE
04628 APR 17 8
FPSC-RECORDS/REPORTING

ENGINEERING PRACTICES
TABLE OF CONTENTS

	ICM Inputs	Page(s)	PAR/GTEP Reference
1.	Engineering Feeder Factor – This factor represents the growth capacity that is being designed for the copper distribution cables and the pair gain (NGDLC) equipment.	30.33 30.45	PAR 074 – pg. 25, 37
2.	Engineering Distribution Factor – This factor represents the growth capacity that is being designed into the copper distribution cables.	30.54	PAR 074 – pg. 46
3.	NID Basic – Accommodates up to 6 lines	30.89	GTEP 600-200-215, Pg. 11/17
4.	Engineering Administrative Fill – This fill represents the usable capacity of a copper cable. Engineering practices can support 1 % to 3 % administrative capacity.	30.43	PAR 074 – pg. 35
5.	Drop Wire Pairs – This is the number of pairs contained in the service (drop) placed from the distribution serving terminal to the NID at the customer's location – a three pair drop is the standard size used in GTE.	30.6	Refer to attached Product Standardization Bulletin # 5188.
6.	Structure sharing – Based on number of ducts required for GTE cables, plus one maintenance duct.	30.98	GTEP 911-000-070, Pg. 3/10, Section 8.0(a) States "Initial requirements plus one maintenance duct.
7.	The depth of the trench is increased to accommodate sharing	30.148 - 30.154	GTEP 928-000-070, Pg. 19-25/25. Shows trenching separations - no conduit. Also reference the attached document titled "Trenching and Plowing".
8.	One terminal for every 4 housing units	30.143 - 30.146	GTEP 928-000-070, Pg. 14-17/25
9.	2.0 – 2.5 Distribution lines per housing unit.	30.54	PAR 074 – pg. 46

	ICM Inputs	Page(s)	PAR/GTEP Reference
10.	Distribution Cables are sized to meet the Residential and Business demand in the grid	30.164	GTEP 938-010-070, Pg. 10/32
11.	Length of drops	30.83	GTEP 600-200-215, Pg. 5/17
12.	Percent mix of Aerial, Buried, and Underground placement of Fiber/Copper Cable	30.121	GTEP 914-000-070, Pg. 8/16, Section 3.6 – Aerial Cable still comprises a large part of existing OSP. Underground or Buried Cable Distribution is the recommended method of new Cable construction.
13.	Manholes spaced at 750 feet	30.107	GTEP 911-400-071, Pg. 2 of 8, Section 5
14.	Pull Box Spacing – This value represents the distance between pull boxes.	30.212	GTEP 938-624-000, pg. 16 of 26
15.	X Connect Box Factor – This value is a factor (3) that is applied to the number of lines in the feeder cable to determine the size of the cross connect box required.	30.193 30.174	GTEP 938-360-010, pg. 7 of 10, section 5.1 GTEP 938-010-070, pg. 20 of 32
16.	Minimum X Connect Size 1 – This represents the minimum size cross connect box that will be placed in the super cell at a location other than at the DLC location. If the demand grid served by those cross connect boxes is less than this value, a cross connect box will not be placed. This value is set at 100 pairs.		GTEP 938-010-070
17.	Minimum X Connect Size 2 – This represents the minimum size cross connect box that will be placed in the super cell at the DLC location. If the demand in the entire super cell is less than this value, a cross connect box will not be placed. This value is set at 200 pairs.	30.193	GTEP 938-360-010, pg. 7 of 10, section 5.1

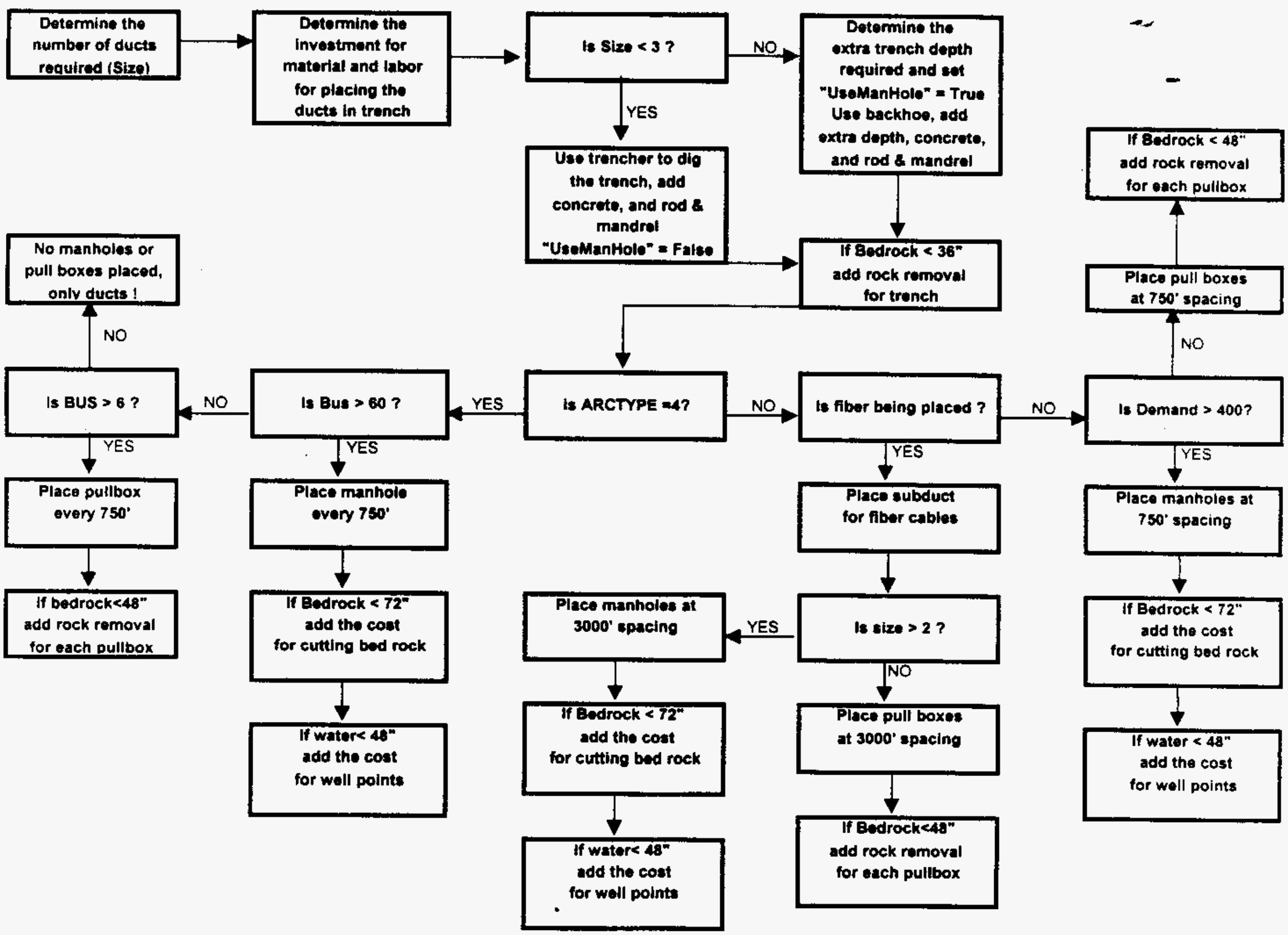
CONDUIT FLOWCHART

The ICM investments for conduit are calculated based on the following logic. In the distribution network, pull boxes and/or manholes are rarely used in residential areas. As the number of businesses in an area increases, the need for pull boxes and manholes increases to facilitate additional branch cables and access to splices for rearrangements to meet changing demands. Therefore, in the distribution network, ICM is modeled to place ducts without pullboxes or manholes in demand units with 6 or less business lines, ducts with pull boxes in demand units with between 6 and 60 business lines, and ducts with manholes when business lines exceed 60 in the demand unit.

In the feeder network, pull boxes are placed at a 3,000 feet spacing for fiber cables.

Pull boxes are placed and spaced at 750 feet for copper cables serving a demand less than 400 lines, and manholes are placed and spaced at 750 feet for copper cables serving demands over 400 lines. When fiber is placed, subduct (1" or 1¼" tubes placed inside the 4" duct) is also placed.

In the distribution and feeder networks, the trenching for duct formations with two or less ducts is based on the trenching being performed by a trencher. For duct formations over 2 ducts, the trenching is performed with a backhoe. The decision chart below summarizes the ICM modeling for underground conduit.



TRENCHING AND PLOWING

TRENCHING

The ICM investments for trenching are calculated based on the following logic. In distribution, all trenching is at a depth required to provide 30 inches of cover. Random separation is modeled for all shared trenching in the distribution based on the assumption that the power voltages are lower in the distribution network. In the feeder, random separation is not permitted based on the assumption that the power voltages would be higher in the feeder network. Therefore shared trenching in the feeder is modeled to reflect an additional 12 inches depth for shared trenching. Sharing assumptions are based on sharing with power companies because in the rare occurrence that trench sharing does occur in the feeder network, power companies are typically the sharing party.

For fiber feeder cables, the preferred method of placing buried fiber is at 48 inches to provide additional protection for the higher capacity fiber cables. Shared trenching for fiber cables would therefore require a depth of 60 inches. When bedrock is at a level that prevents the shared trench depth from reaching 60 inches or non-shared trench from reaching 48 inches, the fiber cables are placed at 30 inches in subduct to provide the protection that is not provided by the extra 18 inches of depth. Whenever the bedrock is within 30 inches of the surface, in both feeder and distribution, the additional investment for rock sawing is added to the trenching. The copper feeder cables are placed at 30 inches with the same additional 12 inches of depth required for shared trench.

Additional investments are also added for hand digging, boring, and removing and replacing concrete. These additional investments are calculated by applying percentages to the trench length to determine the length of each that is required. The percentages are user inputs. In the feeder, these extra investments are not applied in low density (less than 50 lines per square mile) wire centers. In the distribution network , the user determines if the extra investment is applied in various demand unit styles. The user can turn these investment on or off by setting the "STRFLG" for the 9 demand unit styles to 0.0 (off) or 1.0 (on). GTE has set the "STRFLG" to 0.0 in demand styles 1-3.

PLOWING

Plowing is also allowed in ICM in both the feeder and distribution networks if certain requirements are met. Requirements to allow plowing in the distribution network are:
1. Bedrock must be below the plowed depth, >29".
2. The "PLWFLG" on the distribution style table must be set to 1. (user adjustable)
3. Trench users must be less than 3.

Requirements to allow plowing in the feeder network are:
1. Wire center must be low density, i.e., contain less than 50 lines per spare mile
2. No sharing. (Sharing in the feeder network requires physical separation).

The depth requirements when plowing cables are the same as when trenching or backhoeing is used. No additional investments are added to plowing for hand digging, boring, and concrete removal and placement because it is assumed that if these additional investments were required trenching or backhoeing would have been the method selected for placing the cable.

PRODUCT STANDARDIZATION BULLETIN

BULLETIN NUMBER	:5188:
REVISION #	:13:
PRODUCT CLASS	:150313:
OEM CODE	:SPCC:
ISSUE DATE	:10/30/97:

PSB TITLE: WIRE, BURIED SERVICE

MANUFACTURER: SUPERIOR CABLE CORP
150 INTERSTATE N.PKWY, ST#300
ATLANTA, GA 30339
(404) 953-8338

REASON FOR ISSUANCE:

This PIR/PSB is being issued in order to De-Standardize 2 pair buried service wire products. The minimum pair count products that should be installed on a going forward bases is 3 pair. All 2 pair products have been C/T'ed to the similar put-ups of existing Standard 3 pair products.

Also, this PSB now covers the unique 12 pair BSW products that were previously standardized under MIN SM 970007.

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NETWORK PLANNING

INFRASTRUCTURE PROVISIONING
GUIDELINES

PAR 074

GTE NETWORK SERVICES
JANUARY 28, 1998

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PAR 074

INFRASTRUCTURE PROVISIONING GUIDELINES

PAR-074

1/28/98

1.0 PURPOSE

The purpose of this PAR is to document Infrastructure Provisioning (IP) guidelines for development and economic utilization of Maintenance, Obligatory, and Nominal Growth (MONG) funding. Considerations for the impacts of other significant initiatives such as Open Market Transition (OMT), Maintenance and Operating Improvements, Business Case Development, and selected technologies are also included.

2.0 CAPITAL BUDGET RESPONSIBILITIES

2.1 Network Planning - HQ

Network Planning is responsible for providing Unit Driver price components (refer to Attachment J) to Business Analysis (BA) for insertion into the budget model. Headquarters BA and Network Planning develop the strategic plan that contains all product and service deployment goals and plans as submitted by the LOBs. Allocated dollars by State will include funding for both Planned and Reactionary work order activities. Regional input on allocation will be obtained through the Region's General Manager (GM) IP organization.

Network Planning is responsible for determining national design criteria and providing guidelines for development and application of market segment specific design criteria (triggers). Triggers are defined as the percent fill at which margin relief should be considered.

To assist in understanding the process of determining the level of growth funding, please refer to Figure 1.

Budget Development Process (P x Q)

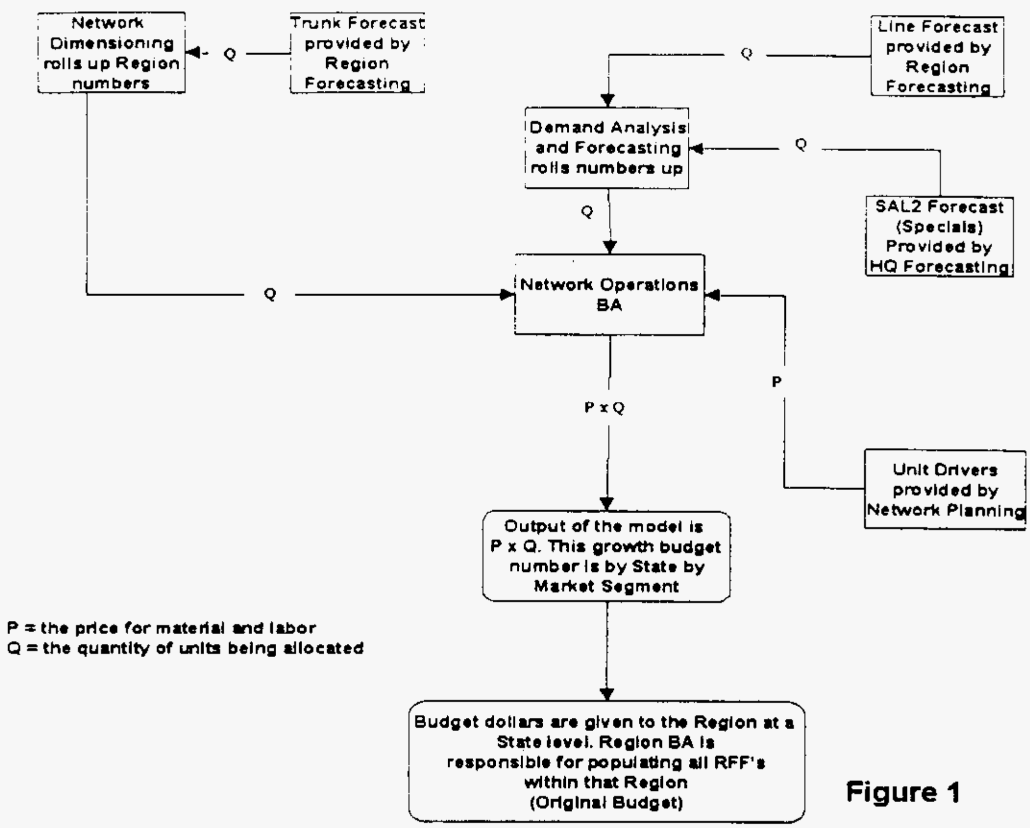

Figure 1

2.2 Network Design/Access Design - Region

2.2.1 Plant Provisioning Committee (PPC) Development

Plant Provisioning Committee (PPC) meeting(s) is/are necessary to ensure the Region requirements have been identified and prioritized within the budget constraints. Any remaining requirements falling below the budget line will require an action plan (see Section 2.2.2.2). This meeting is chaired by IP, with representation from Customer Operations, Access Design, Construction, Network Design, COEI, Forecasting, and Regional Operations Support.

Network Design creates projects for switch, IOF, trunking and overlay network requirements. Access Design creates projects for local loop requirements, both OSP and loop electronics (i.e. DLC). The PPC listing reflects the project and work activities at an exchange level that will satisfy the deployment objectives outlined in the Strategic Plan. **The objective is to maximize the project activity in the Planned category** (reference Section 3.1.1 and 3.1.2 for discussion of Planned and Reactionary project activities). Prioritization and coordination is required between the Network Designer and Access Designer to fit all projects into the allocated budget.

2.2.2 Capital Budget Administration

2.2.2.1 RFF Establishment within CPMS

The Annual "Original Budget" is delivered to the Regions as a component of the Strategic Plan. Once the PPC listing has been established, Network Design and Access Design will send the appropriate Reserved Future Funds (RFF) detail to BA. Region BA will establish all RFFs in CPMS. The actual manipulation and monitoring of the CPMS file is the responsibility of the Region Network and Access Design groups.

2.2.2.2 RFF Maintenance/Project Prioritization

Subsequent to establishing the "Original Budget" file, any adjustments in the total budget level (budget cuts, overlays, etc.), or new requirements within the existing level ('in-period' adjustments) will be coordinated by the GM-IP's designee. This may be accomplished by adjustments in the planned projects, or by a re-prioritization of the entire budget file through additional PPC meetings.

Where critical plant provisioning requirements can't be accommodated within the Regions' original budget levels, the Region may develop a business case for such requirements and submit to Region BA for consideration. A business case includes a cash flow analysis and the business need as to why it is required. To down load a copy of the business case template, click this hyperlink http://netplan.irngtx.tel.gte.com/AIOF/BusCase/BCT.htm

Projects should be subject to a "last look" process prior to approval, to ensure project triggers and construction milestones remain valid. To facilitate this effort, Regional Inventory Management Committees may be beneficial to the process.

2.2.2.3 Budget Monitoring

All employees and work groups within IP will share responsibility for meeting the Capital Budget targets. Network and Access Design will have primary responsibility for monitoring the RFF levels and the overall Capital Budget file for all 22xx and 24xx accounts.

After the monthly financial closing is complete, actuals are loaded into CPMS. Region BA will provide Regional level financial reports to include:

- Actual expenditures to current view estimates
- Monthly actuals comparison to approved view by RFF

The RFF managers will run the work order estimate to actual reports, do analysis, and refer to Network and/or Access Design for the appropriate revisions. The GM-IP is responsible for setting threshold limits on which these revisions are required.

3.0 PROJECT CATEGORIES

Projects will be classified in one of three categories:

1. Growth

2. Maintenance and Operating Improvements

3. Administrative Support

The Access and Network Designers have the responsibility to properly code work orders when initiated in CPMS. This is accomplished by utilizing the appropriate Program Category Code (see Attachment K for detailed listing).

3.1 GROWTH

Growth projects are to be initiated by documented forecast requirements or firm customer orders. Relief projects are to be scheduled to complete as near to facility exhaustion or customer need as possible in order to maximize facility inventory utilization.

The Network and Access Design groups will develop all Inside Plant (ISP), Land and Building (L&B ƆAF Feeder, Distribution and Interoffice facility (IOF) project activities for known growth driven requirements. The Network and Access Design groups will provide work order level detail for all projects, excluding L&B. Standard planning systems and tools should be used to develop this plan consistent with standard design criteria.

3.1.1 Planned Projects

The planned project category contains all those projects that are either:

- Identified through ICAPS/CAPS

- Directed by the Strategic Plan (new products and services, national programs, and overlays).

- Forecasted growth projects

- COE additions
- IOF additions
- Plug-In-Provisioning (PIP) additions (COE, IOF and CAF DLCs)

It is the responsibility of Network and Access Design to consider known and potential requirements when planning Central Office, IOF and CAF feeder facility relief. These could include, but are not limited to:

- H/R links for Remote Switches and DLC sites
- Customer DS-1 requirements
- Customer DS-3 requirements or larger access facilities (VideoConnect, MMDS, ATM network overbuild, etc.)
- Inter-office facility relief
- Placement of customer ring facilities as specified by Competitive Response
- CO Modernization projects support activities
- Other National Program support activities
- Maintenance/expense reduction opportunities
- Defective Plant replacement (TAC)

3.1.2 Reactionary Projects - OSP

The projects that fall into this category are those that are unplanned and generally have In-Service dates of 30 days or less. Activities that fall within these criteria will be funded mainly through the Routine budget (JOBOSP or JOBOSPP). Blanket work orders can be assigned from the Routine budget; these blanket work orders should have a threshold set for the size of a project written against it. It is the responsibility of IP to set the thresholds and monitor compliance.

Activities in this category are mainly entrance cables, cable extensions associated with service order activity, pole placement, and HICAP requests.

Access Design and Construction will initiate and construct drop-in or in-period growth projects within stated project criteria as provided in Attachment G.

Business Response Provisioning Center (BRPC) will be responsible for ordering plug-in cards necessary to provision customer circuits in response to firm orders. Inventory Management will set the level of spare cards and monitor these facilities. Such plug-in cards will be installed in existing shelves. When inventory levels reflect additional shelves are required, BRPC will document these levels and notify Network Design who will be responsible for the provisioning of additional shelves.

Authorization Criteria:

1. Network Design to define authorization limits for BRPC routine growth activities.
2. Activities exceeding specified parameters will be referred to Network Design.

Circuit card ICP and supply inventory levels should be regularly monitored for potential reuse between offices. **Reuse of facilities should be given first consideration for relief requirements**.

3.2 MAINTENANCE AND OPERATING IMPROVEMENTS

Maintenance and operating improvement activities can be divided into six categories:

1. Defective Plant - COE
2. Defective Plant - OSP
3. Obligatory
4. Operating Requirements - Land and Building
5. Central Office HVAC
6. Central Office Grounding

Funding for these categories are allocated via the checkbook funding process administered by HQ Business Analysis and is not a part of the Growth Budget.

3.2.1 Defective Plant - COE

Defective Plant - COE includes expenditures to replace defective central office equipment such as batteries and chargers. Quarterly maintenance routines, power plant maintenance programs, site visits or equipment failures normally trigger this activity.

3.2.2 Defective Plant - OSP

Defective Plant - OSP can be categorized into defective, safety related, business case and air pressure. Refer to PAR 010 for additional information.

3.2.2.1 Defective Plant (TAC Focus)

Defective Plant is the result of an analysis completed by the Trouble Analysis Center (TAC) and isolation testing by Customer Operations. This activity is based on trouble reports and the cost per trouble cleared. Activity has to meet a payback period to be approved for funding.

3.2.2.2 Safety Conditions

A Safety Condition can be defined as a present condition that can cause serious injury to an individual or property. An immediate assessment should be made concerning the severity associated with the unsafe condition. If it is determined the condition presents a serious safety hazard, the condition should be corrected immediately. An example of this would be a pole that is rotten and unsafe to climb. It is the responsibility of IP to ensure that all "low levels/wire on the ground" are truly of an unsafe nature prior to issuing a work order to correct.

3.2.2.3 Business Case

Defective or nonstandard plant can be addressed utilizing a business case approach. These are prepared by the concerned party and submitted to Region BA for approval. Examples of this category would include items that did not meet the TAC payback period or replacement of plant that is nonstandard. In either case, there has to be a sound business reason to perform the activity. For a copy of the 1998 business case template, please refer to the hyperlink list in section 2.2.2.2.

3.2.2.4 Air Pressure

Starting January 1, 1998, there is a new process to help address pressurized cable situations that are either substandard (defective) or are not pressurized but need to be. This process, initiated by Customer Operations, may require input on design/pricing from IP. If approved through a business case format, a work order may need to be generated to correct the condition. An example of this might be the replacement of an air dryer in order to maintain proper pressure on a section of cable.

3.2.3 Obligatory/Plant Damage

Obligatory activity is the result of a request for facility relocation or plant restoration projects required to maintain existing service. Road moves, custom work for outside parties, joint-use relocations, replacement of damaged plant and cable reclamation (wrecking out of retired cable facilities) is to be included. Also included is replacement of plant due to minor storm damage.

Attachment A - Acronyms/Terms

Infrastructure Provisioning Functions

Access	From the customer to the node
Transport	From node to node

ACRONYMS / TERMS

2W	Two Wire
3GDLC	Third Generation Digital Loop Carrier
4W	Four Wire
ADPCM	Adaptive Differential Pulse Code Modulation
DAVAR	Process for verifying OSP facilities
ADQ	Address Inquiry in MARK
ADSL	Asynchronous Digital Subscriber Line
AIN	Advanced Intelligent Network
AML	Added Main Line
ASYNC	Asynchronous
ATM	Asynchronous Transfer Mode
BA	Business Analysis
BAU	Business As Usual
BFR	Bona Fide Request
BRPC	Business Response Provisioning Center
BRI	Basic Rate ISDN (144kbps)
BT	Bridge Tap

CAF	Customer Access Facilities
CAPS	Customer Access Planning System
CCS	Centrum Call Seconds
CDDD	Customer Desired Due Date
CLASS	Custom Local Area Signaling Service
CLEC	Competitive Local Exchange Carrier
CLOB	Carrier Line Of Business
CM-8	Vendor product name of an analog subscriber carrier product
CNID	Calling Number ID
CO	Central Office
COE	Central Office Equipment
COEI	Central Office Equipment Installation
COT	Central Office Terminal
CPMS	Capital Program Management System
CSD	Circuit Switched Data
CTAC	Customer Technical Assistance Center
CXR	Carrier
DA	Directory Assistance
DCBW	Data Channel Band Width
DCS	Digital Cross-connect System
DDS	Digital Data Service
DLC	Digital Loop Carrier

DOR	Delayed Order Request
DS0	Digital Signal Zero (64Kbps)
DS1	Digital Signal level 1 (1.544Mbps)
DS3	Digital Signal level 3 (44.736Mbps)
DS4	Digital Signal level 4 (275 Mbps)
DSC	Digital Subscriber Carrier
DSX	Digital Signal/System Crossconnect
EC	Extremely Competitive
EDT	EXPRESS DIALTONE
ESA	Electronic Serving Area
FAP	Facility Area Plan
FDI	Feeder/Distribution Interface (Crossconnect)
FITL	Fiber In The Loop
FNPA	Foreign Numbering Plan Area
FOT	Fiber Optic Terminal
FSA	Fiber Serving Area
FTTC	Fiber-to-the-Curb
FX	Foreign Exchange
GM	General Manager
HC	Highly Competitive
HDSL	High Density Subscriber Line – works up to 1.54 Mbps
HICAP	High CAPacity service/facility (≥ 1.54Mbps)

HQ	Headquarters
HRE	HDSL Range Extender
HU	Housing Unit
HVAC	Heat Ventilation Air Conditioning
H/R	Host Remote
ICAPS	Integrated Customer Access Planning System
IDLC	Integrated Digital Loop Carrier
IOF	Inter-Office Facility
IP	Infrastructure Provisioning
ISDN	Integrated Services Digital Signal
ISP	Internet Service Provider
IXC	Interexchange Carrier
JOBOSP	Routine Budget
L&B	Land & Buildings
LATA	Local Access Transport Area
LEC	Local Exchange Carrier/Company
LIDB	Line Information Data Base
LIF	Left-In Facility
LIJ	Left-In Jumper
LOB	Lines of Business
MARK	Mechanized Automated/Assignment and Record Keeping
MC	Moderately Competitive

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MCDPG	Multi-Channel Digital Pair Gain
MMDS	Multi-Media Data Services
MOU	Minutes Of Use
MUX	Multiplexer
NETCAP	NETwork Computer Aided Planning
NGDLC	Next-Generation Digital Loop Carrier
NID	Network Interface Device
NOC	National/Network Operations Center
NPV	Net Present Value
OC	Optical Carrier
OC-3	Optical Carrier-level three (155.52Mbps)
OC-12	Optical Carrier-level 12 (622.080Mbps)
OC-48	Optical Carrier-level 48 (2,488.320Mbps)
ODC	Optical Directional Couplers
OPARS	Operations Planning and Reporting System
OPM	Outside Plant Module (cabinet NTI remote switch module)
OS	Operator Services
OSP	Outside Plant
PAD's	Device used to suppress signal strength
PAR	Planning Analysis Report
PDUF	Power Distribution Utilization Frame

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PIC	Plug-in Card; Private Interexchange Carrier; also, Primary Interexchange Carrier; also, Primary InterLATA Carrier
PIP	Plug-In Provisioning
POTS	Plain Old Telephone Service
PMO	Program Maintenance Office
PPC	Plant Provisioning Committee
PRI	Primary Rate ISDN
PSAP	Public Safety Answering Point
PUC	Public Utility Commission
RBOC	Regional Bell Operating Company
RDAP	Rural Distribution Area Plan
RFF	Reserve Future Fund
RFITL	Rural Fiber-in-the-Loop
RURAL	Country setting characterized by open land, distance between homes and or businesses
SAL2	Special Services Forecasting
SCP	Service Control Point
SIA	Strategic Issues Assessment
SONET	Synchronous Optical NETwork
SS7	Common Channel Signaling System No. 7
STP	Signal Transfer Point
TAC	Trouble Analysis Center
TDMA	Time Division Multiple Access

TCDSC	Two Channel Digital Subscriber Carrier
TL1	Transaction Language 1
TSF	Traffic Sensitive Forecasting
T1	Service or line operating at the DS-1 rate (1.544Mbps)
UNE	Unbundled Network Element
URBAN	City-like setting characterized by clusters of homes and/or businesses
V&H	Vertical and Horizontal (Longitude and Latitude)
WDM	Wave Division Multiplexer
X.25	Packet switching standard

Attachment B – Central Office Equipment (COE) Growth Relief Triggers

B1.0 COE Fill Calculation

COE as it relates to this PAR covers the growth and Maintenance of the GTE switching network. The main focus is sizing and provisioning of switches, including memory, trunking, sparing, and L&B. COE working base (fill), calculations will be based on actual working services plus EXPRESS DIALTONE (EDT) lines under 12 months. LIJ lines are not included as working lines but should be monitored by Inventory management and aged properly (reference Section 13.0 - EDT Inventory Management). These three categories will be tracked on a state/market segment level through the Health of the Network reporting and analysis.

B2.0 C.O. Switch Relief Targets

COE facility inventory levels should be regularly monitored for potential reuse between offices. **Potential reuse of facilities should be given first considerations for planned relief projects.** The following charts list the optimal relief targets for given Centrum Call Seconds (CCS)/Line traffic levels by switch type. These traffic levels determine the target relief points for these switch types. For CCS/Line values less than indicated for relief at 98% line fills, use 98% also. Traffic Sensitive Forecasting (TSF) provides CCS and line quantities from which CCS/line can be calculated.

There are many causes of an unusually high CCS/line. One thing that is increasing CCS/line at a rapid rate is internet usage. PAR 082 details many alternatives to satisfy customer demand caused by high Internet usage. http://netplan.irngtx.tel.gte.com/pars/par082/par082r0.htm Some of these are outboard to the central office, some are specific to Internet Service Provider (ISP)'s and some are alternatives to relieve switch congestion. These switch relief options will be briefly discussed below.

The first three solutions can be used in all of the major switch types with varying degrees of effectiveness dependent on the ease of moving lines, and administration of the switch:

- Poor man's Concentration Ratio

  If there are frames in the central office that are not filled with line cards and have low usage, high usage customers, as identified by the Local Balance group should be moved to these frames in order to balance the office. In most switches, these line cards can be reused in other frames or other switches of the same type. The most notable exception is the 5ESS switch, where customers are moved out of frames and the line cards must be left in the slots. This option is the most economical one if there is space in the office and should be pursued first.

- Changing concentration ratios of one to all line frames.

  A switch with the same concentration ratio throughout is the ideal but sometimes that is not economically feasible. Whether one, two or all of the frames are changed to a lower per customer line in order to minimize blockages. There is some concentration changes limits in the DMS100 if they have the older Series 1 peripherals. Changing the concentration ratio on the minimum number of frames is the next most economical solution and thus is recommended as the second option.

- Movement of ISP's

  Internet Service Providers are known extremely high users. These customers can be grouped into one line frame, moved selectively to a very low usage frame, or moved to a device that is outboard to the switch (refer to the PAR082 hyperlink). This option should be pursued when known ISP's are present.

The following applies to remote switchs only:

- Increased numbers of host remote links to the host unit will normally solve the blockage problems out of a remote switch. Each switch type has a different maximum number of link capabilities, and although this may relief the congestion problems in the remote, equipment may need to be added in the host. Many remotes may be required to upgrade to a larger capacity remote, or in extreme cases a base unit may be required.

Switch specific solutions:

- Increase outgoing trunking capacity to 32 channels in a DMS100.

- Use Analog Interface Unit (AIU) in a 5ESS to decrease the concentration ratio:

  The AIU unit available on the 5ESS may be purchased which permits any number of links to be connected between the AIU and the switch matrix. The AIU can connect at any concentration ratio, including 1:1 concentrations. The 5ESS must be at 5E11 to support the AIU. This solution is a great relief mechanism in dealing with high users due to the fact that location of high users and administration of relocating customers on the 5ESS is administratively high cost.

For CCS/Line values above the maximum listed, a lower relief percentage may be warranted. Infrastructure Dimensioning may be consulted in instances that fall significantly outside the range values. Various reports and procedures issued by Infrastructure Dimensioning aide in determining other factors which may affect service and/or relief points.

GTD-5 **Maximum Recommended % fill based on CCS/Line.**

[illegible]	90%	91%	92%	93%	94%	95%	96%	97%	98%
4:1	7.12	7.05	6.98	6.90	6.82	6.75	6.67	6.61	6.55
6:1	5.34	5.28	5.23	5.18	5.11	5.06	5.00	4.95	4.84
8:1	3.56	3.52	3.49	3.45	3.41	3.37	3.34	3.30	3.23

DMS-100

[illegible]	DS30s	90%	91%	92%	93%	94%	95%	96%	97%	98%
4:1	5	6.85	6.8	6.75	6.70	6.65	6.60	6.55	6.50	6.44
6:1	3	4.87	4.83	4.79	4.74	4.70	4.66	4.61	4.57	4.53
8:1	3	4.25	4.20	4.15	4.10	4.05	4.00	3.95	3.90	3.85

5ESS

[illegible]	90%	91%	92%	93%	94%	95%	96%	97%	98%
4:1	6.31	6.25	6.20	6.14	6.08	6.02	5.96	5.91	5.85
6:1	4.73	4.69	4.64	4.60	4.56	4.51	4.47	4.43	4.39
8:1	3.65	3.63	3.59	3.55	3.51	3.48	3.45	3.42	3.38
10:1	2.92	2.89	2.86	2.83	2.81	2.78	2.76	2.73	2.70

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All percent line fill includes 5% lines for EDT

For DCO/VIDAR/DMS10 – Utilize a 97% fill relief point except where the "High CCS/Line Utilization Report" indicates that earlier action is required.

For information on the effect of Internet on central office line fills refer to PAR-082 (Circuit Switched Internet Access Solutions).

http://netplan.irngtx.tel.gte.com/pars/par082/par082r0.htm

Engineering criteria for core relief jobs should attempt to utilize available resources thus minimizing life cycle costs. Engineering intervals for digital additions should be 2-4 years. The smaller, slower growing offices should use the longer (4-year) interval. As office size and growth rate increase, the interval shortens to 2 years. In general, if an office is less than 5,000 lines and the annual growth rate is less than 2%, a 4 year interval should be used. Any office over 10,000 lines, or with a very high growth rate (5% or higher) should be provisioned at a two year interval.

The intervals also will vary depending on available space in the office and amount of peripheral equipment needed for the 3rd or 4th year of growth. **These fills are guidelines only and do not replace sound judgement.** Normally, filling out a frame, module, bay, or shelf with wired capacity and equipping for approximately one year is the most economic choice depending on the growth rate of the office.

B3.0 Digital Cross-Connect System (DCS) Relief Targets

Target objective is 100% fill for electronics relief. The DCS should be managed in a manner to maximize the utilization of the available bandwidth. With the initial placement of a DCS, Network Design is to instruct BRPC as to the circuits that are to be transferred to the DCS. BRPC HQ-Staff will provide general DCS guidelines as to the types of circuits to be provisioned.

All new Digital Cross-Connect Systems are to be equipped with Digital Test Head functionality. Funding for DCS test heads is included in the IOF Growth Unit Driver.

B4.0 Memory, Trunks, Spans Relief Targets

Target objective requirements for these types of facilities will be triggered by Network Design evaluations from existing local study processes. The TSF is being developed by HQ-Network Dimensioning to assist the Network Designer in forecasting memory and trunk hardware requirements. All facilities are to be provisioned using sound judgement in keeping with a "Just In Time" provisioning concept.

The trunk growth unit driver is based on 64 kbs clear channel trunking. EDT's should be provisioned on the GTD-5 for all trunk growth.

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Attachment C - CAF Technology Overview

C1.0 GTE CAF Network Design Strategy

GTE's strategic direction is to maximize the placement of broadband transport capacity throughout GTE's network (IOF, feeder, and distribution). Initial placement of fiber based facilities are typically driven by economics, implementation of market driven broadband services (VideoConnect, Distance Learning) and strategic positioning. These projects should be expanded, within the limits of available capital, to encompass opportunities that would not otherwise have been cost effective on their own merits. With each subsequent fiber facility relief project, the Network and Access Designers should look for opportunities of linking fiber routes together, forming fiber rings and diverse facility routes.

Placement of new copper facilities within the **feeder** network is to be minimized to the fullest extent possible. The Access Designer should reference this attachment for the appropriate application of alternative technologies. However, where the placement of copper feeder facilities is clearly the most cost-effective solution, and there are no strategic advantages to the deployment of fiber facilities, copper feeder facilities should be deployed.

C2.0 Fiber Cable

The Access Designer should consider the use of fiber cable for the following applications;

- H/R links under the following circumstances:
    - Suggested for Remote Switches and DLC sites with line capacities greater than 600 lines - supported by a cost analysis
    - For subsequent Remote Switches and DLCs within fiber based feeder routes, regardless of size
    - When the existing copper cable does not meet the specifications for T1 spans - See GTEP 634-020-500
    - Whenever new facilities must be placed to provide H/R link capacity
- Customer DS-1 requirements (DS-1 High Capacity Provisioning

Guidelines):

- Where initial DS-1 order reflects a total of four or more DS-1s,

- Where chronic service conditions exists with existing metallic DS-1 facilities

- Customer services requiring DS-3 or larger access facilities (VideoConnect, MMDS, etc.)

- Collective customer service requirements warrant placement of fiber facilities

- Interoffice facility relief (in conjunction with the Network Designer)

- Placement of customer ring facilities as specified by Competitive Response

It is the responsibility of the Access Designer to consider all of the above potential requirements when planning fiber facility augmentation in a route, maximizing the synergy potential of the project. Where specific forecasts are not available, the Access Designer must exercise his/her judgement within the limits of available funding to facilitate future demand requirements within the provisioning period. Ideally, fiber projects should be sized to accommodate known and anticipated feeder and IOF requirements for up to five years.

C3.0 Copper Cable

Application:

The Access Designer should consider the use of copper cable under the following applications;

Feeder (Urban):

- Applications where the ultimate customer loop does not exceed 12Kft and feeder facilities are readily available. These feeder projects should be sized for the forecasted and anticipated feeder requirements for three years and not to exceed five years.

- Applications where unused copper facilities exist, and the placement of copper facilities between two points will provide facility continuity from the feeder/distribution demarcation to the central office. For these applications the customer loop is designed for 12Kft but can extend to 15Kft depending on service offerings and population density.. In general, these feeder projects should be sized to match the quantity of the unused copper facilities already in place.

Feeder (Rural):

- Should be deployed when it is clearly the most cost-effective means of providing feeder facility relief. Loaded loops should be minimized. Based on the growth potential and feature requirements of the Region, the Access Designer will be expected to utilize their judgement in determining the tradeoff between minimizing loaded loops and placement of Digital Loop Carrier.

Distribution

- Facility extension from the Feeder/Distribution demarcation point to the subscriber termination point is copper-based technology with the exception of fiber to the home.
- Distribution from Remote Switch or Digital Loop Carrier
  - Urban - ESA Design (Residential/Single-line Business applications):
    - Design customer loops to support digital rates up to 144Kbps
  - Rural
    - Design customer loops to support forecasted services
    - Use of loop treatment equipment is permitted, where the loop treatment is located in an environmentally controlled hut or vault
    - Facility loading is permitted

C4.0 Two-Channel Digital Subscriber Carrier (TCDSC)

- Defer/avoid costly distribution and/or feeder facility expansion which require placement of new facilities
- Used to serve demand in excess of provisioned/planned requirements
- Avoid placement of new drops when drop placement is cost prohibitive
- **TCDSC should not be used for primary services without a cost**

benefit study (NPV)

- Replace two channel analog carrier such as 84A, 85A and AML, to meet service requirements
- Should not be placed/installed on the drop side of a DLC due to additional maintenance and administrative costs
- Prior to purchasing any additional TCDSC, remote units that are in the field and not in use should be reclaimed and returned to supply for reuse.
- TCDSC Local Loop Pre-Qualification Criteria (Reference GTEP 938-360-011)
  - Cable sheath must be void of analog subscriber carrier
  - Non-loaded
  - Less than or equal to 42 dB @ 40 kHz
  - 1,300 ohm impedance
  - Total Bridge taps not to exceed 2,500 ft
  - No one bridge tap to exceed 2,000Kft

C5.0 Remote Switch and Digital Loop Carrier

Use in lieu of copper feeder technology for the following applications;

- Areas beyond 12Kft from the central office, requiring digital rates up to 144Kbps (Switched 56Kbps, ISDN)
- Urban areas, to avoid the application of loop treatment equipment (load coils, loop extenders, and voice frequency repeaters)
- Routes where fiber feeder technology is already in place
- Within 12Kft of the Central Office, where application will avoid the exhaust of the underground support facilities
- Rural applications, where the placement is clearly more cost effective than copper feeder plant
  - As a result of inquiries from the Regions regarding rural pair gain applications, the DLCs referenced in Attachment H are available for

deployment.

- Appropriate test head (RMU) for 4TEL testing must also be provided.

C6.0 Analog Carrier

The following analog carrier policy supersedes the policy communicated via the September 18, 1996 letter to the Region GM-IPs with copies to the Region Presidents.

Analog carrier channels removed on capital funded work orders will not be reused and the shelves will be removed from the office. This equipment will not be re-installed, except for use as maintenance spares. All removed equipment should be returned to your local supply point for disposal or for maintenance distribution.

Single channel analog carrier such as 84A, 85A and AML will not be reused. TCDSC should be used in lieu of additional channels of analog carrier.

Removal of any analog carrier required by the deployment of special services, known to interfere with analog carrier, must be supported by a business case. The business case must be submitted and approved by Region/HQ BA.

Examples of services/technologies incompatible with analog carrier are:

- ISDN
- Centraphone
- Two Channel Digital Subscriber Carrier (TCDSC)
- Digital Data Service (DDS)
- Switched Fractional T1
- Local Packet Switching
- Quickconnect
- Circuit Switched Data (CSD)
- HDSL
- T1

- ADSL
- Fractional T1

C7.0 High Density Subscriber Line (HDSL)

- The HDSL system provides transport of a 1.544 Mbps DS-1 signal over two twisted copper pairs without requiring line repeaters. The local loop should meet the following criteria to deploy HDSL:
    - Must not include any analog carrier in the same cable sheath
    - Must be non-loaded
    - Less than or equal to 33 dB @ 100 kHz
    - Cannot exceed 2.5 kft of total bridge tap with no single tap section exceeding 2.0 kft

      Note: Better reliability and less trouble is experienced when the bridge taps are removed.
    - No existing repeatered T1 facilities available
    - Customer location is within 12 kft when a combination of 24, 22 and 19 gauge cable is used. Using the HDSL Range Extender (HRU), an additional 12 kft can be achieved.
    - Customer location is within 9 kft when a combination of 26, 24 and 22 gauge cable is used. Using the HRU, an additional 9 kft can be achieved.
- Benefits:
    - Decreases the cost of installing T1 lines and significantly decreases the amount of time required to install them
    - The adaptive signal processing algorithms employed by HDSL result in a much higher transmission quality than repeatered T1
    - On the remote end of the line, HDSL uses a minimal amount of power, making remote powering from the central office feasible
    - The elimination of repeaters increases overall system reliability and transmission performance

- No separate monitoring equipment is required with HDSL

- Through today's advanced electronics, HDSL is immune to crosstalk, while yielding signal quality comparable to fiber optics, bit error rate 10^-10

C8.0 Async Fiber Optic Terminals (FOT)

Async FOT have a limited future and therefore reuse of Async. Equipment should generally be avoided. ASYNC FOT's should only be re-deployed in accordance with the below guidelines:

- ASYNC FOT's reuse alternatives must produce a compelling economic advantage over a SONET deployment alternative.

- ASYNC redeployment must not conflict with the provisioning requirements dictated by tariffed offerings such as Metrolan II, Incremental SONET, etc. Reference PAR 027 for more details.

- ASYNC FOT's must not be re-deployed in EC and HC markets.

C9.0 SONET (OC-3) Fiber Optic Terminals

SONET FOT's should be deployed:

- For local loop fiber ring applications driven by competitive Response and Market Response programs.

- When deployments are to support tariffed SONET services such as Metrolan II, Incremental SONET, etc. Reference PAR 027 for more details.

C10.0 SONET (OC-12) Fiber Optic Terminals

- For local loop fiber ring applications driven by Competitive Response and Market Response programs

    - Funding for the Lines of Business will identify local loop fiber ring applications, where large business customers or high minutes-of-use (MOU) end customers exist. Exceptions to this directive must be supported by an approved business case.

C11.0 Asynchronous Digital Subscriber Line (ADSL)

Pending the results of the ADSL Operations Trial, the following are the Local Loop Prequalification guidelines for ADSL applications:

(Note: Results of the field trial to be included in final release.)

- 2-wire twisted POTS metallic cable pairs can be used to transport ADSL services.
- All loops are nonloaded cable.
- If all cable is 24-gauge cable or coarser, the maximum allowable loop length for 1.5 Mbps/64 Kbps ADSL is < 15 Kft. It should be noted, however that central office and customer premise wiring loop distances have not been accounted for separately in the development of the loop limits. These losses should be included in the external loop loss calculations. The following downstream rates can be realized for the indicated distances of 24-gauge wire:

Downstream line rate	Upstream line rate	Distance Loop w/BT
1.5 Mbps	64 Kbps	15,000 ft
2.0 Mbps	160 Kbps	15,000 ft
6.0 Mbps	640 Kbps	15,000 ft

- For loops with 26-ga cable (used in combination with other gauge cables), the maximum allowable loop length including bridged tap length for 1.5 Mbps/64 Kbps ADSL is < 13 Kft. The following downstream rates can be realized for the indicated distances of 26-gauge wire (used in combination with other gauge cables):

Downstream line rate	Upstream line rate	Distance Loop w/ BT
1.5 Mbps	64 Kbps	13,000 ft
2.0 Mbps	160 Kbps	*
6.0 Mbps	640 Kbps	*

* NOTE: Distance limitations associated with these ADSL rates are still under assessment. Also, the location of the bridge tap from the central office may affect transmission parameters.

- The maximum collective bridged tap allowed on one cable pair is 2.5 Kft total, with a 2 Kft maximum length for any single bridged tap.

  Note: Better reliability and less trouble is experienced when the bridge taps are removed.

- ADSL is spectrum compatible with:
  - ADSL (a maximum of 24 disturbers is allowed in a 50-pair binder).
  - DDS.
  - 2-pair HDSL (784 Kbps full duplex on each pair).
  - ISDN (a maximum of 24 disturbers is allowed in a 50-pair binder).
  - POTS (metallic).

- ADSL is not spectrum compatible with:
  - Traditional T1 span lines coexisting within the same cable binder c[illegible]s.
  - Traditiona[illegible]1s existing in adjacent binder groups.
  - 1-pair HDSL in the same and/or adjacent binder groups.
  - Analog subscriber carrier (multi-channel or single channel) coexisting in the same cable sheath as ADSL.

- Compatibility with ADSL is still under evaluation for:
  - Two Channel Digital Subscriber Carrier (TCDSC)
  - Quad POTS (multi-Channel Digital Subscriber Carrier)

TCDSC and Quad Pots utilize 2B1Q transmission formats. As such, it is anticipated that these technologies will prove to be compatible with ADSL. Compatibility with ADSL will be validated with the ADSL field trial due to be complete in March 1998.

C12.0 ADPCM / Transcoder Use

OVERVIEW

The TC421 Transcoder is a four to one digital multiplexer that provides a cost-effective means of expanding the capacity of a standard T1 (DS1) line. The transcoder is ideally suited to expand trunks and subscriber DS1 capacity without adding additional transmission span line equipment. When a TC421 is connected to each end of a standard T1 span, the capacity of the span is increased by a factor of 4:1, i.e., from 24 channels to 96 channels depending on operating conditions. The bandwidth allocation assignment for voice is dynamic, therefore as the voice traffic is increased the voice circuit will be assigned a bandwidth of 40 kbps, 32 kbps, 24 kbps, or 16 kbps as required. On the other hand, as traffic decreases the continuing call will be reassigned to the highest possible available bandwidth. The Adaptive Differential Pulse Code Modulation (ADPCM) technique permits a 64kbps signal to be described in 40 kbps or 32 kbps bandwidth.

Echo cancellation is required when using the TC421 compression package. The EC24 Digital Echo Canceler is an adaptive split type echo control system designed for use in digital carrier facilities operating at the 1.544 Mbps DS1 level. The EC24 eliminates any echo component that is enhanced by the effects of the additional circuit delay encountered when using the TC421 compression algorithms.

BENEFITS

- Facility Relief
- Quality Voice Compression
- Increased total T1 Line Traffic
- High Speed Data Support (28.8 kbps)

PLANT REQUIREMENTS

Prequalification criteria:

Any copper T-1, fiber optic carrier, low density digital microwave radio, high density digital microwave radio or Time Division Multiple Access (TDMA) satellite facility can take advantage of the capacity increase provided by the TC421/EC24 system.

LIMITATIONS

ADPCM TC421/EC24 is for voice messaging circuits only. **It is not designed for the use of H/R links**. In addition, ADPCM does not allow 4TEL® testing.

The TC421/EC24 system can support dial-up or dedicated data rates with some limitations. For dial-up data some restrictions are imposed on the user selected data channel bandwidth (DCBW) option. For DCBW setting of 32 kbps and 40 kbps, up to 24 dial-up data calls can be processed simultaneously, while supporting data rates up to 4.8 kbps and 9.6 kbps respectively.

The bandwidth allocation efficiency realized by the compression algorithms in the TC421/EC24 system is impaired when excess channels are fixed (uncompressed). The number of fixed channels should be kept to a minimum. It is not recommended to set all channels to a user as "fixed" bandwidth. There are a maximum of 192 payload bits available (1.456 Mbps). The following chart illustrates how fixed bandwidth channels will consume available bandwidth.

Fixed Rate	Bits per/ch	Max # Chnls	Payload bits	Payload rate usage
64 kbps	8 bits	22 channels	176 bits	1.408 Mbps
40 kbps	5 bits	36 channels	180 bits	1.440 Mbps
32 kbps	4 bits	45 channels	180 bits	1.440 Mbps
24 kbps	3 bits	60 channels	180 bits	1.440 Mbps
16 kbps	2 bits	91 channels	182 bits	1.456 Mbps

TRAINING

The TC421 Transcoder and EC24 Echo Canceler are by design relatively simple to engineer, install, provision and place in service. The operations and maintenance manuals provide all of the information required successfully installing, provisioning and placing in service a TC421/EC24 system. Telephone support for engineering, installation, provisioning and turn-up questions at no charge by contacting DSC's Customer Technical Assistance Center (CTAC) at 972/519-4141.

Attachment D - OSP Feeder Relief Triggers

D1.0 OSP Fill Calculation

CAF feeder relief requirements will be based on existing working fills plus documented forecasts. Working fills include:

- Active working service
- Seasonal left-in stations
- New dedicated services
- EDT lines dedicated to an address where EDT is implemented (Reference Section I3.0 for EDT Inventory Management)
- LIF/LIJ lines dedicated to an address where EDT is not implemented
- CLEC unbundled services

Feeder facility **non-repairable** bad pair allowances will not exceed 2%-Urban and 3%-Rural for any working base (fill) or project trigger calculation. Distribution facility **non-repairable** bad pair allowar⁻e will not exceed 1%.

For the purpose of this document Urban refers to areas with "city like" characteristics, clusters of homes and/or businesses. Rural refers to areas with "country settings" characterized by open land and a reasonable distance between homes and/or businesses.

D2.0 Feeder Cable Relief Triggers

CAF relief strategy will be based on standard planning systems, technology, and tools. The Access Designer should ensure that an ADQ MARK run has been performed for the route being considered for relief to ensure that no available pairs exist that would allow for project deferral to a future year.

The CAF feeder relief triggers are as follows:

- When TCDSC can not be cost justified or utilized, Access Design typical cable segment fill relief triggers will be;

1. EDT Office

Market	Relief Trigger
MC	95%
HC	93%
EC	93%

2. NON-EDT Office: Segment Growth Rate < 2%

MC	95%
HC	94%
EC	93%

3. NON-EDT Office: Segment Growth Rate 2% - 4%

MC	93%
HC	92%
EC	90%

4. NON-EDT Office: Segment Growth Rate > 4%

MC	93%
HC	90%
EC	85%

All of the above include a 2%-Urban and 3%-Rural allowance for **non-repairable** defective feeder pairs.

The Access Designer should reference Attachment D for the Copper Cable

Deployment Strategy and applications.

- When TCDSC is utilized, a typical feeder relief trigger for qualifying facility area cross connects should routinely range from 105% to 110% of assigned cable in count.

    - Feeder relief strategy should include placement of facilities to permit removal of existing TCDSC for potential reuse elsewhere within the C.O. serving area. Remote TCDSC units should only be removed consistent with the need to reuse these units elsewhere within the central office maintenance area.

D3.0 Digital Loop Carrier (DLC)

When utilizing DLC devices for CAF Feeder relief strategies, the following guidelines are to be applied:

- Size the DLC lot (purchase property, public or private easement) for the ultimate requirements at that location (15-20 yrs).

- DLC cabinet should be sized (wired capacity) for minimum of five years growth.

- All new DLC placement should be equipped with 4TEL test capability.

- DLC common equipment should be sized for a minimum of two years growth.

- DLC line card provisioning should be calculated for one year minimum and two year maximum requirements, or as required by global contracts.

Typical relief trigger for DLC line cards and common equipment will be 97%. Typical relief trigger for DLC OSP cabinets will be 95%.

The Network/Access Designer should reference Attachment H for Remote Switch and DLC applications.

D4.0 HICAP

Planned HICAP prepositioning or upgrading facility provisioning requirements will be evaluated by Access Design with participation from BRPC and Network Design. Planned provisioning for HICAPs will be done with sound business management and economic judgement. Priority of technology selection for placement of facilities;

- 1st - Fiber
- 2nd - HDSL on existing copper sheath
- 3rd - Groom existing copper for repeatered DS1
- 4th - Place new copper sheath for;

  A) HDSL, or

  B) Repeatered DS1

Implementation of the selected technology should be synergistic with other route facility requirements.

DS-1 Hot Spares should be provided in accordance with the GTE DS-1 Hot Spares Provisioning Guidelines dated May 20, 1996 (See Attachment L). The process outlined in the referenced memo should be used to determine where to deploy DS-1 Hot Spares. Funding for DS-1 Hot Spares is contained in the growth budget.

Attachment E - OSP Feeder Design Parameters & Market Segment Guidelines

E1.0 Standard OSP Feeder Design Parameters

There are four basic OSP Feeder Design Parameters:

- Analog (Basic voice, POTS, and low bandwidth services)
- Digital (Up to and including Basic Rate ISDN (BRI))
- High Capacity Transport (up to and including DS1)
- Wideband/broadband (> than DS1)

<u>Analog</u>

Strategy - Minimize costs while providing P.01 grade of service meeting Commission requirements (P.01 refers to the number of blocked calls). Changes in technology such as fiber optics and digital pair gain will be deployed only when it is the best economic choice or customer requirements are mandated to be met.

Design - The Analog network design employs the least cost combination of technology (pair gain and/or copper cable). There are no practical loop length limits. Loop treatment devices, such as load coils, loop extenders, voice frequency repeaters, can be deployed. Within company policy and product design parameters, two channel digital subscriber carrier (TCDSC) is a viable alternative. This traditional network design provides quality service when built and maintained as specified in 937-004-075, CAF Quality Provisioning Guidelines.

<u>Digital</u>

Strategy - Position facility capability for digital services up to and including Basic Rate ISDN (BRI) [144 Kbps] at a minimum cost. Please refer to PAR 036, CAF Forecast Business Process for details on forecasting multiple bandwidth requirements.

Design - Electronic Serving Area (ESA) design concepts are used in the Digital Planning Area. Customer loops are limited to 12,000 feet. Complete grooming of the distribution plant is not required (i.e. removal of bridge taps, fixed count terminals).

High Capacity Transport

Strategy - Migrate and preposition facility capability for services up to and including repeater-less DS-1, where anticipated, at minimal cost.

Design - Fiber Serving Area (FSA) design concepts are used in the High Capacity Transport Planning Area. Customer loops are limited to 5,000 feet. Requires a high functionality fiber fed DLC to implement. No analog carrier, bridge tap, or loop treatment allowed within the service area.

Broadband

Strategy - Strategically migrate facility capability for services greater than DS1 at minimal cost.

Design - Fiber to major business customers. Fiber optic IOF and host remote links servicing Digital Loop Carriers. Design must allow for migration of fiber links to a ring topology.

E2.0 Design Guidelines:

The Access Designer should utilize historical information and best judgement when determining the number of pairs to provision. These guidelines cannot cover every aspect of opportunities that exist in GTE's network, but, below are some general guidelines outlined by Network Planning:

Locations out of the serving device (RSU, RLU, DLC) should be sized to meet a 2.0* pair per housing unit (pr/HU) for residential growth in EC and HC markets and 1.5* pr/HU in an MC market (see chart on next page). Sizing for Commercial growth is dependent on the type of business.

* Deviation from the above figures is at the discretion of the GM-IP or designee.

MARKET	Pairs per Lot
EC	2.0
HC	2.0
MC	1.5

E3.0 Market Segment Provisioning Guidelines

GTE has segmented its central office serving areas into three different market segment types [Extremely Competitive (EC), Highly Competitive (HC), and Moderately Competitive (MC)].

The market segment provisioning guidelines consist of the definition and general rules of provisioning for each market segment.

Extremely Competitive Markets

These are very large metropolitan areas that share market presence with a CLEC.

Market Strategy - GTE must exceed customer expectations for all services to grow their market share. We will provision broadband and digital services while achieving incremental growth in our core business. Aggressive investment in new Lines of Business to build regional market strength.

Provisioning Guidelines

- Continue to provision Electronic Service Areas (ESAs) to enable enhanced services on short distribution cable plant.
- Fiber is preferred for H/R links to DLC's. The placement of fiber enhances our ability to deploy new digital technology and services and will also enhance our competitive position.
- Proactively maintain plant margins to mitigate held orders.
- Use existing fiber network (IOF and Feeder) to maximize fiber host/remote (H/R) links to ESAs.
- Two Channel Digital Subscriber Carrier (TCDSC) to be deployed as an

alternative to copper for 2nd and 3rd line growth.

- High-bit-rate Digital Subscriber Line (HDSL) to be pre-provisioned for Hi-CAP (DS-1) services on or before Customer Desired Due Date (CDDD).

- Migration of business customers to ring diversity for broadband services.

- Reuse of equipment will not be considered unless it has the ability to provide all CLASS services (i.e., CNID, Call Forwarding, etc.).

- When IOF cable sheath exhausts and placement of IOF cable is required, all IOF cable sheath relief will utilize fiber optic facilities (Reference Section F2.0).

Highly Competitive Markets

These market segments are urban in nature where GTE has a significant market presence. Other areas could include suburban markets adjacent to metro areas where GTE has small market presence in the overall area.

Market Strategy - GTE will capture market growth and exceed customer network expectations by using current technology that most economically fits GTE's strategic direction. We will use second tier deployment (reuse of fiber terminals and pair gain systems) to preempt competition. Reuse of this equipment will not be considered unless it has the ability to provide all vertical services (i.e., CNID, Call Forwarding, etc.).

Provisioning Guidelines

- Actively preposition enhanced services to line growth areas.

- Use existing copper or TCDSC for facility relief when within technical limits.

- When ESA deployment is economically justified, redeployment of unused pair gain equipment will assist in implementation.

- H/R links to be deployed on best economic choice (i.e. existing fiber, existing screen or exchange cable) in accordance with PAR-025.

- Rural portions of Highly Competitive Markets are to be provisioned based on provisioning guidelines for a Moderately Competitive Market.

- When IOF cable sheath exhausts and placement of IOF cable is required, all IOF cable sheath relief should utilize fiber optic facilities (Reference

Section F2.0).

Moderately Competitive Markets

These markets are small cities with moderate or minimal growth potential.

Market Strategy

GTE will provide the regulatory required grade of service. We will invest in the network to foster economic development and to meet growth requirements at minimum cost. The existing network will be used for new services.

Provisioning Guidelines

- Proactively preposition for new line growth.
- Use existing copper or TCDSC for facility relief when within technical limits.
- Digital ESA deployment where economically viable.
- When ESA deployment is economically justified, redeployment of used digital pair gain equipment will assist in implementation. If enhanced service forecasts exist in these areas, the reuse equipment must be capable of providing all CLASS services (i.e., CNID, Call Forwarding etc.).
- H/R links to be deployed on best economical choice in accordance with PAR-025.
- When IOF equipment exhausts, fiber terminals most likely will be installed by the redeployment of used equipment.
- When IOF cable sheath exhausts and placement of IOF cable is required, all IOF cable sheath relief should utilize fiber optic facilities (Reference Section G2.0).
- When IOF routes are exhausted, the first choice for temporary relief would be the use of ADPCM.

Attachment F - IOF Relief Triggers

F1.0 IOF Electronics (DCS, FOTs, Channel Banks) Relief

Target objective requirements for these types of facilities will be triggered by Network Design evaluations from existing local study processes. All facilities are to be provisioned using sound judgement in keeping with a "Just In Time" provisioning concept.

All fiber optic terminals (Async/SONET) should be configured with the appropriate PADs and X.25 circuits to allow for monitoring by the Network Operations Center (NOC). The IOF Unit Driver addresses the funding associated with this requirement.

F2.0 IOF Cable Sheath Relief

Target objective of 95%-Urban and 100%-Rural trigger fills for cable sheath relief. Alternative solutions (e.g., asynchronous vs. SONET, lease vs. build, reuse or TC421) should be considered prior to major investments being committed.

All IOF cable sheath relief should utilize fiber optic facilities. When initiating IOF cable sheath relief the Network/Access Designer should look for potential:

- Synergy opportunities with BAU-Growth
- Route and ring diversity opportunities
- Coordinate with National Program activities
- Competitive response positioning

Unplanned IOF cable sheath relief requirements driven by Product Management requiring dedicated IOF fiber facilities include services such as 100 Mb MMDS and analog Video Connect. Product Management will be responsible for identifying the location where services will be offered, as well as an estimate of the quantity of services requiring dedicated IOF cable pairs.

To assist with the allocation of the IOF Supplemental in the preparation of the Original Budget, Infrastructure Provisioning will be requested to provide to HQ-Network Planning in 2nd Quarter a prioritized list of IOF sheath relief projects scheduled for the up-coming year.

F3.0 IOF Route Diversity

- Extremely Competitive Markets
    - Upgrade all existing routes to route diverse SONET technology
    - Deploy route diverse SONET technology in all new routes
    - Deploy only fiber optic facilities
- Other Markets
    - An approved business case must justify route diversity (Reference memo from AVP-Network Operations Center, dated May 8, 1996, subject: Business Cases - See Attachment N). Referenced criteria were jointly developed by Network Operations Center (NOC), Carrier Line of Business (CLOB), and Network Planning.
    - All route diversity requests should be analyzed locally via the criteria provided in the attachment to the above memo.
    - For routes which meet the criteria, business cases should be forwarded to Network Planning and Region Operation Support for approval.

GTE Confidential

Attachment G - OSP Distribution Guidelines and Routine Growth Relief Triggers

G1.0 Planned Distribution Growth

Definition:

Planned Residential or Commercial Distribution growth consists of all activity required to provide service for new tract locations.

Design Guidelines:

There are several items to consider when sizing distribution plant. Location (distance from central office), and type of customer (Commercial or Residential) are two main factors.

The Access Designer should utilize historical information and best judgement when determining the number of pairs to provision. These guidelines cannot cover every aspect of opportunities that exist in GTE's network, but, below are some general guidelines outlined by Network Planning:

- Locations leaving the Control point cross-connect should be sized to meet a 2.5* pair per housing unit (pr/HU) for residential growth in EC and HC markets and 2.0* pr/HU in an MC market (see chart on next page). Sizing for Commercial growth is dependent on the type of business.
- Deviation from the above figures is at the discretion of the GM-IP or designee.

MARKET	Pairs per lot
EC	2.5
HC	2.5
MC	2.0

Note: EC/HC/MC Market Segments defined in section E3.0.

G2.0 Reactionary Growth

Definition:

Reactionary Growth is OSP growth activity such as entrance cables and associated cable extensions due to requested or expected service order activity. Refer to section 3.1.1 for additional details.

Design Guidelines:

Utilization of TCDSC systems should be approached as an alternative for sheath relief in the Network. According to PAR 057, TCDSC minimizes and/or avoids deployment of additional copper distribution plant in areas of slow growth or utilized in areas where GTE is attempting to extend the life of the existing copper plant. The Access Designer should complete a cost analysis in order to prove its cost effectivene[illegible]er the placement of copper facilities in the distribution Network. (Refer to D4.0 for additional information on TCDSC)

G3.0 Hicap

Definition:

Facilities capable of transporting data rates up to 1.544 Mbps.

Design Guidelines:

These facilities should be provisioned in accordance with the DS1 Hot Spare Provisioning Guideline, dated May 20, 1996. (See Attachment N)

Selection of facility medium should be based on the following priority;

1st choice - Existing fiber DS1

2nd choice - Utilization of HDSL on existing copper.

3rd choice - Existing copper span with repeatered DS1

4th choice - Build new copper span, utilizing HDSL

5th choice - Build new copper span, with repeatered DS1

G4.0 Design Considerations

Specifications:

While designing the distribution portion of the Network, it is imperative to follow current specifications. Some of the important specifications to follow are Practice 912-200-070 (Cross-Connection Outside Plant Design Engineering Application), Practice 938-010-070 (Outside Plant Facility Area Plan Design), Practice 938-010-071 (Outside Plant Rural Distribution Area Plan Design Concept) and Practice 914-000-070 (Distribution Cable - General). These practices will give the Access Designer additional information on how to arrange facilities and the resulting operational characteristics of the distribution portion of the Network.

Attachment H – Direct Digital Interface Applications

	GTD – 5*	5 ESS	DMS 10	DMS 100
DSC Litespan	TR 303 (1Q 1998)	TR 303	TR 08	TR 303
NORTEL Access Node	TR 303	TR 303	Proprietary	Proprietary
RELTEC DISC*S	TR 303	TR 303	TR 08	TR 303

* Verify if the compatibility of the DLC for operation with the software release level of the GTD 5 switch.

Note: Other types of DLC's available are:

- Fujitsu FACTR for business case applications
- Seiscor – S24-DU, 48 line cabinet may be used until a suitable replacement is available.
- Lucent – SLC 5 FPI, 51A and 90A cabinets may be deployed in GTD 5 offices that do not have TR 303 capability. The larger, 80 series cabinets should not be used.
- All NGDLC should be equipped with 4TEL test capability.,

Attachment I - EXPRESS DIALTONE (EDT)

I1.0 Definition

EDT is a network strategy that establishes a single permanent dedicated circuit from the central office line equipment to the customer demarcation point with restricted dial tone. Only one EDT circuit is provisioned to a service address and is limited to residential and selected business one party service.

I2.0 Office Selection Criteria

Central office selection is based on the capital and expense cost to implement. This investment should be compared to the expense savings along with the GTE strategy for competitive positioning. Generally, central offices in the Extremely Competitive and Highly Competitive markets meet the requirements for investment to expense savings. In the Moderately Competitive markets, market conditions and order activity should be used to identify EDT office candidates.

The following are general guidelines for selecting an office for EDT:

1. Digital Technology required.

2. High inward/outward R1 and B1 order activity. Central offices that have a network churn rate that exceeds 20% annually should be considered for EDT. Churn rate is a calculation of R1 and B1 inward movement divided by total working R1 and B1 lines.

3. Central offices that are being converted from electro-mechanical or analog to digital technology.

I3.0 Inventory Management

EDT lines are permanent dedicated facilities and are counted as working for fill calculations. However, EDT lines that have been in inventory for over 12 months with no order activity will be considered as available when performing fill calculations on capital driven projects. If it is determined that releasing the EDT lines over 12 months will defer the cost of a work order to a future year, than the EDT's will be released by Access Design. When an EDT line has been in inventory for 18 months or longer with no order activity they are then considered available and should be treated as such. When an EDT is released, the telephone number and line equipment should be released for reassignment and the remaining plant facility placed in a left-in status. Direct interface MUX's with dedicated facilities should be managed in a similar manner. For further clarification on inventory methods on EDT lines over 18 months, please refer to the EDT and LIJ Administration Policy dated June 11, 1997.

Inventory Management should review the MARK system inventory at least once per quarter. EDT aging information is available from the MARK system EDT AGING REPORT. This report can be run on demand for each individual wire center and will provide the total number of EDT's in inventory by age group. The Aging Report will also provide a listing of individual EDT lines by telephone number.

Attachment J – Unit Drivers

UNIT DRIVERS

The Network Planning - Access/IOF staff is chartered with the responsibility for development of unit drivers for the growth portion of the capital budget, as it relates to the local loop and interoffice portions of the network.

In an effort to clearly communicate our intended methods, and also provide you an opportunity to recommend enhancements, we have set forth a list of assumptions for each of the unit drivers we will be submitting for the coming year's budget.

For additional information on unit drivers, please access http://netplan.irngtx.tel.gte.com/UDrvrs/UDrvrs.htm on the Intranet.

LOCAL LOOP UNIT DRIVERS

1. DS0 (POTS) Service

Assumptions:

- Average loop length taken from CAPS/ICAPS
- Three-year average cost per pair-kilofoot taken from OSP Capital Activity Summary
- Support structure (i.e. poles, conduit, manholes) included

2. DS1 Service

Assumption:

- 15% of DS1 gain via fiber
- 45% DS1 gain via HDSL
- 40% DS1 gain via Copper T1s
- 65% of DS1 fiber applications are initial installations
- 35% of DS1 fiber applications subsequent installation added to existing location

- FOT cost based on 6MB FOT technology
- 7,500 feet 12 fiber cable for fiber applications
- support structure overlay provided for OSP Construction
- 25% T1/DS1s equipped with spare spans

3. DS3 Service

Assumptions:

- 70% of Customer Premise FOTs are rack mounted
- 30% of Customer Premise FOTs are cabinet mounted
- 10% of Customer Premise locations require an FOT
- 65% of the DS3 gain is initial DS3 installations
- 35% of the DS3 gain is subsequent installation added to existing FOT
- 25% of the DS3 gain generates moves to new locations
- OC3 FOT used to establish OC3 cost
- 7,500 feet of 12 fiber cable for new installs and relocations
- prorate given for consumption of existing fiber margins
- 3,000 feet; 2 fibers

4. ISDN - <12 Kft

Assumptions:

- 75% of ISDN services <12 Kft
- 9 Kft average loop length

5. ISDN - >12 Kft (new)

Assumptions:

- 25% of ISDN services >12 Kft
- 15 Kft average distance to remote concentrator

- 6 Kft average loop length to customer

6. ATM - DS1 (new)

Assumptions:

- 15% of DS1 gain via fiber
- 45% DS1 gain via HDSL
- 40% DS1 gain via Copper T1s
- 65% of DS1 fiber applications are initial installations
- 35% of DS1 fiber applications subsequent installation added to existing location
- FOT cost based on 6MB FOT technology
- 7,500 feet 12 fiber cable for fiber applications
- support structure overlay provided for OSP Construction
- 25% T1/DS1s equipped with spare spans

7. ATM - DS3/OC3

Assumptions:

- 70% of Customer Premise FOTs are rack mounted
  - 30% of Customer Premise FOTs are cabinet mounted
  - 10% of Customer Premise locations require an FOT
  - 65% of the OC3 gain is initial OC3 installations
  - 35% of the OC3 gain is subsequent installation added to existing FOT
  - 25% of the OC3 gain generates moves to new locations
  - OC12 FOT used to establish OC3 cost
  - 7,500 feet of 12 fiber cable for new installs and relocations
  - prorate given for consumption of existing fiber margins

- 3,000 feet; 2 fibers
- 25% of ATM DS3/OC3 circuits originate in office where ATM switch is located

Attachment K - Program Category Codes

Program Category Code Descriptions

(Core Program only-does not include HQ Program Codes)

<u>GROWTH</u>

GA00 Growth to Switching Equipment

This category includes expenditures for central office switching equipment to meet local growth requirements within the central office. Included in this category is land and building expenditures as a result of switching growth.

GE00 Growth to Inter-Office Facilities

This category includes expenditures for central office transmission equipment and outside plant to meet local growth requirements in the inter-office facilities.

GE70 Growth to Inter-Office Facilities

This category is for the DS-1 policy to have hot spares for hicaps.

GH00 Local Loop

This category includes expenditures for transmission equipment and outside plant to meet the requirements for local growth. This part of the network is from the central office to the customer. It includes pair gain devices, repeaters, OSP, etc., as well as land and building requirements to support pair gain deployment.

[illegible]I00 Internet Growth

GP00 Access Tandem

This category includes expenditures for central office switching equipment to meet tandem growth requirements. It includes land and building requirements as a result of switching growth.

Attachment L – Letters

May 20, 1996

To: Distribution List

Subject: DS-1 HOT SPARES PROVISIONING GUIDELINES

The intent of this policy letter is to provide the GTE Telephone Operations guidelines and recommendations regarding the provisioning of DS-1 hot spares in the CAF network. The attachment provides the details for establishing a DS-1 hot spare, and the methodology for appropriating funding in the MONG budget via the unit driver process from 1997 and beyond.

The primary objective of the "Hot Spares" program is to improve customer perception of DS-1 services by reducing failure frequency and time-to-restore measurements of DMOQ. The ability to provide services in a responsive manner has become more of an issue we experience competition from alternate carriers. GTE is committed to achieving significant improvements in network reliability in order to meet the expectations of business, consumer and carrier market customers.

We recognize that this is an important and sensitive issue, however, clarification of GTE's position on this matter should provide the direction that is needed to satisfy customer service requirements. We trust this updated policy will be a significant enabler as you develop your deployment strategies.

Subject: DS-1 HOT SPARES PROVISIONING GUIDELINES

Attachment DS-1 Hot Spares Provisioning Guidelines

(Applicable for GTE CAF portion between serving wire center and end user customer)

Overview

The hot spare policy includes the strategy and methodology to deploy hot spares (BAU) on a going forward basis beginning in 1997. Also, included in this policy is information regarding funding in the MONG budget via the unit-driver process.

A DS-1 high capacity hot spare span line is defined as a conditioned metallic facility to assist in the rapid service restoral of an impaired transmission facility. The primary purpose of this hot spare span line is to reduce the amount of service down-time due to the impaired transmission facility, while providing for the transfer of a customer service span from a known bad facility to a good facility. Metallic based facilities includes both T-1 and HDSL technologies.

With customer demands increasing, GTE must maintain its embedded copper facilities to guarantee a competitive advantage while improving performance and reliability of the DS-1 network. One solution involves installing smart T1 network equipment onto the existing copper facilities. Smart network equipment refers to an infrastructure of span line equipment with remotely addressable repeaters, performance monitoring network interface devices (NIDs) and T1 network interface maintenance switches. The provisioning of hot spares equipment does not include automatic protection switching, test access, test equipment or quasi-random systems. Hot spares is not provided on fiber facilities, since redundancy protection is already provided on both the fiber network and equipment.

Drivers for Hot Spare deployment includes the following:

1) Service/Maintenance - Identify big hitters in the embedded base, and DS-1 facilities that have historically demonstrated non-compliance of the DMOQ service restoral times, and circuit failure frequency measurements. Improvements in these service quality measurements will favorable impact our ability to meet the IXC Time-to-Restore (TTR) repair targets, and the Customer

Desired Due Dates service levels.

2) Strategic/High Visibility Account or Application - Because of the limited program dollars, target hot spares growth to IXCs, high-end Branch accounts and major GTE market offices.

3) Central Offices - Hot spares require manual switching at the serving central office. Therefore, "biggest bang for the buck" in reducing restoral times can be realized in manned COs. The attached prioritized listing of central office locations with the highest density of DS-1s was provided to each Region along with the transfer of hot spares funding during March of 1995. This list should be used as an initial starting point for determining where hot spares should be deployed.

Deployment Criteria

Hot spare DS-1 high capacity facilities will be provisioned using the following criteria:

1) Maintain a ratio of one spare line for every four DS-1 circuits provisioned, i.e.,

- 1 - 4 DS-1s = 1 spare,
- 5 - 8 DS-1s = 2 spares,
- 9 - 12 DS-1s = 3 spares, etc.

2) Fiber facilities should be provisioned on any initial order of four or more new DS-1 services. In the Extreme, High and/or Moderately competitive markets, fiber is fast becoming the medium of choice for new installations because of its reliability and high performance. Replacing all copper is in itself expensive and impractical, therefore reducing costs and improving service is critical. Therefore, for an interim period, DS-1 services may be provided via metallic facility until a fiber facility is available. Provide a fiber facility when:

Customer's initial order reflects a total of four or more DS-1s.

Customer agrees to additional facility provisioning time when necessary.

3) When a chronic service condition exists on a existing DS-1 facility, provide a hot spare high capacity DS-1 facility. A Region Operations team should evaluate the customer T1 outage conditions, and recommend where to deploy the hot spare DS-1 facility. A chronic condition is defined as company detected trouble or repeated customer trouble occurring three (3) times within a 30-day period on the same DS-1 facility where a hot spare would have eliminated the

trouble report.

4) A Network Planning/Design evaluation will be made on existing metallic facilities operating with four or more DS-1s. In situations where the distribution facility serves several customers with four or more DS-1s, conduct the route evaluation for possible fiber augmentation within the next planning period (i.e., one year). This is applicable for both new and/or existing services.

Funding

Beginning in 1997, funding for provisioning a hot spare line will be included in each Regions MONG budget via the unit driver process. An additional cost/DS-1 component factor will be inserted in the unit driver algorithm when provisioning a DS-1 hot spare on a local loop facility. As the forecasted growth for DS-1s increase annually, BA will include a incremental funding for a hot spare hicap span line in the MONG budget.

Recommendation

The Regions/States will be responsible to develop a tactical plan to address DS-1 facility problems, due to failure frequency and time to restore measurements, for the embedded base and on a going forward (growth) basis. The plan should include hot spares that are required to address the remaining embedded problem areas and also fund hot spares on a going forward (growth) basis, i.e., during 1997 and beyond.

We recommend that a Region team be convened to address hot spares provisioning, and be responsible for ensuring that the maximum benefit is attained from the allotted funding in the MONG budget. This team should consist of representatives from Network Planning/ Design, Network Engineering, Network Reliability and the BRPC groups. The team should address hot spares provisioning with the intent of improving DMOQs, by addressing the major drivers previously mentioned and by taking into consideration the outlined deployment criteria.

May 8, 1996

Subj: Business Cases

NETWORK RELIABILITY ROUTE DIVERSITY CRITERIA

Current strategies have been to provide route diversity in offices designated as extremely competitive, i.e., based on Carrier LOB priority list, and where funding is included in the IOF SIA (TP13) Strategic Plan. In high and/or moderately competitive markets/offices, route diversity is not provided unless there are some overriding business or strategic reasons. The issue is how to achieve a common methodology for evaluating route diversity business cases in the high and/or moderately competitive markets. One significant measure of network reliability is blocked calls due to network failures. Route diversity aids in reducing blocked calls and failure frequency. Therefore, in the high and/or moderately competitive markets, route diversity requests will be evaluated using the following criteria/ thresholds:

Criteria	Threshold/Factors
Network Health, {#of Incidents + (Blocked Calls / 5000)} for past 2 years	> 5
Network Throughput /year, (Interlata + Intralata toll MOU)	> 12M MOU /yr.
Diversity Cost	$ Capital
Diversity Cost /MOU Protected	< $.01 /MOU
Relative Ranking Index, (note * Network Health * (Network Throughput/Diversity Cost) * Market Position	> 5
Revenues, (Retained /New)	$ Revenues
Savings, (Capital /Expense /Maintenance)	$ Savings
Frequency /History of Incidents and/or Cable cuts, - Root Cause of Cuts (Special Cause/Common Cause)	Avg # /year, and period of time

Strategic Drivers /Positioning. • New Services, • Offerings, • By-pass Alternatives, • Type of Facilities /Modernization, • IXC Requirements, • DMOQ Impacts	

Note 1: Network Health * (Network Throughput/Diversity Cost) * Market Position = Relative Ranking Index

Where: Network Health = Network Incidents (Time & Volume) for past 2 years

Network Throughput = Equivalent MOUs /year

Diversity Cost = Capital Cost for Diversity

Market Position = Tandem Tier/ Cluster Market Value, (High=2,Moderate=1)

Relative Ranking Index = A Number Used to Rank Business Cases

Attachment - Provisioning Guidelines for Unbundled Network Element

M1.0 General Information

The following section of this attachment provides general direction related to the provisioning of Unbundled Network Elements (UNE). Some differences may exist between the information provided in this attachment and components of actual GTE/CLEC contractual agreements.

a) CLEC personnel should be contacting GTE through their designated GTE Account Manager. If Network Operations employees are contacted by a CLEC, they should be referred to the CLEC's GTE Account Manager unless the Account Manager has previously approved CLEC contact with designated

Network Operations employees.

b) Review the appropriate section(s) of the GTE/CLEC contract before providing any information or performing any work activity. DO NOT assume that any two GTE/CLEC agreements are the same.

c) DO NOT perform any service for a CLEC that is not permitted by their contract. (i.e., DO NOT perform any service for a CLEC just because we contractually provide such service for another CLEC). This could harm contractual agreements, which have been or will be negotiated with other CLECs.

d) Consult your Region/State Legal or Regulatory department with any questions concerning the execution of contractual services for CLECs.

M1.1 Impact to Methods of Provisioning

Based on GTE's interpretation of the 8th Circuit Court ruling, CLEC's purchasing UNE's will be required to collocate (physical and virtual) at the Central Office where the UNE's are being provided. Each loop or port element shall be delivered to the CLEC collocation arrangement over a loop/port connector applicable to the UNE's. The CLEC shall combine UNE's with its own facilities. GTE has no obligation to combine or recombine any network elements for the CLEC.

M2.0 Local Loop Unbundling

GTE agrees to unbundle the 2-wire local loop network element. These unbundled loop elements will be provided to the CLEC at parity with GTE customers and will comply with GTE voice grade loop design specifications.

a) The unbundled loops begin at the main frame of the wire center that serves as the rate center for the CLEC end user associated with such loops, and ends at the associated NID.

b) Any such loop will meet GTE specifications for voice frequency transmission parameters and may include load coils, bridge taps, etc, or may be carrier derived (i.e. pair gain applications, loop concentrator/multiplexers).

c) GTE is responsible for the maintenance of unbundled local loop network elements.

M2.1 Unbundled Loop Facility Certification

Before deploying any service enhancing copper cable technology (e.g., HDSL, ISDN, etc.) over unbundled 2-wire network element, the CLEC shall notify GTE of such intentions.

a) GTE will assess the loop transport facility to determine whether there are any existing copper cable loop transport technologies (e.g. analog carrier, etc.) deployed within the same cable sheath that would be interfered with if the CLEC were to deploy the proposed service enhancing copper cable technology.

b) If there are existing copper cable loop transport technologies within the same cable sheath, or GTE already has planned projects to deploy such technologies within the next six months, GTE will inform the CLEC that their request will not be permitted.

c) If the CLEC has deployed these technologies without notifying GTE and it is determined that these services are causing interference, the CLEC will be directed to immediately remove these services. The CLEC will be required to reimburse GTE for all incurred expenses related to these activities.

d) Conversely, prior to GTE deploying service enhancing copper cable technology, GTE will validate, through a search of its facility assignment records, that CLECs have not deployed technologies that would interfere with those planned by GTE. Should such incompatibility exist, GTE will not deploy such technology.

e) If the CLEC can demonstrate that they have complied with GTE's certification policy, and that GTE has subsequently deployed technologies which cause interference with a CLEC's end-user's service, GTE will remove such technology from the cable sheath, and reimburse the CLEC for all related costs.

M2.2 Integrated Digital Loop Carrier (IDLC) Unbundling

Where GTE uses Integrated (Direct Interface) Digital Loop Carrier, GTE will make alternative arrangements to permit the CLEC to order a contiguous unbundled network element from the CLEC's end-user to the GTE main frame, to the extent such arrangements are technically feasible.

a) These arrangements may include;

1. Utilization of existing embedded copper cable facilities,

2. Over-building with D4 channel banks,

3. Conversion of integrated (direct-interface) DLCs to non-integrated (universal) systems,

4. Where NGDLC technology exists, employ virtual remote terminals,

5. Permit the CLEC to purchase an entire Integrated DLC.

This decision will be made by Region Infrastructure Provisioning based upon economics and forecasted demand provided by the CLECs.

a) GTE is permitted to recover the costs of unbundling such loops. Consult your Region/State Regulatory department with questions concerning the method of cost recovery.

b) In some cases it may not be technically feasible to unbundle IDLC loops.

   1. The local municipality may not permit the placement of additional OSP cabinets that may be required,

   2. The facility is incapable of supporting the capability (i.e. ADSL) desired by the CLEC.

M3.0 Sub-Loop Unbundling

Some GTE/ LEC agreements require GTE to provide access to the sub-loop at the Feeder/Distribution Interface (FDI) [cross-connect box location]. These agreements may vary state to state. Be sure to consult the GTE / CLEC contract agreement from your particular state. If the contract does not specifically require sub-loop unbundling, then no such services should be performed. **Note: All sub-loop unbundling requests need to go through the BFR process**.

a) The CLEC pays the cost to modify the GTE network to support sub-loop access, over and above the cost of the loop.

b) The CLEC pays GTE to perform all cross-connects at the FDI to their facilities, over and above the cost of the loop.

c) The CLEC is NOT permitted to access GTE's FDI.

d) GTE is NOT responsible for the end-to-end loop design/performance of CLEC facilities that utilize GTE sub-loop elements (i.e., **GTE designs to a total loop configuration. GTE does not separately guarantee the transmission characteristics of either the loop feeder or loop**

distribution. No such design specifications for the loop feeder and loop distribution have been established by the standards bodies.)

e) Technical interface specifications, maintenance and administration issues will be resolved to the mutual satisfaction of GTE and the CLEC. If the parties cannot agree, GTE will provide access to the sub-loop network elements using existing interface specifications, maintenance and administrative policies.

M3.1 Unbundled Loop Feeder and Loop Distribution

Unbundled Loop Feeder and Distribution provided to the CLEC will be of the same condition that exists for the current GTE customer. All sub-loop unbundling requests need to go through the BFR process.

a) Any special conditioning of the Unbundled Loop Feeder and Distribution required by the CLEC will be provided on a case-by-case basis, and must be paid for by the CLEC.

b) The CLEC will be required to perform the necessary loop certification (see Section K3.2) for unbundled loop feeder and distribution network elements.

c) GTE is responsible for maintaining the unbundled Loop Feeder and Distribution network elements.

d) Unbundled Loop Distribution shall support available functions associated with provisioning, maintenance and testing itself, as well as provide necessary access to provisioning, maintenance, and testing functions for Network Elements to which it is associated.

e) Where the Unbundled Loop Feeder and/or Loop Distribution is other than a copper facility the CLEC may require copper twisted pair Unbundled Loop Feeder and Loop Distribution.

1. GTE is required to provide such copper twisted pair to the extent it is not required by GTE for its planned requirements.

2. If such copper twisted pair Unbundled Loop Feeder and/or Distribution is not available GTE is NOT required to construct such facilities for the CLEC.

f) GTE is NOT responsible for the end-to-end loop design/performance of CLEC facilities which utilize GTE sub-loop elements. (Reference note in paragraph K4.0.d.)

M3.2 Unbundled Loop Concentrator / Multiplexer

Unbundled Loop Concentrator / Multiplexer provided to the CLEC will be of the same condition that exists for the current GTE customer. All sub-loop undbundling requests need to go through the BFR process. Loop Concentrator/Multiplexer include D4 channel banks, direct interface Digital Loop Carrier (DLC) systems, universal (COTed) DLC systems, etc.

a) Any special conditioning of the Unbundled Loop Concentrator / Multiplexer required by the CLEC will be provided on a case-by-case basis, and must be paid for by the CLEC.

b) GTE is responsible for maintaining the Loop Concentrator / Multiplexer.

c) GTE is NOT required to replace the embedded Loop Concentrator / Multiplexer in order to provide features and capabilities which the embedded loop concentrator is incapable of performing.

d) GTE is NOT responsible for the end-to-end loop design/performance of CLEC facilities, which utilize GTE sub-loop elements. (Reference note in paragraph K4.0.d.) GTE views Loop Concentrator/Multiplexer as an alternative feeder technology.

M4.0 Unbundled Dark Fiber

In some states GTE is required to provide access to unused fiber (dark fiber) as an unbundled network element. In some states this is limited only to fiber that exists in GTE's Inter-Office network. In other states access to unused fiber feeder is permitted. Consult with your local Legal and / or Regulatory department concerning the specific requirements for your state.

a) GTE is NOT required to make available for lease by a CLEC more than 25% of its unused dark fiber capacity in a particular feeder or dedicated interoffice transport segment.

b) In those applications where the CLEC requests optical regenerators, such regeneration will be provided by GTE on a case-by-case basis with the additional costs to be borne by the CLEC. The CLEC may provide its own optical regeneration equipment within the CLEC's physical/virtual collocation space.

c) GTE lease agreements for such fiber may provide that they are revocable upon twelve months notice by GTE provided;

1. GTE must demonstrate that the subject fiber is needed to meet GTE's bandwidth requirements, or the requirements of another CLEC,

2. GTE can demonstrate within a twelve month period after the date of a fiber lease that the CLEC is using the leased capacity at a transmission level less than OC-12,

3. Whenever GTE revokes a dark fiber lease agreement, GTE will provide the CLEC a reasonable and sufficient alternative means of transporting the traffic.

d) In the case of fiber feeder the CLEC will bear the cost of extending dark fiber in the feeder segment of GTE's network to the CLEC's end-user premises or to the CLEC's facility access hub within GTE's loop access network.

M5.0 Unbundled Local Switching

GTE will provide an unbundled local switching element to the CLECs. This element provides the capability for the CLEC to offer switched-based services to their end-users using GTE's switches.

M6.0 Unbundled IOF

CLECs are permitted to lease unbundled IOF (dedicated) transport from GTE and interconnect these elements with; 1)Their physical/virtual collocation equipment, 2) Unbundled Loops or Unbundled Loop Feeder, 3) Unbundled Local Switching, and 4) GTE multiplexing devices including D4 channel banks or digital cross-connect systems.

The CLEC will be permitted to lease unbundled IOF at any technically feasible rate (i.e., DS0, DS1, DS3, OC-N). Refer to the GTE / CLEC contract for your state to determine which IOF transmission rates will be provided on an unbundled basis.

The point of interconnection between the CLEC and GTE equipment will be the appropriate cross-connect frame of DSX/3X or fiber patch panel (for OC rates).

The CLEC may have access to GTE's digital cross-connect systems (DCS) in the same manner as made available to IXCs.

M7.0 Remote Switch Collocation

At locations where GTE's central offices are configured in a Host/Remote arrangement, the following factors must be considered before determining the collocation site: 1) The central office must have its own NPA/NXX; 2) The central office must have its own unique CLLI Code; and 3) The central office must have its own set of V&H coordinates.

Example #1: In a Host/Remote arrangement where the NPA/NXX resides in the remote unit, collocation is required in the remote unit.

Example #2: In a Host/Remote arrangement where the NPA/NXX resides in the host unit, collocation is required in the host unit.

Some state commissions have ruled that GTE must permit collocation of remote switching technology. This requirement will vary from state to state. Therefore, it is very important that you review the GTE/CLEC agreements to determine the specific requirements for your state(s).

If collocation of remote switching equipment is not specifically permitted by contract in your state, you should assume that it is not permitted.

GTE continues to advocate maintaining a 5-year planning horizon for reserving central office space, unless otherwise specified within the GTE / CLEC contractual agreement for your state.

Buried Service Wire – Description and Installation

Contents

(continued)

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Contents, continued

1. General

1.1 Purpose

This practice describes the GTE standard buried service wire that is served by aerial or buried facilities.

1.2 Filing Instructions and Supersedures

Discard all previous issues and associated addenda of this practice and file this issue numerically in your GTE Telephone Operations practices set.

This practice supersedes:

- All local practices, policies, procedures, general instructions, letters, and memoranda which address this subject.
- Any document which provides information contrary to the information contained in this practice.

1.3 Reason for Reissuing

This practice has been reissued to incorporate multiple changes in the content. Read this entire practice to ensure your familiarity with the new information.

1.4 Responsibility

This practice was published by the GTE Telephone Operations Administrative Services Department. For more information about this practice, contact the Headquarters Network Provisioning Department.

1.5 Disclaimer

This practice was prepared solely for the use of GTE Telephone Operations. It must be used only by its employees, contractors, customers and end users, when installing, operating, maintaining, and repairing GTE Telephone Operations' equipment, facilities and services. Any other use of this practice is forbidden. The information contained in this practice may not be applicable in all circumstances and is subject to change without notice. By using this practice the user agrees that GTE Telephone Operations will have no liability (to the extent permitted by applicable law) for any consequential, incidental, special, or punitive damages that may result.

2. Overview

2.1 References

The following documents are referenced in this practice, and could be required for performing certain related tasks.

For Information About...	See...
Station Grounding Requirements, Description	435-600-100
Wire Open – Bridling – Description and Installation	628-290-200

2.2 Definitions

The following chart provides definitions for the acronyms and terms used in this practice.

Acronym	Definition
AWG	American Wire Gauge
EPTR	Extended Thermoplastic Rubber
MGN	Multi-Grounded Neutral
NESC	National Electrical Safety Code
NID	Network Interface Device
PLP	Performed Line Products
PVC	Polyvinyl Chloride
R.H.	Round Head

3. Description of Buried Service Wire

3.1 General Description

GTE-standard buried service wire is a shielded, paired wire product for direct burial installation. It provides telecommunications services between the outside plant serving cable facility and the station protection device.

The buried service wire is suitable for random lay-joint trench with power facilities under 300V, and is available in two- and five-pair, armored and nonarmored configurations. It is also available preinstalled in a ½-inch polyethylene innerduct (service wire induct).

3.2 Buried Service Wire Identification

The following are descriptions of two-pair and five-pair buried service wire.

Pair Type	Number	Description
Two-Pair	#1	Blue/white with blue longitudinal stripe.
	#2	Orange/white with orange stripe.
Five-Pair	#1	Blue/white with blue stripe.
	#2	Orange/white with orange stripe.
	#3	Green/white with green stripe.
	#4	Brown/white with brown stripe.
	#5	Slate/white with slate stripe.

3.3 Nonarmored Service Wire

Nonarmored buried service wire is used in areas not susceptible to sheath damage by:

- Subsurface rodents.
- Rocks.
- Foreign objects.

Components include a:

- Black polyvinyl chloride (PVC) outer jacket extruded over a 4-mil bronze alloy corrugated tape shield and nylon rip cord.
- Clear plastic mylar wrap surrounding color coded, solid polyolefin insulated, 22-AWG solid annealed copper paired conductors, encapsulated with 80° Extended Thermoplastic Rubber (ETPR) filling compound.

3.4 Armored Service Wire

Armored buried service wire is used in:

- Rocky soil conditions.
- Known gopher-infested areas.

Design features include a:

- Black PVC outer jacket extruded over a 5-mil copper-clad stainless steel shield and inner black polyethylene jacket.
- Clear plastic mylar wrap surrounding color coded, solid polyolefin insulated, 22-AWG solid annealed copper paired conductors, encapsulated with 80° ETPR filling compound.

3.5 Service Wire induct

The service wire induct is a ½-inch inner diameter prelubricated high-density polyethylene innerduct, with the service (drop) wire preinstalled and ready for placement.

Placement methods are the same as for standard service wire. Use the service wire induct wherever buried service wire is normally placed to provide service to a residential or business customer. The duct can be ordered without wire and with a pull string.

3.6 Jacket Marking

The outer surface of the jacket is indented at 2-foot intervals with the:

- Manufacturer's name.
- Year of manufacture.
- Number of pairs.
- AWG identification.
- Sequential length marking.

4. Installation Guidelines

4.1 Introduction

Observe the following guidelines when installing buried service wire or drop-in duct.

- Avoid:
  - Sharp bending.
    - Not less than 6-inch radius for buried service wire.
    - Not less than 10-inch radius for drop-in duct.
  - Kinking.
  - Crushing.
- Place buried service wire and drop-in duct by:
  - Using static or vibratory plow machines.
  - Using a trencher.
  - Hand digging.
- Cover the wire a minimum of 12 inches unless mandated by local regulatory agencies.

  NOTE: **Minimum covers are specified from final grade.**
- Make the buried service wire location, when possible, the shortest distance from the main cable trench or terminal to the customer service entrance.

  NOTE: **Avoid obstacles such as septic tanks, large trees, proposed sites for garages, swimming pools, buildings, flower beds, and other utilities.**

4.2 Buried Service Loop Design Limits

Buried service wire facilities must not exceed lengths greater than 1000 feet unless Network Facilities Engineering provides approval.

4.3 Joint Trench

In a joint trench place buried service wire ONLY with primary conductors of 300 volts or less (phase to ground), having a bare concentric neutral.

4.4 Random Lay

In random lay configurations, lace buried service wire with secondary power conductors, having voltages of 120 volts (phase to ground), regardless of neutral configuration.

The protector where the wire terminates must be bonded to the power neutral/ground in accordance with GTE Telepnone Operations Practice 435-600-100.

If the pedestal where the wire terminates is located within 6 feet of the power transformer, the pedestal must be bonded to the transformer with a #6-AWG insulated. grounded wire. This is a National Electrical Safety Code (NESC) requirement.

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5. Buried Service Wire—Terminated on Outside Building Wall

5.1 New Installation Guidelines

When the buried service wire is terminated on the outside of the building wall:

- Mount the protector on the outside wall approximately 60 inches above the final grade level.
- Terminate the buried service wire in the station protector or Network Interface Device (NID) and the wire shield bond, using the PLP floating servi-bond service wire shield connector.

5.2 Mechanical Protection

Use one of the following two options to install buried service wire.

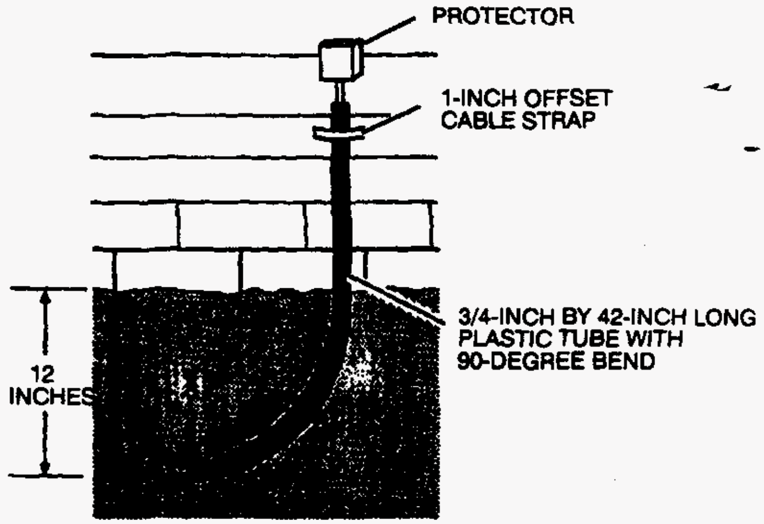
- The wire can be protected by a ¾-inch I.D., 42-inch L. PVC entrance tube with a 90° bend. The 42-inch plastic tube is required to protect the drop wire if it is used in a building's interior.
- Use ⅝-inch plastic molding to protect the buried service wire at the customer premises when the structure foundation extends beyond the wall, or otherwise prevents parallel alignment of the PVC entrance tube.

Drop-in duct application does not require additional protection on external building applications because the drop-in duct is not approved for interior applications. Use coupling to connect the drop-in duct to the plastic tube. Use this coupling when reconnecting duct sections that have been severed.

5.3 Installing the Entrance Tube

Install the entrance tube as described in the following chart.

Step	Installing the Entrance Tube
1	Remove the earth in an area around the service wire, if necessary, 12 inches deep, and out to at least 18 inches from the wall.
2	Insert the free end of the buried service wire into the 18-inch end of the entrance tube.
3	Continue to push the wire through the tube until the 90° bend can be positioned in the bottom of the hole and next to the wall.
4	Position the bottom of the tube 12 inches below the final grade line.
5	Secure the tube to the wall by placing a 1-inch cable clamp 1 inch below the top of the tube, as shown below.



5. Buried Service Wire—Terminated on Outside Building Wall, continued

5.4 Extending the Entrance Tube

When the station protector is mounted higher on the structure than 30 inches, and it is not practical to lower it, extend the entrance tube by using the straight entrance tube and coupling. Extend the 90° bend entrance tube as described in the following chart.

Step	Extending the Entrance Tube
1	Measure the desired length of the extension, from the top of the 90° bend tube to the required 6 inches below the station protector.
2	Use a hacksaw to cut a straight entrance tube to the desired length.
3	Apply PVC cement around the top end of the 42-inch tube and inside half the PVC coupling.
4	Place the cemented half of the coupling on the top end of the 90° tube.
5	Apply PVC cement: • To the bottom end of the additional tube length. AND • In the unused portion of the coupling.
6	Force the cemented end of the additional tube into the vacant end of the coupling.
7	Place the service wire through the tube assembly.
8	Using a cable clamp located 1 inch below the top of the extension tube, secure the extended length of tubing to the building.

6. Buried Service Wire Served from Aerial (Cable/Wire) Facilities

6.1 Mechanical Protection

Cover the service wire with a 1⅛-inch by 5-foot steel cable guard.

EXCEPTION: **In California, an 8-foot guard is specified by the regulatory body.**

Steel cable guards are preferred on pole locations vulnerable to impact by vehicles and power equipment.

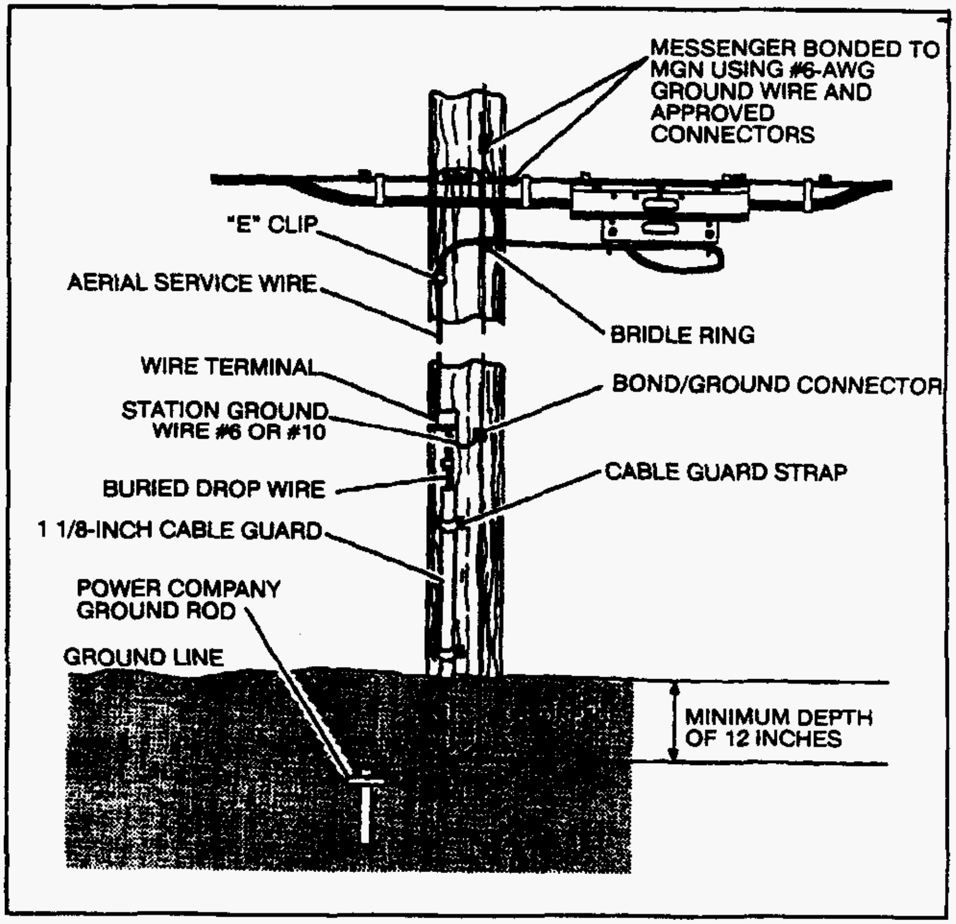
In locations where local governmental agencies and power companies permit, use the ⅝-inch plastic molding or the PVC entrance tube with a 90° bend.

Fasten the cable guard to the pole as shown in the illustration below. When fastening the cable guard, use:

- Two steel cable guard straps.
- Four ¼-inch by 2-inch (minimum) lag screws.

NOTE: **Local supervisors must:**

- **Be knowledgeable in the types of grounding used on power systems within their serving area.**
- **Coordinate with local Engineering when necessary.**



6.2 Employee/ Public Protection

When placing the GTE pedestal and/or ground rod within 6 feet of the power company neutral conductor, bond the GTE ground rod by #6-AWG insulated ground wire to the:

- Power company grounded rod, if present.

  OR
- Multi-grounded neutral (MGN) conductor (on the pole) 6 inches above earth level.

NOTE: **Bond the power company ground to the GTE ground rod in the GTE pedestal if the GTE ground rod cannot be easily located and exposed.**

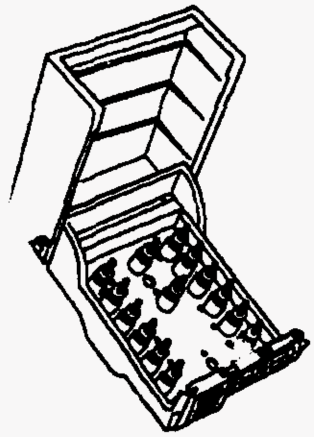
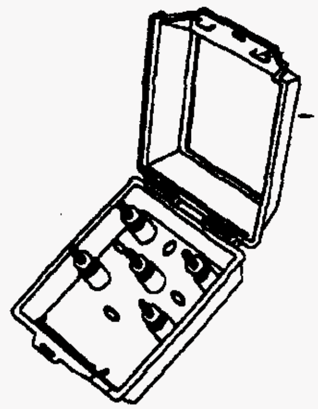
6.3 Bonding and Grounding

Do the following to bond and ground the service wire depending on whether there is a verified MGN.

If...	Then...
If there is no MGN	Obtain shield ground with: • A permanently grounded metallic structure (steel support structure). OR • An 8-foot driven ground rod.
• There is a power ground conductor extending down the aerial service wire attachment pole AND • Local Facilities Engineering has secured MGN verification from the local power utility	• Bond the wire terminal ground lug to the MGN, using #6 AWG (maximum) insulated copper wire. AND • Observe the 6-inch minimum radius rule when making all ground wire connections.

6.4 Installation Procedures

Procedures for placing buried service wire from aerial cable facilities are outlined in the following chart.

Step	Placing Buried Service Wire from Aerial Cable Facilities
1	Position the serving pedestal away from the pole. If the serving pedestal is located away from the aerial attachment pole, place the buried service wire: • Subsurface from the pedestal a minimum depth of 12 inches. • To the side of the pole least vulnerable to the traffic. • Extending 6 feet (minimum) up the pole to provide approximately 12 inches of conductor ends for bonding and termination.
2	Terminate the buried service wire conductors and ground the shield in the standard wire terminal containing a ground post, as shown below. 6 PAIR  2 PAIR 
3	Mount the wire terminal on the pole at least 6 inches above U-guard level, unless otherwise specified by a state regulatory body.
4	Place the wire terminal on the pole with two No. 14 x 1½-inch R.H. galvanized wood screws.
5	Use the PLP gloating servi-bond service wire shield to bond the buried service wire shield.

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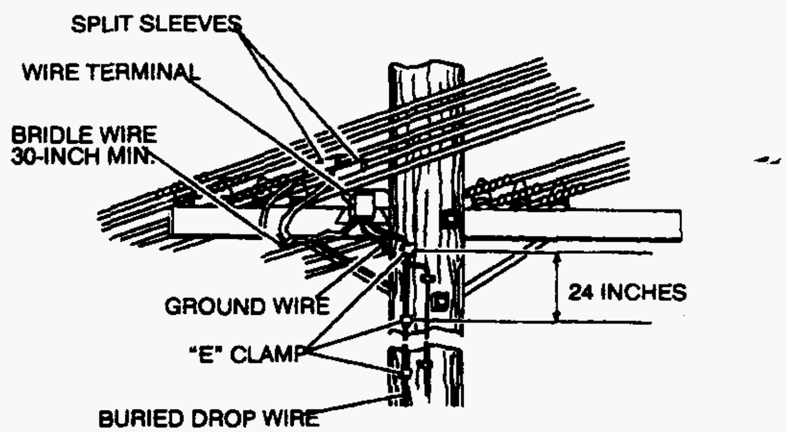
7. Buried Service Wire Connecting to Aerial Wire

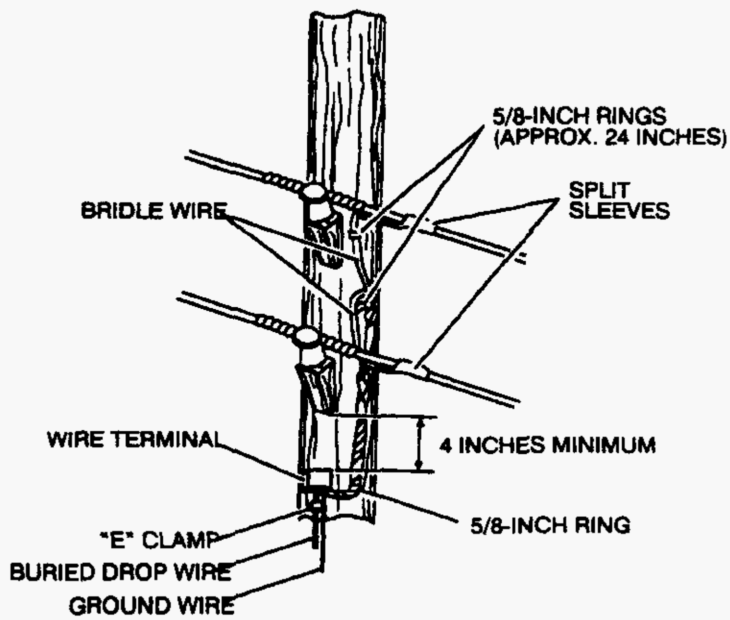
7.1 Installation for Aerial Wire

Procedures for connecting buried service wire to open wire or C-wire are described in the following chart.

NOTE: **The buried service wire or drop wire in duct is placed on the pole as described in Section 6.4.**

Step	Connecting Buried Service Wire to Open Wire or C-Wire
1	Place a standard wire terminal on the pole above the cable guard.
2	Insert a fusible link of bridle wire (minimum 30 inches long) between the open wire conductors and the wire terminal.
3	Route the bridle wire between the wire conductors and the wire terminal as illustrated below. **NOTE: Refer to GTE Telephone Operations Practice 628-290-200 for information concerning wire bridling.**





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8. Subsurface Splicing of Buried Service Wire

8.1 Splicing

Subsurface splicing of buried service wire is permitted only when using the standard buried service wire splice kit which encapsulates the completed splice.

NOTE: Drop wire that is part of the drop-in duct installation is replaced, not spliced.

8.2 Splice Closure Description

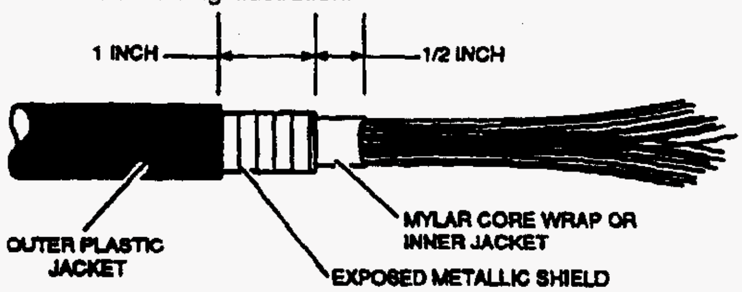
The standard buried wire splice kit is the PLP Ranger SERVISEAL®. It is a reenterable splice closure that accommodates wire diameters up to .500 inches or a maximum five-pair buried service wire.

Removable inserts in the grooved cap provide the range necessary to accommodate the various sizes of buried service wire used in the network. The insert must be removed prior to entry of wire larger than .400 inches.

8.3 Splice Closure Installation Procedure

Prepare each buried service wire for splicing and encapsulation within the SERVISEAL, as described in the following chart.

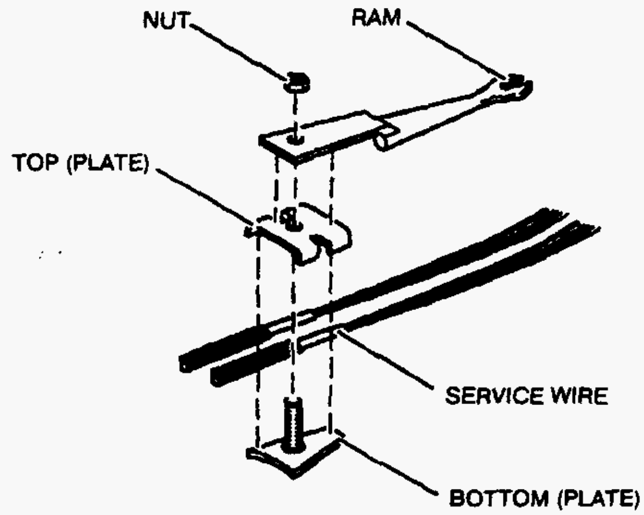
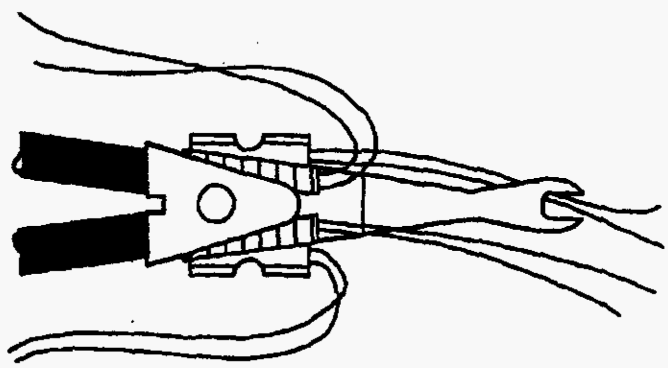
Step	Installing Splice Closure
1	Remove the outer jacket approximately 5 inches from the end of the service wire.
2	Remove the shield leaving ¾ inch exposed above the end of the outer jacket.
3	Remove the mylar wrap and inner PVC sheath if necessary, ½ inch above the end of the shield.
4	Cut the exposed conductor ends cleanly, leaving no less than 4¾ inches remaining. When preparation is complete, the wire will resemble the following illustration.



(continued)

SERVISEAL® is a registered trademark of Preformed Line Products.

8.3 Splice Closure Installation Procedure, continued

Step	Installing Splice Closure
5	Position and assemble the components of the shield connector on the wires as shown below. 
6	Tighten the shield connector with a 3/8-inch terminal wrench.
7	Select one wire from each pair and drape them over the notch at the end of the insertion RAM. 

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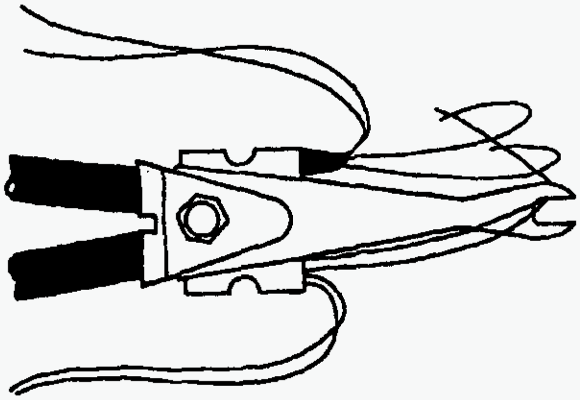
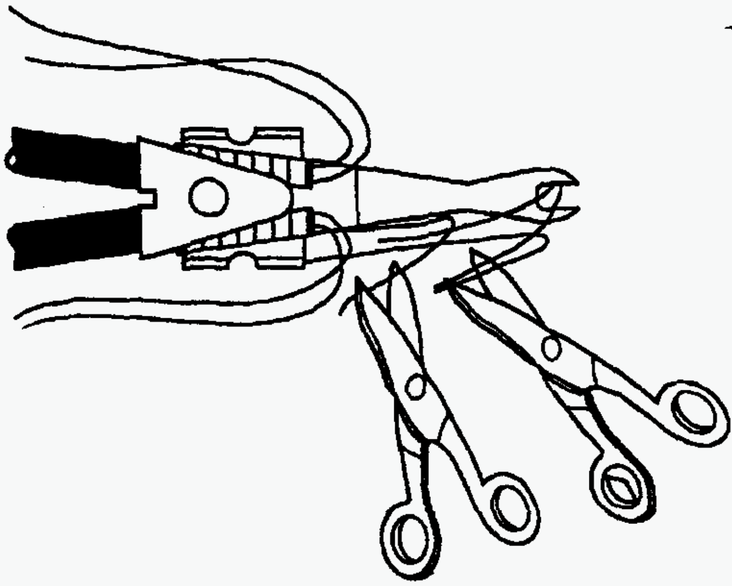
8.3 Splice Closure Installation Procedure, continued

Step	Installing Splice Closure
8	Loop the matching wire of each pair outside the insertion RAM. 
9	Trim the wires of each pair so as to stagger the splice bundle beginning at the center portion of the insertion RAM. 

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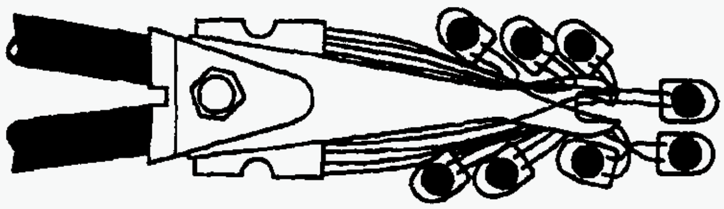
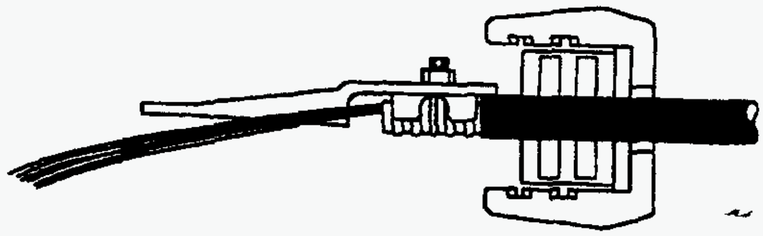
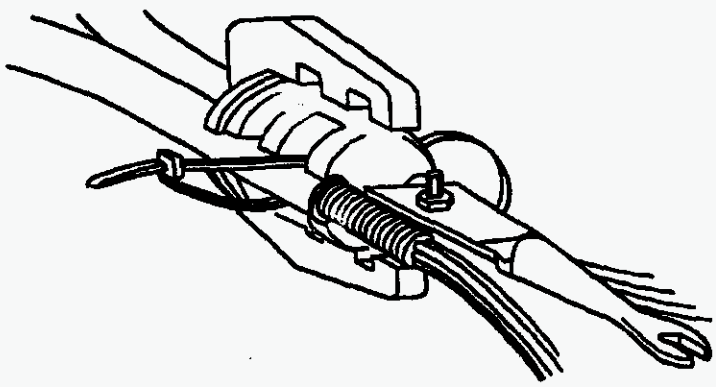
8.3 Splice Closure Installation Procedure, continued

Step	Installing Splice Closure
10	Apply standard splice connectors. 
11	Slide the cap onto the cable so that the ears of the cap are flush with the edge of the shield connector. 
12	Secure the cap to the cables with the cable tie as shown below by: • Inserting the tie through the space between the cap and insert area. • Securing the cable tie and positioning the tie head into the cap slot and cutting off excess wire. 

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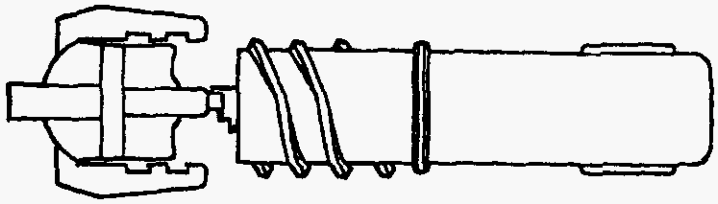
8.3
Splice Closure Installation Procedure, continued

Step	Installing Splice Closure
13	Insert the spliced wires and cap in the sealant-filled vial to the point where the cap ears contact vial threads.
	
14	Grip the cap firmly with one hand and twist the vial clockwise with the other hand until the ridge around the cap contacts the end of the vial.

8.4
Reentry

Do the following if reentry to an in-service SERVISEAL is required.

Step	Reentry of Existing SERVISEAL Closure
1	Remove the grooved cap form the vial.
2	Dispose of the vial. **CAUTION: Do not reuse the vial.**
3	Install a new vial using a Vial Replacement Kit (Part #80008946).

9. Supplementary Reading

9.1
Additional Information

For supplementary information related to this practice, see GTE Telephone Operations Practice 629-100-200, Exchange Buried Cable – Distribution and Service Wire Placing.

CONDUIT
GENERAL CONSIDERATIONS

CONTENTS PAGE

1. GENERAL

1.01 This section provides the basic considerations and fundamentals necessary in designing an economical and practical underground conduit system.

1.02 In designing a conduit system, the engineer should be familiar with the work of the construction and maintenance forces as well as the latest approved materials and methods of construction.

1.03 In the design of conduit systems, the engineer is also required to be familiar with all municipal, state, and federal franchises, ordinances, and other regulations governing underground construction in his territory.

1.04 System approved conduit materials used in the construction of underground conduit systems, together with conduit design and layout considerations, are covered in other sections of this series of Practices.

1.05 This section is being reissued to incorporate Section 911-100-071 and to provide the current fundamental planning aspects used by the operating companies to provide an economical and practical conduit system. Due to the extent of changes, marginal arrows are not used. Remove and destroy all copies of Section 911-000-070, Issue 2 and Addendum 1.

2. FUNDAMENTAL PLANNING – ROUTE SELECTION

2.01 A fundamental plan, in map form, has been established for most exchanges. The plan for an area shows the location of existing and proposed central offices, ultimate boundaries of each central office area, existing and proposed conduit routes, and divisions of feed, as of the ultimate date of the plan. Before basing any important action upon the fundamental plan, it should be determined that it is sufficiently up-to-date to provide a proper basis for future planning.

2.02 The area to be served by a proposed conduit addition or extension is usually determined by the most direct route to the central office. When considering a proposed conduit addition or extension, all data should be reviewed from the standpoint of expected central office boundary changes, civic improvements, possibility of future changes in zoning (single-family to multiple dwellings, residence to manufacturing, marketing forecasts, etc.) and other factors that could cause a change in the character of the area to be served.

2.03 Conduit routes should conform as closely as practical to those set forth on the fundamental plan. The routes indicated on the plan are arranged as to provide a direct feed from the customer's location to the operating center, insofar as this is permitted by topographical limitations, land use and development, and economic factors. The routes set forth on the fundamental plan are laid out so that normally no great change in route need be made. A field survey should be taken to ascertain if any construction problems exist and whether any economy could be realized by selecting a different route than that indicated on the fundamental plan. Judicious judgement must be applied when laying out a conduit route to obtain the best location for construction, maintenance, cable placing, and minimum miles of cable.

3. GROWTH REQUIREMENTS

3.01 The initial area to be served by a proposed conduit system will usually consist of several ultimate (forecast) areas as determined through the use of the station forecast. These areas should be carefully studied so that the most economical and practical conduit system is designed and that the forecasted growth is amply provided for.

3.02 The number of ducts required in a proposed conduit addition or extension depends upon the number of cables necessary to provide for the expected line growth. This line growth is based on cable fills, as determined through the station forecast plus any additional duct requirements such as leased facilities, toll or trunk cables, municipal, or other requirements.

3.03 In analyzing the growth estimates for a proposed conduit system, the current line fill should be reviewed and compared with the station forecast. If there is any question as to the accuracy of the forecast, it should be referred to the party or parties preparing the estimate.

4. ECONOMICS

4.01 Underground conduit construction is usually a major investment and, as such, it is important that any conduit additions be economically planned.

4.02 Economic cost comparisons play an important part in considering underground conduit construction. There are times when common sense is the only practical approach to a certain type of construction, regardless of the cost. In this type of situation, the engineer must use good judgement and be able to justify his reasons for approaching a particular job on a practical basis. An example of this situation would be in municipalities where an ordinance would prohibit or mandate a certain type of construction.

4.03 The engineer should determine that other types or methods of providing outside plant facilities are impractical or otherwise prohibited due to various circumstances. Basically, there are seven conditions that require the construction of conduit. The seven conditions are as follows:

(a) When a pole line, either existing or new, will not sup. rt a sufficient number of conductors or when an existing pole line must be removed.
(b) Governmental requirement.
(c) When buried plant will not provide suffi nt conductors or required space is not available.
(d) When right-of-way limitations preclude other choices.
(e) When an area is too congested to permit other types or methods.
(f) When underground subdivision agreements forbid other types or methods
(g) When other types or methods (including the use of customer carrier) of providing outside plant facilities are not economically feasible and/or practical.

4.04 In instances where there is an alternative to underground conduit construction, the cost of conduit and cable should be compared with the costs of the alternatives. Having decided that conduit is warranted, it should be designed so that the most economical plant (for its expected life) will result.

5. LOCATING CONDUIT RUN

5.01 The location of duct run, manholes, and laterals with respect to curb or property lines can usually be determined when the visit to the field is made to decide the feasibility of the route indicated on the fundamental plan. While in the field, the engineer should make rough sketches and comprehensive notes showing the location of the proposed lines, center lines of streets, etc., and the locations, as nearly as can be determined, of existing substructures such as gas, water, and sewer mains, and other companies' conduit runs and manholes. All special construction details, such as railroad crossings, attachments to bridges, etc., should be clearly indicated.

5.02 A conduit run may be located between the curb and property line (parkway), under the street (either paved or unpaved portion), or in the area in the middle of divided streets (center parkway, bridle path, or parking strip). It should be kept in mind, however, that conduit located in the center parking area may present access problems, or the center parkway may be converted to other use, and should be considered only when no other location is practical.

5.03 The most advantageous location for conduit, under most circumstances, is to locate the run in the parkway under either the grass or the sidewalk. Usually, a conduit system in this location is more economical and the hazards of vehicular traffic to construction and maintenance forces is greatly reduced. However, the engineer should be aware of the following disadvantages to parkway locations and take each into consideration when locating the duct run:

(a) Future construction of storm drains and catch basins that may require relocation or rearrangement of the ducts.
(b) Nearness to existing trees, which might require tunneling under roots possible damage to trees, or root damage to ducts.
(c) Possibility of a street being widened so as to bring a new curb over manhole openings.
(d) Difficulty of locating cable reel in a desirable location for pulling-in cable.
(e) Advance plans for freeways, bridge footing, or other major construction should be considered in locating the duct position and the manholes.

5.04 Locating the conduit system in the traveled portion of the street may, at times, be unavoidable because of civic regulations restricting manhole locations or other reasons (paragraph 5.03). The traffic hazards to personnel working in manholes in the street cannot be overstressed in this type of construction. If it is necessary to place the duct system under the paved portion of the street, the structure should be located not less than 3 feet from the curb to avoid present or future catch basins and to minimize surface water drainage into manholes. The conduit run should not be located so far out in the traveled portion of the highways as to interfere with traffic, future or existing sewers, flood control projects, etc.

6. ADVANCED CONSTRUCTION

6.01 The engineer, by keeping abreast of civic developments, should know well in advance of starting work on any proposed paving or repaving of streets or highways or other improvements. Each engineering office should have someone assigned to maintain contact with the various governmental agencies and utilities in the area to keep abreast of activities. As soon as it is known that pavement is to be placed in a street where conduit will later be required, the engineer should determine whether it would be economical to place the conduit at once (considering the annual charges for the period during which the conduit would be idle) or to place conduit later at a greater cost. Many new pavements are placed under bond for a number of years after construction. This means that no opening can be made in the new pavement within the time limits specified, except in emergencies. Under these circumstances, immediate conduit construction may be necessary unless alternate routes are available. Cutting newly paved streets for conduit also adversely affects public relations. Cost studies should be made to determine if it would be economical to place the conduit now or postpone it to a later date at a greater cost. The engineer should keep in mind that economy is not always the deciding factor since, as mentioned before, it may be impossible to obtain permission to excavate within a stated period after placing of the pavement.

6.02 Instances where freeways, bridges, major highways, etc., are being constructed may also require advanced construction, depending on the circumstances involved.

7. RIGHT-OF-WAY AND PERMITS

7.01 All necessary permits and/or arrangements for a right-of-way required for constructing underground conduit should be arranged for prior to starting construction. The most common types of rights and permits that may be required are described in the following paragraphs.

7.02 Franchise Rights. These are usually in blanket form, and generally cover only the basic right to erect and maintain various types of telephone plant in or on public streets and highways.

7.03 Construction Permits. Permits for underground construction or maintenance word that is to take place on a county, city, or state street or highway must be obtained from the applicable regulatory authority before starting the work. Applications for these permits usually must be accompanied by sketches or detailed prints of the proposed work.

7.04 Easements. An easement must be secured from the individual property owner or owners involved before placing conduit on private property. Easements should be permanent except that a temporary right-of-way may be secured when conduit and cable are required over a temporary route during building or highway construction.

7.05 Railroad Crossing. When underground railroad crossings are planned, a permit must be obtained from the railroad company, whether or not the crossing is on public or private property. The permit application must be accompanied by drawings of the proposed crossing.

7.06 Bridges and Streams. Special permits are necessary for attachments to bridges or for crossing under navigable and nonnavigable streams. Most bridges are under the jurisdiction of the state or county. Navigable streams and some nonnavigable streams are under the jurisdiction of the federal government. A detailed drawing of the conduit structure and/or the proposed crossing is required in most cases and must be submitted with the permit application to the governmental agency having jurisdiction.

7.07 Government Property. Permits from the state or federal government may be necessary for temporary or permanent occupation of their property. Such permits are usually granted only after submitting sketches or detailed plans of the proposed construction.

7.08 Miscellaneous Permits. Permits for closing streets to traffic or for placing materials temporarily on private property of others may be required. Arrangements for such permits are usually made by the contracting firm awarded the work.

8. DUCT REQUIREMENTS

8.01 The decision as to the total number of ducts to be placed in a proposed conduit installation is dependent upon the number of cables required to provide for immediate requirements and expected growth over the economical period of fill of the conduit. Basically, there are eight primary considerations that must be applied to the selection of the total number of ducts to be placed in a conduit run. These are as follows:

(a) Initial requirements plus one maintenance duct.
(b) Routing changes.
(c) Flexibility across central office boundaries.
(d) Branch intersections.
(e) Central office approaches.
(f) Special construction.
(g) Public inconvenience at further reinforcement.
(h) Other wire-using companies (leased ducts).
(i) Franchise agreements (city, fire, police, etc.).

The above considerations are discussed in the paragraphs that follow.

8.02 Initial requirements to be considered, with respect to the number of ducts, fall into two categories: existing cables and cables required for growth.

8.03 Quite often, there will be existing cables along a proposed conduit run which should be provided for at the time the proposed conduit is installed. Examples of these are the following: aerial cable leads to be superseded by underground cable, where rerouting of existing cable is contemplated, central office recentering projects, cables in existing underground conduit that must be abandoned for one reason or another, etc. A new underground cable intended to replace existing facilities will, quite often, provide for a reasonable period of growth. In this case, allowance should be made for such growth in the final determination of duct requirements.

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8.04 The rate of growth expressed in terms of cables per year, which in turn depends on circuit growth, is the most important element in determining the economic number of ducts to install. The basic growth data applicable to a given run is obtained from the forecasted growth estimates for the area to be served. If the proposed conduit run is to provide for trunk, toll, or other circuits, in addition to exchange lines, provisions for these should also be taken into consideration.

8.05 The graph shown in Figure 1 gives the average cables per year that may reasonably be expected as the result of a given estimated line growth per year. In computing the curve, a study was made to determine the probable size of cable that would represent an average of all cables of all sizes that normally might be expected in a conduit run serving any one of the series of assumed line growth. On the basis of the more or less approximate indications of this study, a smooth curve was plotted showing what is considered to be a reasonable relationship between growth and average cable size. This in turn was used as a basis for establishing the curve in Figure 1, which shows the average number of cables per year that may be reasonably expected as the result of a given estimated line growth per year, in all gauges.

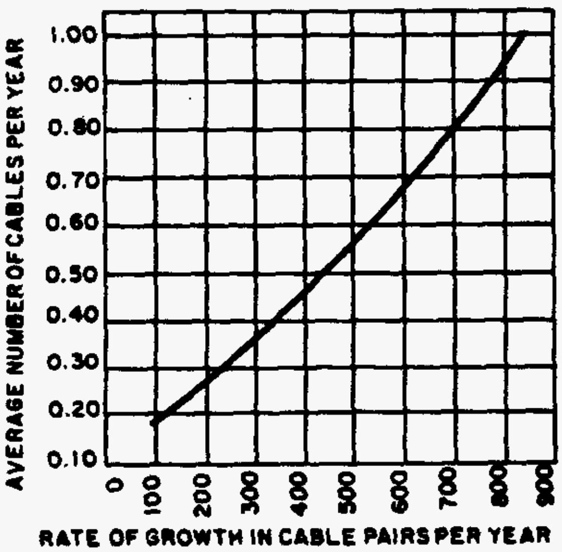
8.06 Routing Changes. Recentering plans or rearrangements of feeds to different areas may affect conduit requirements despite the fact that actual overall circuit growth may proceed at a reasonable uniform rate. For example, along a route where growth of 0.5 cables per year is forecasted, a total of 14 ducts might be economical to place for growth. At a rate of 0.5 cables per year, this run would not require relief for 28 years. If, however, plans are made to transfer part of the area to a new central office at the end of 12 years, only six to eight ducts may be required for growth.

8.07 It is recognized that the size of the average cable in a conduit run serving a given line growth may be affected by many factors. Studies have indicated that within reasonable limits, the variation in average cable size should not be large. It is believed that the curve in Figure 1 should be helpful in estimating cable growth where more detailed estimates are not available or where a check of a detailed estimate is desired.

8.08 Flexibility Across Central Office Boundaries. It may be advisable to provide spare conduits across central office boundaries in addition to the basic requirements for inter-office trunks, toll, or other through circuits to take care of possible recentering operations and boundary changes.

8.09 Branch Intersections. As a general rule, it is not desirable to diminish the size of a conduit run at points other than where branch conduit runs will intersect the main conduit route. When a main conduit run has two or more branches, the sum of the ducts in these branches for the estimated growth may exceed the number indicated for the main conduit run. This could result from larger-sized cables placed in the main run as opposed to smaller cables in the branch runs.

8.10 Central Office Entrances and Approaches. When designing conduit entering a central office building, a sufficient number of ducts should be provided on the initial installation to care for the estimated ultimate capacity of the building. Whenever practical, extra ducts should be provided for a reasonable distance away from the office to ensure that conduit approaches will not be blocked by foreign construction.



CALCULATIONS FOR CURVE INTERSECTIONS AT POINTS

0.20 - 126
0.30 - 237
0.40 - 332
0.50 - 421
0.60 - 511
0.70 - 600
0.80 - 679
0.90 - 763
1.00 - 842

Figure 1. Rate of Growth Graph.

8.11 Special Construction. At locations such as railroad crossings, bridges, freeways, etc., it is desirable, if not mandatory, that the ultimate number of ducts be placed on the initial installation since access for reinforcing or relief is generally impractical. Also, thought should be given to providing extra ducts in structures where conduit transpositions are required to clear obstructions which would otherwise result in a structure that would be difficult to reinforce at a later date.

8.12 Public Inconvenience. Future subsurface installations, traffic density, paving costs, etc., may preclude the opening of streets for additional conduit; or excessive construction changes may prohibit further conduit reinforcement.

8.13 Franchise agreements and other wire-using companies. The city franchise may provide a free duct for fire, police, and other facilities to be carried in the conduit system. Also, other wire-using companies (i.e., schools, wide spectrum systems, telegraph, etc.) must be considered if a possibility exists that such services will be provided in the duct system.

8.14 Costs. The matter of costs is of primary importance when deciding the route and number of ducts to be placed initially. The principal costs that must be taken into consideration, aside from material costs, are as follows:

(a) Labor, freight, or other costs that vary, depending upon the location of the job site.

(b) Subsurface conditions such as rock, water, sand, obstructions, etc These conditions relate directly to labor costs, which currently make up the major portion of conduit construction costs. The cost of paving must also be considered because various types of paving differ considerably in costs.

(c) The type of duct formation determines the width and depth of the trench which, in turn, relates directly to labor costs. Most contracts are set up on a predetermined "standard" trench dimension, and deviations from these dimensions usually result in extra costs.

9. ECONOMIC NUMBER OF DUCTS FOR GROWTH

9.01 Determining the number of required ducts by annual charge studies entails a specific set of conditions as to rate of growth and construction charges, and involves considerable detailed computation.

9.02 Figure 2 has been prepared to provide a convenient method of determining the economic number of ducts in a given case, based on the following conditions:

(a) The initial installation of conduit would be in an unpaved street or parkway but subsequent installations would be under pavement.

(b) Reinforcement of the initial run by placing the same number of ducts later would cost from 25 to 35 percent more than the original installation.

(c) The cost penalty of underestimating the growth and installing too few ducts would be greater than over-estimating the growth and installing too many ducts.

9.03 The following procedure is used to determine the number of ducts for economic growth:

(1) Determine the rate of growth in number of cables per year.

(2) Determine the subsurface condition that will be encountered, e.g., excavation in soil with little rock content, with average rock content, or with 50 percent rock content.

(3) Determine the first cost per trench foot of cutting, restoring, paving, and special construction that may be incurred when the conduit is placed. (Add additional charges for extraordinary special construction on cost-per-trench-foot basis.)

(4) Use Figure 2 and read the corresponding curve for the required cost per trench-foot.

(5) Add or subtract the percent of deviation, as required.

(6) The placing of additional ducts (Figure 2) may be desirable when the conduit system is to be encased in concrete and future reinforcement will be impractical.

10. LATERAL DUCTS

10.01 The determination of the size of a lateral duct run usually develops into a decision as to whether two or more ducts should be placed between the manhole and a terminating point such as a building or pole. This can generally be solved as follows: spare ducts should usually be provided when planning lateral ducts to distribution points.

10.02 When built at the same time as the main conduit run, lateral ducts should be placed on top. This is not only the most economical way to place the lateral duct but also affords some top protection for the main run. Lateral ducts for future use should be placed at the same time as the main run. The only additional cost involved is the cost of the material which is negligible, when compared with the cost of placing a lateral system at a later date. Lateral ducts between manholes that may be picked up and extended, when and where necessary greatly facilitate additions and changes in distribution plant. Lateral ducts being provided for the future should be planned only after careful consideration of their future use.

10.03 A conduit system is only as good as its laterals which should permit a readily accessible network for distribution cables.

10.04 The length of a lateral duct is limited mainly by the size of the cable which will be pulled into it and the number of bends it will contain.

10.05 In some locations, 4-inch duct costs no more than 3-1/2 inch duct. In these cases, the larger size should be specified.

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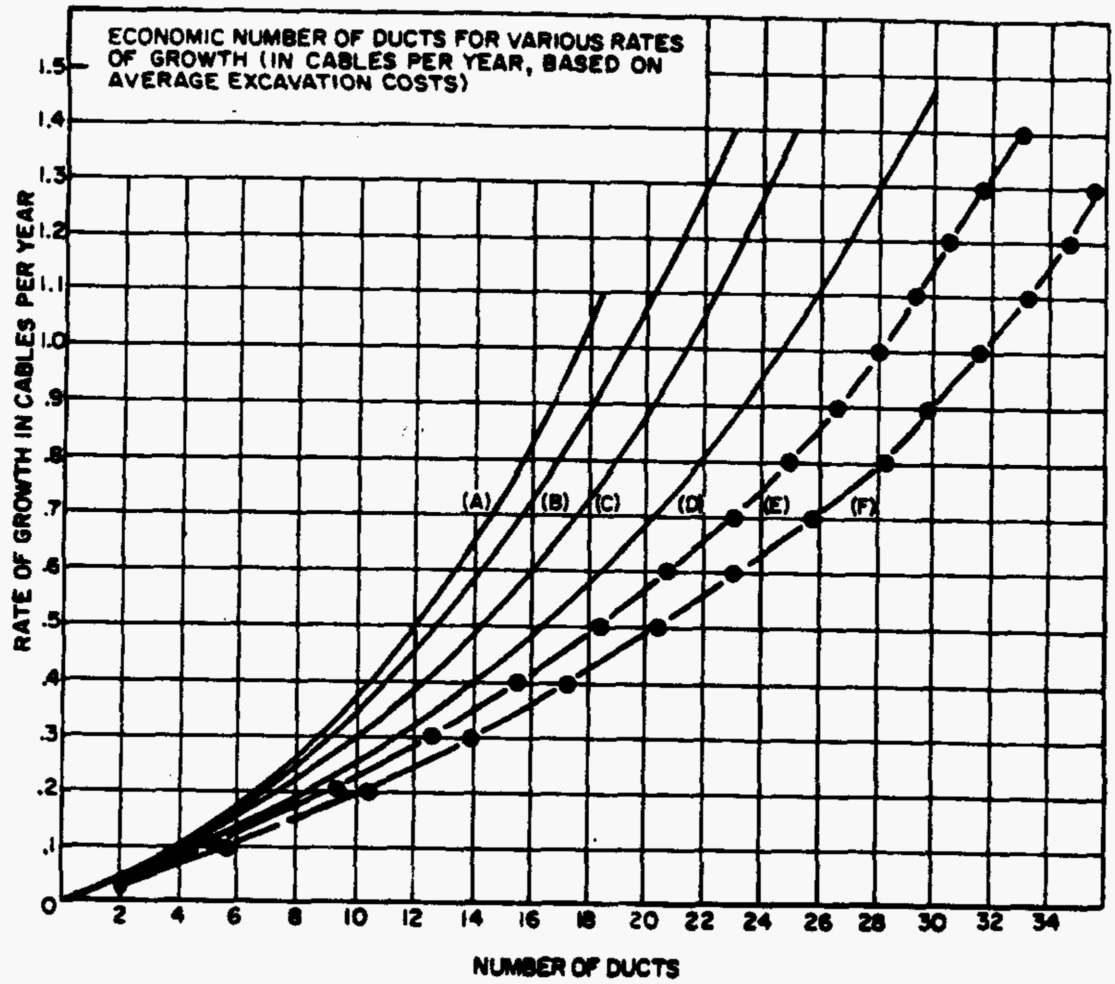

DEVIATION FROM TRENCH FOOT PAVING COSTS PER CURVES A,B,C,D,E, AND F.		PER CENT DEVIATION IN NUMBER OF DUCTS	
		LOW EXCAVATION CHARGES CONDITION A	HIGH EXCAVATION CHARGES CONDITION B
CURVE A	NO PAVING CHARGES ENTAILED	10.0	+10.0
CURVE B	PAVING CHARGES $ .50 PER TRENCH FOOT	4.0	+ 7.0
CURVE C	PAVING CHARGES $2.00 PER TRENCH FOOT	1.0	+ 4.0
CURVE D	PAVING CHARGES $4.00 PER TRENCH FOOT	.0	+ 1.0
CURVE E	PAVING CHARGES $6.00 PER TRENCH FOOT	NOT APPLICABLE	
CURVE F	PAVING CHARGES $8.00 PER TRENCH FOOT	NOT APPLICABLE	

NOTE:

PAVING CHARGES INCLUDE THE COST OF CUTTING AND RESTORING PAVING AND OF ANY EXTRAORDINARY SPECIAL CONSTRUCTION CHARGES.

Figure 2. Curves of Required Economic Duct Sizes.

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10.06 Lateral duct construction feeding two blocks from a common alley should be placed as shown in Figure 3.

10.07 When the feeder is along the ends of the blocks and the density of lines is heavy enough to require a manhole at alternate street intersections, and direct underground connections to buildings is required, a satisfactory and economical way of feeding the blocks (provided right-of-way can be secured, and no physical barrier or danger of damage to the cable prevents extending it from the point of entrance at point A to point B) is shown in Figure 4. This plan (Figure 4) requires that the cable be run through one or more basements. Aerial spans may be used to point B (Figure 4) instead of underground conduits.

10.08 Where there is a high fill concentration in a business area, the lateral duct construction feeding each individual business area is usually constructed as shown in Figure 5.

10.09 Figure 6 shows lateral duct construction in T-alleys. Figure 7 shows the method used to feed through to a long portion of a block. When right-of-way conditions prevent feeding through to the long portions of the blocks, the methods shown in Figures 6, 7, and 8 may be used.

10.10 Figure 9 illustrates a method of making underground entrances to blocks having T-alleys with the feeder along the alley ends of the blocks. This method may be used in exceptional cases where the width of the blocks is such that the manhole may be spaced at every third block without exceeding the allowable maximum length of section.

10.11 Figure 10 shows a manhole placed every third block where an underground pole is established to feed the alleys on the opposite side of the street.

10.12 Figure 11 shows a lateral duct run from the last manhole of a conduit run when it is known that the main cable run will be extended at a later date. It may be economical to build the conduit in the same trench with the lateral duct, as shown in Figure 11.

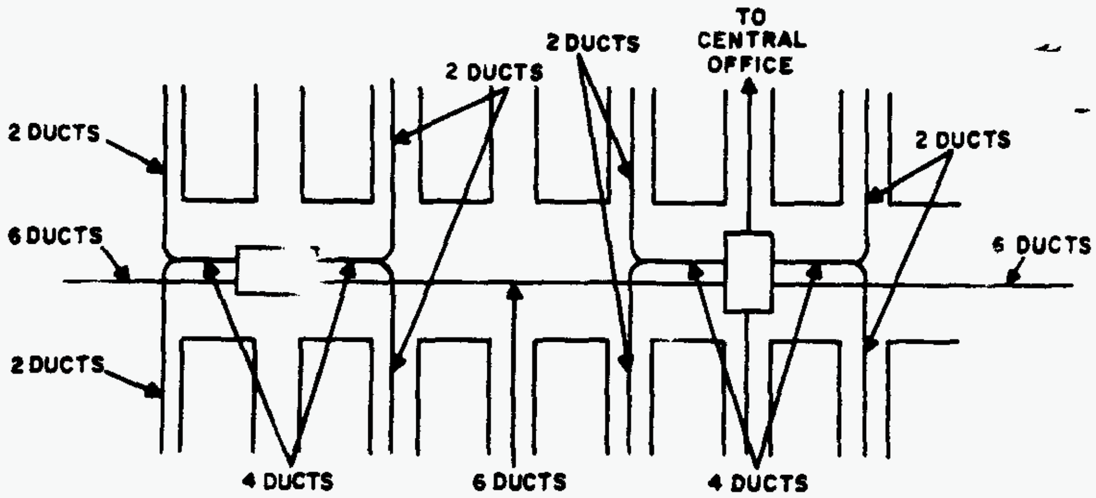

Figure 3. Lateral Duct Feeding from a Common Alley.

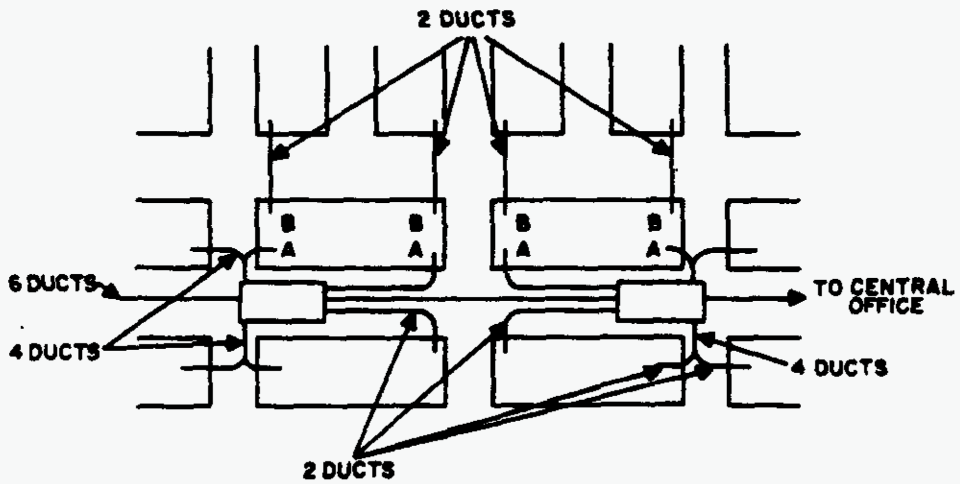

Figure 4. Feeder Along Ends of Blocks — Manhole Located at Alternate Street Intersections.

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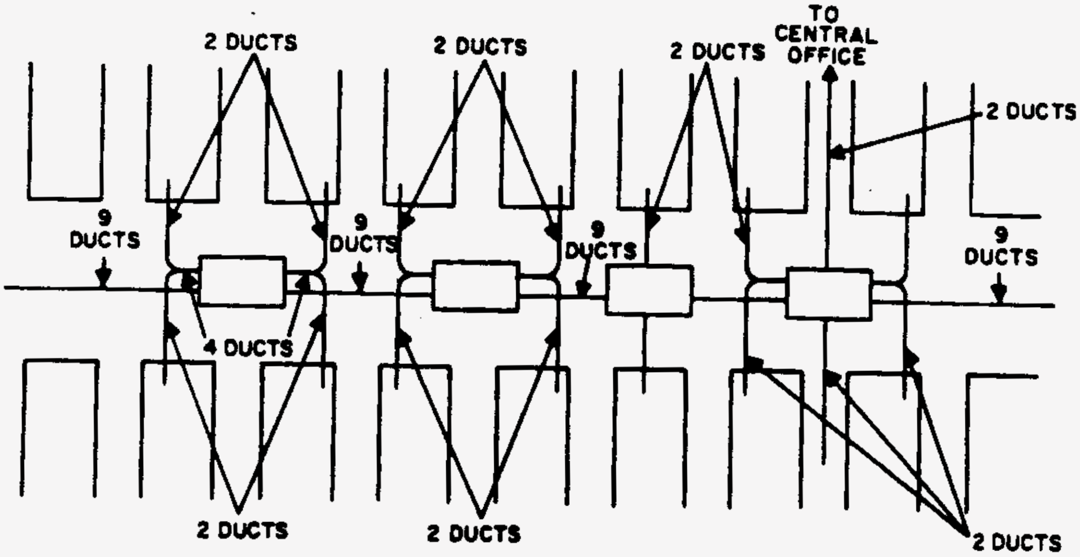

Figure 5. Lateral Ducts Feeding Individual Business Area.

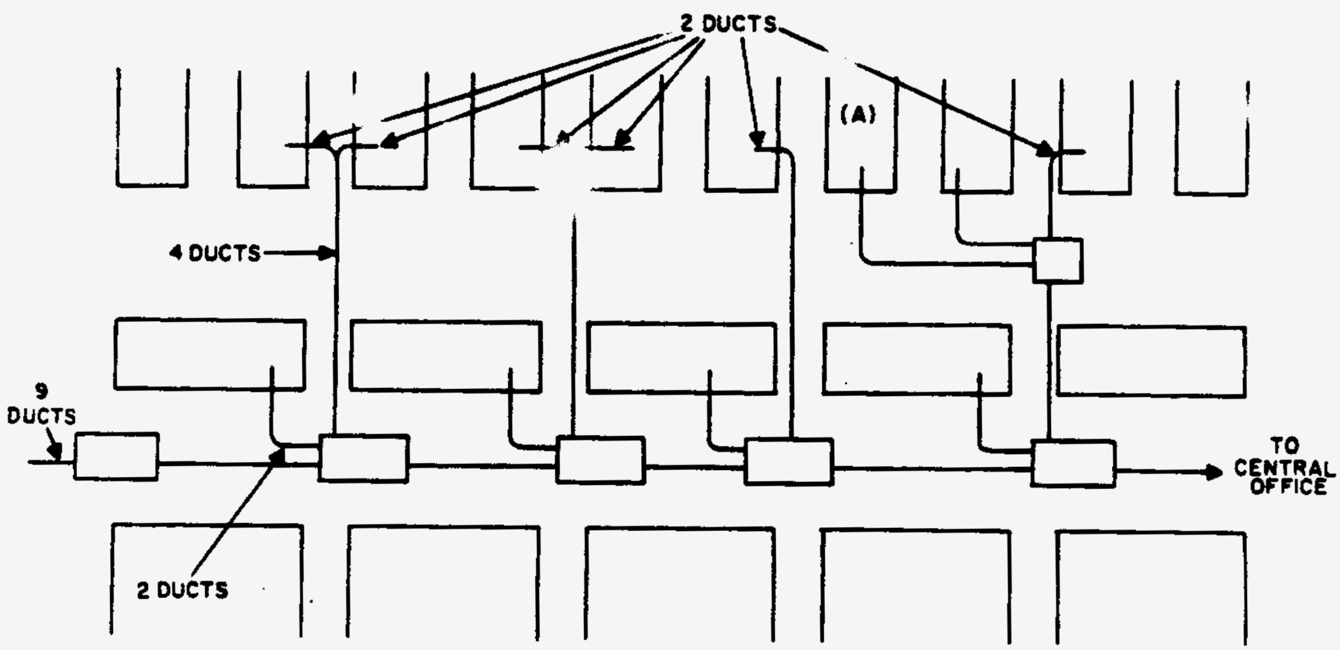

Figure 6. Lateral Duct Construction In T-Alleys.

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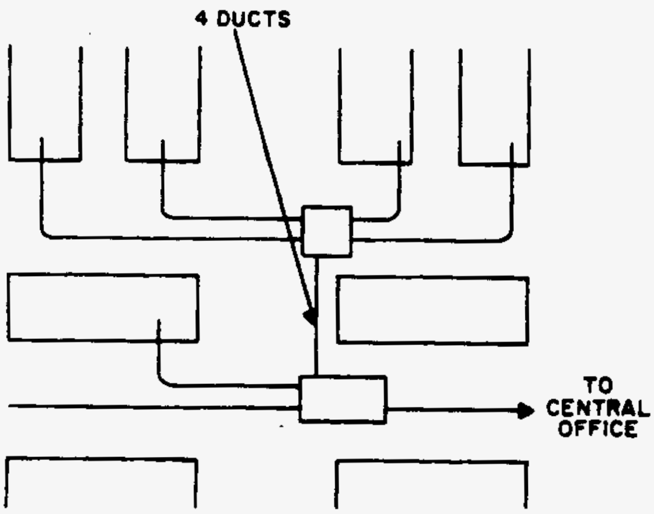

Figure 7. Feeding Through to Long Portions of Block.

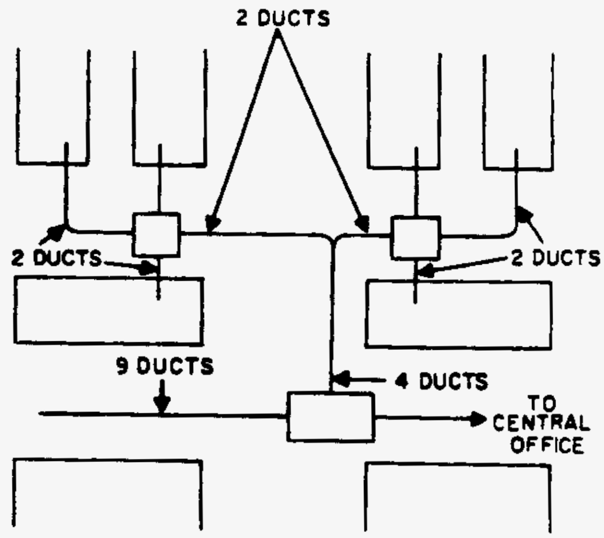

Figure 8. When Right-of-Way Conditions Prevent Feeding Through to Long Portions of Blocks.

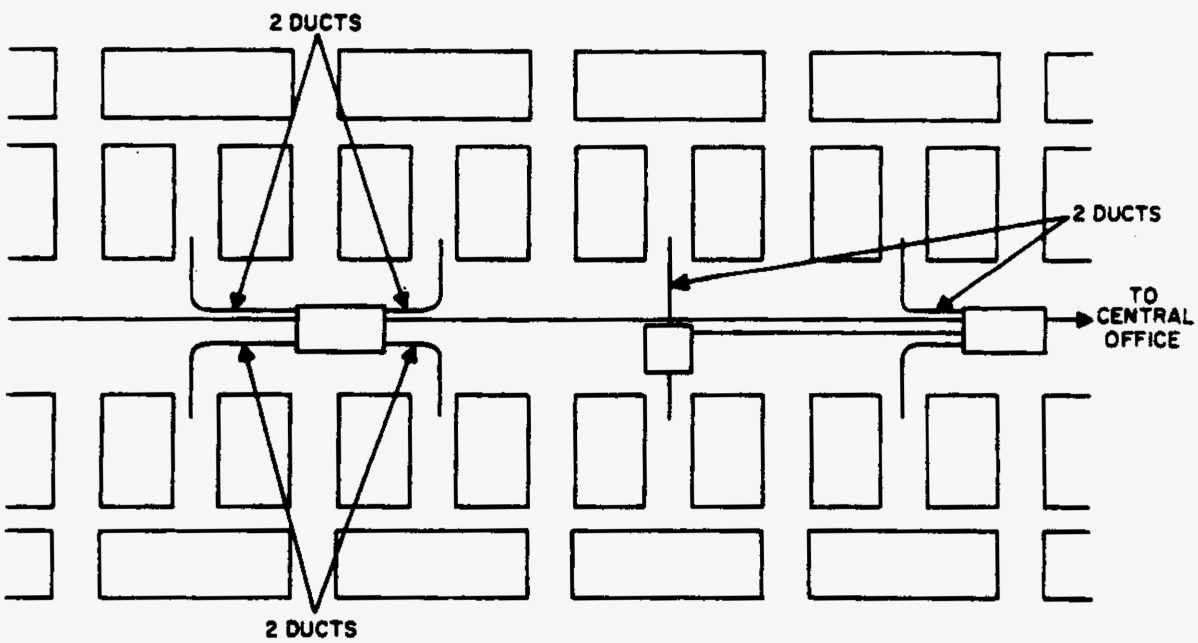

Figure 9. Entrance to T-Alleys with Feeder Along the Alley Ends of Blocks.

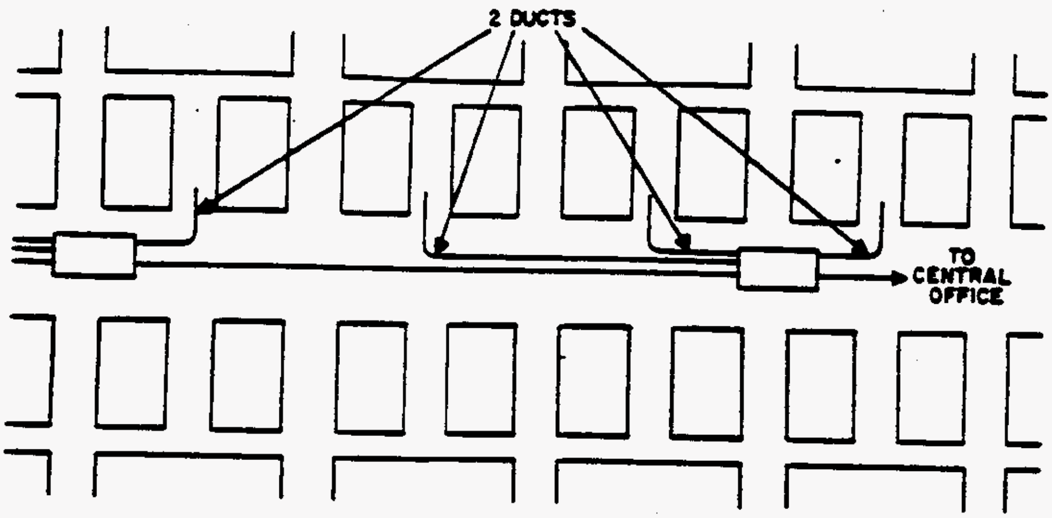

Figure 10. Manholes Every Third Block.

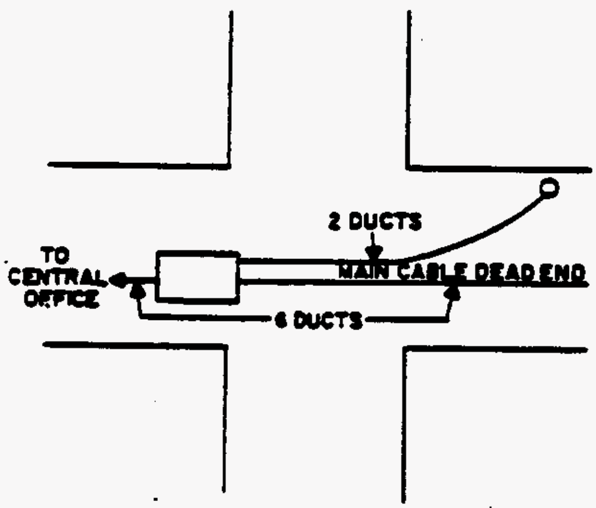

Figure 11. Lateral Duct from Last Manhole When Main Run is to be Extended at a Future Date.

CONDUIT
DESIGN AND LAYOUT

CONTENTS PAGE

1. GENERAL

1.01 This section provides information to aid the engineer in the design and layout of conduit systems.

1.02 It is important that all conduit systems be constructed in conformance with operating company specifications since these specifications are based on requirements necessary to result in good service, conformance with applicable regulations, and minimum maintenance costs of the underground system.

1.03 Conduit is a long-life type of plant. There are records of conduit installed as early as 1889 that is still in service. Conduit should be engineered with the expectation that it will continue serviceable for 75 to 100 years.

1.04 Because of the high unit cost and long life expectancy of conduit, the engineer and others have the responsibility of assuring a high-quality conduit job at the time of construction. Repairs to conduit are expensive, whether needed as the result of outside interference or because of failure due to poor initial construction. Control over the latter can best be accomplished through continuous inspection by competent personnel. This phase of conduit construction is sometimes neglected.

1.05 As a general rule, the method to be followed in constructing conduit in the situations listed below shall be covered in detail on the work order or plan drawings:

(a) At crossings of bridges, viaducts, culverts, etc.
(b) At any crossings where attachment is to be made to a specially designed structure.
(c) At crossings under railroad tracks or embankments by means of boring, jacking, or tunneling methods.
(d) When the ducts are to be laid through swamps or other unstable ground requiring piling or other means of support.

1.06 This section is reissued to reflect the changes in design and layout in conduit systems that are currently industry standard. Material formerly included in Section 911-400-072 is now incorporated in this section. Due to the extensive changes, marginal arrows are not used. Remove and destroy all copies of Issue 1 of this section.

2. INTERGRATED DESIGN

2.01 All main conduit design should take into account the importance of the circuits it will house in relation to their vulnerability to future disturbance. In many routes, circuits for exchange and trunk pairs can be anticipated. Carrier is assuming increasing importance, with the result that circuits many times the number of physical pairs are likely to be involved.

2.02 Consideration should be given to the degree of mechanical protection that is justified to safeguard the conduit from manmade troubles as determined by the likelihood of other underground activities in the vicinity. Also, soil conditions will determine the degree to which strength should be built into the structure to resist earth movements and possible misalignment of ducts.

2.03 During the life of the conduit, highway relocations may place heavy traffic loading over conduit that was originally located outside the driving area. Grade changes may reduce cover or expose the conduit to the loading imposed by heavy earth-moving equipment or other construction machines. Such activity is increasing with the current highway program and may exact a penalty from any conduit system built without regard for this possibility.

3. PLANT MAINTENANCE AND OPERATING ASPECTS

3.01 Conduit design should take into account the opportunities afforded by a particular system for reducing the cost of putting the conduit in condition to receive cable and reducing the costs associated with the actual

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cable-placing operations. Conduit with poorly made joints, or joints that open in service, eventually becomes fouled with silt, and this situation becomes progressively worse as time goes on. In addition, tight joints, which limit the admission of water to the system, minimize corrosion of cable and aid in manhole operations in areas of high water table.

3.02 Costs for rodding in preparation for cable placing vary depending on the condition of the ducts and the methods employed. Rodding by mechanical or manual means is required where the continuity of the ducts is broken at the joints, e.g., in multiple clay or concrete conduit. Plastic ducts having substantially airtight joints between manholes can be rodded pneumatically. Investment for equipment is lower than that required for mechanical rodding, and costs per duct foot are greatly reduced.

4. CONDUIT MATERIALS AND MANHOLES

4.01 Each type of conduit material and manhole has advantages and disadvantages, depending on local conditions, expected use, and the anticipated activity of other operations in the vicinity. (Refer to the 911-200 and 911-300 series of GTE Practices for manhole and conduit selection.)

5. SECTION LENGTHS

5.01 The length of a conduit section is governed by the practical length of cable that can be pulled in and by the location of manholes and loading facilities. It is desirable to make the sections as long as practical to reduce the number of manholes, splices, and set ups for pulling. The section is basically limited by the length of maximum size cable that can be placed on a standard size reel.

5.02 The spacings between load points in standard loading systems are evenly divisible by 750 feet. Therefore, a conduit section length that results in a 750-foot measurement from splice center to splice center is desired.

5.03 In some economic considerations, nonstandard conduit sections and spacing between the load points in excess of 750 feet are permissible.

6. SEPARATION FROM OTHER SUBSTRUCTURES

6.01 For identification, protection from arcing, and reduction of stray currents (especially those resulting from cathodic protection on foreign pipes), the following minimum separations between foreign substructures and telephone plant have been established as industry standard:

(a) From Telephone Conduit:

- (1) Electric light, power, or other conduits — 3 inches of concrete, 4 inches of masonry, or 12 inches of well-tamped earth.
- (2) Foreign pipes such as gas, water, oil lines, etc — 6 inches clearance with supports on each side when crossing, 12 inches when paralleling.

(b) From Telephone Manholes:

- (1) Electric light, power, or other conduits — 3 inches clearance from the outside surface of the manhole wall or roof.
- (2) Foreign pipes such as gas, water, oil lines, etc — 12 inches clearance from the manhole wall or roof.

Deviations from (a)(1), (a)(2), and (b)(1) above are not permissible under any circumstances. The clearances in (b)(2) above are provided to facilitate maintenance of the foreign substructure, and deviations shall be made only after first consulting the owning company. When in doubt about any separation, consult the latest issue of the National Electrical Safety Code.

7. DUCT FORMATIONS

7.01 Conduit formations are determined by the number of ducts required, the window(s) arrangement of the manhole, and the conduit material selected. As a general rule, conduit formations consisting of four or more ducts should not be less than two nor more than four ducts wide. Formations made up from three vertical rows should be avoided where possible. Standard formation for multiple plastic duct (MPD) is covered in Section 911-300-070.

7.02 All conduit formation made from two or four vertical rows should be splayed at the manholes as shown in Figure 1. If the formation is two vertical rows and duct requirements are no greater than the racking capacity of one side of the manhole, only one side shall be used and the conduit shall be placed from window to window as shown in Figure 1a. When the conduit formation is made up of four vertical rows or the duct requirements are greater than the racking capacity of one side of the manhole, conduit shall be placed on a center line and splayed to both sides as shown in Figure 1b. Center window manholes should be used for conduit formations consisting of three or more than four vertical rows as shown in Figure 2.

7.03 Where special construction problems exist, it may be necessary for the engineer to design a conduit system involving a transposition in the ducts. This type of situation might occur at a bridge, at a freeway, or at river crossings. A transposition of ducts may also be necessary to avoid an obstruction. Special attention to records is required in transpositions.

8. CURVES, OFFSETS, AND CHANGE IN GRADE

8.01 Except for splaying at manholes, curves should be avoided whenever possible. In all cases, curves shall not tranverse more than 90 degrees. Curves that traverse more than 90 degrees, or curves with excessively small radii, are potentially troublesome and may result in expensive conduit repairs or cable damage. When heavy cable is being pulled into sections with curves, there is a distinct tendency for the pulling line to cut into the inside wall of the curving duct. If the curve is excessively sharp, the line may cut completely through the wall of the duct.

8.02 The permissible length of conduit section containing a bend or curve depends upon the angle between the straight conduit run on each side of the curve and the radius of the curve. The maximum section lengths of conduit for various degrees of curve and radii of curve should not exceed those indicated in Figure 3.

8.03 An offset is defined as the displacement of one portion of a straight conduit run relative to the remainder of the run, the displacement occurring in any plane. The displaced lengths of conduit are connected with large radius sweeps to minimize the resistance offered by the sweeps when cable is pulled in. A typical offset is illustrated in Figure 4.

8.04 If an offset is to be used to cross from one side of the street to the other, the engineer should first determine whether the authorities will permit this type of crossing. Some civic bodies require right angle crossings. The radii of curves in offsets should be large; radii of 100 feet or more are desirable. Where the offset distance is not more than 5 feet, the offset may be disregarded in determining maximum section length. However, if the offset in an otherwise straight section of conduit is more than 5 feet or the radii of the sweeps in the offset are less than 100 feet, the length of the conduit section should be shortened proportionately (up to one-third for extreme conditions). Generally, sections that include an offset should not exceed 700 feet.

8.05 The foregoing paragraphs can be illustrated by the following example: Assume that a conduit run is to be built along a curved street as shown in Fiugre 5. At point B, a 4-foot offset is required to pass an obstruction. The radii of the offset curves are about 125 feet, and the trench distance between proposed manholes 1 and 2 is 550 feet. A field measurement shows that the angle made by the curve is approximately 60 degrees and the conduit at A must be laid with a 40-foot radius. Since the offset at B is less than 5 feet, the radii of the two bends required for the offset may be disregarded. Based on a 40-foot radius and an angle of 60 degrees, the maximum section length as determined from Figure 3 is 670 feet. The proposed section length of 550 feet is, therefore, practical.

Figure 1a. Conduit Formation of Two to Four Vertical Rows and Duct Requirements Are Greater Than Racking Capacity of One Side of Manhole.

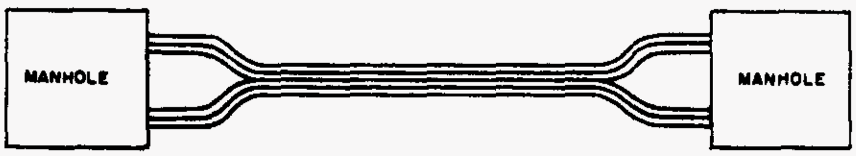

Figure 1b. Conduit Formation of Four Vertical Rows or Duct Requirements Are Greater Than Racking Capacity of One Side of Manhole.

Figure 1. Conduit Splaying At Manholes.

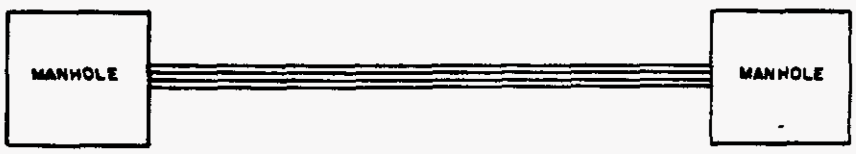

Figure 2. Center Entrance in Manholes When Conduit Consists of Three or More Vertical Rows.

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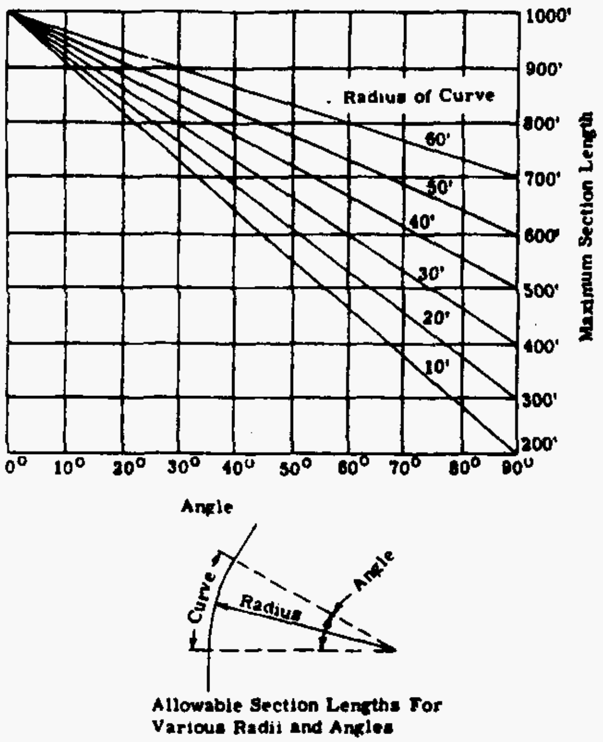

Figure 3. Permissible Length of Conduit Section Containing Curves.

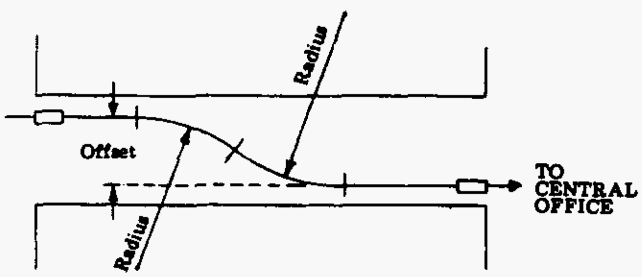

Figure 4. Typical Conduit Offset.

8.06 Based on the same conditions as set forth in paragraph 8.05 except that the offset distance at B is 15 feet, the recommended maximum section length would be reduced by one-third (see paragraph 8.04), from 670 feet to 445 feet. Since this is less than the proposed distance of 550 feet between manholes 1 and 2, manholes 1 and 2 would have to be relocated or an intermediate manhole placed.

8.07 Whenever it is necessary to increase or decrease the depth or grade of the conduit section beyond that normally provided for section drainage, a profile drawing of the section should be provided for the contractor (Figure 6). This will assist the conduit construction crew to plan the grade of the trench where aan abnormal grade is necessary and to obtain proper cover. Examples of the desirability of profile drawings are crossing of storm drains or railroads or where a longitudinal rise and fall exists in the surface of the street. Refer to company specifications for minimum conduit depths and drainage requirements.

8.08 Low points in conduit sections should be avoided. Stagnant water tends to form in these areas and could cause damage to cable sheaths. Where low points are unavoidable in conduit sections between manholes, the ducts should be sealed at the manholes to make them watertight. This work should be specified on the work order.

8.09 When planning conduit in streets without established grades, every effort should be made by the engineer to obtain the final grade from the proper authority so that the depth of the installation necessary to ensure standard ultimate cover can be indicated on the work order. Usually, grade stakes are placed by the municipal engineer or surveyors for private real estate operators or contractors before it becomes necessary for the conduit to be placed.

9. PROTECTION

9.01 Under normal conditions, a 30-inch ground cover is considered adequate and no protection is required. If ground cover is less than 30 inches or if hazards are considered likely, protective measures for the safety of the buried plant should be applied.

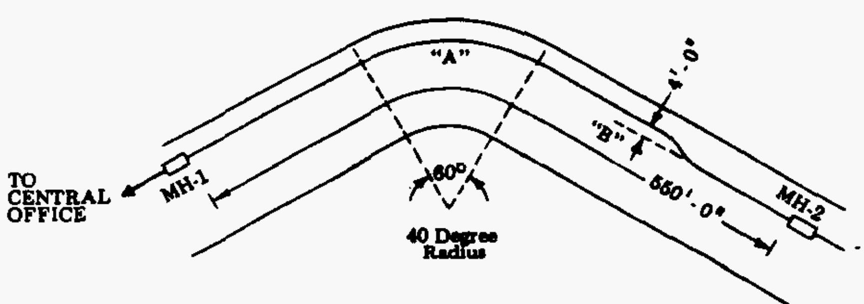

Figure 5. Offset Curve on a Curved Street.

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9.02 Generally, conduit protection consists of either concrete or creosoted wood planking for mechanical protection against settlement of the ducts or damage by excavating equipment. Protection may consist of top protection only, base only, top and sides only, or complete encasement, depending on the particular case.

9.03 The type of protection should be specified on the work order; however, if during the progress of the construction unexpected conditions are encountered, the engineer should not hesitate to add or revise protection requirements.

9.04 A concrete base should be specified whenever the ground is spongy or yielding, such as in swamp or marshland, or where the base is desirable as a leveling medium under conditions where a sand base trench is subject to washing out.

9.05 In cases where conduit is placed in fill dirt, special precautions should be taken to ensure the safety of the conduit, especially where it appears that further settlement is likely. Each case should be considered individually because in some instances only soil compaction may be required while in others shoring or another type of special construction may be required.

9.06 Where only top protection is required, creosoted plank may be desirable because of its identifying characteristic, which may cause further investigation by workmen excavating in the area.

Steel Casings

9.07 At certain times it may be necessary to place the conduit in large steel tubes as a means of protection or to otherwise facilitate a crossing where it is impossible to provide an open trench. Instances such as these may occur at railroads, major state highways and freeways, river or stream crossings, etc. Since this type of protection usually requires that the tubing be placed by boring or jacking methods and is an expensive operation, it should be specified only when other methods prove impractical. Upon completion of the duct installation, the casing is filled with fine sand, blown in under air pressure, and sealed off at both ends with a 3-inch wall of concrete. The minimum wall thickness of the casing should be three-sixteenths inch.

9.08 Thick-wall plastic or concrete conduit requires no encasement except in areas of heavy vehicular traffic, unstable soil conditions, high soil compaction (85 percent or greater), or when a minimum of 30 inches of cover cannot be maintained. Thin-wall plastic must always be encased in concrete or some type of approved stable sleeving.

10. CENTRAL OFFICE ENTRANCES

10.01 Many types of cable vaults with various floor plans and cable racking arrangements are built; it is, therefore, not practical to set forth hard and fast rules as to a standard conduit entrance to each vault. For this reason, the layout of the individual conduit entrance is left to the engineers' judgement as influenced by the primary objectives prescribed. It is necessary, however, to lay out the ducts entering the vault so that they coincide with the established cable racking plan for the office. Refer to Section 911-500-075 for central office entrances.

10.02 To the extent practicable, the ultimate number of ducts required to provide for the estimated capacity of the office should be installed in the vault wall initially. These ducts should extend out from the office a sufficient distance to ensure that the conduit approach will not be blocked by foreign substructures that may be placed at a later date.

10.03 The most desirable arrangement for a conduit entrance results when the conduit run is located on the side of the street opposite the central office building. Under this condition, the ducts from both directions may be turned into the front wall of the vault with large radius bends as shown in Figure 7.

10.04 Duct runs on the same side of the street as the central office building, and close to or even back of the curb line, may still be terminated in the front wall, providing there is sufficient space in which to make a curve. A greater radius permits easier pulling of the cables; therefore, attain maximum radii.

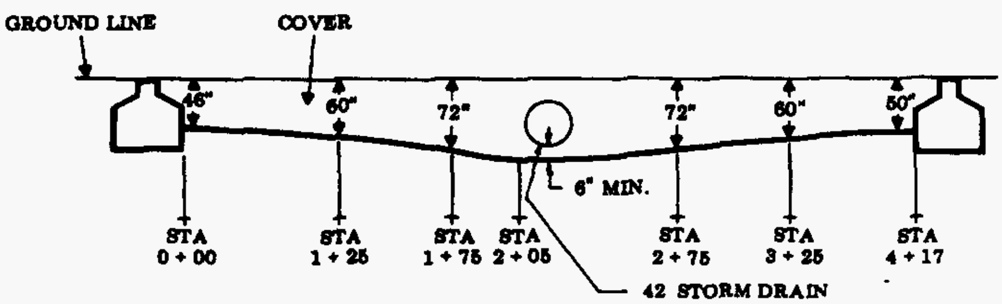

Figure 6. Sample Profile Drawings Showing Grade and Cover Requirements.

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11. CONDUIT ON BRIDGES

11.01 Due to the expanding diversity in bridge design, it is impractical to prescribe a set or standard method of placing conduit on these structures. There are, however, certain fundamentals that require a consideration by the engineer designing conduit for a bridge crossing.

11.02 Whenever bridge crossings are to be made always consult the proper authorities regarding (1) structural strength problems if the ducts are to be incorporated in the bridge structure itself and (2) obstruction of waterways if attached under the bridge.

11.03 Manholes built as terminations for conduit construction across bridges should generally be built close to the bridge ends in the approach fill. If, due to the bridge length, this results in an excessively long section, it may be necessary to place pullboxes or specially designed splicing chambers of sufficient size to facilitate the pulling in and splicing of cables.

New Bridges

11.04 In the case of new bridge construction, such provisions as seems necessary should be made for conduit in the original design of the bridge. A study of the detailed construction drawings on file in the office of the governmental agency involved will greatly assist the engineer in determining the method to be used in crossing the bridge. In most cases, prints of the necessary plans may be secured by the engineer for the detailed work order drawings. Figure 8 shows conduit installed in the sidewald portion of a bridge. It will be necessary to arrange for a right of way or permit and have the ducts installed before the sidewalk is placed.

Existing Bridges

11.05 All possibilities shall be explored by the engineer relative to deciding on the method of construction conduit on existing bridges. In the interest of economy, it may prove to be expedient to explore other methods of getting the cable across the bridge space (by caternary aerial construction, submarine crossing, etc).

11.06 Figures 9 through 12 show the various methods of facilitating a bridge crossing. It is imperative that the bridge authorities be consulted about the use of devices that cut into the bridge structure or require the removal of rivets, bolts, or other fastenings.

11.07 Concrete, steel, and some other types of bridge structures have joints to compensate for movement and/or expansion and contraction. If it becomes necessary to place conduit across such structures, anticipated movement of approximately 3 inches may be compensated for by providing sliding joints at the bridge abutment or, if the manhole is close, in the manhole wall.

11.08 From the information provided herein, it can be seen that it is imperative that the engineer cooperate with all authorities when preparing plans for bridge crossings. In most cases, detail drawings of the work to be done by the telephone company are required before permission will be granted to proceed with the work.

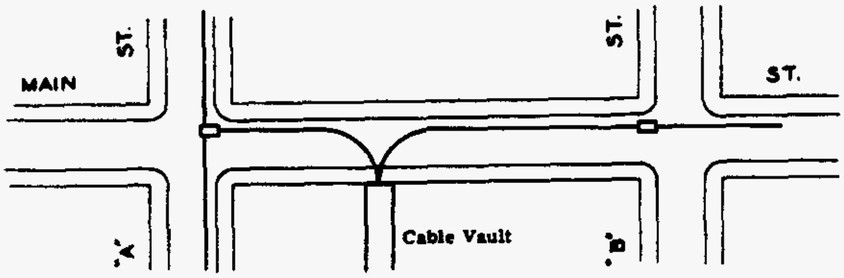

Figure 7. Conduit Entrance to Central Office Building When Conduit Run is on Opposite Side of Street.

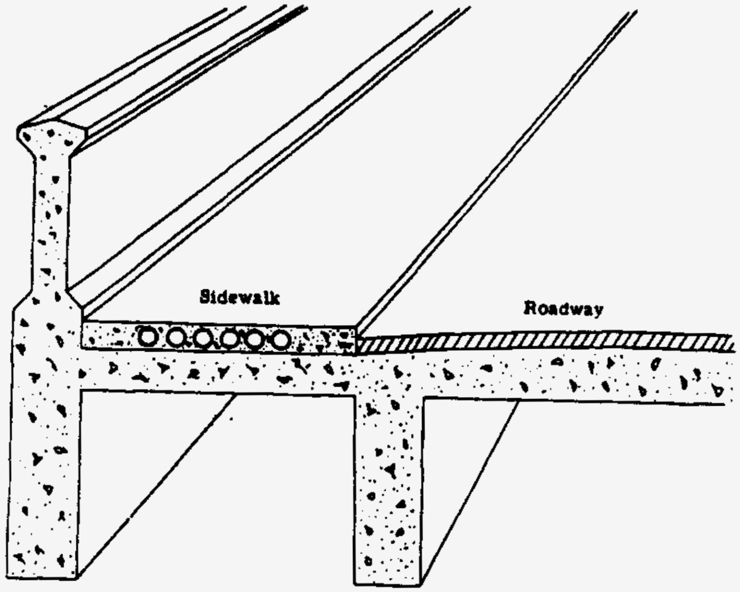

Figure 8. Conduit Installed in Sidewalk Portion of Bridge.

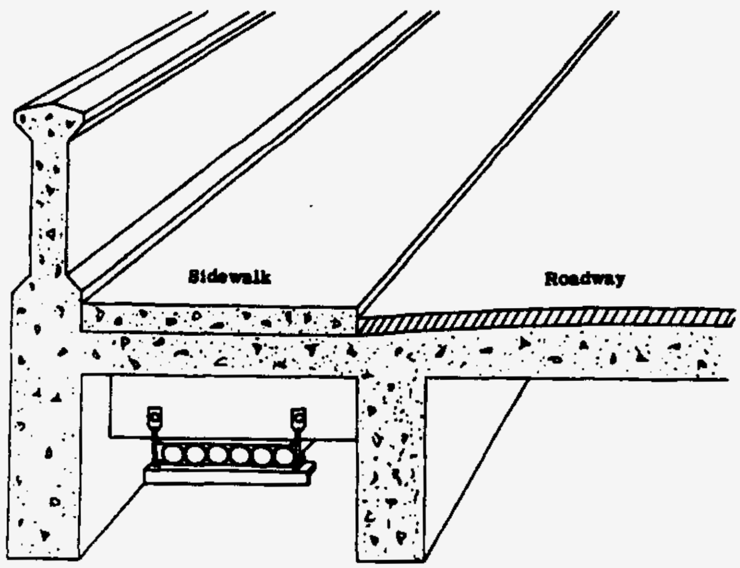

Figure 9. Conduit Installed by Hanging Under Sidewalk Portion of Bridge.

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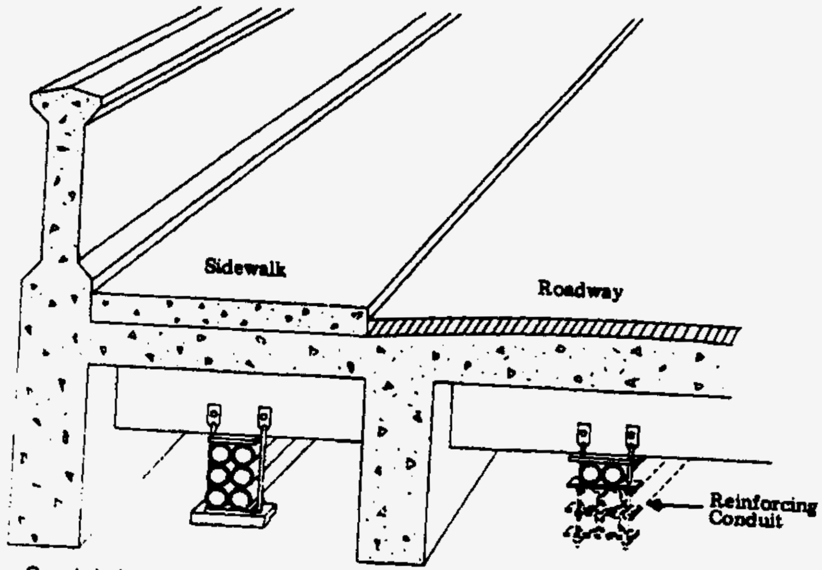

Figure 10. Conduit Installed by Hanging Under Sidewalk and Roadway Portion of Bridge with Reinforcing Conduit Mounted Under Roadway Portion of Conduit.

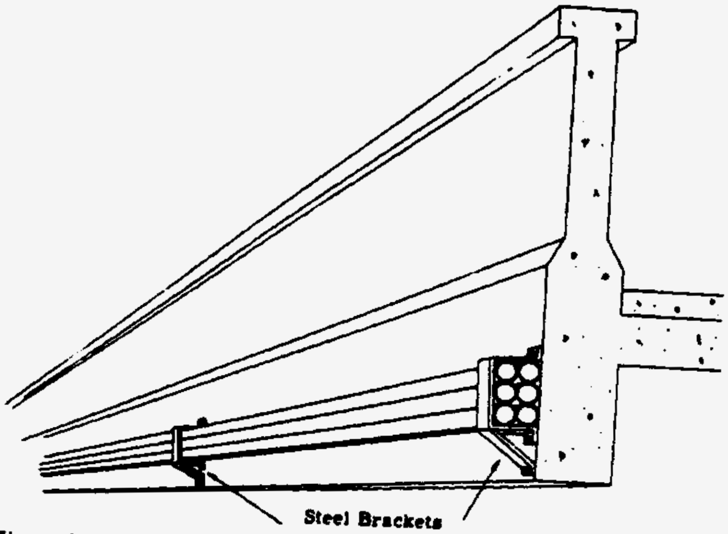

Figure 11. Conduit Run Attached to Side of Bridge with Steel Brackets.

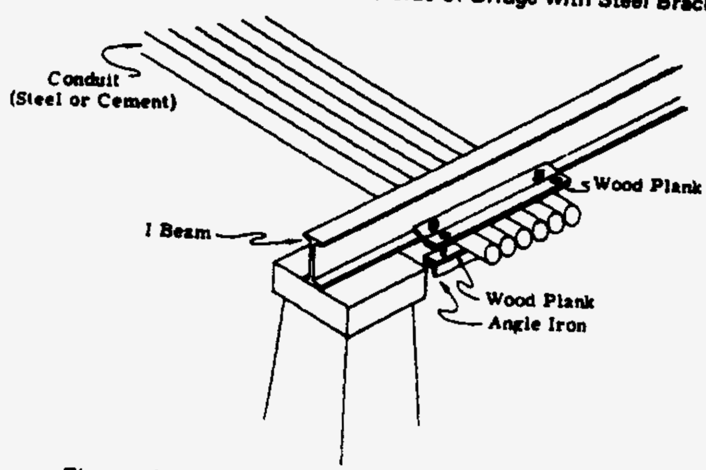

Figure 12. Conduit Runs Attached to Steel I-Beams.

Distribution Cabling – Conventional Distribution Design

Contents

(continued)

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Contents, continued

1. General

1.1 Purpose

This practice provides:

- General information about "distribution cabling."
- Specific information about "conventional distribution design" of distribution cabling.

NOTE: The type cable discussed in this practice is wire cable.

1.2 Filing Instructions

This practice supersedes Issue 4, titled "Distribution Cable General," issued April, 1986. Remove and discard Issue 4 and replace with this issue 5 in your practices set.

1.3 Copyright and Responsibility

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2. Overview

2.2 Acronyms, Terms, and Definitions

The following chart explains acronyms and terms used in this practice. The terms and definitions, as presented, are specific to distribution cabling and facility area planning.

Term	Definition
Addressable Locations	A service location that can be identified by a numbered address on a public street. (For plant administration purposes, the preferred means of identifying a service location is by street address.)
Business Location	A building used to house one or more businesses. These include: • Hotels. • Motels. • College buildings. • Etc.
CAPS	Customer Access Planning System - A mechanized system for the Demand and Facility (D&F) function for customer access facilities, given certain parameters. CAPS indicates the need for additional plant capacity. It drives the outside plant forecast to the service section.
Committed Pairs	Feeder cable pairs from the host switching unit or from a remote switching unit that are terminated on the feeder (IN) side of a connector. Committed cable pairs are: • Multiple-free. • Committed to a particular connector in 25-pair groups.
DCC	Digital Connectivity Capability - A descriptive term for facilities that will support up to 144 kbs transmission requirements (i.e., services which require up to this level of capability can be provided "on demand" with only special terminating equipment as required for the specific service). This capability is primarily a function of loop length parameters and grooming requirements for the copper network.
Dedicated Fixed Count Terminal	One pair is required for each service address served from this terminal and identified as a "dedicated pair" in the Mechanized Assignment and Record Keeping (MARK) system. All other spare flex pairs are available to be assigned to any of the service addresses that fall within the wiring limits of that terminal. This terminal is compatible and has been identified as "half-dedicated" in the MARK system. All dedicated pairs are terminated at the serving terminal and the field side dead-ended.

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2.2 Acronyms, Terms, and Definitions, continued

Term	Definition
Dedicated Pairs	Permanently assigned cable pairs that have continuity from the central office main distribution frame or from a connector terminal.
Distribution Facilities	Portions of facilities which are: • Located within a service section. • Designated to serve only customers within the service section where they are located. • Equipped with terminals for connection to service drops.
ESA	Electronic Serving Area - A geographic area that: • Consists of one or more service sections. • Is served directly by either a central office or digital pair-gain device. The size of the ESA is bounded by transmission limits which will facilitate the provision of digital connectivity capabilities. These limits are characterized by a maximum distance (approximately 12,000 feet, or the distance it takes to measure a 8.0 DB non-loaded cable loss) from the central office or pair-gain device to the ESA outer boundary. "Theoretical" ESAs are those for which a pair-gain device itself has not yet been planned, based on economic or marketing criteria.
FAC	Facility Area Connector - A device for connecting cable pairs that originate at a central office (or at a remote terminal) with the distribution cable pairs within a facility area.
Facility Area	A well-defined geographic area, whose size is based on the number of housing units and business locations one Facility Area Connector (FAC) will serve. **NOTE: Once the area boundaries are established by Planning and Engineering, the boundaries must be documented on outside plant records.**
FAP	Facility Area Plan
Feeder Cable Route	One or more feeder cables that serve a defined geographical area.
Feeder Facilities	Portions of facilities which form a "backbone" from a central office (or from a remote terminal) to and/or through one ore more service sections.

(continued)

2.2 Acronyms, Terms, and Definitions, continued

Term	Definition
Housing Unit	A single-family residence or each unit of a multi-family residence such as an apartment building.
RDAP	Rural Distribution Area Plan
Ready Access Terminal	A terminal with full accessibility to the cable's complements for service. **NOTE: Terminal has been discontinued.**
RTs	Remote Terminals - A digital system with switching or pair-gain capability. It supplements feeder plant by using T1 or fiber span line connection to: • The host office. • Another remote switching terminal. • A corresponding central office terminal.
Service Section	A geographic area, agreed to by Planning and Engineering, which: • Is contiguous. • Defines a distribution cable network/area administered as a unit. • Corresponds (usually) to a forecasting Serving Area Location (SAL). • Is (normally) synonymous with a "facility area" where FAP and RDAP is implemented.
SOD Terminal	Subsurface, Out-of-sight Distribution Terminal - SOD construction eliminates the need for a cable terminal, protectors, and arresters in buried, filled alpeth distribution plant.
Spare Flex-Dedicated Pairs	Pairs that are available to be assigned to any service address that falls within the wiring limits of that terminal. These pairs may or may not be cut off at the serving terminal. **NOTE: See section 4.3, Bridge Tap Limitations.**

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3. Distribution Cable Design

3.1 Recommended Design

The Facility Area Plan (FAP) design is the ideal design for distribution cabling. The FAP design is the first design to be considered for all new areas that qualify. Use the most economical adaptation of the design to gain as many of the benefits of the FAP design as practical and possible (i.e., with a minimum of capital and expense cost at the earliest practical date).

NOTE: See GTE Telephone Operations Practice 938-010-070, Outside Plant Facility Area Plant - Design Concept.

The Rural Distribution Area Plan (RDAP) design is the ideal design for distribution cabling for predominantly rural areas. It is not suitable for business complexes or industrial complexes.

NOTE: See GTE Telephone Operations Practice 938-010-071, Outside Plant Rural Distribution Area Plan - Design Concept.

The Conventional Distribution design ("Conventional Design" or CD) is the design for distribution cable to implement for all applications that do not meet FAP or RDAP application parameters. Conventional Distribution design is explained in Section 5 of this practice.

Other designs for distribution cabling exist within the network, although the designs are not acceptable for new construction. (An example of another design is Multiple Outside Plant Design.)

3.2 Cable System

In designing an adequate cable system, each feeder cable and distribution cable must be designed as a component part of the total system and not as an individual unit. Feeder cable usually represents a greater:

- Investment and expense.
- Opportunity for economy.

Properly designed distribution cables can also provide a:

- Substantial contribution toward economy in the feeder plant.
- Favorable effect on everyday operating activities.

3.3 Distribution Cable Size

Size all facility area distribution cable on the basis of:

- The availability of the best housing unit information.
- An estimate of service demand.
- Cable sizing criteria for the particular distribution design designated for the area served.

NOTE: Segregating distribution, feeder, or trunking functionality into its own cable sheath is a worthwhile objective, to the extent that multiple sheaths exist or new sheath is necessary. It would not, however, be prudent to place a new sheath if existing capacity is sufficient.

To help achieve acceptable transmission in the distribution network, design rules are used to control loop transmission performance. Loops are designed on a global basis to guarantee that:

- Loop transmission loss is statistically distributed.
- No single loop in the distribution network exceeds the signalling range or transmission objectives for the service to be provided.

3.4 Distribution Cable Gauge/Loading

Gauge distribution cables by using the Resistance Engineering to Measured Limits (REML) transmission design procedures.

NOTE: The Resistance Engineering to Measured Limits (REML) transmission design procedures are outlined in the 832- and 938-divisions of GTE Telephone Operations Practices.

Generally, no loading is required within the first 12 kft from the base or remote serving area. If loading is required on any customer service within the facility area, the load coil spacing must be compatible with the loading arrangement used in the feeder cable complement that serves the loaded distribution complement.

Special service lines (e.g., Private Automatic Branch Exchange [PABX] trunks, data circuits, etc.) that require loading need individual attention. However, for administrative purposes, such circuits should be contained within one or more 25-pair cable binder groups in the feeder cable. In the distribution cable, it may be advantageous to load the entire 25-pair cable complement.

3.5 Sub-Surface Cable

Buried or underground cables are a substantial part of the cable distribution system. Buried or underground cables are commonly placed:

- Along streets, alleys, and highways.
- Along rear property lines (and other private property locations).

Under usual conditions, it is the recommended method of cable construction. In some locales, burying cables is the method used almost exclusively. New distribution cable should be buried unless there are compelling economic reasons to implement another method. The present trend in the United States is toward a distribution system that is entirely underground.

When the distribution cable is buried, consider the various methods of connecting the customer service to the distribution cable. Methods include:

- Terminals in handholes.
- Buried terminal housings.
- Terminals on poles.
- Pre-assembled buried cable (PRETERM).

If front cabling is selected, the engineer must decide which of the following to implement:

- Place cable/terminals on one side only and have drops crossing the street.
- Place cable/terminals along both sides.
- Place cable along one side with cable/terminals lateral crossings for opposite side drop access.

NOTE: Guidelines for application vary from area to area.

<u>3.5.1 Buried Distribution Plant</u>

Buried distribution plant can be installed most economically where:

- Labor-saving equipment can be employed advantageously in the installation.
- The buried distribution plant can be installed before land improvements (provided that present grade is within six inches of final grade).

3.6 Aerial Cable

Aerial cable still comprises a large part of the existing cable distribution system. Because underground or buried cable distribution is the recommended method of cable construction, expanding aerial distribution systems is discouraged.

The maximum practical limitation for pole line aerial cable construction is three strands and their supported sheaths.

3.7 Block Cable

Block cable on rear walls of buildings or on poles in the interior of city blocks is permitted where:

- It is more economical or practical.
- Municipal regulations or public sentiment limit the use of aerial, buried, or underground cables.

Block cable method is most often used where landscaping or other considerations preclude visible cable runs. The initial cost for block cabling is somewhat less than for most other types of completely concealed distribution plant. Difficulties in accessing the terminals for installation and maintenance exist when block cable is employed. Some of these difficulties include:

- Locked areas.
- Building remodeling.
- Work done in the building that must suit owners.
- Legal responsibility and liability.
- Building owners who may be reluctant to grant permission to place cable on or through their building to other buildings.

4. Digital Connectivity Capability

4.1 Introduction

Distribution cable design is crucial to digital connectivity capability (DCC). Distribution designs will provide DCC in most applications. Exceptions will primarily be in rural areas where loading may be required. This section details aspects of distribution cabling that affect DCC.

4.2 Analog Carrier

Remove all analog carrier working within the facility area. Where feeder or distribution complements serving adjacent facility areas have analog carrier in the same sheath, arrange to eliminate the carrier by using compatible facilities.

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4.3 Bridge Tap Limitations

Dedicated cable pairs are multiple-free, dedicated to an addressable location. All dedicated pairs are terminated and the field side dead-ended at the serving terminal.

Spare, flex-dedicated cable pairs can be multiplied and are permitted to a maximum of three terminals and/or are not to exceed:

- 1,000 feet from first to last terminal appearance in urban areas.
- 2,000 feet from first to last terminal appearance in rural areas.

No multiplying of pairs should occur between two or more distribution cable legs.

NOTE: **For additional information about applying fixed count terminals, see GTE Telephone Operations Practices:**

- **938-010-070, Outside Plant Facility Area Plan - Design Concept.**
- **938-010-071, Outside Plant Rural Distribution Area Plan - Design Concept**

4.4 Sheath Integrity

Sheath integrity of all distribution cables must be maintained to eliminate inadvertent disruption by workers. Existing ready access terminals are to be replaced with sealed fixed count terminals. Ready access splice cases are to be replaced with sealed cases.

4.5 Loop Treatment

On loops within 12 kft of the central office and on loops within 12 kft of a remote terminal, existing loop treatment (e.g., load coils, build out capacitors, etc.) must be removed from the distribution cables. All other conditions still require treatment as outlined in current GTE Telephone Operations Practices. (See GTE Telephone Operations Practice 832-100-072, Loop Customer - Transmission Design and Objectives - Resistance Engineering to Measured Limits.)

4.6 Protection Bonding and Grounding

Inspect distribution cables to ensure cable protection and the bonding and grounding of cable sheaths meet current GTE Telephone Operations standards. (See the 605 division of GTE Telephone Operations Practices on the subject of Protection and Bonding.)

4.7 Party Line Grouping

Each existing party line requires its own cable pair to allow grouping at the central office main frame or at the cross-connect box.

4.8 Record Updating

After necessary work is complete and test indicate the distribution cable will carry digital traffic at 144kb/s, Mechanized Assignment Record Keeping (MARK) cable assignment records will show the complements that have digital connectivity capability.

NOTE: **The program within MARK is called "special conditioning flags."**

GTE Confidential

5. Conventional Design

5.1 Introduction

Conventional Distribution design is explained in this section. Conventional Distribution design ("Conventional Design" or "CD") is the design for distribution cable to implement for all applications that do not meet Facility Area Plan (FAP) or Rural Distribution Area Plan (RDAP) application parameters.

NOTE: **The use of Conventional Distribution design for distribution cable is restricted to areas which cannot or will not be converted to the Facility Area Plan, either now or in the foreseeable future.**

5.2 Design Application

There are three different types of distribution plant within Conventional Design:

- Multiple Outside Plant (OSP) design (MOP).
- Dedicated Outside Plant (OSP) design (DOP).
- Interfaced Outside Plant (OSP) design (i.e., X-Conn'ed).

If the feeder cable network functionality goes directly to a customer location, this is defined as Direct Fed Design (DFD).

NOTE: **FAP/RDAP are special-case interfaced OSP design standards which meet special application requirements and distribution plant design parameters. For additional definition and charactertzation of these design standards see Planning Analysis Report (PAR) - 019, Facility Relief and Network Margins Policy.**

5.2.1 Multiple OSP Design

Multiple OSP design (MOP) is where wire center cable count (feeder counts) appear in more than one (i.e., "multiple") leg of distribution cable through spliced connections. Multipled design creates bridge tap conditions which degrade transmission characteristics and adversely affect operational aspects of the network.

NOTE: **This is NOT a design standard for new construction and will be phased out of the network with new construction.**

5.2.2 Dedicated OSP Design

Dedicated OSP design (DOP) is where wire center cable counts (feeder counts), which appear through spliced connections, do not appear in more than one leg of distribution cable. This has improved operational and transmission characteristics but has limited accessibility throughout the network. This network configuration is advantageous in established and stable business districts.

5.2.3 Interfaced OSP Design

Interfaced OSP design (i.e., X-Conn'ed) refers to plant designed with interface (e.g., cross-connect or facility area connector) distinguishing feeder/distribution functionality. Overall connectivity from the wire center to the customer is established by jumpering between the feeder and distribution (hard wired) cable counts. This design is similar to FAP/RDAP except overall land usage is not known. The OSP Engineer must assess the potential and probable uses of undeveloped land and size distribution facilities based on that assessment.

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5.3 Distribution Cable Planning

Make a field survey to learn the:

- Geographical features of the area.
- Existing outside plant situations and conditions.

The field survey notes the locations of:

- All housing units or business locations under construction. This information is used to:
  - Develop the near-future cable pair requirements.
  - Determine the timing of relief (if necessary).
- All vacant property (include designated future use if information is available). This information is used to develop the ultimate housing units and business locations.
- Natural or man-made boundaries (e.g., rivers, lakes, railroads, highways) and other geographic features.

NOTE: **Use Outside Plant records, subdivision plats, or building plans to record this survey data for future reference.**

5.4 Determining Future Pair Requirements

Develop the future pair requirements for each section of plant. Pair requirements can only be forecast by considering the future needs of:

- Pair requirements for existing housing units.
- Pair requirements for existing business locations.
- Now-vacant property.

Regarding the pair requirements for existing housing units, a decision on future requirements is usually based on the characteristics of the area (i.e., whether customers in the area will require more than one pair per housing unit).

Regarding the pair requirements for existing business locations, a decision on future requirements is usually based on the characteristics of the area - Are the business locations commercial or industrial? What is the potential need for business and special service lines in the future?

Regarding the future needs of now-vacant property, a decision on future requirements is usually based on zoning of the property (business, multi-family, single-family) and plans for development (existing or proposed).

All this information is necessary to determine the pairs required for the ultimate number of housing units and business locations in each section of plant.

The engineer must work to determine future cable pair requirements. The information the engineer uses to this determination includes:

- Subdivision plats, zoning maps, housing and population forecasts.
- Interviews with owners, developers, local planning people.
- Information obtained in the detailed field survey.
- Estimated multiple-service requirements per unit.

5.4 Determining Future Pair Requirements, continued

An up-to-date 20-year forecast that details locations and circuit quantities is necessary to determine outside plant requirements for the present and for the future. Use the forecast to obtain information for the cable fill boxes – information such as:

- Number of existing and ultimate housing units and business locations.
- Short-term cable pair requirements (include reroute).
- Ultimate cable pair requirements.

Record the data in the fill boxes by starting from the outer ends of the distribution cable to accumulate and record this information back to interface point with the feeder network. (See Exhibit 1, FAP, RDAP, or Grooming Conventional Design Fill Box Standard, below.)

(1)	Existing	0
(2)	Reroute	0
(3)	Two Yrs.	0
(4)	HL/STA	0
(5)	Ultimate	0

Exhibit 1 - FAP, RDAP, or Grooming Conventional Design Fill Box Standard

5.5 Cable Fill Boxes

Cable fill boxes (illustrated above in Exhibit 1) are placed:

- At the beginning of each facility taper point, branch facility route, etc.
- For every section of new cable plant proposed.

A sufficient number of fill boxes are to be placed and shown to:

- Indicate the growth patterns of the area under consideration.
- Substantiate the engineering proposal for additions or rearrangements.

A fill box as illustrated above, or an engineering design drawing is placed as near to its point of reference as possible. If, for reasons of clarity, the fill box is not placed near its point of reference, a cross-reference method of identification is required.

5.5 Cable Fill Boxes, continued

The following chart explains what to enter on each line of the fill box. (The line numbers indicated in the chart correspond to the numbers labeling each line in Exhibit 1, on the previous page.)

Line	Enter...
1	The existing, working cable pairs.
2	Any working cable pairs that are to be rerouted from one feed area or cable to the facility under study. (This line will illustrate cross-section condition when rerouted pairs are added to or removed from existing working pairs.)
3	The projected working pairs that will exist at the end of the second year.
4	The number of housing units or lots if the fill box is for FAP or RDAP. OR The number of stations (party lines) if the fill box is used for grooming (removing carrier, etc.) or conventional design.
5	The number of pairs using the appropriate FAP, RDAP, or grooming factor.

5.6 Analyzing Outside Plant Network

Using the information assembled to determine future pair requirements (field survey, 20-year forecast, etc. - see section 5.4) engineering forces must analyze the existing and forecasted requirements in each distribution section of outside plant to identify:

- Immediate or future facility shortages.
- Multiple conditions.
- Nonstandard, aged existing plant that must be replaced.

This analysis requires that the number of pairs shown in the short-term and ultimate space in each fill box be compared to the size of the existing cable(s). This comparison enables the engineer to determine when the existing cable(s) will exhaust.

Engineering must also analyze all cables in multiple to determine when the multiple must be removed to allow for growth and/or digital connectivity. Mark the cable fill boxes to indicate:

- Short-term or ultimate cable pair shortages.
- Multiple problems.

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5.7 Determining Cable Size

The engineer determines the size cable needed based on their analysis of future pair requirements and outside plant network. Their determination as to the cable size is also based on the requirement that in urban and suburban areas (and in some rural areas):

- At least two pairs must be provided for each of the ultimate number of housing units anticipated, plus extra pairs for the ultimate business requirements.
- All distribution cable must be multiple-free and administered in 25-pair groups. (Groups must not be split between branch cables.)
- The pairs per housing unit must be assigned by the engineer, permanently committed from the interface, and cut off beyond the service connection point.
- At business locations, the dedicated pair is permanently assigned and cut off beyond the service connection point. Flex-dedicated pairs may or may not be cut off at serving terminal. (See section 4.3, Bridge Tap Limitations.)

5.8 Determining Distribution Cable Taper Points

Because the use of Conventional Distribution design for distribution cable is restricted to areas which cannot or will not be converted to the Facility Area Plan, either now or in the foreseeable future, the need consider implementing taper points arises. When determining taper points, consider the following:

- The need for construction forces to handle an extra reel of cable.
- Taper points involve having an extra straight splice.
- The difference in material cost because of the length of the cable being placed.
- When one size cable is terminated and different sized cable starts a new operation in a continuous run, a discontinuity results in the cable-placing operation.
- Reinforcing distribution cables is expensive as compared to extending the larger size cable further.

Evaluating and comparing tapering versus nontapering can be expressed as a length at which the two costs are equal. If costs are nearly equal, decide not to taper because:

- Without tapering, an increased number of pairs are available.
- Without tapering, future reinforcement costs would be saved.

In general, distribution cable should not be tapered until the cable size can be reduced at the taper by 50 percent.

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6. Gauge of Conductors

6.1 Determining Gauge of Conductors

Gauge and distribute conductors in distribution plant according to Resistance Engineered to Measured Limits (REML) transmission design procedures. These procedures are detailed in the following two divisions of GTE Telephone Operations Practices:

- 832 – on the subject of Exchange Area Transmission.
- 938 – on the subject of Outside Plant Systems – Design.

6.2 Assigning Facilities

To facilitate administration of assigning facilities, a complete facility area is to be served from a remote terminal from the initial cutover. Do not mix physical and electronically derived circuits within a facility area (except for special circuits). This allows the new distribution cables to be gauged using a finer gauge.

NOTE: **Much of the cable in distribution plant is in sections which will not be extended. Evaluate and implement (if prudent) using minimum gauges in these situations.**

7. Terminals

7.1 Locating Aerial Terminals

In general, the location of distribution terminals on aerial plant is determined by the following:

- Number and location of services anticipated to be provided.
- Relative economy of placing a terminal in comparison to paralleling the cable with service wire.

NOTE: **Specify terminals only for known or clearly indicated service needs when engineering an aerial distribution cable project.**

7.2 Planning Requirements for Buried Terminals

The cost of adding distribution terminals to an existing buried system is much greater than when the terminals are placed in conjunction with the cable. Carefully plan the terminal requirements for buried systems to avoid unnecessary costs.

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7.3 Terminal Count

The count of a terminal may include any group of numbered pairs contained in the count of the cable to which it is spliced. This count should always be consecutive, but at times using a split count is required. It is recommended that terminal counts not split 25-pair groups.

Establishing terminal counts upon conversion to fixed-count terminals must be coordinated with service office assignments. To minimize physical rearrangements, consider that recorded pair counts (posted to location records) will:

- Be broken in many cases.
- Not follow a sequential pattern of numerically ascending order.

Use good judgement to ensure proper count. Examples:

- Correct T123:

  3 + 6 - 8 + 27 - 31 + 34

- Incorrect T123:

  27 - 31 + 34 + 3 + 6 - 8

NOTE: **Avoid this type count. All new cable terminals must have consecutive fix counts assigned.**

7.4 Replacing Terminals

When replacing terminals, base the sizing on existing need. "Existing need" is comprised of:

- Mechanized Assignment Record Keeping (MARK) assignment records.
- Recorded subdivision plats (where available).
- Condition of existing units.
- Type of service.
- Existing congestion.
- Pair spread of existing terminal.
- Potential for additional growth.

7.5 Cable End Point

For both buried and aerial distribution systems, carefully consider the end point for the cable. Where an extension is not possible, clear and cap the cable at the last service requirement.

7.6 Combination Trunk and Exchange Cable

Combining direct, tandem, and toll-connecting trunks with exchange facilities is not recommended.

BURIED PLANT
GENERAL

CONTENTS PAGE

1. GENERAL

1.01 This practice explains general requirements for buried telephone plant, including:

- Engineering considerations.
- Economic comparisons with aerial plant.
- Federal, state, and local utility regulations.
- National Electrical Safety Code (NESC) rules.

1.02 This practice:

- Conforms to the joint random construction rules contained in the latest edition of the National Electrical Safety Code.
- Is reissued to update buried telephone plant information. Remove the previous issue of this practice from the binder or microfiche file and replace it with this issue.

2. DEFINITIONS AND ACRONYMS

2.01 ALPETH - A telephone cable sheathed with corrugated aluminum tape and jacketed with polyethylene.

2.02 ASP - Filled Alpeth with an FPA-aluminum-steel-polyethylene shield.

2.03 CATV - Community antenna television.

2.04 FIXED SEPARATION - Separation requirements established by the National Electrical Safety Code.

2.05 FPA - Fused polyethylene-aluminum shielded cable.

2.06 MAIN TRENCH - The easement or public right-of-way that accommodates:

- Gas lines.
- Primary and secondary power cables.
- Telephone distribution cable.
- Service wires.

2.07 NESC - National Electrical Safety Code.

2.08 PERIOD OF FILL - The length of time an installed cable has sufficient capacity to satisfy the traffic requirements of its serving area; beyond this point new cable must be laid.

2.09 PIC - Polyethylene insulated cable.

2.10 RANDOM SEPARATION - Separations mutually agreed upon by all parties concerned for utilities placed in the same trench with telephone facilities.

2.11 SERVICE TRENCH - The trench which extends from the terminal facilities to the customer's residence or building.

2.12 SERVICE WIRE - Commonly called drop wire, service wire is actually a cable consisting of an insulated wire pair enclosed by a protective sheath.

2.13 STALPETH - A telephone cable sheathed with longitudinal aluminum tape covered by soldered steel tape and jacketed with polyethylene.

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3. BACKGROUND

3.01 Engineering considerations for buried cable are basically the same as for any engineering job. Good engineering will produce a design that:

- Meets service standards.
- Returns the most for an investment.
- Can be efficiently constructed.

3.02 Buried exchange plant is generally more economical than any other type of plant when placed using the latest tools and materials. This practice includes various engineering and economic comparisons of buried cable with other types of construction.

3.03 Federal, state, and local regulatory authorities are increasingly requiring utilities to place all new facilities underground. Recent regulatory rules in some areas require the planned replacement of existing aerial facilities with below ground plant.

3.04 Become familiar with all regulatory ordinances affecting the placement of underground and buried plant before starting any construction projects. Applicable ordinances can include those of the following regulatory bodies:

- Federal.
- State.
- Local.
- Other.

3.05 When designing buried cable facilities:

- Avoid:
  - Locating terminals in swamp areas or in deep ground depressions.
  - Locating terminals on property lines to prevent property line marker dislocation and to avoid damage to facilities during future fence construction.
  - Terminal locations that could be a hazard to snow removal, traffic, or street cleaning in front lot construction.
  - Locations that would impair future extensions and maintenance.
  - Damage to trees and shrubs, including their root systems, and other private or public property.
  - Terminal locations that could be objectionable to property owners.
- Ensure that:
  - All other subsurface utilities are identified and located prior to starting construction.
  - Space is available for operating the plow train or trenching equipment.
  - All federal, state, and local ordinances are complied with and that all the necessary permits and easements are obtained prior to starting construction.
  - Trenching or plowing operations do not interfere with natural drainage or contribute to soil erosion.
  - The cable trench or plow slot is located so as to avoid other underground facilities.

4. APPLICATIONS AND ADVANTAGES

4.01 Buried plant is suitable for all areas of:

- Exchange.
- Toll.
- Interoffice trunk plant.

4.02 Established business or residential sections have many permanent structures that make direct earth burial of cable difficult or nearly impossible. Conversely, the conditions that make buried plant most advantageous are usaily found in rural and suburban areas.

4.03 Some of the advantages of buried plant are explained in Exhibit 1 on Page 3.

4.04 Cost, reliability, and other factors make using buried plant in subdivisions advantageous. Buried plant:

- Can be readily designed to conform to irregularities in lot boundaries as shown in Exhibits 5 and 6 on Pages 12 and 13. Since aerial plant cannot readily follow irregularities, it is impractical and expensive in such situations.
- Does not affect the aesthetic value of the property. Both above-ground terminal housing and flush construction provide a better physical appearance than aerial construction.

4.05 Buried plant has a number of other applications, some of which include:

- Making underground dips to avoid undesirable power exposures.
- Accommodating difficult right-of-way situations, e.g., golf courses, cemeteries, and airports. It is possible to obtain permission to bury plant, where permission to establish a pole line would be difficult or impossible.

Buried Plant Advantages

ADVANTAGE	EXPLANATION
Economy	Unless major subsurface obstacles are encountered during installation, the first cost of buried plant is usually very low compared to aerial plant. With favorable conditions, the cost of plowing in cable may be less than the material cost of suspension strand for aerial cable. The economic advantage of buried plant is realized through the elimination of: • Pole line construction. • Tree trimming. • Suspension strands for aerial cables.
Maintenance	When buried plant is properly installed, relatively little maintenance is required. This is particularly significant in rural areas because of the travel time involved. Though the cost of clearing an individual case of trouble in buried plant usually exceeds the cost of clearing trouble in aerial cable, the frequency of trouble in buried plant is much lower than for aerial plant.
Reliability	Buried plant is less susceptible to damage (and resulting repair costs) from sleet, hurricanes, falling trees, traffic, etc. The advantage of trouble-free service to customers is very important, particularly when other methods of communication may be disrupted.
Appearance	Buried plant, versus aerial plant, improves the appearance of the area. This is especially true with flush construction, as described in other practices in this series. In some urban and most rural areas, appearance may be of less importance, and above-ground terminal housings can be used. However, other considerations arise; for example: in cultivated fields, both poles and terminal housings can interfere with farming operations. In this instance, consider flush construction.
Speed of Installation	The time interval between the start and completion dates can be much shorter for a given buried plant project than for a comparable aerial plant project. In addition to labor cost savings, shortened construction time will: • Reduce interest costs during construction. • Advance the revenue-producing date for the plant. • Provide earlier service to the customer.
Safety	Aerial plant presents a constant and serious threat to plant forces since telephone pole accidents constitute a large percentage of injuries for any telephone company. Also, aerial plant is exposed to direct contact with high-voltage power conductors.

Exhibit I

4.06 Some of the disadvantages of buried plant, especially when flush construction is used, are:

- Restricted access to facilities.
- Non-reenterable encapsulated splices.
- More costly to locate and clear faults.

5. TYPES OF WIRE AND CABLE

5.01 Single-sheath filled Alpeth-FPA (fused polyethylene-aluminum shielded) cable is especially suitable for buried construction and should be considered the first choice facility. Other types of cables available and acceptable for buried construction under certain circumstances include:

CABLE TYPE	IS SUITABLE FOR. . .
Single-sheath air core Alpeth-FPA	Buried construction where subsurface moisture is not a problem.
ASP	Areas requiring rodent protection.
Double-sheath Alpeth-FPA air-core	Use where higher core-to-sheath dielectric strength is required when: • The desired size is not available in filled-core cable. • Subsurface moisture is not a problem. (Continued)

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CABLE TYPE (continued)	IS SUITABLE FOR. . .
T or D screen filled [illegible]	Use with PCM carrier.

5.02 Polyethylene-insulated conductor (PIC) cables have high dielectric strength, which gives added protection against lightning. Stalpeth cable, containing paper-insulated conductors with low dielectric strength, is susceptible to moisture problems; it is a second-choice facility only.

5.03 Service wire can be used as buried drop wire; such runs should not exceed 500 feet. Where longer drop wire runs are required, use buried distribution wire.

5.04 Do not use buried distribution wire in place of distribution cable. This facility may be used for buried service wire runs exceeding 500 feet.

5.05 Use cable for facilities requiring a size range of one to six pairs.

6. URBAN PLANT

6.01 Subsurface construction is the method preferred by all local and state governmental agencies. For this reason, the first consideration for any new plant or rehabilitation of existing plant should be an all-buried system.

6.02 Burying distribution plant in urban areas is most applicable to new subdivisions or residential developments because it is often possible to place facilities before permanent pavements, walks, buildings, etc., are completed (where facility requirements are clearly defined). This type of plant also applies to established urban areas where existing distribution facilities are scheduled for replacement due to:

- Obsolescence.
- Deterioration.
- Aesthetic reasons.
- A request from a regulatory body.
- Local ordinances.

6.03 In general, a new subdivision or an established residential area can be classified into one of the types listed in Exhibit 2 on Page 5.

6.04 Advance planning is necessary to realize the greatest advantages of buried distribution plant. Complete arrangements and negotiations with other utilities, municipalities, builders, and developers before any design or construction begins. These arrangements must be thoroughly understood by all involved parties. When planning work in a new subdivision, negotiate an agreement under which the builder or subdivider agrees to:

- Furnish recorded lot and easement lines with property line stakes as required.
- Furnish a final grade for the entire width and length of the easement.
- Provide a final grade in the road or public right-of-way at cable crossing locations.
- Provide a final grade from the easement or public right-of-way to the customer's house or foundation when required to install service to the premises.
- Keep all easements and service entrance routes clear of debris and other obstacles.

6.05 The design of buried distribution plant is governed by:

- The type and size of the subdivision and the rate of development.
- The availability, size, and location of the easements.
- Whether or not:
  - Power distribution will be buried.
  - The separation required for adequate inductive coordination during normal and faulted power conditions can be maintained.
- Cooperation with the subdivider and other utilities (e.g., gas, water, power, sewer, and community antenna television [CATV]).

6.06 In newer subdivisions where there are no alleys, a utility easement of at least 10 feet can usually be found at the rear property line. When separate trenching is done, it is common practice for the:

- Telephone company to use half the space.
- Power company to use half the space.
- Water, sewer, and other facilities to be served from the street.

6.07 In joint trenching applications, the trench may be located in the center of the easement on either side of the property line. Placing terminals on alternate lot corners usually provides service to four lots from each terminal location. In a subdivision where houses are built on an individual rather than mass-production basis, this layout may prove to be the most practical. This plan is illustrated in Exhibits 7 and 8 on Pages 14 and 15.

Development Types

FOR. . .	USE THIS METHOD. . .
New subdivisions laid out and built up with homes on every lot under mass production methods by a developer	Place buried service wire: • During initial construction while the distribution cable is being placed. OR • In a continuous operation as groups of houses are completed.
New subdivisions laid out by a developer, who may: • Build certain houses on selected lots. OR • Sell lots individually to prospective owners, contractors, or builders.	If possible, provide: • Only distribution cable during initial construction. • Buried service wires on an individual basis as service is required.
Established residential areas presently served by aerial plant from rear easements or alleys, or from street distributions	When major replacement of distribution plant is required in these areas, consider using buried plant. When adequate easements and/or right-of-ways can be obtained, both distribution cable and buried service wires can often be completed as a continuous operation under the construction work order.
Existing aerial facilities whose expected service life warrants such consideration	Remove the plant and place it in trenches or split conduit to realize the service investment. Prior to selecting this method, make a thorough investigation of the condition of the: • Cable. • Existing terminals. • Branch cables.

Exhibit 2

6.08 In some locations, it may be easier to serve more than four lots from each terminal. Buried service wires serving lots other than those adjacent to the terminal can be buried in the same trench as the distribution cable. If residences have not been started on these lots at the time the distribution cable is placed, bury the service wire up to the vacant lot line as shown in the 600 division of GTE Practices.

6.09 In some areas, it may be better to serve lots from a front rather than from a rear easement. When the cable will be located in the front, place it within the public right-of-way. This path within the right-of-way is governed by the locations of existing utilities in many instances. Exhibits 9 and 10 on Pages 16 and 17 illustrate this plan.

6.10 If a planned apartment or condominium development is constructed by one agency, a random route through the complex may be desirable due to:

- Random placement of the buildings,
- Accessibility to terminations within each building.

6.11 This plan is illustrated in Exhibit 11 on Page 18.

7. JOINT TRENCHING - SEPARATIONS

7.01 When power, telephone, gas, water, sewer, and CATV plant will be buried together, obtain complete understanding and cooperation in joint planning between the:

- Subdivider.
- Power company.
- Gas company.

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- CATV company.
- Water company.
- Sewer authority.
- Telephone company.

7.02 Cooperation is necessary to:

- Realize potential construction savings.
- Prevent future maintenance problems.

NOTE: Compliance with Part 3 of the NESC is also required.

7.03 Joint trenching reduces the possibility of damage to telephone cable that may occur when other utility services are placed independently. While telephone and CATV cables may have a random lay, other separations described in the 629 division of GTE Practices must be maintained.

Fixed Separation

7.04 Typical joint and nonjoint trenchings are illustrated in Exhibits 12 and 13 on Pages 19 and 20. If the telephone and CATV cable will be placed within an easement and the power distribution will not be placed at the same time, place the telephone and CATV cables in one half of the easement as shown in Exhibit 14 on Page 20.

7.05 Separations between power primary cables and telephone cables must be:

- 3 inches of concrete,

  OR

- 4 inches of masonry,

  OR

- 12 inches of well tamped earth.

Random Separation

7.06 Communication and power supply conductors or cables may be buried together at the same depth with no deliberate separation between facilities, provided:

- All parties are in agreement.
- The conditions and requirements of NESC's Section 354 are met.

7.07 This method of burial is referred to as random separation. Such burials apply only to cable facilities having aluminum or copper tape inner shields.

NESC Rules

7.08 When the radial separation between conductors or cables is less than 12 inches, follow the rules given in Exhibit 3. Exhibit 3 paraphrases NESC Section 354, Random Separation, Additional Requirements.

NESC Rules on Random Separation

ITEM	REQUIREMENT
Supply conductors or cables	The conductors or cables of a supply circuit and those of another supply circuit may be buried together at the same depth with no deliberate separation between facilities, provided all parties involved agree.
Communication conductors or cables	The conductors or cables of one communication circuit and those of another communication circuit may be buried together and at the same depth with no deliberate separation between facilities, provided all parties involved agree.
Supply and communication conductors or cables	Supply cables or conductors and communication cables or conductors may be buried together at the same depth with no deliberate separation between facilities if all parties involved agree and the following requirements are met: ● For power facilities, do not operate: - Supply systems in excess of 22,000 volts to ground. - Ungrounded supply systems in excess of 5,300 volts phase-to-phase. ● For bare grounded conductors: - A supply facility operating above 300 volts to ground must include a

Exhibit 3 (Continued)

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NESC Rules on Random Separation (Continued)

ITEM	REQUIREMENT
Supply and communication conductors or cables (Continued)	bare grounded conductor in continuous contact with the earth. This conductor, adequate for the expected magnitude and duration of the fault current that may be imposed, must be one of the following: 1. A sheath, an insulation shield, or both. 2. Multiple concentric conductors closely spaced circumferentially. 3. A separate bare conductor in contact with the earth and in close proximity to the cable where such cable or cables also have a grounded sheath or shield that is not necessarily in contact with the earth. The sheath, shield, or both, as well as the bare conductor, must be adequate for the expected magnitude and duration of the fault currents that may be imposed. NOTE: This is applicable when cable in a nonmetallic duct is considered as a direct buried cable installation and random separation is desired. EXCEPTION: Where buried cable passes through a short section of conduit, such as under a roadway, the contact with earth of the grounded conductor can be omitted, provided the grounded conductor is continuous through the entire length of the conduit. 4. The bare conductor or conductors in contact with the earth shall be of suitable corrosion-resistant material.
Underground supply cables	Cables of an ungrounded supply system operating above 300 volts must be of effectively grounded concentric shield construction in continuous contact with the earth. Such cables must be maintained in close proximity to each other.
Multiple cable systems	More than one cable system buried in random separation may be treated as one system when considering clearances from other underground structures or facilities.
Protection	• Supply circuits operating above 300 volts to ground or 600 volts between conductors must be so constructed, operated, and maintained that, when faulted, they will be promptly de-energized initially or following the subsequent operation of any protective device. For example: - Phase-to-ground faults for grounded circuits. - Phase-to-phase faults for ungrounded circuits. • Ungrounded supply circuits operating above 300 volts must be equipped with a ground fault indication system. • Communication protective devices must be adequate for the voltage and currents expected to be impressed on them in the event of contact with the supply conductors. • Adequate bonding must be provided between the effectively grounded supply conductor or conductors and the communications cable shield or sheath (bonding intervals must not exceed 1,000 feet). • In the vicinity of supply stations where large ground currents may flow, the effect of these currents on communicaton circuits should be evaluated before communication cables are placed in random separation with supply cables.

Exhibit 3

7.09 To avoid future inductive interference problems (noise) as the power load builds up over the years, GTE recommends, if possible, placing:

- Feeder cables with fixed separation only.
- Distribution cables with random separation.

7.10 Further, the feeder cable must be extended through the serving area so that each distribution cable is:

- Less than 1 mile long.

  AND

- Preferably not more than 0.5 miles long.

7.11 When any of these conditions cannot be met, fixed separation is required.

8. DEPTH OF BURIAL

8.01 Exhibit 4 lists the exhibits in this practice pertaining to minimum covers and/or separations for supply, communication, and gas facilities in the same trench. All depths shown are from the final grade.

NOTE: No minimum separation is required between gas lines and communication cables or wires.

9. RURAL PLANT

Right-of-way Burial

9.01 The improved equipment available today

Trench Illustrations

FOR TELEPHONE FACILITIES WITH AN. . .	AND PLACED IN A. . .	WITH. . .	USING. . .	REFER TO EXHIBIT	ON PAGE
Inner shield made of aluminum tape	Joint main trench		Fixed separations	15	21
			Random separations	16	21
		Gas lines	Fixed separations	17	22
			Random separations	18	22
	Joint service trench	Gas lines	Fixed separations	19	23
			Random separations	20	23
			Random separations	21	24
Armor shield made of steel strip	Joint main trench	Gas lines	Fixed separations	22	24
			Fixed separations	23	25
	Joint service trench	Gas lines	Fixed separations	24	25

NOTE: No minimum separation is required between gas and communication cables or wires.

Exhibit 4

(e.g., tractors, trucking equipment, and plows) makes installing buried plant economical in locations previously not considered feasible.

9.02 Facilities in rural areas may be buried within the highway right-of-way or on private property, depending on conditions. Telephone plant within the right-of-way may be placed:

- Between the road ditch and fence or property line.
- In the shoulder of the road.
- In the center of the road (see Paragraphs 9.06 through 9.08).

9.03 The location chosen in any particular case depends on factors such as:

- Terrain.
- Soil conditions.
- Number and type of underground obstructions.
- The ease with which equipment can be operated.
- The amount of hand trenching required.
- Requirements of public authorities responsible for the right-of-way.

9.04 Considering each location, the engineer should be alert to conditions that may lead to excessive maintenance or rearrangement expenses, e.g., an inadequate drainage ditch. Even though the plowing or trenching may be more difficult elsewhere, staying out of the ditch will:

- Be more economical in the long run.
- Eliminate future maintenance and rearrangements.

NOTE: Select a location that minimizes exposing the plant during future road maintenance.

9.05 Hold buried crossings on paved roads to a minimum. Where a crossing must be made and highway officials or the public objects to opening the road surface, make the crossing by pushing pipe or boring an opening under the pavement. Extreme circumstances may require constructing an aerial crossing.

Center Burial Along Roads

9.06 Along unpaved rural roads, cable may be buried in the center of the traveled road. The crown location offers the advantage that road scraping operations tend to protect rather than expose the plant. Take care to provide additional cover where the cable extends to terminals at the side of the road. This method has the disadvantage that buried plant can be rendered inaccessible by subsequent road surfacing.

9.07 In cases of trouble after the paving is laid, it may be necessary to plow in new lengths of cable between accessible points such as terminals or test points. This hazard is usually not serious, however, since roads suitable for center burial are generally lightly traveled and the possibility of paving is remote.

9.08 On narrow roads, where there is no shoulder, the only practical location for buried plant is in the center of the road. In most of these cases, subsequent paving will not entail radical grade changes; the buried plant will still have adequate protection.

Crossing Obstacles

9.09 The engineer will determine the best way to install plant across streams or other obstacles. This can be done by burying the cable directly in the stream if:

- The banks of the stream are not too steep.
- The bed of the stream will support the plow.

NOTE: Prior to placing cable directly in the stream, ensure that all governmental requirements are met.

9.10 Other means of crossing such obstacles include:

- Attaching steel pipe or PVC conduit to a bridge.
- Erecting an aerial crossing.

9.11 Tree roots can cause installation difficulties. Avoid locations close to large trees or heavy lateral roots because special digging equipment or hand digging may be necessary.

9.12 Place and maintain buried plant on private property with the least inconvenience to the property owner or tenant. Locate plant so that it is not subject to damage by work normally performed on the property. In agricultural regions, bury the cable deep enough to avoid farming operations. Where crop damage may be extensive, schedule plowing operations before or after the growing season. Obtain from the property owner the locations of power services, water pipes, and other underground structures that must be avoided before selecting the route.

9.13 One important point in selecting a route is to choose locations that will minimize damage from wind or water erosion. For a short time after the cable is plowed in, the disturbed earth in the plow slot will permit water to gather and run along the slot. When possible:

- Avoid steep slopes.
- Plow across the slope rather than directly up the slope.

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9.14 Along with the conditions previously mentioned, these factors must also be considered when selecting a route across private property:

- Number and location of customers on the side of the road <u>opposite</u> that of the selected route.
- Possibly cutting across curves or turns in the road to shorten the route.
- Limitations of plowing or trenching equipment and techniques.

9.15 The depth of buried plant in rural areas must, of necessity, vary with:

- Local conditions.
- The capabilities of the plowing equipment.

9.16 Excavations by foreign utilities and construction companies have caused more damage to buried plant than any other single cause. Much of this damage would have occurred even though the plant was buried to a depth of 3 feet or more.

9.17 As a rule, the shallower the plowing depth, the less effort required to draw the plow. Generally, bury a cable to the maximum depth at which the plowing equipment is capable of efficient operation. Plowing depths for normal situations are:

MINIMUM COVER	DEPTHS IN INCHES FOR. . .	
	WIRE OR CABLE	SERVICES
In soil	18	6
Under drainage ditches	36	36
In rock (any location)	12	6
At roadway crossings	24	24

10. FEEDER CABLE SIZING

10.01 Size buried feeder cables in accordance with the 912 division of GTE Practices.

10.02 The period of fill must be tempered by the particular circumstances involved with the individual project. For example, if the cable is planned for an area that may be built up with paved streets or sidewalks it may be more economical to make the initial cable oversize or to place conduit. Other factors that should be considered in determining the period of fill are:

- Size and gauge of the initial cable.
- Methods of providing future relief.
- Annual growth.
- Routes of initial and future relief cables.

10.03 As with underground feeder cable, plan buried feeder cable with the following factors in mind:

- Future relief.
- The ultimate area the cable will serve.

10.04 With knowledge of the current project and an estimate of the future, the engineer can make intelligent decisions concerning size and period of fill.

10.05 Burying oversize cables to defer costly reinforcement has been mentioned. Usually a cost study will prove or disprove the soundness of a proposal to increase the size of a cable and thereby lengthen the period of fill. Alternate plans can be prepared to compare the costs of installing various sized cables initially with complementary relief cables or carrier systems at varying future dates. The cost of relief cables or carrier systems must include any extraordinary costs that can be expected for placing a second cable along one route.

10.06 When placing buried feeder cable by trenching, consider laying one or more spare conduits if placing future relief cables will be difficult or expensive.

10.07 All methods of providing relief for underground feeder cables can be adapted to buried feeder cables. Relief can be accomplished by transferring distrubution cables to the new feeder by:

- Intercepting and cutting off the old cable along the same or a parallel route.

  OR

- Replacement.

11. DISTRIBUTION CABLE SIZING

11.01 Buried distribution cable size depends on the termination method. Termination can be in terminal housings that use either:

- Pedestal construction.

  OR

- Flush construction.

NOTE: Distribution cables must be sized to meet the maximum expected requirements.

11.02 Size all buried distribution cables according to the best forecast information for the area. When a formal forecast is not available, prepare an engineering forecast for each distribution cable branch.

Flush Construction

11.03 Size distribution cables for flush construction with a:

- Minimum of 2.0 cable pairs per forecasted housing unit.
- Margin for special services and business requirements.

11.04 The total circuit requirements often fall between two nominal cable sizes. In this situation, select the larger size.

11.05 Terminate business and special service cables along a flush construction route in buried terminal housings when facility requirements are indefinite. When facility requirements are definite and a commercial building exists, place and terminate an entrance cable. In this instance, the terminal housing is not required.

Terminal Housing Construction

11.06 Size distribution cable for terminal housing construction with:

- A minimum of one pair per forecasted housing unit.
- A margin for special and business requirements.

11.07 Where fractional cable pairs between one and two per lot or housing unit are forecast, provide such fractional cable pairs in the distribution cable.

11.08 Circuit requirements usually fall between two nominal cable sizes. Since judgment would be used in selecting the lines-per-lot factor, judgment must also be used in determining whether to use the larger or smaller size. If the lines-per-lot factor is:

- High, use the smaller cable size.
- Low, use the larger size.

NOTE: If the circuit requirements are within one or two pairs of a nominal size, that size should be selected.

12. TERMINATION

12.01 An economical telephone distribution system requires good use of all available circuits. Since PIC cables are used almost exclusively in buried plant, either terminal housings or flush splice closures can be employed. When:

- Terminal housings are used, the detail work plan must indicate specific counts to be terminated in each unit.
- Nonreenterable splice closures are used, assign cable pair counts to individual lots or housing units. It is important that the required cable pair(s) be assigned to each housing unit at the time of design, whether such a cable pair is used now or at some future date. Show these assigned cable pairs on the detail work plan.

13. TRANSMISSION AND PROTECTION

13.01 Select cable and wire gauges using the methods outlined for aerial plant.

13.02 Since two small cables can be buried at one time with the same plow and these two cables can be of different gauge (one coarse and one fine), the coarse-gauge cable need not be looped into terminal housings in the fine-gauge area.

Loading

13.03 Loading for buried exchange plant generally follows the H-88 loading system: 88-mH loading coils spaced at intervals of 6,000 feet of nominal 0.083 μF/mile cable (or equivalent on a mutual capacity basis). The following standard load spacing accuracy requirements apply:

- Average spacing - Within ± 2 percent of standard spacing (6,000 feet for H-88).
- Each individual deviation - Less than 2 percent of the average spacing.
- The average of the individual deviations from the average spacing - Less than 0.5 percent of the average spacing.

13.04 This is a standard loading system for exchange aerial and underground cable; therefore, no special problems will arise at junctions of buried plant with aerial and underground cables. Limits on the length of cable pairs permitted beyond the last load coil are described in the 832 division of GTE Practices.

13.05 When open wire is extended with buried plant and the buried plant must be loaded, compute loading for the route as though the open wire were cable. Using this method, whenever part or all of the open wire is replaced by cable, the buried plant loading coil locations need not be changed. The open wire section, including the adjacent cable and buried plant end sections, must be loaded and/or built out as required on a capacitance-equivalent basis so that overall spacing accuracy requirements are met. This must be done at the open wire junctions as far as possible, as loading is never installed on the open wire.

Protection

13.06 Protection for buried plant is described in the 90_ division of GTE Practices. Protection involves, for example:

- Bonding.
- Grounding.
- Dielectric strengths of cables and terminal housings.
- Shield wires for lightning protection.
- Lengths and separations to avoid inductive interference.

NOTE: This is explained in Paragraphs 7.08 and 7.09.

13.07 Buried plant protection is somewhat more stringent than protection for aerial PIC cable. This is because locating and clearing faults in buried plant is more costly than in aerial plant.

13.08 Metal sheaths of buried cable and wire must be continuous and grounded (bonded to the power neutral) at a sufficient number of splice and branch points so that adjacent grounds are no more than 2 kilofeet apart (less, if specified). Buried service wires or entrance cables having metal armor or shields must have their armor or shields connected to the:

- Station protector ground terminal.
- Distibution cable, or wire shield or armor.

13.09 The work order will specify:

- The bonding and grounding required at each splice and branch point.
- All other construction details necessary to meet transmission and protection requirements.

NOTE: The work order will also specify the inspection and completion test requirements (selected from the 634 division of GTE Practices).

Buried Plant Layout - Terminal Housing Construction

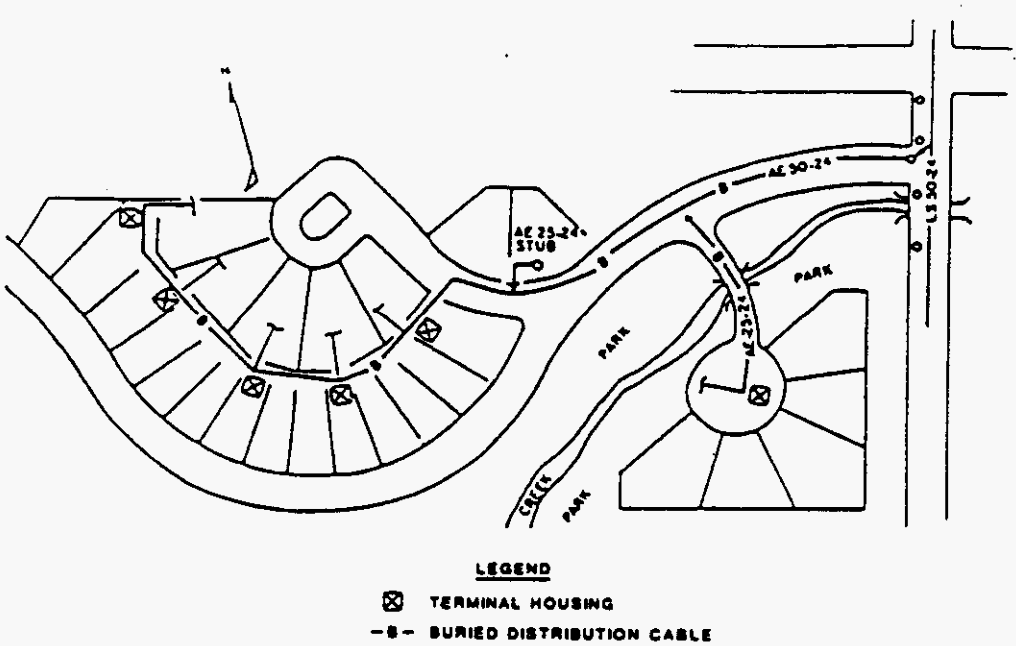
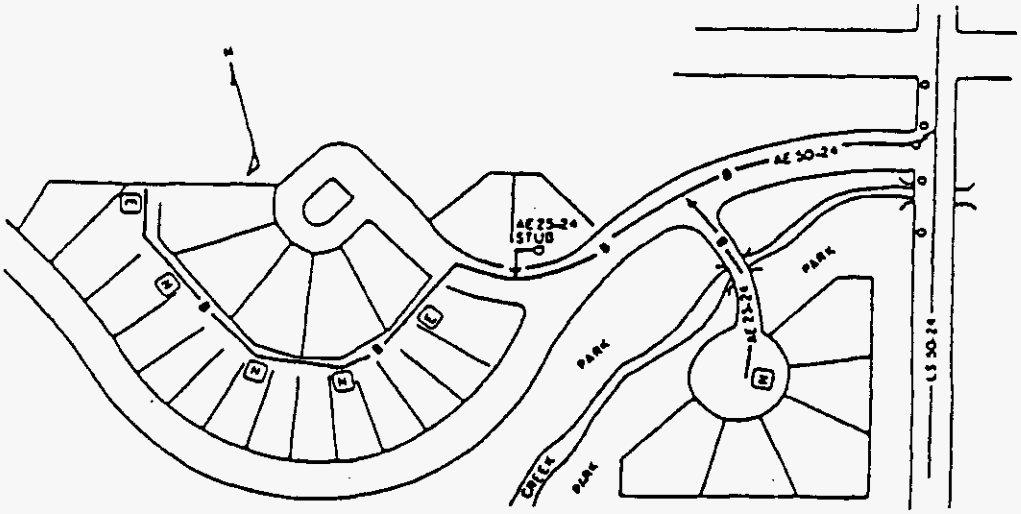


Exhibit 5

Burieo Plant ayout - Flush Construction



LEGEND

Ⓔ CLOSURE, ENTERABLE
Ⓝ CLOSURE, NONREENTERABLE
-B- BURIED DISTRIBUTION CABLE

NOTE: DETAILED LIMITATIONS OF CLOSURES ARE SHOWN IN THE 928 ?IVISION OF GTE PRACTICES.

Exnibit 6

Buried Distribution Plant - Rear Easement Method
Terminal Housing Construction

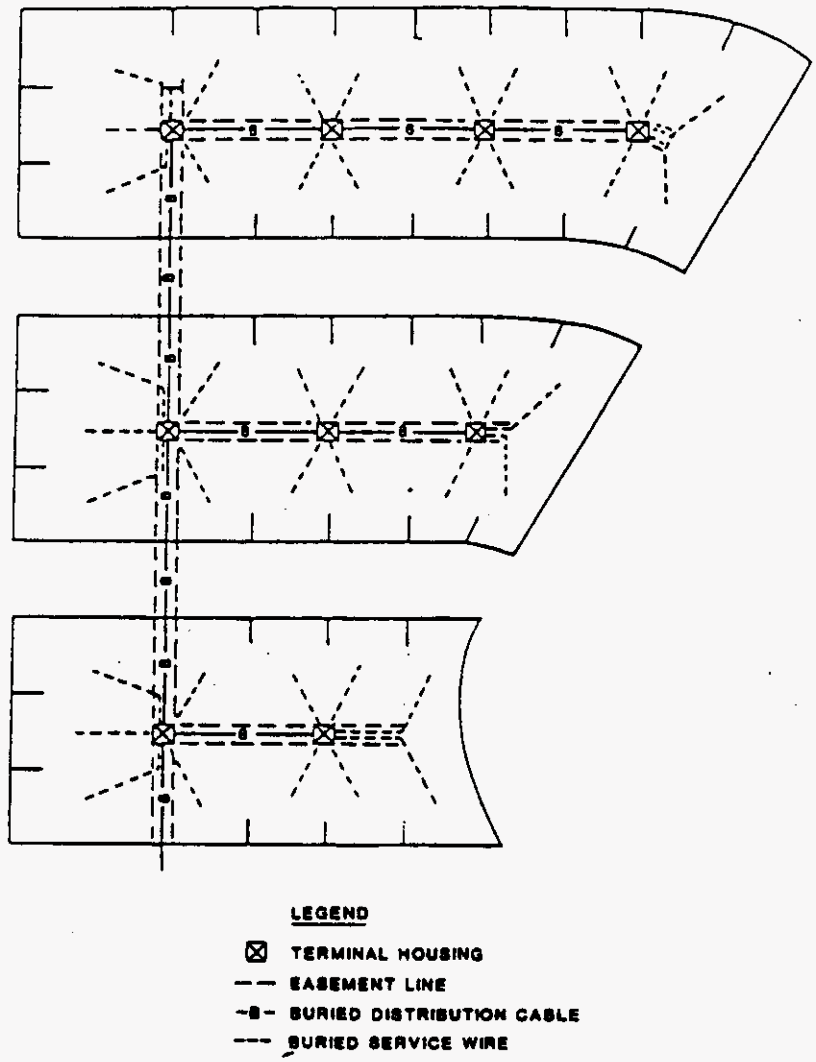
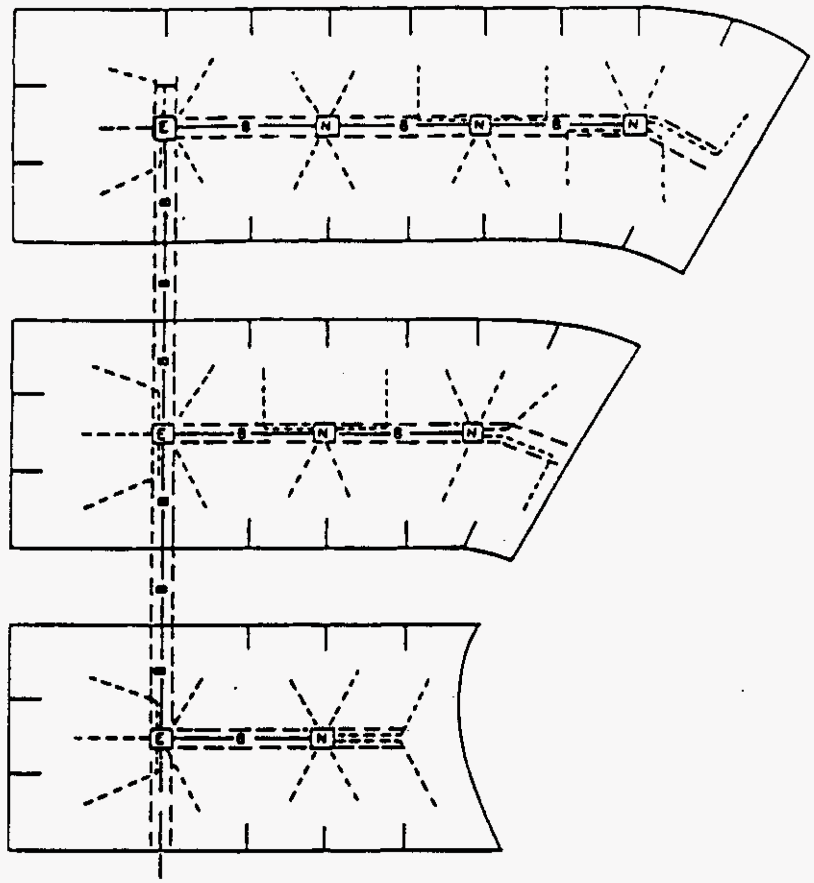


Exhibit 7

Buried Distribution Plant - Rear Easement Method
Flush Construction



LEGEND

- E CLOSURE, ENTERABLE
- N CLOSURE, NONREENTERABLE
- — — EASEMENT LINE
- —B— BURIED DISTRIBUTION CABLE
- - - - BURIED SERVICE WIRE

NOTE: DETAILED LIMITATIONS OF CLOSURES ARE SHOWN IN THE 928 DIVISION OF GTE PRACTICES.

Exhibit 8

Buried Distribution Plant - Front Distribution Method
Terminal Housing Construction

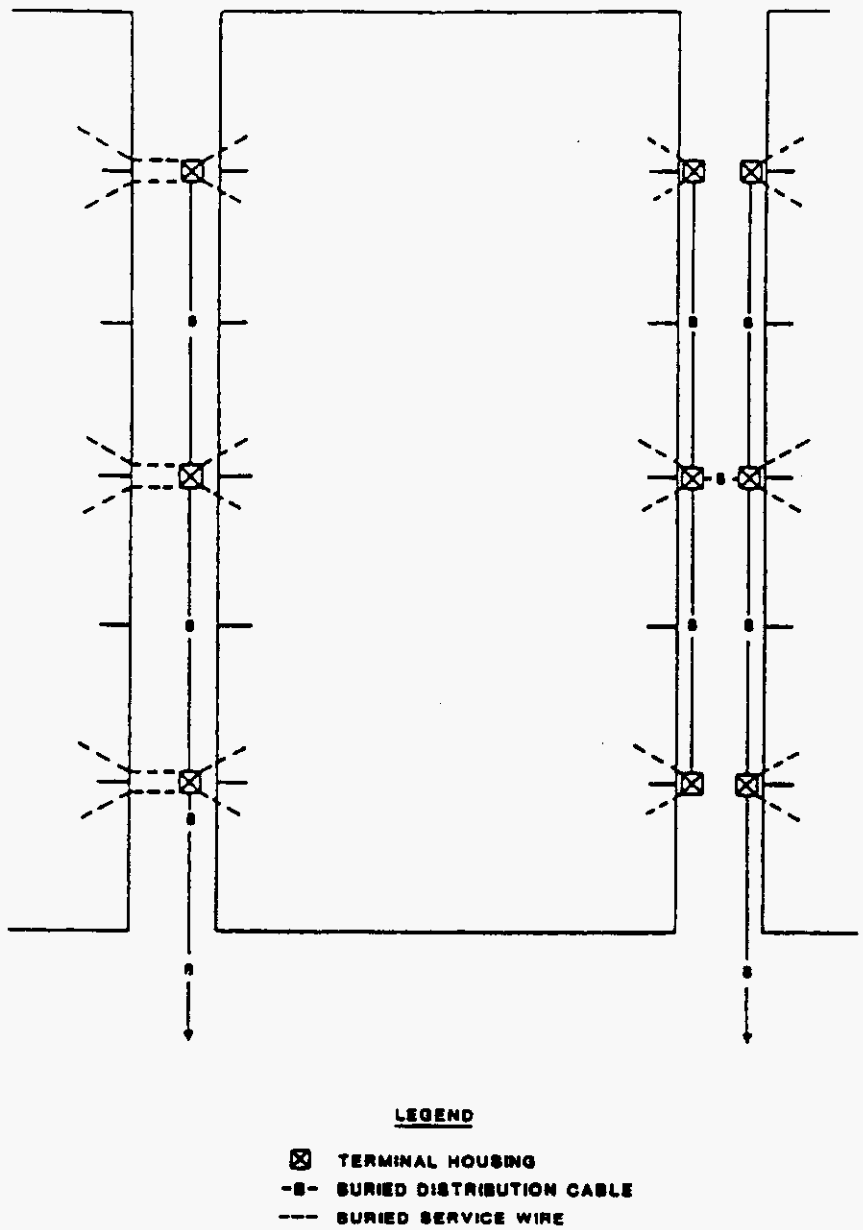
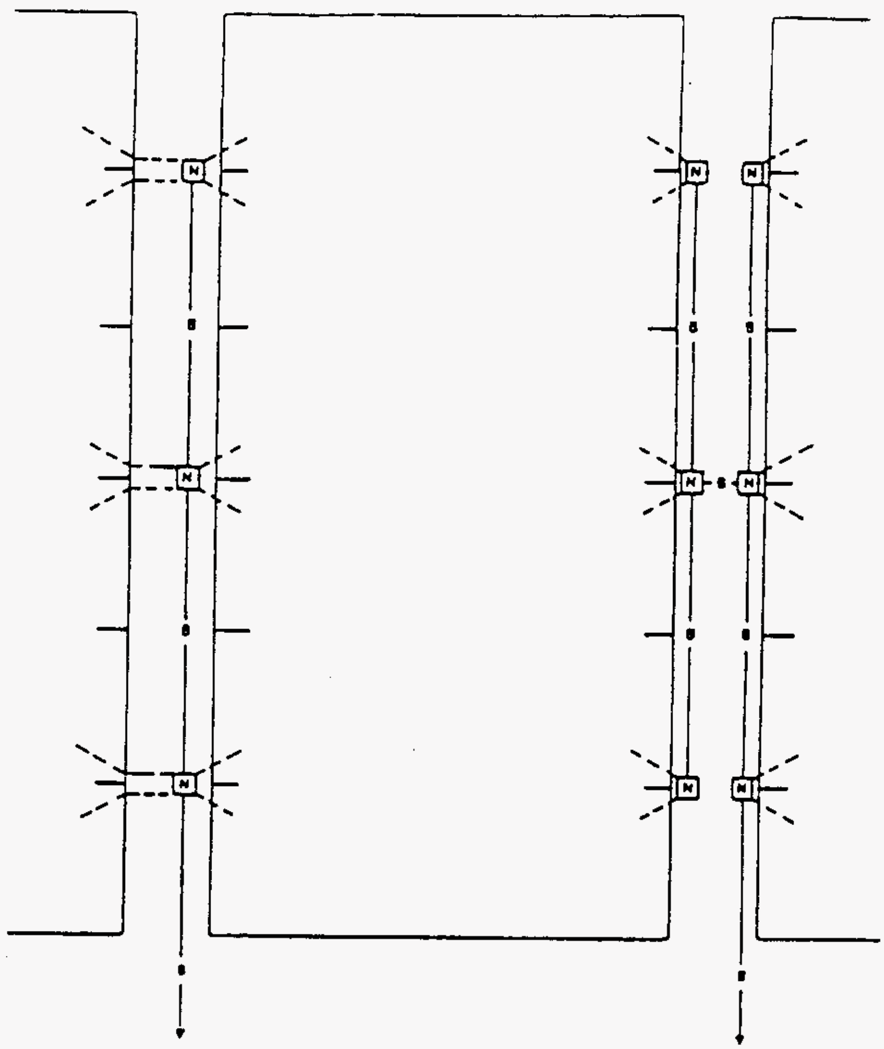


Exhibit 9

Buried Distribution Plant - Front Distribution Method
Flush Construction



LEGEND

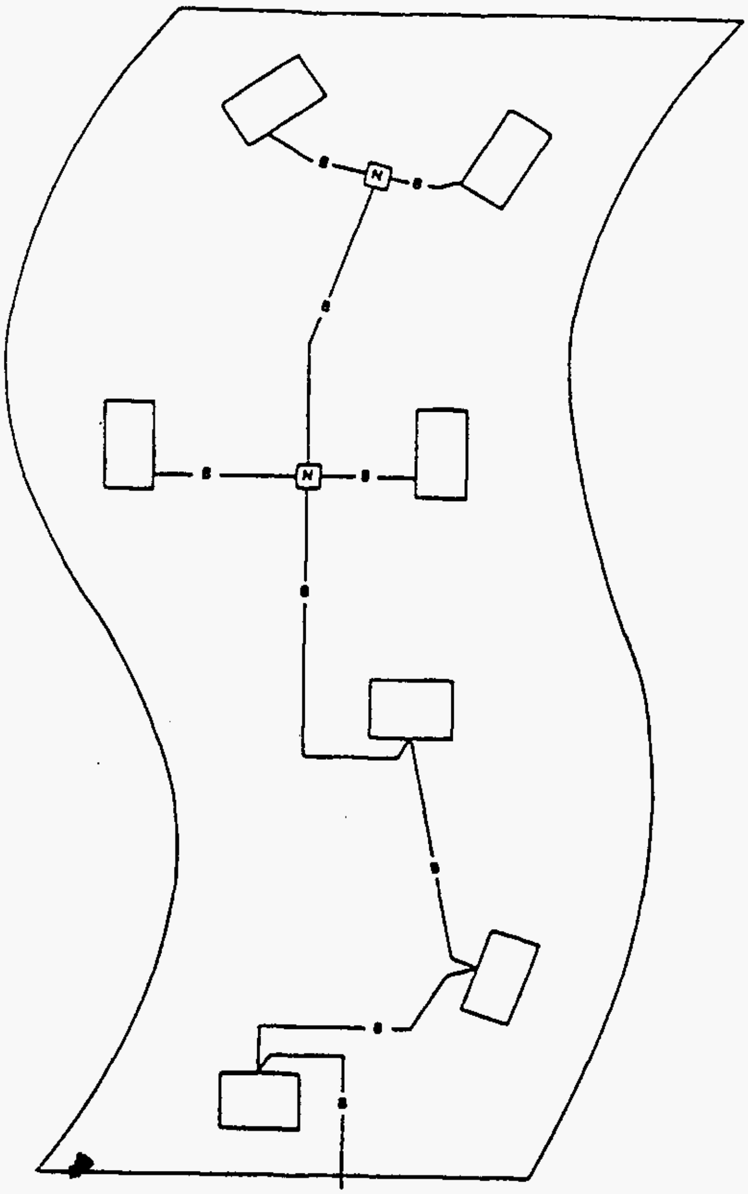
[N] CLOSURE, NONREENTERABLE
-B- BURIED DISTRIBUTION CABLE
--- BURIED SERVICE WIRE

NOTE: DETAILED LIMITATIONS OF CLOSURES ARE SHOWN IN THE 928 DIVISION OF GTE PRACTICES.

Exhibit 10

30 146

Buried Distribution Plant - Random Distribution Cable Placement Method



LEGEND

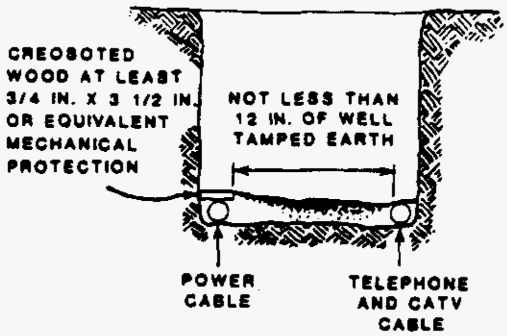
N CLOSURE, NONREENTERABLE

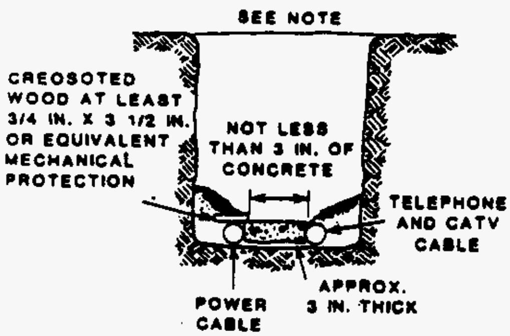
-B- BURIED DISTRIBUTION CABLE

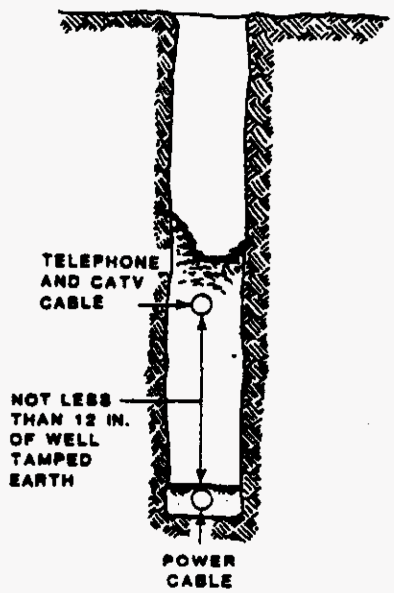
Exhibit 11

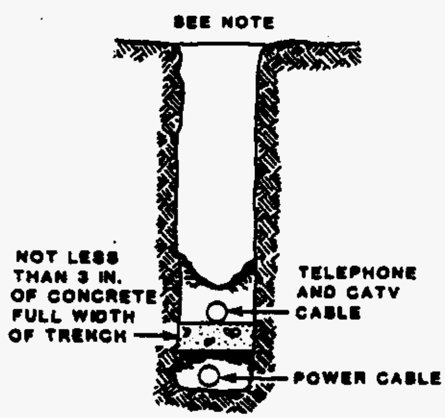
30 147

Joint Trenching - Fixed Separation









NOTE: National Electrical Safety Code requires agreement of authorities and all parties involved for any method providing less than 12-inch separation.

Exhibit 12

30 148

Nonjoint Trenching

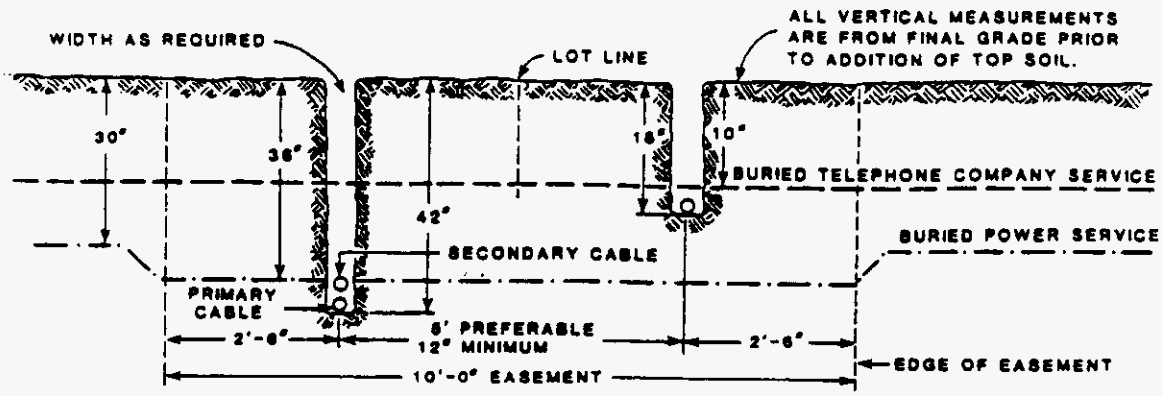


Exhibit 13

Location of Cable Trench and Terminal Housing Stake When Required

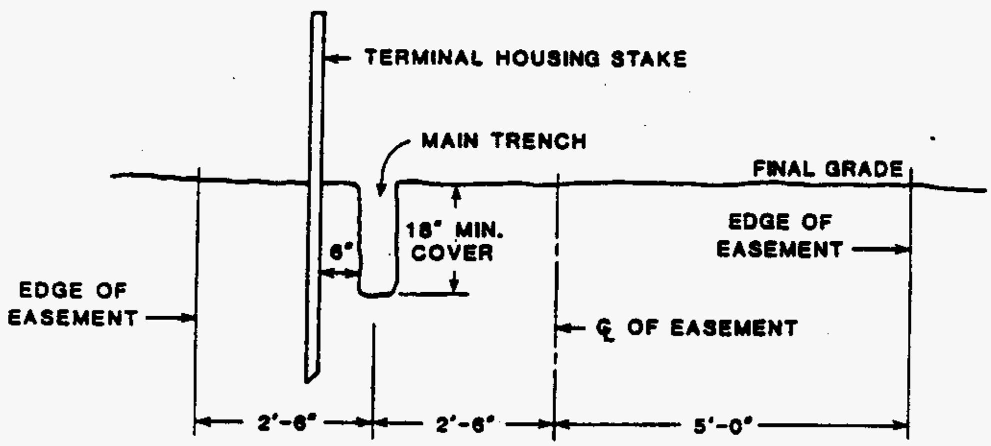


Exhibit 14

30 149

Joint Main Trench - Fixed Separation
For Telephone Facilities with Aluminum Tape Inner Shields

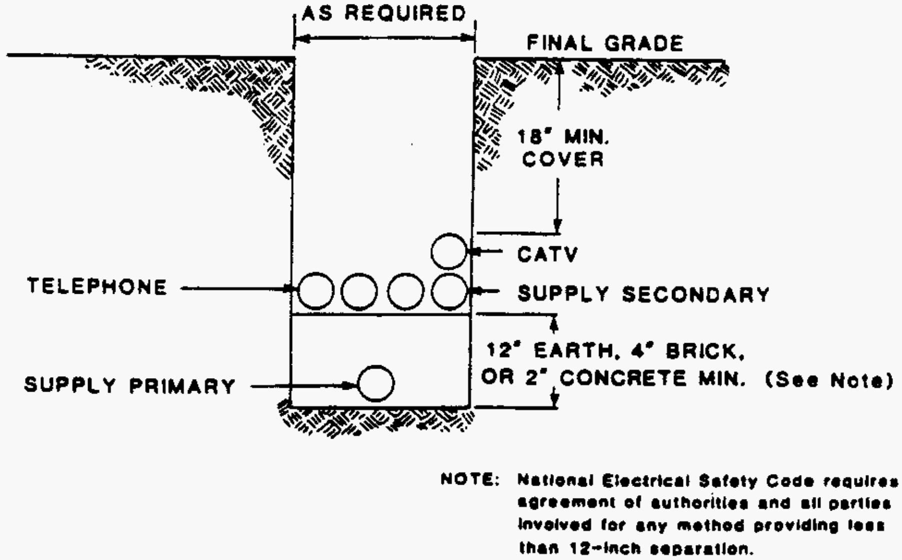


Exhibit 15

Joint Main Trench - Random Separation
For Telephone Facilities with Aluminum Tape Inner Shields

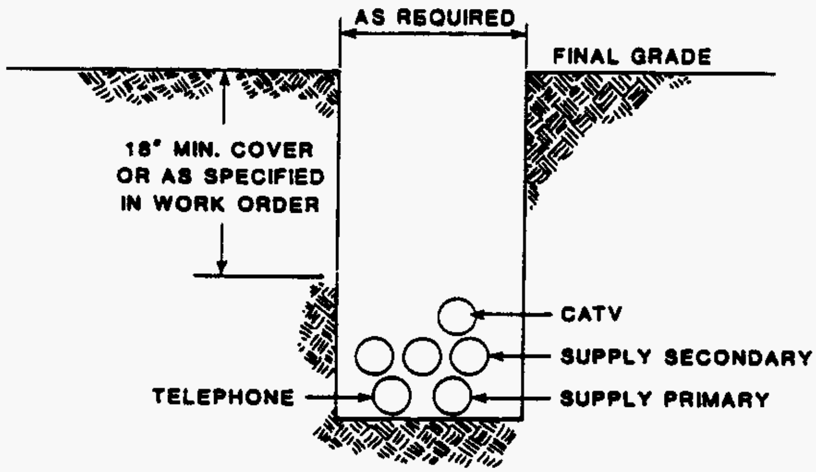


Exhibit 16

30 150

Joint Main Trench with Gas Line - Fixed Separation
For Telephone Facilities with Aluminum Tape Inner Shields

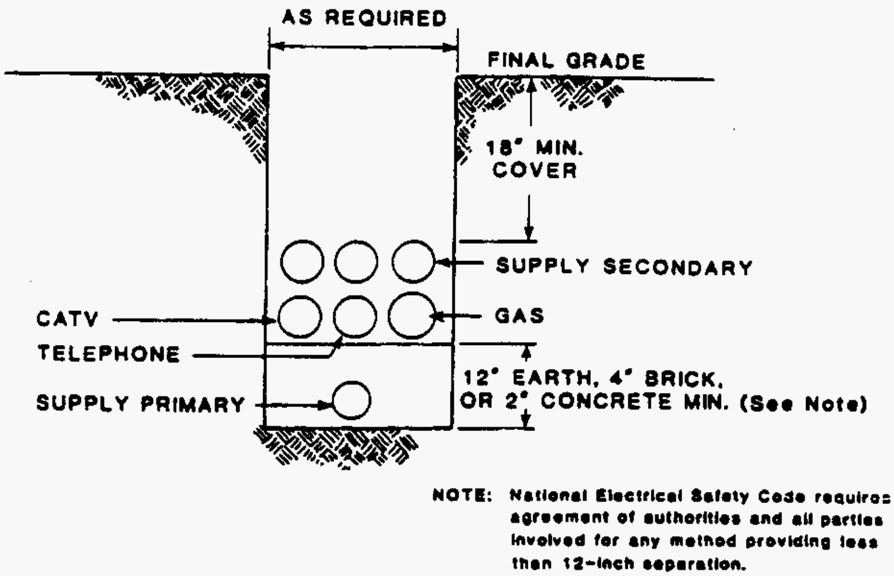


Exhibit 17

Joint Main Trench with Gas Line - Random Separation
For Telephone Facilities with Aluminum Tape Inner Shields

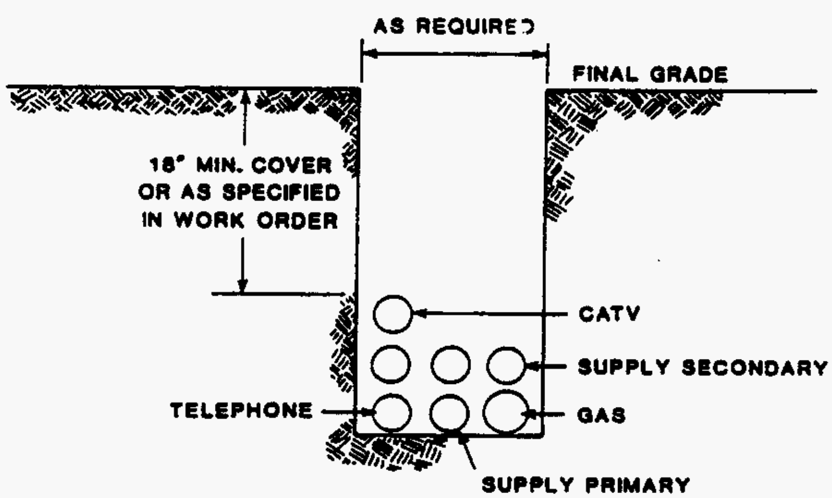


Exhibit 18

30 151

Joint Service Trench with Gas Line - Fixed Separation
For Telephone Facilities with Aluminum Tape Inner Shields

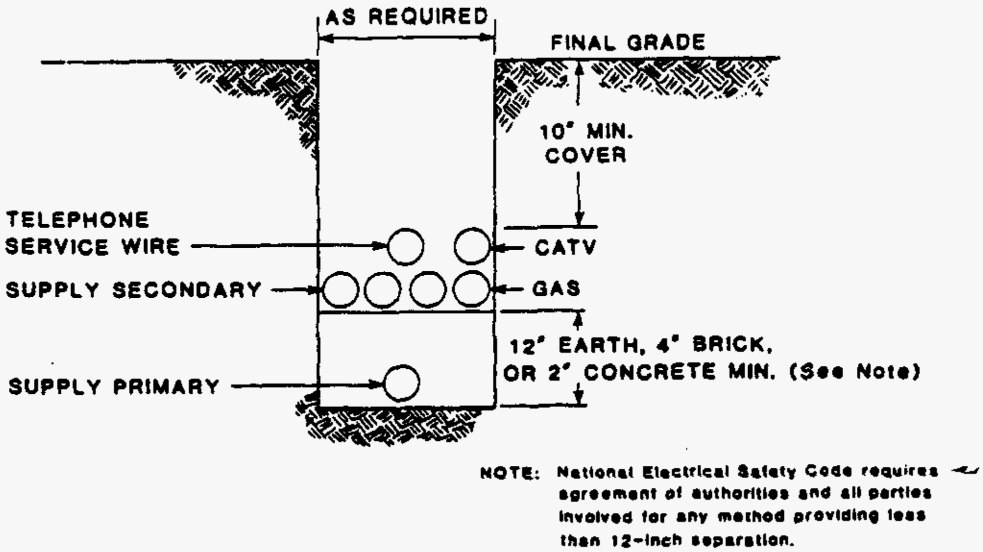


Exhibit 19

Joint Service Trench with Gas Line - Random Separation
For Telephone Facilities with Aluminum Tape Inner Shields

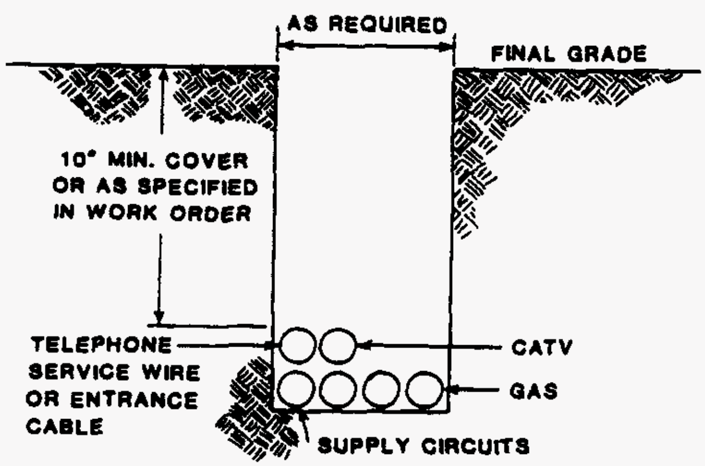


Exhibit 20

30 152

Joint Service Trench - Random Separation
For Telephone Facilities with Aluminum Tape Inner Shields

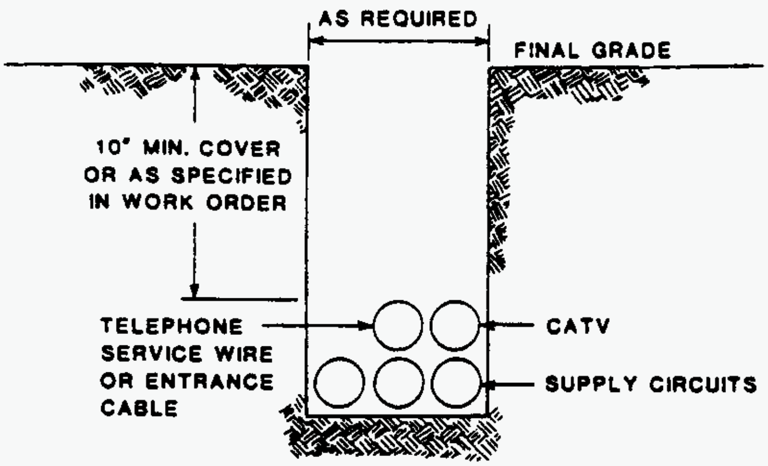


Exhibit 21

Joint Main Trench with Gas Line - Fixed Separation
For Telephone Facilities with Steel Strip Armor Shields

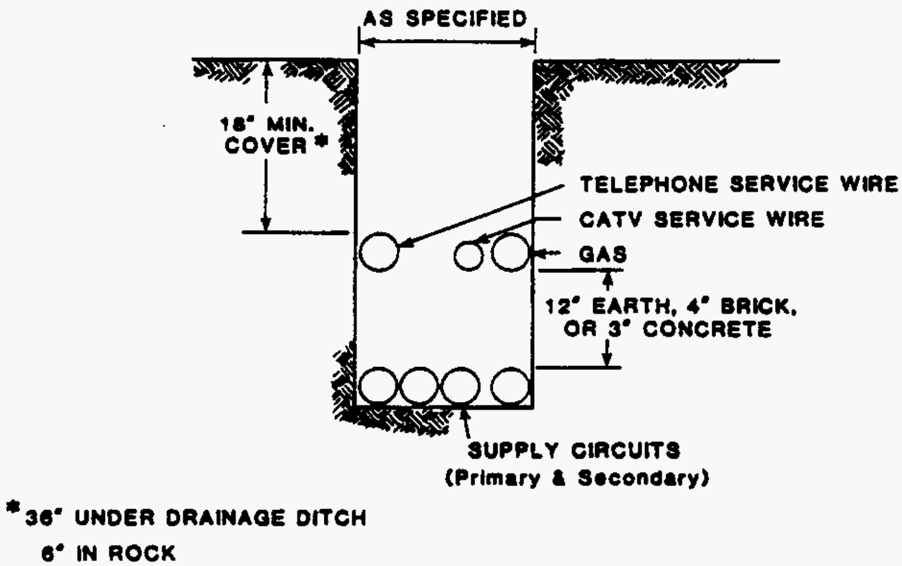


Exhibit 22

Joint Main Trench - Fixed Separation
For Telephone Facilities with Steel Strip Armor Shields

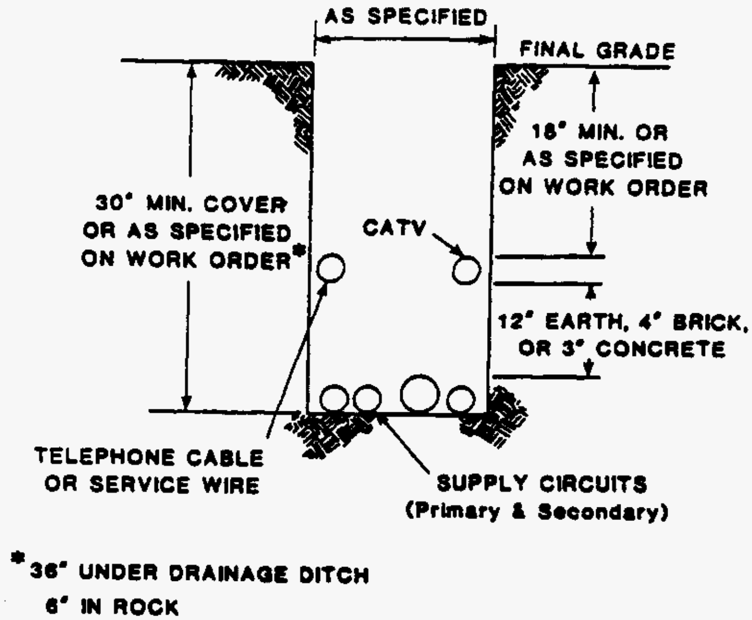


Exhibit 23

Joint Service Trench with Gas Line - Fixed Separation
For Telephone Facilities with Steel Strip Armor Shields

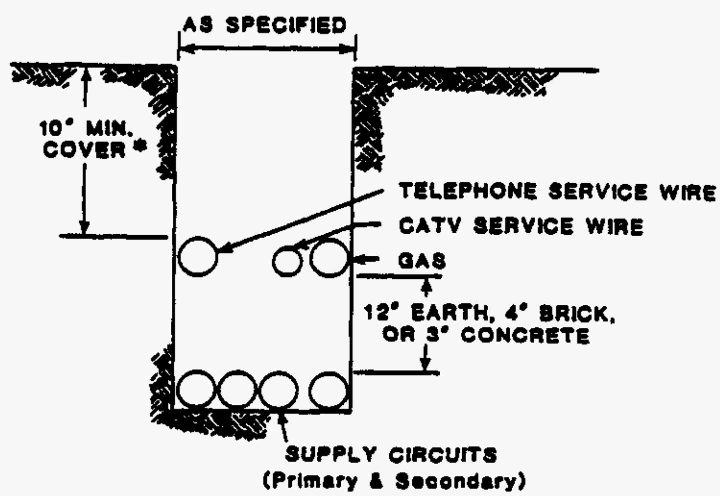


Exhibit 24

OUTSIDE PLANT
FACILITY AREA PLAN DESIGN

Contents

30 155

Contents: continued

GENERAL

Introduction

This practice explains the the Facility Area Plan (FAP) cable design concept that applies to new and existing outside plant feeder and distribution cable.

Previous network design standards have provisioned the Network for Plain Old Telephone Service (POTS), which was primarily composed of analog voice service. Today's standard positions the distribution network for compliance with ISDN basic access as well as POTS. This standard not only meets ISDN and POTS technical standards, but also preferred operational design standards.

The following list provides some of the key ingredients for the current distribution design standard:

1. Distribution network interface to the feeder network via a Facility Area Connector (Cross-Connect) of either the binding post or insulation displacement design.
2. Fixed Count terminals with threaded lugs or binding post connections equipped with Termseal or equivalent.
3. Sealed and unsealed plant construction.
4. No cable count multiplying in different cable legs.
5. Eliminate bridge tap conditions.
6. Absence of analog station/subscriber carrier.

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Filing — Remove the previous issue of this practice from the binder or microfiche file and replace it with this issue.

Definitions — The terms associated with facility area planning are defined below.

TERM OR ACRONYM	DEFINITION
Addressable Locations	For plant administration purposes, all services within a facility area must be identified by an address. This must be the address: o Specified by local government agencies. o Which the customer uses to identify the physical location of the housing unit or business location. Addressable locations include all existing and future: o Housing units. o Business locations.
Business Locations	A building used to house one or more businesses. These include: o Hotels. o Motels. o College buildings, etc.
Committed Pairs	Feeder cable pairs from the host or remote switching unit that are terminated on the feeder (IN) side of a connector. These cable pairs are: o Multiple-free. o Committed to a particular connector in 25-pair groups.
Customer Access Planning System (CAPS)	A mechanized system for the Demand and Facility (D&F) function for customer access facilities, given certain parameters. CAPS indicates the need for additional plant capacity. It replaced FAST by driving the outside plant forecast to the service section.

Definitions, continued

TERM OR ACRONYM	DEFINITION
Dedicated Pairs	Permanently assign cable pairs that have continuity from the central office main distribution frame or from a connector to a terminal.
Dedicated Fix Count Terminal	One pair is required for each service address served from this terminal and identified as a dedicated pair in Mechanized Assignment and Record Keeping (MARK) system. All other spare flex pairs are available to be assigned to any of these service addresses that fall within the wiring limits of that terminal. This terminal is compatible and has been identified as half-dedicated in the MARK system. All dedicated pairs are cut off at the serving terminal.
Digital Connectivity Capability (DCC)	Facilities that will support up to 144 kbs transmission requirements. That is, services which require up to this level of capability can be provided "on demand" with only special terminating equipment as required for the specific service. This capability is primarily a function of loop length parameters and grooming requirements for the copper network.
Distribution Facilities	Portions of facilities which are: o Located within a service section. o Designated to serve only customers within that service section. o With terminals for connection to service drops.
Electronic Service Area (ESA)	A geographical area that: o Consists of one or more service sections. o Is served directly by either a central office or digital pair-gain device.

Definitions, continued

TERM OR ACRONYM	DEFINITION
Electronic Serving Area (ESA), continued	The size of the ESA is bounded by transmission limits which will facilitate the provision of digital connectivity capabilities. These limits are characterized by a maximum distance (which approximates 12,000 feet or 5.5 DB non-loaded cable loss)from the central office or pair-gain device to the ESA outer boundary. "Theoretical" ESAs are those for which a pair-gain device itself has not yet been planned, based on economic or marketing criteria.
Facility Area	A well-defined geographical area. It's size is based on the number of housing units and business locations one FAC will serve. (Once the area boundaries are established, they should be documented on outside plant records.)
Facility Area Connector (FAC)	A device for connecting cable pairs that originate at a central office (or remote terminal) with the distribution cable pairs within a facility area.
Feeder Cable Route	One or more feeder cables that serve a defined geographical area.
Feeder Facilities	Portions of facilities which form a "back-bone" from a central office (or remote terminal) to and/or through one or more service sections.
Housing Unit	A single-family residence or each unit of a multifamily residence such as an apartment building.
Ready Access Terminal	Cable pairs are not dedicated to a service address.

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Definitions, continued

TERM OR ACRONYM	DEFINITION
Remote Terminals (RTs)	A digital system with switching or pair-gain capability. It supplements feeder plant by using T1 or fiber span line connection to the: o Host office. o Another remote switching terminal. o Corresponding central office terminal.
Service Section	A geographical area (normally designated by the current planner) which represents the smallest forecasted area, also known as a Service Area Location (SAL). **NOTE:** A service section can consist of one or more rural distribution areas; an ESA consists of one or more service sections.
SOD Terminal	Subsurface Out-of-sight Distribution terminal
Spare Flex-Dedicated Pairs	Pairs that are available to be assigned to any service address that fall within the wiring limits of that terminal. These pairs must be cut off at the serving terminal.

OVERVIEW

Applying FAP Concepts

Applying the FAP concept simplifies outside plant:

o Design.
o Construction.
o Administration.
o Maintenance.

Consider the FAP concept only when the total land usage is known and the ultimate pair requirements can be determined.

Use conventional designs in:

o Rural areas not suited to RDAP (See GTEP 938-010-071).

Applying FAP Concepts, continued

- o Urban areas where land usage cannot be determined. However, consider converting to the FAP concept as soon as knowledge of the land usage is available.

Do not use the FAP (as described in this practice) to serve predominantly business or industrial complexes because of the extreme changes in service requirements.

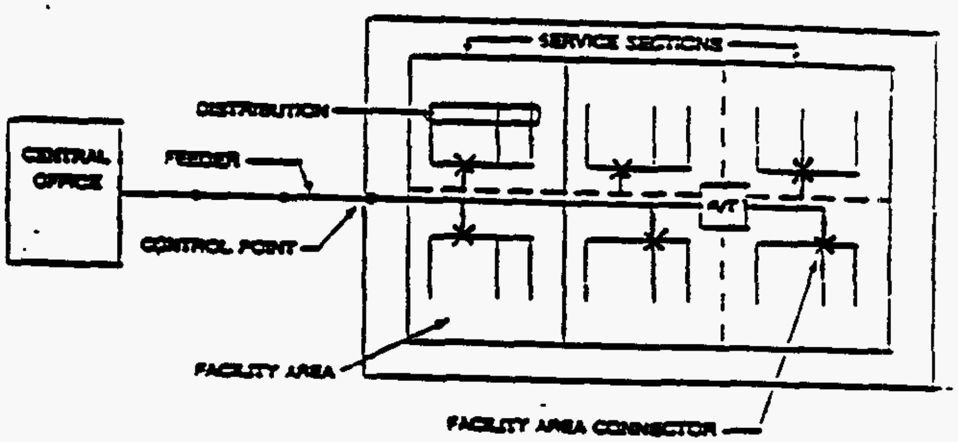
Furthermore, complexes containing large commercial and industrial sites will generally have complete complements of cable pairs connected from the Central Office (CO) to the site.

ESAs and DCC are compatible with the FAP concept.

Establishing DCC, however, requires:

- o Removing analog carrier systems.
- o Placing restrictions on loop limits.
- o Minimizing bridge tap.
- o Removing load coils and loop treatment devices on circuits assigned for digital services.

The following illustration diagrams an Electronic Serving Area (ESA).



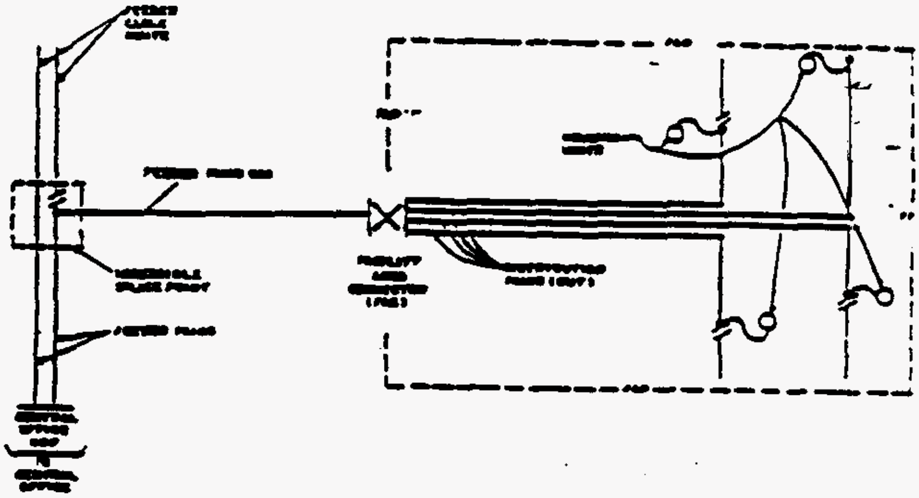
FAP Definition

The FAP design is ideal when it is applied to predominantly residential areas containing small businesses, providing that sufficient spare cable pair allowances are made to handle an unusual demands for service at the business locations.

The FAP consists of the following:

- o A clearly defined area (a facility area) with dedicated distribution cable plant.
- o A single cross-connect point for each FAC. It connects the distribution and feeder cable pairs.
- o Main feeder facilities sized on an economic selection basis.
- o Feeder pair complements provisioned to FACs to meet short-term line requirements, usually two to five years.

The following drawing illustrates the component parts of an FAP.



Party Line Bridging

At time of new construction, it is recommended to break existing party line field bridges. Only bridge party line service at the Main Distribution Frame (MDF).

FAP Objectives

The FAP concept is designed to:

- o Minimize recurring administration Installation and Maintenance (I&M) expense.
- o Maximize feeder cable usage.

This concept defers feeder cable relief as long as practical while rapidly meeting customer requirements.

Fap Objectives, continued

The FAP design concept is compatible with the CAPS.

This design concept is different from past design methods. Therefore, all departments involved in design, construction, and administration should have thorough training and understanding before they try to apply the concept.

FAP Benefits

The FAP concept:

- Improves a telephone company's ability to provide new service and maintain existing service.
- Minimizes cable and terminal rearrangements, as well as recurring installation and cable maintenance expense.
- Maximizes feeder cable usage.
- Improves transmission by eliminating the bridge tap(s).
- Simplifies feeder cable fill monitoring. Each facility area has only one interface monitor.
- Simplifies administration and promotes accurate records.
- Minimizes feeder cable administration.
- Adapts readily to mechanized feeder cable design procedures.
- Defines a standard design characteristic on which to build standard operating procedures.

FAP Designs - General

Because of existing plant conditions, not all areas will initially be able to adopt to pure FAP.

In FAP design, the following components exist:

- o Feeder cable and route design.
- o Facility area size and boundaries.
- o Connector size and location.
- o Type of construction to be used:
  - Aerial
  - Buried
  - Subsurface, out-of-sight construction (SOD)
- o Feeder pairs are committed to the connector in a minimum of 25-pair binder groups.
- o Distribution cables are sized based on the ultimate requirements of the facility area.
- o There must not be any multiplying of distribution cable pairs between two or more distribution cable legs.

Requirements

For designing all distribution cables and pairs within facility areas in both new or rearranged plant, the OSP engineer must see that the distribution cables will provide:

- o 1.25 or more pairs for each ultimate housing unit. Most upscale housing units will be provided a minimum of two pairs per unit.
- o Cable pairs for the ultimate business and miscellaneous line requirements.
- o Distribution cables are:
  - Multiple-free
  - Administered in groups of 25 sequential pairs. Only exception would be if smaller cables are used such as 6 and 12 pairs.
- o When distribution cable pairs serve housing units, the engineering forces must:
  - Permanently commit a dedicated pair from the connector to each ultimate housing unit, and sufficient spare flex-dedicated pairs to the terminal based on ratio selected.

NOTE: Cut all pairs off beyond the point of connection. There is no exception to this rule in FAP Design for new construction.

Conventional Design

Areas that do not qualify for FAP design must be designed or maintained under conventional cable design methods as described in other TELOPS Practices.

General Requirements

In-depth planning is a prerequisite of establishing a facility area. The distribution planning forces have this responsibility and facility areas must not be established in either new or existing plant until planning is completed for a given area or route.

The success of any design depends on:

- o In-depth planning.
- o Applying the fundamental principles of designing outside plant.

This part discusses the recommended step-by-step uniform study and engineering techniques used to:

- o Review outside plant facilities.
- o Establish a plan for implementing the FAP.
- o All new development, which meets the FAP criteria (provided earlier in this practice) should be built to FAP standards, unless specified otherwise (e.g. "Smark Parks" or "Smart Residential Developments/SRD's").
- o Network Operations Planning will identify rehabilitation of existing distribution areas to FAP design via the IC-Alt/PCM. Once an area is targeted for conversion to FAP design, the following detailed engineering is required.

Gathering Data

Use the following procedures to assemble material that will summarize and record the cable(s) fill data for working facilities within a FAP.

STEP	PROCEDURE
1	Obtain copies of the latest cable assignment records. If your area is converted to the mechanized assignment record system, get a <MARK> run.
2	Find the totals of the working cable pairs for each distribution cable on the cable records. Transcribe them to the appropriate space in the cable fill boxes on the cable schematic.
3	Use the cable schematic to enter the cross-sectional fill data at each cable taper or fill point on the cable(s). **NOTE:** Work from the extreme outer end of the cable network.

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4 Total each section of the cable network until you reach the FAC.

Make a field survey to learn the:

o Geographical features of the area.
o Existing outside plant situations and conditions.

The survey should give the locations of:

o All housing units or business locations under construction. This information is used to:

- Develop the near-future cable pair requirements.
- Determine the timing of relief, if necessary.

o All vacant property (include future use). This information is used to develop the ultimate housing units and business locations.

o Geographical features of the area. Define natural or man made boundaries such as rivers, lakes, railroads, highways, etc.

NOTE: Use outside plant records, subdivision plots, or building plans to record this survey data for future reference.

Future Pair Requirements

Develop the future pair requirements for each section of plant. Pair requirements can only be forecast after considering:

FUTURE NEEDS	DESCRIPTION
Pair requirements for existing housing units.	This decision is usually based on the characteristics of the area, e.g., whether customers in this area will require more than one pair per housing unit.
Pair requirements for existing business locations	Are the business locations commercial or industrial in nature? What is the potential for future business and special service lines?
Use of Vacant Property	Is the property zoned for business, apartments, or single-family residential? What are the owner's or developer's plans for the property? What is the timing of development?

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All of this information is necessary to determine the pairs required for the ultimate number of housing units and business locations in each section of plant.

The forecaster and the engineer must work together to determine future cable pair requirements. The information they use includes:

o Subdivision plots, zoning maps, housing and population forecasts.
o Interviews with owners, developers, and local planning people.
o Information obtained in the detailed field survey.
o Anticipate multiple-service requirements per unit.

An up-to-date, 20-year forecast that details location and circuit quantities is necessary to determine outside plant requirements for the present and future need. Use the forecast to obtain information for the cable fill boxes:

o Number of existing and ultimate housing units and business location.

o Short-term cable pair requirements, to include reroute.

o Ultimate cable pair requirements.

Record the data in the fill boxes by starting from the outer ends of the distribution cable to accumulate and record this information back to the FAC (see Exhibit 7, page 33).

Analyze Outside Plant Network

Using the information discussed in Gathering Data and Future Pair Requirements, the engineering forces must analyze the existing and forecasted requirements in each distribution section of outside plant to identify:

o Immediate or future facility shortages.
o Multiple conditions

This requires that the number of pairs shown in the short-term and ultimate space in each fill box be compared with the size of the existing cable(s). This will determine when the existing cable(s) will exhaust.

Engineering must also analyze all cables in multiple to determine when the multiple must be removed to allow for growth and/or digital connectivity. Mark the cable fill boxes to indicate:

o Short-term or ultimate cable pair shortages.
o Multiple problems.

Use the FAP design concept where the land usage is known and the ultimate cable pairs requirement can be determined. It is acceptable to use conventional design in urban areas where the land usage cannot be determined. When knowledge of the land usage is available; however, consider converting to the FAP design concept.

Apply the FAP design in these areas in accordance with the Overview part of the practice. FAP may apply in areas having small businesses intermixed with residential areas if sufficient spare cable pair allowances are made to handle any unusual demand for additional business and/or miscellaneous lines.

Define Facility Area Requirements

Define the facility areas and implement the plan for relief. After a plan for relief and the type of design is decided, the planning and engineering forces must analyze the information shown on the fundamental plan and cable schematic to determine:

- The ultimate number of housing units and business locations to be included in the facility area.
- The distribution cables which will require immediate or future relief or replacement.
- Where new distribution cables will be required.
- The immediate or future rearrangements necessary in the distribution cables and terminals.
- Where main feeder cable relief is required.
- Rearrangements necessary in the feeder cable(s).
- The boundaries of the facility area:

  Must be exactly documented in the outside plant records so that plant forces know which terminals, splice closures, or service connection points would be included.

  Should also be documented in the fundamental plan to ensure that future additions do not exceed the boundaries.
- How many immediate and ultimate feeder pairs will be required for the facility area. The connector size determines the size of the feeder stubs.
- How using committed feeder cable pairs at the connector affects the pair requirements for the balance of the feeder route.

After these determinations have been made, the details for implementing the FAP can be prepared.

FACILITY AREA

FAP Applicable Areas

The FAP applies to predominantly residential areas. Under the FAP design concept, the applicable areas are divided into geographical sections called facility areas.

These areas are established when:

o The land is zoned residential and development is in progress.
o Sufficient knowledge of the ultimate requirements are available.

While the FAP design can serve urban residential areas with scattered businesses, it is not desirable to apply FAP to strictly business areas because the requirements:

o Are difficult to anticipate.
o Fluctuate with the different types of business involved.

Facility Area Size

The size of the facility areas ideally ranges from 50 to 600 housing units plus small business requirements. It is based on the ultimate:

o Number of residential units, and
o Cable pairs for businesses and miscellaneous service.

The ultimate size of the facility area is based on:

o Economic size. Consider:

  - Usage of distribution.
  - Density of an area.
  - Size of the lots.

o Scattered businesses:

  - The capacity of the FAC may have to be increased to make allowances for these business services.

  - Predetermining the type of development, e.g., single or multi-unit.

  - If some portion of a developing FAP site is rezoned for multi-unit, garden, or high rise apartments, it may become necessary to divide the existing facility area into two or more facility areas.

  - This division should be effected as quickly as changes are known, to eliminate overextending the current facility area beyond its capacity.

Facility Area Boundaries

The facility area boundaries should follow natural or man-made boundaries, such as freeways, main thoroughfares, rivers, railroads, etc. where possible.

The facility area boundaries, once established, should:

o Constitute the ultimate boundary of the facility area.
o Not overlap any service section boundary.

Indicate facility area boundaries on work order(s) and construction prints.

Document the ultimate facility area boundaries on fundamental and engineering plans so that the boundaries are not exceeded in the future unless the original conditions under which the facility area was established have changed. See Facility Area Size.

Facility Area Identification	The facility area identification scheme should be compatible with the Mechanized Assignment Record Keeping System (MARK) in the local operating company.

DISTRIBUTION CABLE DESIGN

Recommended Design	FAP - Design is the ideal design and should be the first consideration for all new areas that qualify. Use the most economical adaptation to gain the benefits of the FAP design with a minimum of capital and expense cost at the earliest practical date.
Distribution Cable Size	Size all facility area distribution cable on the basis of the availability of the best housing unit information and estimate the service growth. All distribution cable within a facility area should generally extend from the connector in its own sheath even when it extends parallel to a feeder cable, unless there are substantial cost savings in combining them.
Distribution Cable Gauge/ Loading	Gauge distribution cables by using either the Expected Measured Los (EML) or the Resistance Engineering to Measured Limits (REML) transmission design procedures. **NOTE:** These are outlined in the 832 and 938 divisions of TELOPS Practices. Generally, there should be no loading required in the first 12 kft of the base or remote serving area. If loading is required on any customer service within the facility area, the load coil spacing must be compatible with the loading arrangement used in the feeder cable complement that serves the loaded distribution complement. Special service lines, Private Automatic Branch Exchange (PABX) trunks, data circuits, etc., that require loading need individual attention; however, for administration purposes, such circuits should be contained within one or more 25-pair cable binder groups in the feeder cable. In the distribution cable, it may be advantageous to load the entire 25-pair cable complement.

Distribution Cable Count

Distribution cable pairs terminated in the connector are assigned a consecutive pair count starting at pair one regardless of the number of distribution cable sheaths. The assignment of pair count to cables in the distribution network is on the basis of uniform 25-pair binder groups.

Terminate those cable pairs planned for ultimate use when a distribution cable is placed in a connector. All distribution cables leaving a connector should not have any dead pairs or dead complements. Only exception would be if the ultimate requirements were 700 pairs and you placed a 900 pair-cable, you would not terminate the additional 200 pairs.

Distribution Terminals - FAP

Local conditions will usually dictate whether SOD construction or buried terminal housing type construction should be used.

All distribution terminals must be:

- o Fixed count whether buried or aerial.
- o Given an assigned count ranging from a minimum of 1.25 cable pairs per housing unit. to 2.0 plus per housing unit. Good engineering Judgment will dictate this ratio.
- o All new construction FAP'ing should employ consecutive ascending cable counts in distribution terminals.
- o Additional consideration should be given to providing consecutive ascending counts to distribution terminals when existing cable/distribution terminals are being replaced (drop rearrangement is already necessary).

All distribution terminals must be identified. All terminals counts must be assigned by the engineering department.

Terminal Count

The count of a terminal may include any group of numbered pairs contained in the count of the cable to which it is spliced. This count should usually be consecutive, but at times require that a split count be used. Consider the concept that terminal counts should not split 50-pair groups.

Establishing terminal counts upon conversion to fixed-count terminals should be coordinated with service office assignments. In order to minimize physical rearrangements, consider that recorded pair counts (posted to location records) will:

- o Be broken in many cases.
- o Not follow a sequential pattern of numerical ascending order.

Use good engineering judgment to ensure proper count.

o Correct T123: 3 + 6 - 8 + 27 - 31 + 34
o Not correct T123: 27 - 31 + 34 + 3 + 6 - 8

NOTE: Avoid this type count. All new cable terminals must have consecutive fix counts assigned.

Replacing Terminals

When replacing terminals, the sizing should be based on existing need by using:

- o Assignment records.
- o Recorded subdivision plats, where available.
- o condition of existing units.
- o Type of service.
- o Existing congestion and pair spread of existing terminal.
- o Potential for additional growth.

FEEDER CABLE DESIGN

Requirements for Design

This concept does not involve any changes in the design of feeder cables. It does require:

- o Forecasting growth in well defined geographic areas.
- o Provisions for complete interconnection between distribution and feeder plant.

This permits the orderly and efficient use of feeder facilities with a minimum of future rearrangements.

Commitment of Feeder Pairs to a Connector

They are permanently committed to the connector in 25-pair complements. In no case must less than a 25-pair complement be committed.

As the number of feeder pairs are terminated in the "IN" portion of the connector, pairs committed may have to be activated at the splice in the feeder cable.

Assigned feeder cable pairs in the connector must be multiple-free in a minimum of 25-pair groups.

Adequate feeder cable pairs must be assigned to a connector to provide for:

- o Existing service.
- o Approximately two to five years of forecasted growth within the facility area involved.

o If a connector is placed to serve an industrial or multi-tenant business complex, reserve "HI-CAP" transmit and receive complements in the feeder and do not terminate them into the "IN" portion of the connector. Network Operations Exchange Planning should determine the size of these complements. This is done to protect these circuits from work person error.

Once a feeder cable pair complement is committed to a connector, it must not be reassigned to another connector or another use, by OSP engineer.

Committed feeder cable complements must not appear in more than one connector. If two or more 25-pair cable complements are committed to a connector, do not begin assigning in the second complement until the first cable pair complement is filled.

Committed feeder cable pair complements must not have distribution terminals or distribution cables in the feeder cable connected to these committed complements.

When a feeder cable complement is committed to a facility area, cut off the complement beyond this point. This arrangement will eliminate multiples or bridge tap on the feeder complements committed to the facility area.

Nonloaded feeder complements will be provided in all commercial/industrial areas up to 18 kilofeet (minimum of 5 percent of total assigned complement), unless pair gain is colocated with FAC. These pairs may be reserved for future digital systems. Physical pairs used for PABX trunks exceeding 12 kilofeet will require loading.

FACILITY AREA CONNECTOR

Connector Definition

The connector is a device for interconnecting feeder plant to distribution plant. Feeder and distribution cable pairs are fully terminated to facilitate interconnection of any distribution cable pair to any feeder cable pair.

Company forces should be thoroughly trained to install and maintain the connector because it is entered frequently. Proper installation and maintenance are critical.

Connector Size

Size the connector, for the ultimate requirements of the facility area, whether it is placed in new or existing plant.

Determine the size of the connector by the total number (ultimate) of cable pairs to be terminated, both feeder and distribution. An example of connector sizing follows:

NOTE: Conditions may exist whereby you may elect to feed a new FAP area out of an existing connector in close proximity that has sufficient idle capacity.

Connector Size

STEP	SIZING THE CONNECTOR
1	Assume that a serving area will ultimately contain: o 380 housing units o 20 business locations
2	Provide a minimum of two pairs per housing unit for the distribution and assume that: o 1.5 pairs per unit would satisfy the feeder requirements. o Assume the 20 business locations will ultimately require 110 pairs.
3	Multiply the number of housing units (380) by 2.0 pairs. Add pairs required for business locations (110) to determine the total distribution requirement (870).
4	Multiply the number of housing units (380) by 1.5 pairs, then add pairs required for business locations (110) to determine the total feeder requirements (680).
5	Determine the connector size: o Take the largest cable pair requirement (870), normally the distribution. o Double the amount. o This equals the sum (1,740) of terminations required for the connector.
6	The connector selected (1,800 pairs) should be the nearest size larger to the ultimate number of terminations (1,740) required.

NOTE: The estimates used are for this example only. Individually determine the allowable number of pairs (either feeder or distribution) f(· each unit in the facility area.

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Cable Terminations

Cables terminated in the connector must be even-count cables in:

o 24- or 26-gauge filled cable.

You may combine "In/Out" in the same sheath or place separate cables for feeder and distribution pairs. Distribution cables may be added to the connector at any time, but there is no provision within the connector for storing:

o Pairs planned for future use.
o Unused pairs.

NOTE: Terminate pairs planned for future use when placing cable. Consideration should be given to terminating-filled cables directly into the FAC, thus avoiding cost of a stub and additional splice.

Size the connector feeder cable stub to facilitate the ultimate number of connections on the feeder portion of the connector. Terminate all feeder pairs and show then on the work order, whether initially committed or dead.

Connector Location

The engineering forces must:

o Use good judgment in selecting the physical location of the connector.

o Remember that all initial and future interconnections or rearrangements for service will be made at the connector.

o Allow room for the doors of the connector to open fully and provide adequate work space around the connector.

o Location detail must indicate the exact location of the connector.

o Should be placed on easement when possible.

The location of the connector within the facility area is an important economic factor. Place the connector in the quadrant of the facility area nea st the feeder cable (Exhibits 4 and 5).

Studies have shown that the location of the connector can affect the distribution cable's conductor footage by as much as 40 percent.

Because the connector determines the distribution network layout and cable sizing the location shown in Exhibit 4 would be the most economical for facility areas that have streets parallel to the feeder cable route, and the location shown in Exhibit 5 would be the most economical for facility areas that have streets perpendicular to the feeder cable route.

Engineering should plan the physical location of a connector in terms of:

o Its permanency, since the physical location of a connector is expensive.

o The public relations involved, i.e., the connector should be acceptable to property owners and others.

Connector Location, continued

The engineering forces must consider:

LOCATION CONSIDERATIONS	DESCRIPTION
Accessibility	The work force must have access to all sides of the connector and arouse a minimum of objection from the public.
Safety to employees and public	The location must provide safe working and parking conditions.
Vulnerability to damage by vehicular traffic	The site should be away from traffic, if possible.
Danger of flooding or standing water	The site should be on high ground.
Vandalism	Minimize the possibility of vandals damaging the connector.

The exact connector location must be shown on construction drawings.

NOTE: It may be advisable to secure a permanent easement and, in some cases, to lease or purchase a small parcel of land for the connector site.

Connector Identification

Make the FAC identification scheme:

- o Compatible with the local operating companies mechanized record systems.
- o Flexible to allow for:
  - The differentiation of FACs from remote terminal (RTs).
  - Reporting purposes.

The following connector information is required on all orders:

- o Identification
- o Type and size
- o Cable pair "I :" count
- o Cable pair "OUT" count

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General Information

Not all existing residential areas are qualified to convert to the FAP. Good candidates are residential areas where:

o The development is nearing the ultimate housing capacity.

o It appears that converting to this concept could gain feeder pairs in the feeder route.

Before establishing facility areas in existing plant, distribution planning forces must:

o Lay out the plan for the ultimate requirement of the entire area.

o Determine how the separate sections of the distribution plant will ultimately fit together (see In-Depth Planning Required).

Complete conversion of an entire feeder cable route is not necessary under the FAP design because a feeder cable route can be completed gradually (as found desirable).

This will allow locations undergoing change to be deferred until a more stable condition prevails. While conversions of entire feeder cable routes are sometimes practical, it appears that conversion of each facility area on an as-required basis:

o Is effective.
o Will yield a steady improvement in operation cost.

Convert conventional plant to facility area plant at the proper time. The planner should monitor such areas and convert them as soon as economically viable.

The smaller distribution cables are generally adequate, or a minimum amount of new cable will provide relief. Some rearrangements of the feeder cable and/or distribution cables are required initially to convert to the FAP design.

This is necessary because the plant must be adjusted to:

o Conform to a discrete geographical area and the location of the connector.

o Permit assignment of full feeder cable pair complements to a connector.

Once the rearrangement is complete, future relief should generally require additions primarily to the feeder cable plant (Exhibit 7).

Base the actual timing of FAP implementation in a particular area (assuming the area qualifies) on specific requirements. Give priority treatment to areas with:

o A need for relief.
o High transfer rates.
o Poor outside plant conditions.

General Information, continued

The planning forces must analyze the existing and forecasted requirements to determine what plan to pursue.

The following criteria should be considered when determining the appropriate actions in conjunction with existing facilities:

1. Sheath consolidation should be considered when cable sizing permits (emphasizing replacement of maintenance prone sheath types such as lead, pre-73 Alpeth, buried air core PIC, etc.).

2. Where existing sheath augmentations are required, the additional cost to rearrange and fix count existing distribution cable and terminal counts in conjunction with the new sheath and terminals should be compared to the total cost of a new sheath arrangement (rearrangements are more straightforward and, therefore, potentially more economical via the total new sheath approach. This is particularly true in short cable legs).

3. Planning identified facility area consolidations or rearrangements would only be considered in conjunction with incidental activity if cable complement requirements necessitated connector replacement.

Feeder Cable

At the cutover of a new connector, the committed pairs should be sufficient to cover cutover plus a two- to five-year growth. To convert existing multipled feeder cable to the FAP design, follow the procedures in:

o Facility Area Plan Design.
o In-Depth Planning Required.
o Facility Area.
o Distribution Cable Design.
o Feeder Cable Design.
o Facility Area Connector.

Distribution Cable

Each facility area must have only one cross-connect terminal. During conversion remove any type of cross-connect facility located within an area being converted to a facility area.

Distribution cables within established, existing plant of a facility area must meet the requirements as described in "Facility Area Plan Design".

In the connector, try to let customers continue to use the cable pairs they were originally using, but realize that some rearranging in the connector may be necessary to group working feeder pairs into as few complements as possible.

Distribution Terminals

Cable pairs must be available for conversion in each distribution terminal. At this time, correct:

o All service wire out of the limits of the proper terminal.
o Other undesirable drop-wire routing or conditions.

Ready-access terminals and/or buried terminal housings in existing cables must be:

o Converted to fixed count as work is required.
o Given a count not exceeding one 50-pair cable binder group.

FACILITY AREA PLAN SYMBOLS

See TELOPS Practice 018-000-003 for standard FAP design symbols.

LIST OF EXHIBITS

EXHIBIT I

FAC Schematic and Cable Pair Designation

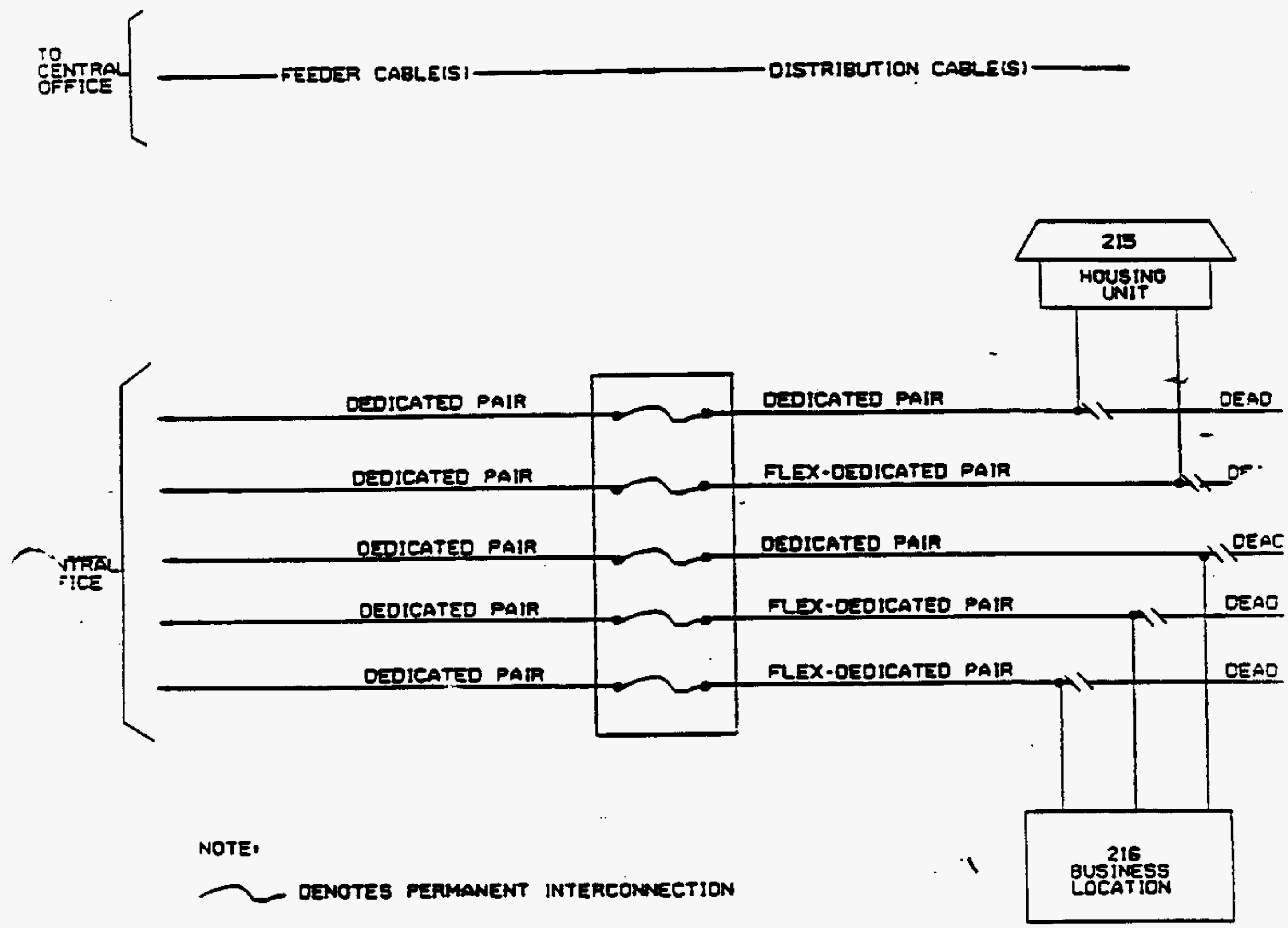
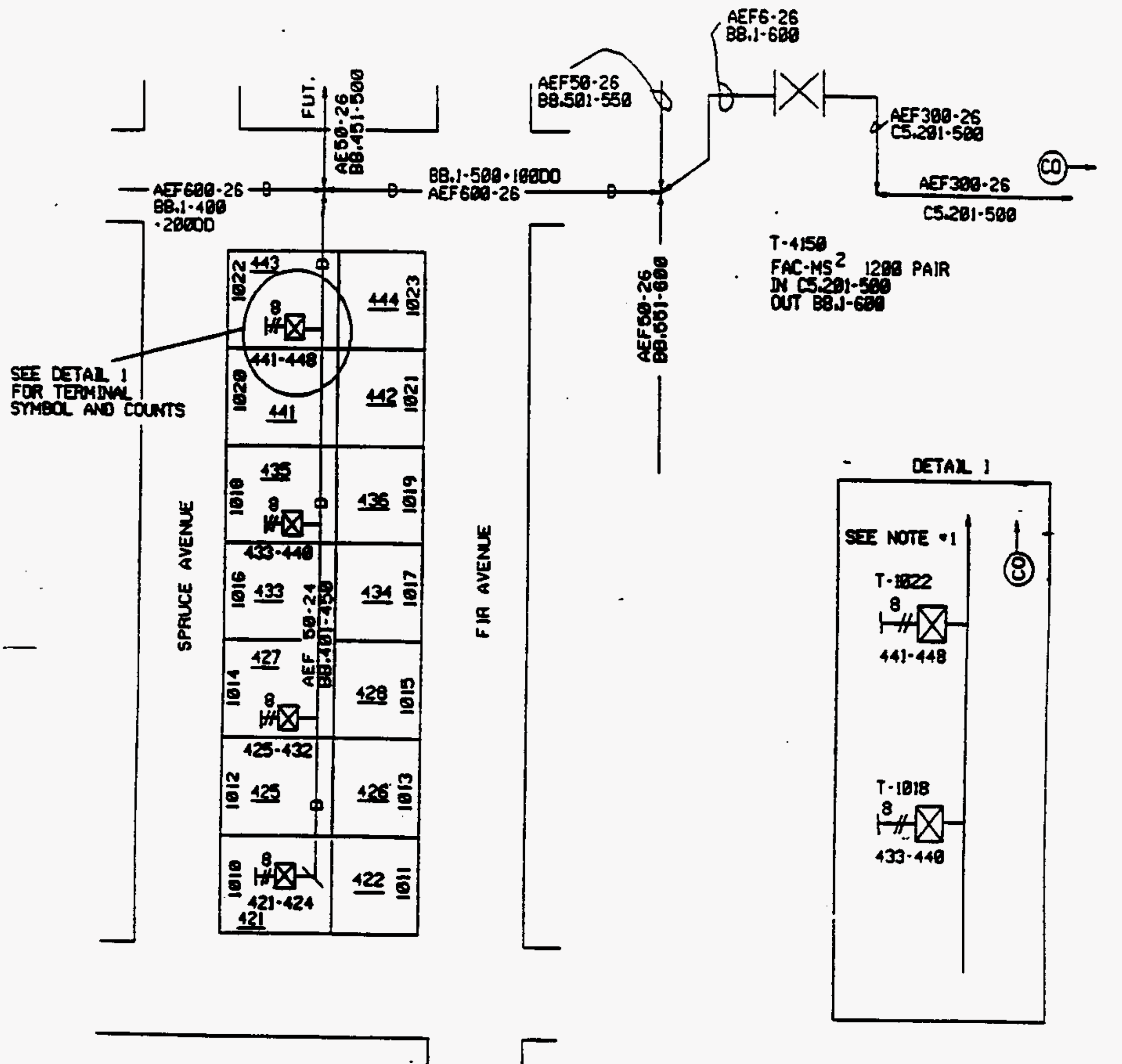


EXHIBIT II
TYPICAL DISTRIBUTION
CABLE SYSTEM
FACILITY PLAN (FAP)



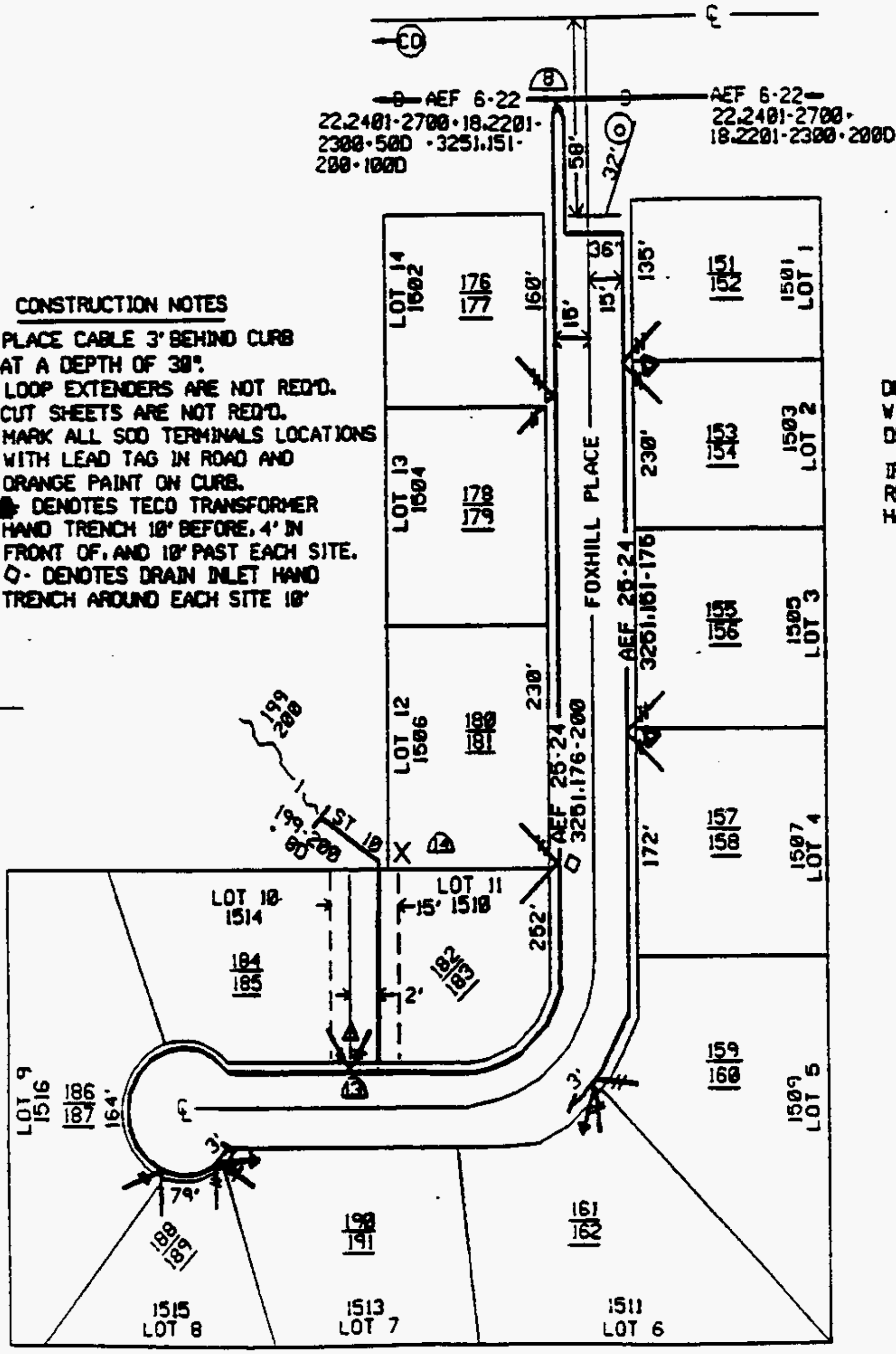
NOTE *1
- AT T-1022 PAIRS 441-444 ARE DEDICATED TO A SERVICE ADDRESS. AND PAIRS 445-448 ARE FLEX-DEDICATED PAIRS THAT CAN BE ASSIGNED TO ANY ADDRESS SERVED BY THAT TERMINAL.

- PROTECTED LOOP THROUGH PEDESTAL
- FLEX-DEDICATED FIXED COUNT
- ├─// HASH MARK INDICATED ALL PAIRS ARE CUT OFF AT SERVICE TERMINAL
- 441 IS A DEDICATED PAIR
  445 IS A FLEX-DEDICATED PAIR

EXHIBIT III

FACILITY AREA PLAN (FAP)

SOD CONSTRUCTION



CONSTRUCTION NOTES

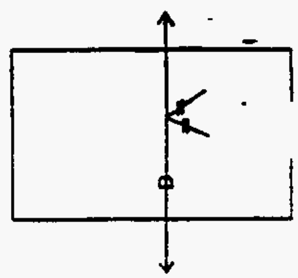
1. PLACE CABLE 3' BEHIND CURB AT A DEPTH OF 30".
2. LOOP EXTENDERS ARE NOT REQ'D.
3. CUT SHEETS ARE NOT REQ'D.
4. MARK ALL SOD TERMINALS LOCATIONS WITH LEAD TAG IN ROAD AND ORANGE PAINT ON CURB.
5. ▲ DENOTES TECO TRANSFORMER HAND TRENCH 10' BEFORE, 4' IN FRONT OF, AND 10' PAST EACH SITE.
6. ◇ - DENOTES DRAIN INLET HAND TRENCH AROUND EACH SITE 10'

NOTE:

IN SOD CONSTRUCTION ONLY!

DUE TO THE FACT THAT THE FUSE WIRE IS 2 PAIR, THE ENGINEER WILL DEDICATE 2 PAIRS PER SERVICE ADDRE

IF ADDITIONAL SPARE FLEX-PAIRS ARE REQUIRED, THE ENGINEER NEEDS TO HAVE ADDITIONAL FUSE WIRES CUT IN.



- SOD TERMINAL
- NON-REENTERABLE
- FUSEWIRE HAS A FIXED COU
- PAIRS ARE CUTOFF IN THE SPLICE.

EXHIBIT IV

LOCATION OF CONNECTOR STREETS
PARALLEL TO FEEDER CABLE ROUTE

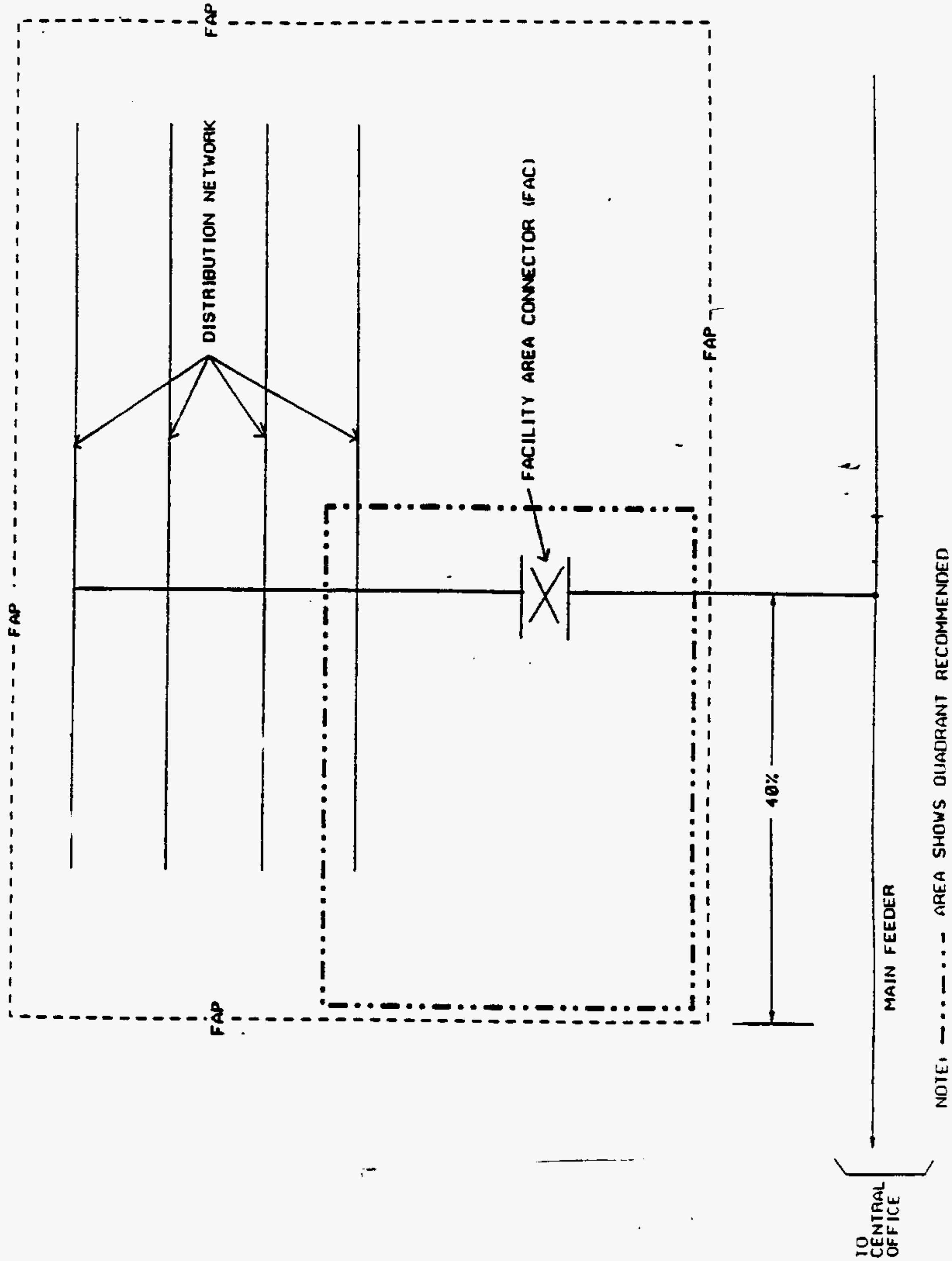


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EXHIBIT V

LOCATION OF CONNECTOR STREETS PERPENDICULAR TO FEEDER CABLE ROUTE

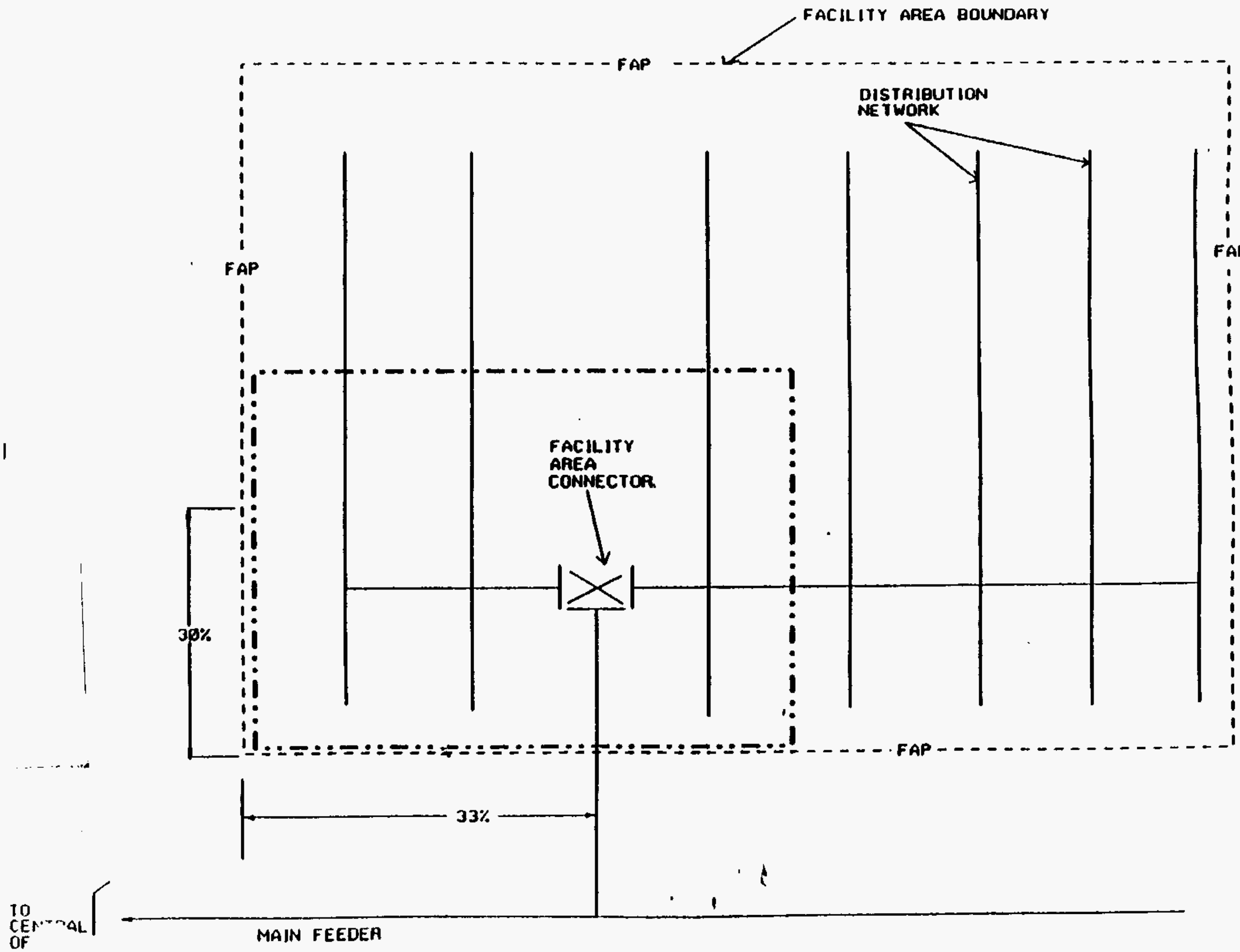

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EXHIBIT VI

TYPICAL CONVERSION OF EXISTING PLANT TO FAP

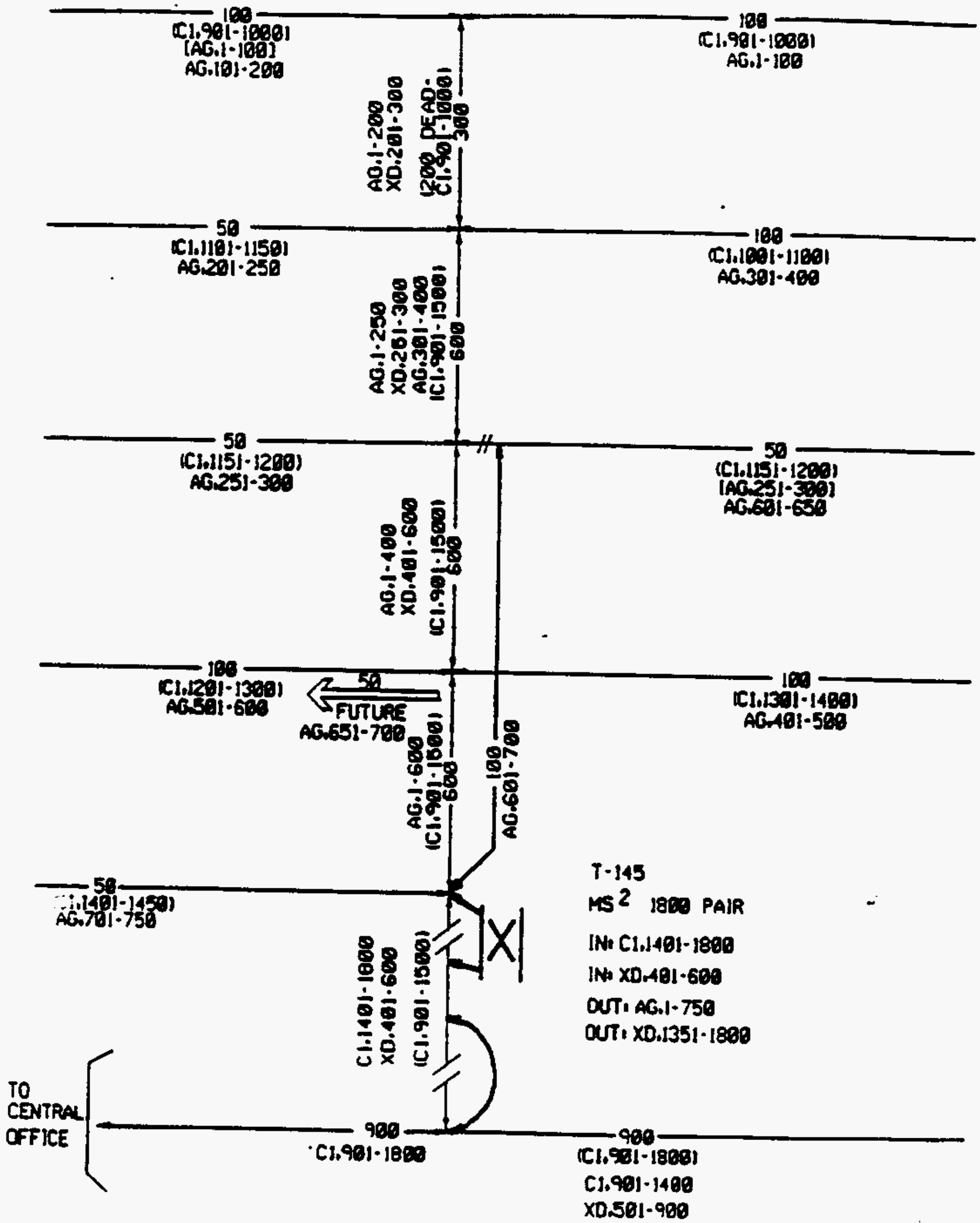

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EXHIBIT VII

FAP, RDAP, or GROOMING Fill Box Standard

Existing	o	1
Reroute	o	2
Two Yrs.	o	3
HL/STA	o	4
Ultimate	o	5

EXPLANATION OF LINE ENTRIES

1. Enter the existing working cable pairs on this line.
2. Enter any working cable pairs that are to be rerouted from one feed area or cable to the facility under study. This line will illustrate cross-section condition when rerouted pairs are added to or removed from existing working pairs.
3. Enter the projected working pairs that will exist at the end of the second year.
4. Enter the number of housing units or lots if the fill box is for FAP or RADP. Enter the number of stations (party lines) if the fill box is used for grooming (removing carrier, etc.).
5. Enter the number of pairs using the appropriate FAP, RDAP, or Grooming factor.

NOTE: The fill boxes will be placed at the beginning of each facility taper point branch facility routes, etc. and for every section of new cable plant proposed.

- o Sufficient fill boxes will be shown to indicate the growth patterns of the area under consideration and substantiate the engineering proposal for additions or rearrangements.
- o Fill boxes shown on the schematic or engineering design drawing will be placed as near its point of reference as possible. If for reasons of clarity, it is necessary to have the fill box disassociated from its point of reference, a system or cross-reference identification will be required.

Outside Plant Engineering of Digital Loop Carrier Systems

Contents

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1. General

1.1 Purpose

This practice:

- Defines GTE standard procedures for the OSP Engineering of Digital Loop Carrier (DLC) Systems.
- Provides the Outside Plant engineer with specific information for DLCs relating to:
  - Architecture.
  - Cable.
  - Remote sites.

NOTE: **Do not rearrange the working carrier systems that are currently in place to meet the requirements of this practice.**

Follow the GTE practice if there are conflicts between the vendor's practice and a GTE Telephone Operations practice.

1.2 Filing Instructions

File this practice in numerical order in your GTE Telephone Operations practices set.

1.3 Supersedures

This practice supersedes:

- All local practices, policies, procedures, general instructions, letters, and memoranda which address this subject.
- Any document which provides information contrary to the information contained in this practice.

1.4 Copyright and Responsibility

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1.5 Disclaimer

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2. Overview

2.1 Acronyms

The following chart defines terms used in this practice:

Acronym	Definition
CAF	Customer Access Facilities
CEV	Controlled Environmental Vault
DC	Digital Connect
DLC	Digital Loop Carrier
ESA	Electronic Serving Area
H/R	Host/Remote
OSP	Outside Plant
PAR	Planning Analysis Report
PCM	Project Control Memorandum
TAC	Trouble Analysis Center

2.2 References

Refer to the following for additional information concerning the DLC provisioning process:

For Information About...	See GTE Telephone Operations Practice/PAR...
Outside Plant Feeder Planning	PAR 007
Digital Pair Gain Deployment	PAR [illegible]
CAF PCM Development Guidelines	PAR 016
Spare Span Line and Spare Span Switching Policy	PAR 022
Investment Area Plan	PAR 039

(continued)

2.2 References, continued

For Information About...	See GTE Telephone Operations Practice/PAR...
Cable Completion Testing	634-020-500
Central Office Grounding Systems - Engineering Applications	795-805-071
Inspecting Central Office Grounding and Electrical Protection	795-805-074
Remote Electronic Serving Area Grounding Systems - Engineering Considerations	795-805-075
Loop Customer - Transmission Design and Objectives - Resistance Engineering to Measure Limits	832-100-072
T1 PCM Repeatered Line - Transmission Considerations for Engineering	835-000-071
9104A 24/48 Channel PCM Repeatered Line Equipment	836-910-081*
Cable Voice Frequency Loading Systems	852-050-050
Engineering Fundamentals of Electrode Ground Design	887-600-070
Fundamentals of Ground Measurements	887-600-071
Engineering Methods for Measuring Electrode Ground Systems	887-600-072
Determination of Minimum Separation Between Digital Sites and Electric Power Utilities	887-800-044
Optical Fiber Cable General Outside Plant Design Consideration	938-624-000

* AG Communication Systems Practice

3. DLCs Relating to Architecture

3.1
General

Deploy all Digital Loop Carrier (DLC) Systems:

- To ESA standards.

  OR

- At a minimum, in a way to facilitate future migration toward ESA design.

There is only one digital connect (DC) point for each ESA.

4. DLCs Relating to Cable

4.1
Host/Remote Link

The preferred medium for the H/R link is single mode fiber.

Make the H/R link fiber if:

- A new cable is required for the DLC H/R link.

  OR

- The DLC serves a GTE-1 customer.

The minimum size fiber to place is:

- DLC for residential application - four minimum fibers.
- DLC for SMARTPARKS - 24 minimum fibers.

Vacant pairs within an existing exchange cable can be used to provide H/R links for new and existing pair gain systems if all of the following conditions are met:

- The cable does not have a clearly documented trouble pattern history on file with the Trouble Analysis Center (TAC.)

  NOTE: An isolated or one-time occurrence does not constitute a history.

- OSP Construction tests the cable pairs. The pairs must meet the requirements of the following transmission tests:
  - Loop resistance.
  - Resistance unbalance.
  - Insulation resistance.
  - Insertion loss.
  - Digital errors.
  - Crosstalk.

The use of a new screened facility to provide H/R links is less desirable than using an existing exchange cable.

If unscreened cable is used, the high frequency pairs must be safeguarded.

Design the H/R link according to GTE Telephone Operations Practices:

- 938-624-000, Optical Fiber Cable General Outside Plant Design Consideration, for fiber.
- 835-000-071, T1 PCM Repeater Line, for copper.

4.2 Distribution Cable

The distribution cable for the DLC can be:

- Loaded.

  OR

- Non-loaded.

NOTE: **Every effort must be made to locate the DLC where loading will not be required. Based upon the ESA boundary, this will position the network for future enhanced services.**

If the Distribution Cable Is...	Then...
Loaded	The ideal location for the remote digital unit is at a load section's midpoint. This allows feeding pairs beyond the terminal without modifying the existing loading scheme.
Non-Loaded	The customer loops must not exceed the supervisory limits of the DLC or 8 dB loss.

At those locations where the practical DLC location is not coincident with the loading midpoint, the loading scheme requires:

- Re-spacing.

  AND/OR

- Capacitance build-out treatment.

Consider the following primary methods:

- Revising the loading scheme to eliminate all capacitance build-out requirements.
- Locating capacitance build-outs beyond the first load point.

The final loading will be as follows, per GTE Telephone Operations Practice 852-050-050:

- Section next to the DLC 26[illegible] - 3000 feet.
- Full load sections 6000 feet plus or minus two percent.

4.3 Jumper Work

Jumper work is required for both the central office end and the remote end of the DLC.

Time for the jumper work in the central office and in the remote DLC cabinet is included in the central office work order. The time for the jumper work at the remote end cross connect is provided on the OSP work order. This is whether the jumper work is:

- Internal to the DLC cabinet.

  OR

- In an external cross connect.

4.4 Testing

Testing is required for the host/remote link and distribution cable. See AG Communication Systems Practice 835-000-071, T1 PCM Repeatered Line - Transmission Considerations for Engineering, and GTE Telephone Operations Practice 634-020-500, Cable Completion Testing, for information.

4.5 Conduit

All OSP cable conduits/ducts in the DLC must be sealed using GTE standard conduit plugs per GTE Telephone Operations Practice 628-020-202.

5. DLCs Relating to Remote Sites

5.1 Cross Connect Cabinets

A cross connect is required at all DLC pad mounted remote locations.

If the DLC Has an Ultimate Capacity of...	Then the Cross Connect...
192 lines or less	May be contained within the DLC cabinet.
More than 192 lines	Must be external to the DLC.

Make the in-to-out count ratio at least 1:2.

Do not provide cross connects when the DLC is placed in a hut or CEV.

5.2 AC Service Requirements

The OSP engineer must provide the following at all DLC pad-mounted remote locations:

- AC service disconnect
- AC power transfer switch.
- Emergency generator receptacle.
- Surge arrester.

NOTE: See PSB #5016 for ordering information for pad mounted DLCs.

Provide the AC service disconnect and surge arrester in a separate enclosure. Make the enclosure either:

- Pole-mounted.

  OR

- Pad-mounted.

NOTE: **If the DLC is in a building, hut, or CEV, Land and Buildings is responsible for the:**

- **AC service disconnect.**
- **Surge arrester.**
- **AC power transfer switch.**
- **Emergency generator receptacle.**

The ampere capacity of the power transfer switch and emergency generator receptacle must be large enough to serve the:

- Ultimate number of DLCs at the site.

  AND

- Associated ancillary equipment such as the fiber optic terminal for that location.

Determine the required power transfer switch and the emergency generator receptacle using the:

- Power drain for all of the equipment being placed.
- Product Standardization Bulletin (PSB) #5016 for switch power transfer.

5.3 Grounding

Ground all GTE standard DLC's according to GTE Telephone Operations Practice 795-805-075, Remote Electronic Serving Area Grounding Systems - Engineering Considerations.

The T&P administrator must do the following before finalizing a site acquisition:

- Take soil resistivity measurements. (Refer to GTE Telephone Operations Practice 887-600-070.)
- Complete the ground grid design. (Refer to GTE Telephone Operations Practice 887-600-071.)

The OSP engineer must make the size of the site:

- Compatible with the ground grid design.
- Large enough to accommodate ultimate requirements.

Ground grid design and test resistance measurements are explained in GTE Telephone Operations Practices:

- 887-600-070. Engineering Fundamentals of Electrode Ground Design.
- 887-600-071, Fundamentals of Ground Measurements.
- 887-600-072, Engineering Methods for Measuring Electrode Ground Systems.

Use GTE Telephone Operations Practice 887-800-044, Determination of Minimum Separation Between Digital Sites and Electric Power Utilities, to determine minimum separation from electric power facilities.

The Administrator - T&P must approve a proposed site location for the above protection concerns before GTE commits to a site.

5.4 Special Service Circuits

Special service circuits are safeguarded at the cross connect appearances. The special service circuits are provided via a DLC.

Provide special service circuits using special service channel units either:

- In the DLC.

  OR

- On channel banks within the DLC cabinet.

5.5 Pad Requirements

DLC pads may be either concrete or a GTE standard fiberglass pad for all standard DLC cabinets except for the AT&T 80D cabinet. The 80D cabinet must be placed on a concrete pad.

Concrete poured pads must meet the following specifications:

1. Use 3 to 6 inches of gravel or sand under foot print or foundation for height and level control.
2. Pad dimensions depend upon the:
   - Type of equipment being installed.
   - Number of cabinets.
3. Portland cement will be the following to conform to the American Society for Testing and Materials (ASTM) specifications for portland cement:
   - Type I (general use).

     OR
   - Type III (high early strength).
4. Conform aggregates to the ASTM specifications for concrete aggregates CSS. Grade course aggregates from 3/4" to No. 4. Lightweight aggregates are not permitted.
5. The minimum acceptable compression strength for the concrete is 3600 psi.
6. Use either a #3 or #4 rebar.
7. Make the foundation:
   - Level within 1/2".
   - Approximately 2" above surrounding grade.
8. The AC meter loop must meet NEC requirements with:
   - Minimum fuse size 60 amp.
   - Minimum wire size #6 AWG.

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5.5 Pad Requirements, continued

9. Use a 4" flexible conduit as required per the type of equipment being installed.
10. Use a 1" electrical conduit for AC service as required per the type of equipment being installed.
11. The ground ring:

- Is installed a minimum of 4' from the housing and a minimum 18" outside of the concrete pad.
- Is at least 30" deep and below the frost line.

  NOTE: **A ground ring is required at all remote DLC sites. The concrete pad alone cannot be used for grounding.**

  Refer to the following GTE Telephone Operations Practices:

  - **795-805-071**
  - **795-805-075**
  - **887-600-070**
  - **887-600-071**
  - **887-600-072**

- Should be a #2 AWG bare solid tinned copper wire with a minimum of four each 5/8" x 8' ground rods (one rod in each corner.) Either OSP Engineering or the Administrator – T&P is to meg and inspect the ground ring before covering.

  NOTE: **Refer to the following GTE Telephone Operations Practices:**

  - **795-805-071**
  - **795-805-075**
  - **887-600-072**

OPTICAL FIBER CABLE
GENERAL OUTSIDE PLANT DESIGN CONSIDERATIONS

Contents

(continued)

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Contents, continued

GENERAL

Purpose

This practice provides:

- Design guidelines for optical fiber cable Outside Plant (OSP) Engineering.
- Unique considerations inherent in optical fiber cable design.

Reason for Reissuing

This practice is reissued to update optical fiber cable information.

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Responsibilities

Since most optical fiber cables are high priority, heavy traffic facilities, OSP Engineering and Construction duties are most important. The following chart outlines these responsibilities.

<table>
<tr><th>WHO DOES IT</th><th>WHAT HAPPENS</th></tr>
<tr><td>OSP Engineering</td><td>• Carefully selects the best possible cable route.
• Considers the terrain, environment, obstacles, and distance.
• Chooses a route with the following installation technique priorities.
1. Underground.
2. Buried.
3. Aerial.
• Consults with the transmission engineer to ensure that total fiber facility loss does not exceed fiber link loss budget.
• Determines splice point locations.
• If necessary, provides a communications system (i.e., separate copper cable, hardware, radio, or optical talk sets). This allows:
- Splicers to communicate with the office/end testers to optimize splice loss.
- Instant communications which enhance repair operations.
• To ensure a timely and well-built facility, consults with appropriate construction personnel when either:
- Unique situations arise.
- Additional expertise is required.</td></tr>
<tr><td>OSP Construction</td><td>To successfully install optical fiber cable, closely coordinates and cooperates with:
• OSP Engineering.
• Other involved departments.</td></tr>
</table>

References

Other practices referenced in this practice include:

FOR INFORMATION ABOUT...	SEE TELOPS PRACTICE.
Cable Bonding and Grounding Joint and Nonjoint Construction	605-100-100.
Installing Subduct for Underground Optical Fiber Cable	624-622-000.
Placing Aerial Optical Fiber Cable	624-627-000.
Placing Optical Fiber Cable Underground	624-628-000.
Placing Buried Optical Fiber Cable	624-629-000.
Central Office Grounding Systems - Engineering Applications	795-805-071.
Long Pulls of Underground Cable - Engineering Specifications	911-400-073.

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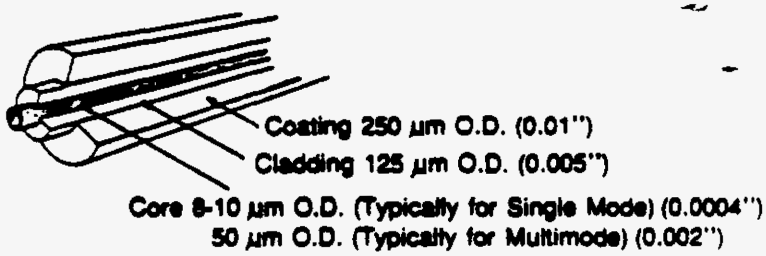
Terms

Some of the terms and definitions that apply to fiber optics are.

TERM	DEFINITION
Attenuation	A measure of the decrease in energy transmission (loss of light) expressed in decibel (dB). In optical fibers, attenuation is primarily due to absorption and scattering losses.
Cladding	A glass covering over the core that helps contain the light signal (see the illustration below).
Coating	A layer of composite plastic material covering the fiber to provide mechanical protection (see the illustration below).
Core	The glass central region in an optical fiber that provides the means for transmitting light.



TERM	DEFINITION
Decibel	The standard unit used to express the ratio of two power levels. In communications it expresses either a gain or loss in power between the input and output devices.

THIS LOSS...	IS A DECREASE IN POWER OF APPROXIMATELY...
3.0 dB	50%
2.0 dB	37%
1.0 dB	20%
0.5 dB	11%

(continued)

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Terms, continued

TERM	DEFINITION
Microbend	Local discontinuities on a microscopic scale resulting from mechanical stress on a fiber which induce additional attenuation.
Multimode	A fiber that allows more than one mode to propagate. One type of fiber with a core size of 25-100 microns.
Operating Wavelength	The light wavelength at which a system is specified, normally expressed in nanometers (nm). Most single mode fibers can operate at 1,300 nm or 1,550 nm (see the Optical Spectrum Chart on Page 7).
Optical Link Loss Budget	The total losses allowed for satisfactory operation of an optical fiber system (see the following example):

LINK NHWD-01/PACM-XF — BIT RATE 405 Mbps

WAVELENGTH 1310 nm — FIBER TYPE Single Mode

REGEN TYPE NEC 405 MB

EQUIPMENT LOSS:

A. Receiver Level at 10^{-11} BER	-36.0
B. Average Transmitter Level	-3.5
C. ILD Reflection Loss	0.5
D. Connectors Loss (4 X 1.1 dB)	4.4
E. WDM Filter and Connectors Loss	5.0

CABLE LOSS:

F. Multimode Dispersion Loss	-
G. Chromatic Dispersion Loss	1.0
H. Splice Loss (7 X 0.25 dB)*	1.8
I. Fiber Loss (7.842 km X 0.50 dB/km)	3.9
LINK MARGIN	15.9

This span required 10 dB attenuators.

* Includes pigtail and field splices.

NOTE: The above link loss budget is an example only. Transmitter levels, receiver levels, connector and splice losses, etc., vary depending on the manufacturer and the splicing method.

(continued)

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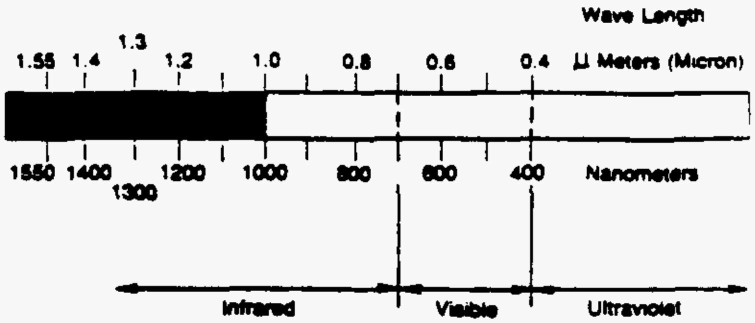
Terms, continued

TERM	DEFINITION
Optical Spectrum Chart	The illustration below shows an optical spectrum chart: 
Pigtails	Small single fiber cords used to terminate optical fiber cables at Central Offices (COs) or regenerators. Each has a: • Connector at one end to interface the equipment. • Bare fiber at the other end for splicing to a fiber in the main cable.
Single Mode	A fiber that supports the propagation of only one mode. One type of low-loss optical fiber with a very small core (8 microns). The size of the core radius approaches the wavelength of the source; consequently, only one mode (path of light) is disbursed.
Spot Size (Mode Field Diameter)	Mode field diameter is the diameter of the spot of light transmitted in a single mode fiber. This spot extends into the cladding.

Metric Conversion Chart

Since many manufacturers express measurements in metric units, the following conversions are useful to OSP engineers.

The conversions are:

- Kilometer (km) X 3.281 = feet.
- Meter (m) X 3.281 = feet.
- Centimeter (cm) + 2.54 = inches.
- Millimeter (mm) + 25.4 = inches.
- Newton (N) X 0.2247 = pounds.
- Kilogram (kg) X 2.2046 = pounds.

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Background Information

The glass fibers that convey light (lightwaves) as an information carrier are called optical fibers

As part of fiber optic systems. optical fibers are ideal for the broad band width requirements of digital transmission. Consequently. optical fiber cable is used to accommodate the increasing presence of digital switching and transmission.

In the simplest terms. a fiber optic transmission system consists of a:

- Light source (laser or LED).
- Transmission medium (optical fiber).
- Light detector (photodetector).

The source must emit light at a wavelength that glass fiber can carry with minimal loss. The detector must:

- Be highly sensitive to the transmitted wavelength.
- Respond to rapid light pulses originated at the digital source.

Bit Rate and Voice Channel Capacity

The following chart represents the associated bit rate and voice channel capacity common to most systems:

BIT RATE	DS-1	VOICE CHANNELS	DS-3
45 Mbps	28	672	1
90	56	1.344	2
135	84	2.016	3
405	252	6.048	9
565	336	8.064	12
1.2 Gbs	672	16.128	24
2.2	1.344	32.256	48

Optical Attenuation

The optical attenuation in a fiber determines the distance a light signal can travel before the signal must be regenerated. Several mechanisms in optical fibers produce signal attenuation. The most important ones are:

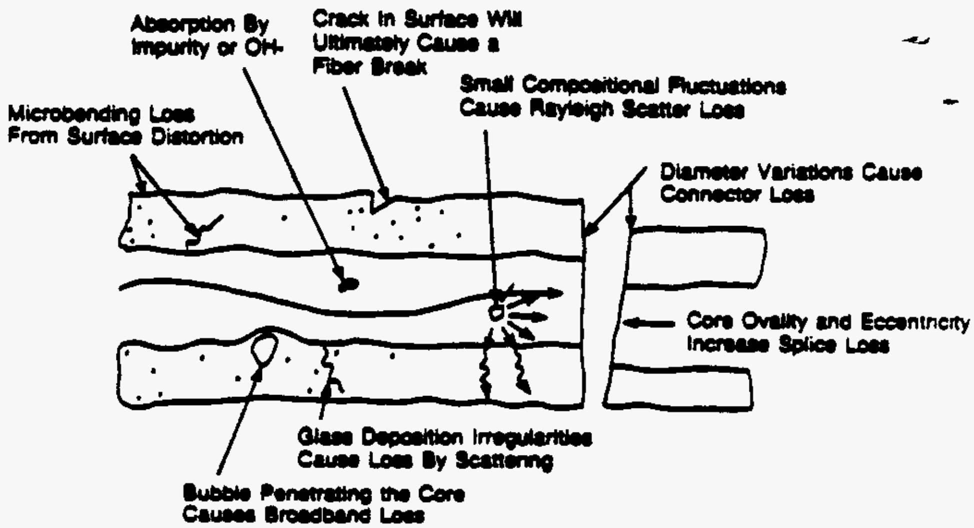
- Rayleigh scattering.
- Absorption.

Influences which contribute to attenuation characteristics are:

- Preform processing conditions.
- Impurities in the fiber.
- Fiber variance imperfections.
- Microbending.
- Microbubbles.

The maximum attenuation of each single mode fiber within a cable, when normalized to a length of 1 km, at λ = 1.300 nm, will be in the range of 0.4 dB/km to 0.8 dB/km.

The illustration below demonstrates the influences which contribute to attenuation.



Cabling Optical Fibers

Optical fibers must be coated and cabled to protect them from external forces. This is necessary because optical fibers:

- Remain brittle.
- Are subject to losses caused by microbending and cracking.

(continued)

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Cabling Optical Fibers, continued

The cable sheath must protect the fibers from:

- Abrasion and tensile loads during cable installation.
- A hostile environment (i.e., moisture and temperature extremes).

Provide optical fiber cables with characteristics, makeup, and handling performance which allow installation:

- In all kinds of OSP environments.
- Using standard equipment and procedures with few modifications.

Diameter Sizes

Optical fiber cables are usually small, normally less than 0.7 inches outside diameter. This allows long cable reel lengths to be manufactured and installed.

Reel lengths:

- Of 2 km are commonly installed.
- Up to 6 km or more may be installed.

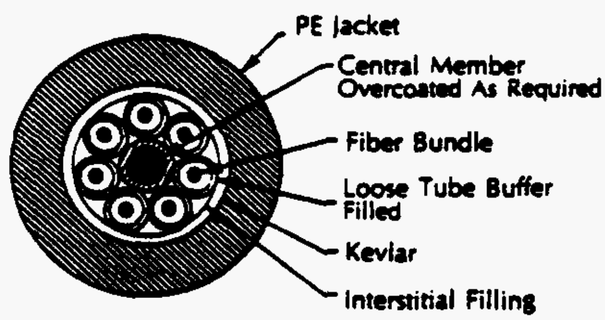
Cable Design and Cross-Section

Cables for general use:

- Are of a loose buffer design.
- Contain the coated fiber in an oversized "buffer tube." Both the fibers and buffer tubes are color coded.
- May include an integral metallic shield if required for buried applications.

NOTE: Cables may contain more than one fiber per buffer tube and more than one buffer tube per cable.

The following drawing illustrates a typical cable cross-section:



Fiber Count and Buffer Color Code

The following table shows the current standard fiber count and buffer color code sequence.

GTE FIBER CABLE MAKE-UPS

SINGLE MODE

BUFFER COLOR
BUFFER NUMBER

FIBER COUNT	BL 1	OR 2	GR 3	BR 4	SL 5	W 6	R 7	BK 8	Y 9	V 10	P 11	A 12
	NUMBER OF FIBERS PER BUFFER TUBE											
4	2	2	-	-	-	-	-	-	-	-	-	-
8	4	4	-	-	-	-	-	-	-	-	-	-
12	4	4	4	-	-	-	-	-	-	-	-	-
16	4	4	4	4	-	-	-	-	-	-	-	-
20	8	8	4	-	-	-	-	-	-	-	-	-
24	8	8	8	-	-	-	-	-	-	-	-	-
28	8	8	8	4	-	-	-	-	-	-	-	-
32	8	8	8	8	-	-	-	-	-	-	-	-
36	8	8	8	8	4	-	-	-	-	-	-	-
40	8	8	8	8	8	-	-	-	-	-	-	-
44	8	8	8	8	8	4	-	-	-	-	-	-
48	8	8	8	8	8	8	-	-	-	-	-	-
72	8	8	8	8	8	8	8	8	8	-	-	-
96	8	8	8	8	8	8	8	8	8	8	8	8

NOTE: The fiber color code within each buffer tube is the same color sequence as the buffer color code listed above.

Fiber Splicing

The objective of fiber splicing is to:

- Connect the cores of the fibers being spliced.
- Allow as much light as possible to be coupled from one fiber to the next.

(continued)

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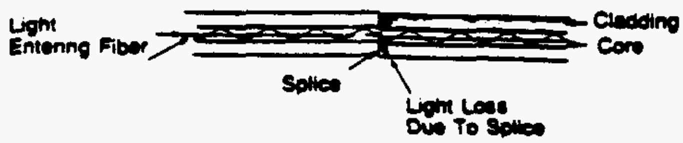
Fiber Splicing, continued

If light leaves the core, it travels in the cladding and is no longer a part of the usable light signal.

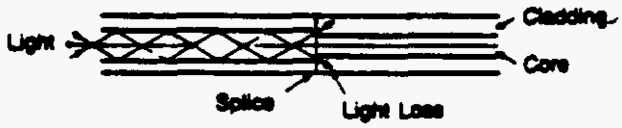


Splice Loss

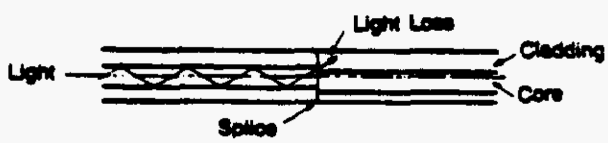
The following chart explains how splice loss can be affected by factors controlled by the:

- Fiber manufacturer.
- Cable splicer.

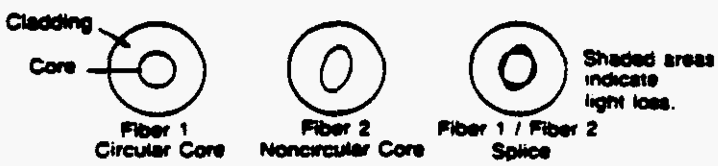
THE...	CAN CAUSE INCREASED SPLICE LOSS THROUGH...
Manufacturer	• Different core diameters.



• Cores not centered in the fiber.



• Noncircular cores.



(continued)

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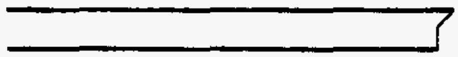
Splice Loss, continued

THE	CAN CAUSE INCREASED SPLICE LOSS THROUGH
Cable Splicer	• Fiber ends that are improperly cleaved before splicing, including:

- Fiber ends that are improperly cleaved before splicing, including:
  - Angled ends.

  - End spurs.



  - Fractured or chipped ends.

NOTE: A properly cleaved end should be square.

- Not keeping the fiber ends clean.

NOTE: The fiber ends must be free of dust or other particles that can block light from being coupled from one fiber to the next fiber.

Design Considerations

Some different aspects of optical fiber facility design are:

- Extended section lengths - fewer splice points.
- Additional lap for splicing.
- Splice location considerations.
- Tension limit (typically 600 pounds).
- Consideration of the number of fibers per buffer for future deployment and splicing configurations.
- Minimum bending radius:
  - Ten times the cable diameter when the cable is not under tension.
  - Twenty times the cable diameter when the cable is under tension.

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CENTRAL OFFICE AND REMOTE SITE ENGINEERING

Introduction

Area OSP Engineering and Equipment Engineering must conduct a joint survey of the CO and the remote site to determine the best cable route to follow from the vault (or cable entry point) to the optical terminal equipment.

The cable route is indicated on the OSP work order with the appropriate footages shown.

Cable Routing Guidelines

The following guidelines for proper route selection serve most conditions:

- Do not use power cable runways to support optical cables.
- Install a new runway or conduit to support the planned optical fiber cable if an office:
  - Is equipped with a cable grid only.

    AND/OR

  - Does not have available existing cable troughs/runways.
- Optical fiber cables may be routed with high frequency (CXR) cable.
- Take care to avoid a route that would stack future cables (in excess of 150 pounds) on top of fiber cables.
- Observe the fiber cable's minimum bending radius. Check the manufacturer's recommendation if in doubt.
- Coil 100 feet of slack cable in the cable vault for restoration.

Fire Protection Requirements

When placing optical fiber cable within the confines of a CO, put the cables inside a fire retardant conduit (rigid or flexible) for:

- Fire protection requirements.
- Mechanical protection.

Grounding Optical Fiber Cable Sheaths

Metallic optical fiber cable sheaths must be grounded to the cable vault ground bar as close as possible to the cable entrance. If metallic conduit is used, it must be grounded to the metallic sheath and connected to the vault ground bar.

NOTE: Refer to Telops Practice 795-805-071.

SUBDUCT ENGINEERING

Introduction

Subduct tubing is:

- Made of extruded, smooth-wall, coilable polyethylene.
- Ordered on individual reels or in loose coils.

Subduct primarily provides multiple raceways within a conduit system designated to contain optical fiber cable. Multiple raceways are provided:

- To allow maximum use of the larger conduit while preventing damage to new or existing cable(s) during cable installation or removal.
- For use in aerial installations (see Telops Practice 624-627-000).

Placing Subduct

Assign ducts in the same way as copper cables. In one vacant 3½- or 4-inch conduit you can install:

- A maximum of four 1-inch (inside diameter) subducts.
- A minimum of three 1-inch (inside diameter) subducts.

When placing subduct:

- Do not allow the pulling length of underground subduct to exceed 1,500 feet.
- Have additional personnel at pull-through manholes to:
  - Help guide the subduct into the opposing duct.
  - Alert the pulling personnel in the event of a mishap.
  - Help with lubricating.
- Use a 15-inch minimum bending radius during installation.
- Avoid conduit offsets. (Conduit offsets are changes of levels within a manhole, handhole, or pull box).

NOTE: GTE Telops Practice 624-622-000 provides methods and techniques for placing underground optical fiber cable subduct.

During placing operations, the following is not recommended, but:

IF YOU MUST...	THEN...
Place optical fiber cable in occupied ducts	The ducts must be large enough to accept a 1-inch subduct plus the existing cable.
Bury subduct	Use rigid ABS, PVC, or heavy-walled polyethylene conduit.

Identifying Subduct

Subducts may be ordered with a color code system to readily identify multiple ducts in one ductline.

To help distinguish subduct, the construction print must include placement information such as:

- Duct assignment.
- Length of the subduct to be left at each cable feed manhole.

  NOTE: This subduct extends out of the manhole and acts as the cable guide.

- Construction notes identifying a 15-inch minimum bending radius for subduct during installation.
- Possible problem areas (e.g., severe bends, dips, conduit transpositions, etc.).
- A subduct section numbering scheme, if the subduct is ordered to cut lengths.
- Subduct racking position (e.g., on or under the cable racks, on walls, ceiling, etc.).
- Subduct identification (if required).

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New Conduit Systems

Consider all conduit systems as possible fiber optic and copper routes. Design the systems for both.

Determine the manhole spacing by the pulling tension calculations for the largest copper cable expected (see Telops Practice 911-400-073).

When planning a new conduit system to accommodate optical fiber cables and copper cables, keep in mind that the overall quantity of 4-inch conduits may be reduced if up to four passageways are provided within one main conduit space.

NOTE: These passageways can be achieved by placing three to four 1-inch subducts within a standard 4-inch conduit.

UNDERGROUND CABLE ENGINEERING

Introduction

WARNING: Measurement accuracy is critical since optical fiber cable has longer reel lengths. For instance, a one percent error in a 2 km (6,562 feet) measurement can result in a shortage of 20 meters (66 feet).

A well organized and carefully designed plan is more essential with optical fiber cable than with conventional communication cables, because fiber optic cable splicing and installation requirements are unique.

When placing optical fiber cable in unoccupied underground ducts:

- Select ducts containing subducts.
- Place three or four polyethylene, 1-inch or 1 1/4-inch (inside diameter) subducts in 3½- or 4-inch ducts.

NOTE: Telops Practice 624-628-000 covers placing optical fiber cable underground.

Developing an Engineering Design Construction Print

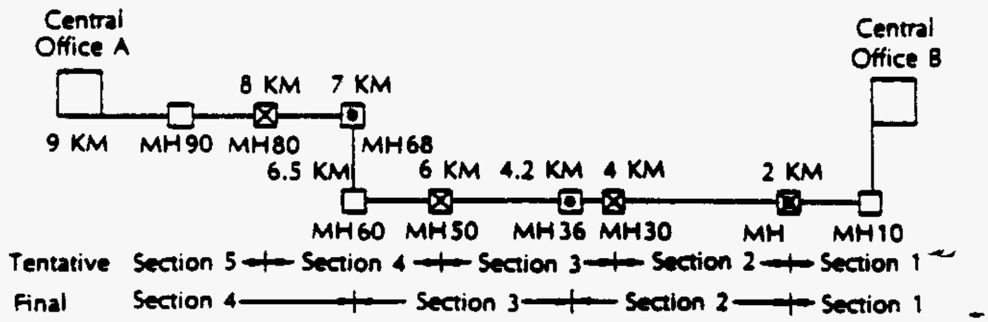
Use the following procedure to develop an engineering design construction print:

STEP	DEVELOPING AN ENGINEERING DESIGN CONSTRUCTION PRINT
1	Lay out a sketch of the route showing such things as: • Wall-to-wall measurements. • Manholes. • Ninety degree bends. • Sweeps. • Dips.
2	Determine the tentative splice locations based on standard 2 km section lengths. Be sure to allow for sufficient length for: • Racking in pull-through manholes. • Slack at splice points. • CO cabling. NOTE: Consider future branch splice needs when determining present splice locations, so that branch splices will not require new cable openings.
3	Reduce the number of splices where there are excessive bends, sweeps, and dips by: • Shortening the cable section. • Planning for "figure 8" installations. • Balancing out the cable elsewhere in a pull that allows for additional length.

An Engineering Design Construction Print

The following is an example of an engineering design construction print:

SECTION	TENTATIVE LENGTH (X)	FINAL LENGTH (o)
1	2.0 km	2.0 km
2	2.0 km	2.2 km
3	2.0 km	2.8 km
4	2.0 km	2.0 km
5	1.0 km	—



1. Layout 2.0 km sections.
2. Section 4 has two 90° bends. Make splice in MH68 rather than MH80.
3. The field survey revealed:

   a. MH30 to be too congested for splicing. MH36 is a better choice.
   b. MH36 to MH60 is a good straight run—no dips or bends. Make one selection.
   c. MH10 and MH60 can be "figure 8" locations.

Field Survey

Once a tentative plan is complete, conduct a field survey of the route with appropriate construction personnel. The survey must include:

AN INSPECTION OF . . .	TO . . .
Splice and pulling locations	Determine if traffic/parking problems exist close to the manhole.
Splice manholes	Ensure that adequate space is available for splicing and racking.
The entire route	Determine if conditions exist that could change the tentative design.

(continued)

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Field Survey, continued

Include a selection of cable reel setup locations which allow adequate space for:

- Cable trailers.
- Trucks.
- "Figure 8's" of cable for split reel pulling.

Based on the results of the survey, make any necessary adjustments to the reel lengths. If any reel is shortened, lengthen another section or sections to avoid creating additional splices.

Reel Cut Lengths

The reel cut length should be the total of the following:

- All wall-to-wall lengths.
- The amount for racking in all pull-through manholes.
- The slack loop length at splice points (typically 50 feet on each end).
- The lap required for splicing (both ends of the reel) - 3 meters (10 feet).
- CO cabling.

NOTE: Consider additional manpower requirements associated with longer pulling lengths.

Notes for Construction Prints

In addition to standard information, the following notes should be included on the engineering design construction prints. The:

- Location for setting up the cable reel.
- Minimum bend radius of the cable to be installed.
- Maximum pulling tension of the cable.
- Reel lengths in both feet and meters.
- Warning and cable identification markers required in each manhole.
- Requirements for cable guards (e.g., split duct, flex tubing) in pull-through manholes.

DIRECT BURIED CABLE ENGINEERING

Trenching Method

The plowing method is preferred for burying optical fiber cables; however, local conditions may dictate trenching. When the trenching method is chosen, consider placing a conduit in the same trench to accommodate future cables.

NOTE: Telops Practice 624-629-000 covers placing buried optical fiber cable.

Base the decision to place the conduit on the following criteria:

- Requirements for a future relief cable.
- The available right-of-way for future trenching.
- Emergency restoration.
- A cost comparison between trenching future cable and placing a conduit to accommodate future cable.

  NOTE: Include the cost for pulling subduct and future cable into the conduit.

Splicing

A well-planned engineering design construction print is essential to ensure that:

- The designated number of splice points are not increased from the initial design requirements.
- Splice points are spaced to coincide with designated reel lengths.
- Suitable splice locations are selected.

NOTE: Since attenuation is a crucial consideration, keep the number of fiber splices to a minimum.

Choosing a Splice Location

When choosing a splice location, look for a location that is:

- Accessible.
- Safe for employees and the general public.

NOTE: Direct buried splices are allowed, but not preferred. They are not easily accessible. Consider placing a small hand hole to allow future access.

Avoid a location that:

- Is vulnerable to damage by vehicular traffic and vandalism.
- Is subject to flooding or standing water.
- Has a number of obstacles, such as:
  - Railroads.
  - Highways.
  - Pipelines.
  - Driveways.
  - Parking lots.

NOTE: Burying cable in these areas makes it difficult to meet the overall loss budget.

Cable Construction

For direct buried placement, the cable construction must contain a steel shield for:

- Protecting the cable core against punctures caused by:
  - Hand tools.
  - Gnawing animals.
- Locating purposes.

NOTE: When required, split duct may be used for additional protection. Split duct should always be used when placing fiber optic cables in sharp, rocky, shale-like conditions.

Placing Cable

Place fiber optical marking tape with the cable (approximately one foot below ground level) to lessen its chances of being accidentally damaged with a digging machine.

Allow for additional cable lengths at buried splice locations to:

- Bring the cable out of the splice pit.
- Place the cable in a location suitable for splicing.

Bond and ground the metallic shield at all splice points. This ground must:

- Obtain a resistance of 25 ohms or less.
- When available, be attached to the power company multiground neutral (MGN).

NOTE: When the installation technique is changed from buried to aerial or underground, it is not necessary to change the type of cable.

Soil Cover

The recommended soil cover for buried cable is:

- Maintain a cover of 48 inches, unless otherwise specified on the engineering design construction prints.
- When at least 30 inches of cover is not provided, you must provide additional cable protection consisting of pvc conduit or:
  - Concrete encasement.
  - Other suitable material.
  - Polyethylene subduct.

Sizing Pedestals and Handholes

Size pedestals and handholes to:

- Maintain the minimum bending radius.
- Contain the splice case and slack cable.

Ordering Considerations

Consider the following when ordering optical fiber cable:

- The measurements between splice points.
- Splicing overlap - 3 meters (10 feet) at each end.
- The amount of cable required for "out-of-pit" splicing - typically 50 feet at each end.

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Introduction

The aerial method of placing optical fiber cable should be the "last choice" of installation methods. However, aerial placement may be the only realistic means of construction due to either:

- Terrain or construction conditions.
- Economic reasons.

NOTE: Telops Practice 624-627-000 covers aerial placing of optical fiber cables.

When possible, design optical fiber cable to occupy the uppermost position of the pole line.

The appropriate messenger is a 6M or 1/4-inch diameter strand. Unusual loading conditions may require using larger messengers.

NOTE: Use the specifications in existing Telops Practices to design and install the strand.

Placing Considerations

Placing aerial subduct must be considered for:

- Providing additional mechanical cable protection.
- Pulling slack for maintenance purposes.
- Easy cable installation.
- Preventing pole changeouts by lashing subduct to existing copper cable.

Aerial subduct must be manufactured with special ultraviolet (UV) inhibitors.

NOTE: Ground the messenger according to Telops Practice 605-100-100.

Lashing Optical Fiber Cable

CAUTION: Do not lash together optical fiber cable and copper cable on the same strand. The differences in the expansion and contraction coefficients of the two cable types result in undue stress to the fibers. Fiber cables may be lashed together.

The single lashing method of cable construction is appropriate when attaching cable to the messenger. However, local conditions and preferences may make double lashing necessary.

NOTE: Telcos will decide whether to single or double lash the cable.

Dielectric Cable

An all-dielectric cable is preferred for aerial installations. However, local conditions may preclude this recommendation. Such conditions include:

- Aerial crossings/inserts in buried routes.
- Areas requiring squirrel (or other wildlife) protection.
- Hunting areas.

Metallic Cable

When placing metallic optical fiber cable (buried type) on a pole line, bond the metallic shield and ground it:

- Using MGN when possible.
- At all splice points.

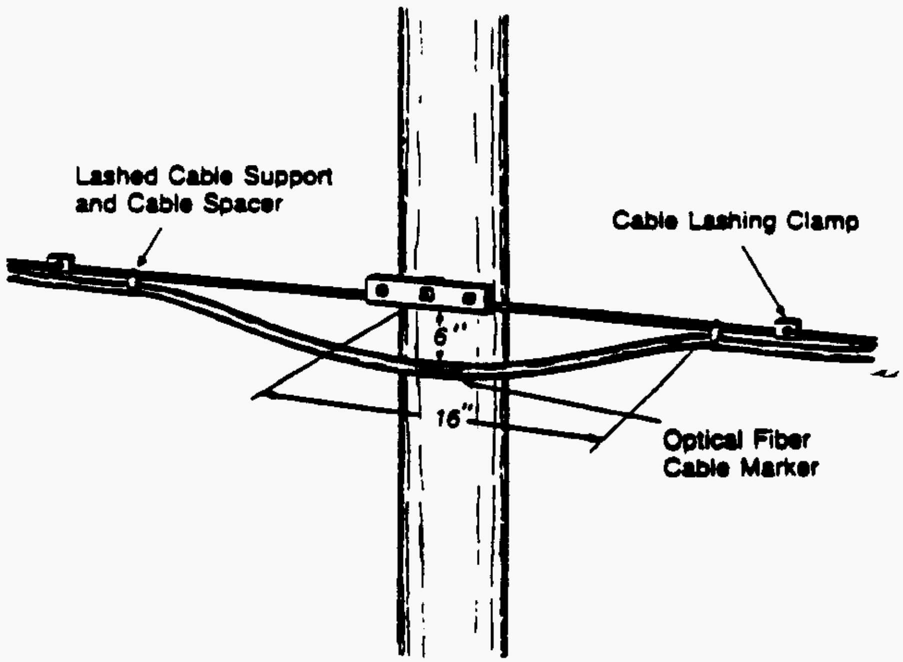
Bonds between the metallic members and the supporting strand should be spaced no more than 1.25 miles (2.02 km) when the inductive effects of nearby power lines are not computed. If separation between bonds exceeds 1.25 miles or there are complicated power exposures, the power environment must be examined by an electrical protection engineer. In no case should bonds be spaced more than 3.0 miles (4.83 km) apart.

Construction Design

In aerial construction design, allow approximately 6 inches of excess cable at every pole as an expansion loop for normal expanding and contracting.

NOTE: This is not required when subduct is placed.

On the construction drawing, make a note to have the construction forces place warning markers at each pole.



A well-planned engineering design construction print ensures that:

- Suitable splice locations are selected.
- The designated number of splice points are not increased from the initial design requirements.
- Splice points are spaced to coincide with designated reel lengths.

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Engineering Considerations

When choosing locations, look for:

- Clear pole space.
- Easy entrance and exit.
- Public areas.
- Areas accessible to:
    - Splicing vehicles.
    - Tools.
    - Test equipment.

Avoid locations involving:

- Employee safety hazards.
- Private property.
- Intersections.
- Congested aerial plant.
- Trees.

NOTE: Provide enough area to accommodate a splice enclosure.

Completing Splicing

It may be necessary to provide additional cable at aerial splices so the splice can be made on the ground. After completing the splice, the cable can be either:

- Coiled and attached to the strand.

  OR

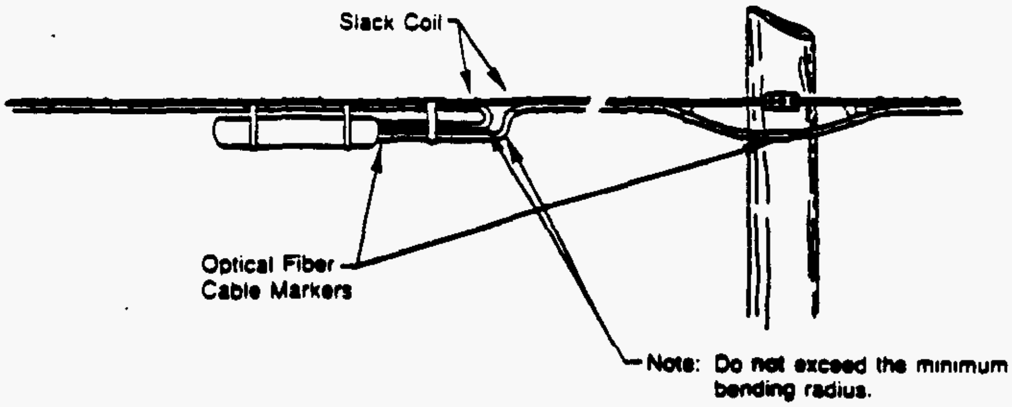
- Placed in an optical storage enclosure.

The straight splice and butt splice/enclosure arrangements allow the splice to be made either on the ground or in the air.

(continued)

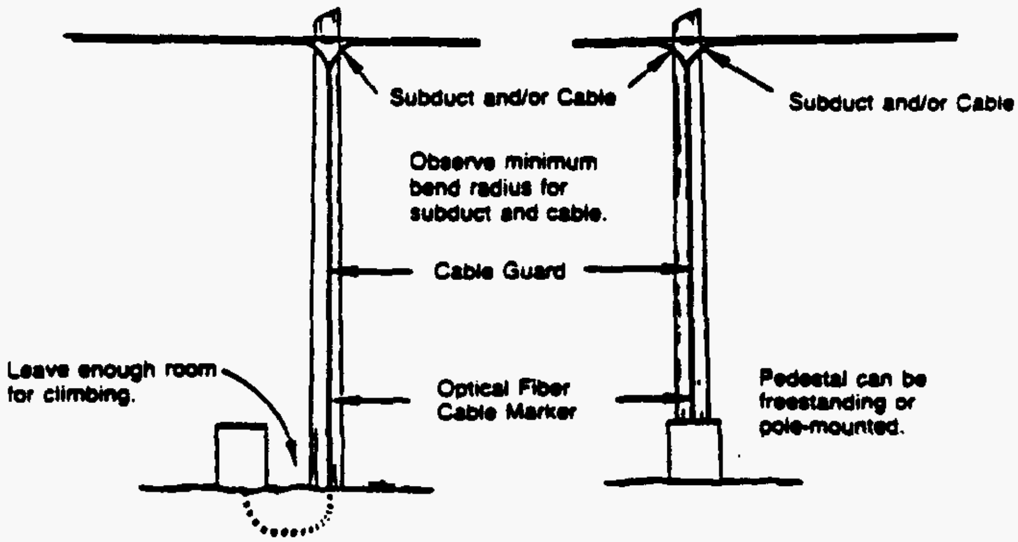
Completing Splicing, continued

The following illustration shows a butt splice configuration with slack stored on the strand:



NOTE: The distance between the pole and splice closure is determined by the amount of cable required for the splice to reach the ground. Multiple coils are not recommended.

The following illustration shows a butt splice with slack stored in a pedestal splice with pedestal:



NOTE: The pedestal may be freestanding or pole-mounted.

Ordering Considerations

Consider the items in the following list when ordering optical fiber cable. The:

- Measurement between splice points.
- Splicing overlap.
- Amount of cable required for on-ground splicing.
- Expansion loop at each pole.
- Slack loop for maintenance (optional according to local Telco practice).

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FACT-FINDER 1998

05/12/98

THREE YEAR AVERAGE MATERIAL LOADING FACTORS (FLORIDA)

		Fact Finder 98 (using Y/ E 97 data)			Fact Finder 97 (using Y/ E 96 data)			Fact Finder 96 (using Y/ E 95 data)			Fact-Finder 98 (3 yr. avg. minormat)		
												3 yr. avg.	
state	ind	supply	minormat	matload	supply	minormat	matload	supply	minormat	matload	supply	minormat	matload
		freight	sales tax	provisioning									
FL1G	CKT												
FL1G	COE												
FL1G	FIBC												
FL1G	METC												
FL1G	POLE												
FL1G	WIRE												

REDACTED

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GTE
Labor Group Labor Rates
Overview

The attached schedules document the Labor Rates used in the Cost study modules. These Labor Rates are sourced from the company's financial records. The rates are detailed by Labor Group and Job Class. The "Labor Group" identifies a specific job function such as a Equipment Engineer or Construction Placer, where a "Job Class: identifies a specific job classification such as a Customer Service Technician.

These schedules include the individual components of the incremental loaded labor rate which include the basic rate for the job function and the additional incremental costs directly associated with that job function.

These components can be divided into the following categories:

Direct Basic(Direct Labor – Productive Occupational) - includes payroll costs of plant and engineering employees (occupational workforce) for basic functional activities, i.e. construction, installation, maintenance and engineering.

Direct Support(Direct Labor – Support) - includes payroll costs of employees in the plant and engineering forces who report to direct supervisors of the occupational employee and whom support the occupational employee. This also includes vacation and holiday pay for these employees.

Direct Supervision(Direct Labor – Supervision)- includes payroll costs of employees in the plant and engineering forces directly in charge of the occupational employee - the first line supervisor. This also includes vacation and holiday pay for these employees.

Overtime premiums – This includes the incurred payroll overtime premium of all productive occupational employees included in the Direct Basic group.

Paid Absent - includes the incurred vacation and holiday paid absence costs for productive occupational employees.

Direct Department Expense(Direct Labor – Miscellaneous and Departmental) - includes miscellaneous employee payroll and related expense items of direct occupational, support, or supervision employees which are not chargeable to other clearing accounts or final accounts. Examples include training and related travel expenses.

Benefits - includes the costs of company paid items such as pensions, employee savings and investment plans, insurance, telephone concessions, and social security and unemployment taxes.

The indirect support/supervison expense rate(Indirect Labor – Support and Supervision) - This includes the incurred payroll costs, overtime premiums, vacation, and holiday paid absences for employees who are above the first level or immediate supervisor level, but below the executive level, and employees who support the indirect supervisor.

<u>The indirect support/supervision expense rate(Indirect Labor – Support and Supervision)</u> - was developed from **8ES6,7 & 8PS6,7.** This includes the incurred payroll costs, overtime premiums, vacation, and holiday paid absences for employees who are above the first level or immediate supervisor level, but below the executive level, and employees who support the indirect supervisor

<u>The indirect support/supervison expense rate(Indirect Labor – Support and Supervision)</u> - was developed from **8EC6,7 & 8PC6,7.** This includes the incurred payroll costs, overtime premiums, vacation, and holiday paid absences for employees who are above the first level or immediate supervisor level, but below the executive level, and employees who support the indirect supervisor

<u>The indirect department expense rate(Indirect Labor – Miscellaneous and Departmental)</u> - was developed from **8##9.** This includes miscellaneous employee payroll and related expense items of indirect occupational, support, or supervision employees which are not chargeable to other clearing accounts or final accounts. Examples would include employee training and related travel expenses.

<u>The indirect department expense rate(Indirect Labor – Miscellaneous and Departmental)</u> - was developed from **8ES9 & 8PS9.** This includes miscellaneous employee payroll and related expense items of indirect occupational, support, or supervision employees which are not chargeable to other clearing accounts or final accounts. Examples would include employee training and related travel expenses.

<u>The indirect department expense rate(Indirect Labor – Miscellaneous and Departmental)</u> - was developed from **8EC9 & 8PC9.** This includes miscellaneous employee payroll and related expense items of indirect occupational, support, or supervision employees which are not chargeable to other clearing accounts or final accounts. Examples would include employee training and related travel expenses. The rates were computed by labor group as follows:

<u>Miscellaneous Support:</u>

<u>Tools(Tools – Other Work Equipment)</u> – This includes salaries, benefits, and other expenses of employees engaged in maintaining and servicing other work equipment. It includes the costs of leases, purchases under the capitalization limit and other miscellaneous related exspenses.

<u>Motor Vehicle(Motor Vehicle)</u> – This includes salaries, benefits, and other expenses of employees engaged in maintaining and servicing vehicles or whose principal job is operating motor vehicles. It also includes leases, parts, supplies, gasoline and oil, and license and inspection fees for these vehicles.

<u>Non-Tbl Dispatch(Non-Trouble Dispatch)</u> – This includes salaries, benefits, and other expenses of employees performing non-trouble dispatch functions.

All of the rates computed for each of the preceding accounts are added together to derive the fully loaded rates (Computed by labor group)

Direct Basic + Direct Support + Direct Supervision +Overtime Premium + Paid Absent + Indirect Support/Supervision + Indirect Support/Supr. + Indirect Support/Supr. + Direct Department + Indirect Department + Indirect Dept. + Indirect Dept. + Benefits + Tools + Motor Vehicle = Fully Loaded Rate

AREA SOUTH
STATE FLORIDA/GTE CC
OP GROU 9SF/9S1

GTE TELEPHONE OPERATIONS
LABOR AND OVERHEAD RATES
YTD CALCULATED RATES THRU DEC 1997

5/11/98
11:00 AM

LABOR GROUP	(a) DIRECT BASIC	(b) DIRECT SUPPORT	(c) DIRECT SUPERV	(d) OVERTIME PREMIUM	(e) PAID ABSENT	(f) INDIRECT SUP/SUPV	(g) INDIRECT SUP/SUPV	(h) INDIRECT SUP/SUPV	(i) DIRECT DEPT	(j) INDIRECT DEPT	(k) INDIRECT DEPT	(l) INDIRECT DEPT	(m) BENEFITS	(n) TOOLS	(o) MOTOR VEHICLE	(p) NON TBL OPRATG	(q) = sum(a) through (p) LOADED RATE
011 - EQUIP ENG / L & E																	
021 - OUTSIDE PLANT ENG																	
101 - EQUIP INSTALL																	
111 - CONSTR PLACER																	
121 - CONSTR SPLICER																	
201 - I&R/MAINT SPLICER																	
211 - SWITCHING SVC																	

REDACTED

T = GTE COMPOSITE LABOR RATE

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