
Projet de train rapide Québec-Windsor

Les recettes potentielles de l'utilisation de l'emprise du train rapide par les entreprises de services publics

Rapport final

Novembre 1993

DELCAN

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Introduction

De tous les tronçons de chemin de fer au Canada, le corridor Québec-Windsor est celui où le trafic est le plus intense. Pour satisfaire la demande croissante qui s'observe dans ce Corridor, il faut étudier la possibilité d'y implanter un service de train rapide. Les coûts de construction et d'exploitation d'une ligne de train rapide étant très élevés, il faut essayer de trouver des recettes d'appoint. L'une des stratégies à cette fin consiste à autoriser les entreprises de services publics à utiliser, aux termes d'un bail, une partie de l'emprise du chemin de fer. Connue sous le nom de «coimplantation», cette stratégie est appliquée dans une grande mesure, en tant que nouvelle source de recettes, par les principales compagnies ferroviaires de l'Amérique du Nord. Cependant, son adoption est subordonnée à l'influence de plusieurs inconnues dont le marché potentiel, l'applicabilité le long d'une voie de train rapide électrifiée et les recettes nettes en puissance. La présente étude examine les pratiques courantes et fournit, à la lumière de la situation actuelle des expériences déjà faites, une estimation des recettes potentielles et une indication des possibilités offertes par le marché. À noter toutefois que ses résultats sont limités à cause de la gamme des hypothèses devant être intégrées à l'analyse et du volume restreint des données sur les recettes émanant des compagnies ferroviaires.

Conclusions

Voici les conclusions de cette étude :

- Les principales compagnies ferroviaires du Canada et des États-Unis utilisent leurs emprises aux fins de la coimplantation et cherchent activement à développer ce marché en tant que nouvelle source de recettes.
- La clientèle se compose des principales compagnies de services publics - gaz, pétrole et électricité - et, plus récemment, des compagnies de télécommunications (téléphone) qui utilisent les fibres optiques.
- Techniquement, l'installation des réseaux de services publics est réglementée par des associations de normalisation établies telles que la CSA (pour les gazoducs) et l'ONT (pour les oléoducs et les réseaux hydro-électriques) et par le Code canadien de l'électricité, pour les installations particulières.
- Le principal marché de la coimplantation réside dans les systèmes de transmission par fibres optiques, mais ce marché sera probablement saturé d'ici quelques années.
- Dans le contexte du train rapide, les recettes éventuelles de la coimplantation seront limitées à cause du calendrier des travaux de construction et de la date de disponibilité de la ligne (d'ici sept ans au moins), date à laquelle les besoins des compagnies de services publics seront probablement satisfaits.

- Un certain nombre de facteurs auront une incidence sur les recettes potentielles de la coimplantation; ces facteurs s'ajoutent à la situation globale du marché dont les plus importants sont : l'option de tracé choisie; la valeur des terres attenantes à l'emprise; la proportion de zones urbaines et de zones rurales; la longueur de l'emprise existante achetée aux compagnies de chemin de fer; les droits de perception des recettes de la coimplantation au moment de la cession et le montant de ces recettes.
- Les recettes estimatives de la coimplantation, en dollars de 1993, pour chacune des trois options de tracé de l'emprise du train rapide se présentent comme suit :

<u>Option</u>	<u>Recettes totales (sur 20 ans)</u>	<u>Recettes par km admissible</u>	<u>Recettes annuelles par km admissible</u>
1	57 500 000 \$	80 000 \$	4 000 \$
2	69 500 000 \$	78 000 \$	3 900 \$
3	69 500 000 \$	57 000 \$	2 900 \$

- L'option de tracé 1 est la plus rémunératrice selon les estimations parce qu'elle prévoit une répartition plus avantageuse entre les zones rurales et les zones urbaines.

Constat des conclusions du rapport

L'utilisation d'une partie de l'emprise des voies ferrées pour l'installation des différents réseaux de services publics (lignes électriques, pipelines, fibres optiques) est assujettie, d'une part, à des lignes directrices établies par l'Association canadienne de normalisation (CSA) et, d'autre part, à des normes détaillées utilisées par les compagnies ferroviaires et les entreprises de services publics elles-mêmes. Ce qui est le plus préoccupant dans le cas d'une ligne de train rapide électrifiée, c'est le risque d'interférence entre le champ électromagnétique du système de propulsion et les réseaux de services publics, en particulier les réseaux de transmission par fibres optiques. Les résultats de l'étude montrent qu'il n'y a pas lieu de s'inquiéter à ce sujet étant donné que les installations des services publics doivent se conformer à des normes de tubage et d'isolation qui empêchent ce phénomène de se produire.

La coimplantation peut se présenter sous deux formes : les croisements, lorsque la ligne de services publics traverse la voie ferrée en formant un angle; les installations parallèles (appelées «longitudinales» aux États-Unis), lorsque la ligne de services publics court parallèlement à l'emprise du chemin de fer. Les croisements sont les plus fréquents, mais aussi les moins rémunérateurs.

En Europe, l'utilisation commune des emprises de train rapide est limitée, principalement à cause des restrictions réglementaires. En France, par exemple, la SNCF est désignée entreprise d'utilité publique et ne peut partager ses emprises avec d'autres services

publics. À noter toutefois qu'elle demande actuellement que la législation soit modifiée de façon à autoriser les initiatives de ce type.

En Amérique du Nord, toutes les grandes compagnies ferroviaires cherchent à exploiter la coimplantation. Les plus importants débouchés sont offerts par les réseaux de transmission par fibres optiques des communications audio et vidéo, lesquels permettent aux compagnies ferroviaires non seulement d'accroître leurs recettes, mais encore de combiner leurs besoins en matière de signalisation et de communication avec ceux des entreprises de services publics. Par ailleurs, les entreprises de services publics ont intérêt à utiliser les emprises du chemin de fer, ces dernières étant assujetties à des mesures qui garantissent leur sécurité et en limitent l'accès.

Les accords passés avec les entreprises de services publics instituent des servitudes ou des droits d'usage. Pour déterminer le prix de location, la compagnie ferroviaire tient compte, d'une part, de la valeur du terrain compte tenu de celle des terres adjacentes et, d'autre part, de l'évolution probable du marché, du champ de compétence gouvernemental en cause et de la vulnérabilité des terres qui confinent à l'emprise. Les droits imposés varient selon le genre de coimplantation et le genre de services publics. Étant donné que la participation des compagnies ferroviaires à ce marché est encore en voie de développement, les prix de location ne sont pas cohérents et présentent d'importantes fluctuations.

Les recettes globales que les compagnies actuelles retirent de la coimplantation sont difficiles à chiffrer étant donné qu'elles ne sont pas cumulées et que toute information de cette nature est strictement confidentielle.

Le marché potentiel

Ce sont les réseaux de transmission par fibres optiques qui représentent les débouchés futurs sur le marché de la coimplantation. À noter cependant que la demande de servitudes dans les emprises, de la part des compagnies de services publics qui utilisent ces fibres, est sur le point de plafonner et que, d'ici la date d'ouverture de la ligne de train rapide, elle sera probablement satisfaite, réduisant à zéro ou presque les perspectives de croissance. L'essor futur du marché dépendra donc de la mesure dans laquelle ces compagnies auront besoin de plus d'espace pour répondre à l'accroissement de la demande de transmission par fibres optiques. Simultanément, l'utilisation de l'emprise du train rapide pour répondre aux besoins des entreprises de fibres optiques ou d'autres services publics dépendra de la compatibilité du tracé ferroviaire avec le tracé du réseau de distribution de la compagnie en cause.

Selon toute probabilité, tout tracé de ligne de train rapide présentera une combinaison d'emprises nouvelles et d'emprises existantes achetées à des compagnies ferroviaires ou partagées avec celles-ci. Pour maximiser les recettes potentielles, toute acquisition de tracé appartenant à une compagnie ferroviaire devrait donner à l'exploitant du train rapide le droit de participer aux contrats de coimplantation en vigueur et des recettes connexes.

En se basant, d'une part, sur les pratiques de coimplantation actuelles et les recettes estimatives qu'elles produisent pour les compagnies ferroviaires et, d'autre part, sur un

certain nombre d'hypothèses, notamment une estimation des kilomètres «admissibles» en tant que source de recettes, les coûts des terrains adjacents, le nombre des croisements et la longueur des installations parallèles, les recettes totales sur vingt ans pourraient se situer entre 57,5 et 69,5 millions de dollars, étant entendu que le maximum réalisable dépendra du tracé choisi pour le train rapide. Des trois options envisageables sous ce rapport, l'option 1 pourrait produire le plus de recettes par kilomètre parce qu'elle présente le ratio emprise urbaine/emprise rurale le plus élevé.

1 Introduction

1.1 Contexte

De tous les tronçons de chemin de fer au Canada, le corridor Québec-Windsor est celui où le trafic est le plus intense; aussi a-t-il été décidé d'étudier la possibilité d'y implanter un système de train rapide (train rapide) pour répondre aux besoins du public qui voyage entre les centres urbains qui s'y trouvent. La direction de cette étude a été confiée à un gestionnaire de projet et son financement est partagé par le gouvernement fédéral et les provinces de l'Ontario et du Québec.

Le gestionnaire de projet a chargé Delcan Corporation d'entreprendre, en collaboration avec SNC-Lavalin, une évaluation préliminaire de l'itinéraire qui serait utilisé par le train rapide et une estimation des coûts connexes. Cette étude porte sur les différentes technologies de train rapide et, ce faisant, sur les tracés possibles, leur faisabilité et les coûts de mise en place d'un service de train rapide pour chaque tracé.

L'élaboration, la construction et la mise en service d'une ligne de train rapide constituent un projet très coûteux dont la réalisation pourrait prendre jusqu'à sept ans à compter de la date d'approbation. Étant donné le coût de ce projet, il importe d'examiner toutes les méthodes susceptibles de faciliter son financement ou d'en réduire par la suite les coûts d'exploitation.

Les compagnies ferroviaires existantes se servent de leurs emprises pour tirer des recettes qui s'ajoutent à leurs recettes d'exploitation traditionnelles. Parmi les stratégies qu'elles adoptent à cette fin figure la «coimplantation», c'est-à-dire l'autorisation donnée à des entreprises de services publics d'utiliser une partie de ces emprises. Étant donné que la construction d'une ligne de train rapide peut donner lieu à la création de nouveaux Corridors, donc de nouvelles emprises, il pourrait être possible d'utiliser ces dernières comme source de recettes. Quel serait le montant estimatif de ces recettes? L'examen des pratiques et des tendances des compagnies ferroviaires existantes permettrait de le déterminer.

1.2 Objet de l'étude

La présente étude a pour objet de passer en revue les pratiques adoptées par les principales compagnies ferroviaires au Canada et aux États-Unis en ce qui concerne l'utilisation de leurs emprises en tant que source de recettes, d'examiner les questions et les contraintes techniques reliées à l'utilisation des emprises à des fins autres que le transport ferroviaire, de définir le marché potentiel et de fournir une estimation des recettes pouvant être tirées des différentes emprises de la ligne de train rapide.

Cette étude vise particulièrement à :

- cerner les contraintes techniques qui influent sur l'utilisation commune de l'emprise à des fins autres que le transport ferroviaire, c'est-à-dire pour l'installation de réseaux de communication, de pipelines ou d'autres services publics;
- faire le point sur les pratiques d'autres pays dans ce domaine et déterminer ce qui est applicable au Canada;
- indiquer s'il y a un marché pour les «coimplantations» de ce type en Ontario et au Québec et dans quelles régions, compte tenu des réseaux routiers et ferroviaires qui sont déjà en service.

Cette étude renferme : une définition des questions et des contraintes techniques liées à l'utilisation commune des emprises pour l'installation de réseaux de fibres optiques, de câbles, d'oléoducs, de gazoducs et autres; une analyse des recettes estimatives tirées de chacune de ces installations par les compagnies ferroviaires; un processus d'établissement des coûts pour la prévision des recettes potentielles de l'utilisation des emprises à des fins autres que le transport ferroviaire.

1.3 Méthodologie

La méthodologie adoptée pour produire le présent rapport a comporté trois grands volets :

- la cueillette et l'examen des renseignements obtenus des organismes de réglementation, des compagnies ferroviaires et des entreprises de services publics, ainsi que des bases de données pertinentes - SNIT, SRIT, etc. - et du TRB;
- des entretiens téléphoniques approfondis avec les représentants des principales compagnies ferroviaires et entreprises de services publics.
- une analyse des différents tracés de train rapide correspondant aux options technologiques, afin de déterminer la mesure dans laquelle ils pourraient produire des recettes d'appoint, et une interprétation des formules d'estimation des recettes qui sont utilisées actuellement par les compagnies ferroviaires.

2 Questions techniques

Dans la présente section du rapport, les aspects réglementaires et techniques de l'installation des réseaux de services publics le long des Corridors ferroviaires, notamment des réseaux de gazoducs, d'oléoducs, de câbles électriques aériens et souterrains et de lignes de télécommunication (en particulier de fibres optiques) sont examinés. Après une description succincte des processus et des règlements applicables à chacun de ces réseaux de services publics, les règlements concernant plus précisément la coimplantation des services publics dans les emprises ferroviaires sont résumés. La section se termine par un sommaire. Des extraits des différents règlements et normes sont présentés à l'annexe.

2.1 Réseaux de services publics

Gazoducs

Pour savoir quels règlements régissent l'installation de gazoducs le long des Corridors ferroviaires, un premier contact a été établi avec la Commission des services publics de la ville de Kingston (Ontario). Selon cet organisme, l'installation des gazoducs est régie par la norme Z184 de l'Association canadienne de normalisation (CSA). Ce document traite principalement des gazoducs qui croisent la voie ferrée, et non de ceux qui la suivent parallèlement. Il porte essentiellement sur les sujets suivants : la profondeur du gazoduc par rapport au terre-plein de la voie ferrée; l'obligation de placer les conduites en polyéthylène dans un tubage en acier et l'aménagement des puits d'accès aux soupapes de contrôle ou aux répartiteurs de débit à une distance minimale précise du rail.

Oléoducs

Lors de l'examen des questions concernant l'installation des oléoducs, c'est la Trans Northern Pipeline qui a été contactée. Les conditions de construction d'une nouvelle emprise de chemin de fer sur un terrain déjà occupé par un oléoduc sont déterminées par l'article 112 de la *Loi sur l'Office national de l'énergie* et le règlement de l'ONE sur les croisements de pipelines (voir l'annexe C). Les conditions d'installation d'un oléoduc sur un terrain déjà occupé par une voie ferrée (le cas de loin le plus courant) sont du ressort de l'Office national des transports en vertu de son ordonnance générale E-10.

L'une des principales compagnies de pipeline, Interprovincial Pipe Line Inc., a indiqué qu'elle applique aux projets de construction et de conception la norme CSA Z183-M90. Les croisements avec son emprise sont admissibles à condition que des plans montrant les dégagements, etc. soient présentés à ses ingénieurs. Ces derniers les examinent et, s'il y a lieu, recommandent les changements à y apporter (voir l'annexe C).

Lignes hydro-électriques

L'installation de lignes électriques le long d'un Corridor ferroviaire est régie par le Code canadien de l'électricité et la norme CSA CAN3 C22.3 n° 1-M87, aussi bien au Québec qu'en Ontario. Pour vérifier l'application de ces normes, Ontario Hydro, Hydro-Québec, le Canadien National et la Commission des services publics de Kingston ont été contactés. Dans chacune de ces juridictions, les plans sont tracés puis présentés à la compagnie ferroviaire, laquelle décide soit de les approuver, soit de les renvoyer, pour révision, à son ingénieur en chef.

Télécommunications

Le Service de consultation - industrie du bâtiment, de Bell Canada, a été contacté. L'installation des lignes de communication est régie par le Code canadien de l'électricité. Les règlements visent à maximiser la sécurité physique et à réduire au minimum l'interférence électrique. En ce qui concerne les fibres optiques, la sécurité physique constitue le principal sujet de préoccupation. Si l'on en juge par l'évaluation des besoins et les pressions exercées par la concurrence, l'utilisation des fibres optiques dans le corridor Québec-Windsor devra s'intensifier. Toutefois, la plupart des lignes de transmission par fibres optiques courent le long de l'autoroute 401. Étant donné les accords passés avec le ministère des Transports de l'Ontario et les municipalités et les capitaux investis dans l'infrastructure actuelle, l'expansion des réseaux de fibres optiques se fera en premier lieu le long de l'autoroute. En ce qui concerne les voies ferrées, il s'agit surtout de croisements plutôt que d'installations parallèles. L'aménagement physique des lignes de communication et la facturation des droits d'usage relèvent de la compagnie ferroviaire.

Conditions générales

Dans les cas où les réseaux de services publics et de pipelines existent avant la construction d'une voie ferrée, situation qui pourrait se présenter avec le projet de train rapide et qui, semble-t-il, est sans précédent, il faudrait supposer, d'après ce qui s'observe dans d'autres juridictions, qu'un droit d'usage en faveur de la ligne ferroviaire devrait être négocié avec les propriétaires fonciers et les entreprises de services publics concernés.

Les règlements et les normes de construction et d'installation des réseaux de pipelines et d'autres services publics sont les mêmes en Ontario et au Québec, mais les accords officiels varieraient d'une province à l'autre parce qu'ils seraient régis par le droit civil au Québec et par la *common law* en Ontario.

2.2 Les normes réglementaires

Le tableau 1 fait une récapitulation des renseignements disponibles qui touchent particulièrement les réseaux de services publics installés dans les Corridors de chemin de fer. D'autres normes sont présentées à l'annexe.

**Tableau 1 Normes régissant l'utilisation des emprises ferroviaires
par les entreprises de services publics**

Profondeur des pipelines dans les emprises du chemin de fer	75 cm	
Profondeur des pipelines dans un espace situé à moins de 7 m du centre de la voie ferrée	200 cm sans tubage 120 cm avec tubage	
Épaisseur nominale minimale de la paroi du tubage en acier, dans les intersections avec tubage, et du conduit porteur dans les intersections sans tubage	Diamètre extérieur	Épaisseur du conduit
	88,9 mm	3,2 mm
	101,6 mm	3,2 mm
	114,3 mm	3,2 mm
	141,3 mm	4,0 mm
	168,3 mm	4,8 mm
	219,1 mm	4,8 mm
	273,1 mm	4,8 mm
	323,9 mm	4,8 mm

Épaisseur nominale minimale de la paroi du tubage en acier, dans les intersections avec tubage, et du conduit porteur dans les inter- sections sans tubage	Diamètre extérieur	Épaisseur du conduit
	355,6 mm	5,6 mm
	406,4 mm	5,6 mm
	457 mm	6,4 mm
	508 mm	7,1 mm
	559 mm	7,9 mm
	610 mm	8,7 mm
	660 mm	9,5 mm
	711 mm	10,3 mm
	762 mm	10,3 mm
	813 mm	11,1 mm
	854 mm	11,9 mm
	914 mm	11,9 mm
	965 mm	12,7 mm
	1 016 mm	12,7 mm
	1 067 mm	12,7 mm
	1 118 mm	14,3 mm
	1 168 mm	15,9 mm
	1 219 mm	15,9 mm
	1 270 mm	15,9 mm
	1 321 mm	19,1 mm
	1 372 mm	19,1 mm
	1 423 mm	19,1 mm
	1 524 mm	20,6 mm

Dégagement vertical des câbles électriques aériens par rapport à la face supérieure du rail, au point d'intersection avec la voie ferrée - Courant alternatif	Nature du câble	Dégagement
	Haubans, câbles porteurs, câbles de communication, câbles d'éclairage	7,3 m
	Câbles conducteurs	6,7 m
	Câbles conducteurs nus	
	0-750 V	7,3 m
	0,75-22 KV	7,6 m
	22-50 KV	8,1 m
	50-90 KV	8,4 m
	90-120 KV	8,7 m
	120-150 KV	9 m
	150-250 KV	9 m + 0,01 m pour chaque kilovolt au-delà de 150
	250-300 KV	10 m + 0,01 m pour chaque kilovolt au-delà de 250
	plus de 300 KV	10,5 m + 0,01 m pour chaque kilovolt au-delà de 300

Dégagement vertical des câbles électriques aériens par rapport à la face supérieure du rail, au point d'inter- section avec la voie ferrée - Courant continu	Nature du câble	Dégagement	
	Câbles conducteurs nus		
	0,75-100 KV	8,8 m	
	100-150 KV	9,1 m	
	150-200 KV	9,3 m	
	200-250 KV	9,5 m	
	250-300 KV	9,8 m	
	300-350 KV	10 m	
	350-400 KV	10,2 m	
	400-450 KV	10,4 m	

Dégagement horizontal des câbles électriques aériens par rapport à la face supérieure du rail, au point d'intersection avec la voie ferrée - Courant alternatif	Nature du câble	Dégagement du câble le plus proche du rail	
		Voie principale	Voie d'évitement
	Haubans, câbles porteurs, câbles de communication, câbles d'éclairage	2,5 m	1,9 m
	Câbles conducteurs nus		
	0-750 V	2,5 m	1,9 m
	0,75-22 KV	2,7 m	2,1 m
	22-50 KV	3,2 m	2,6 m
	50-90 KV	3,5 m	2,9 m
	90-120 KV	3,8 m	3,2 m
	120-150 KV	4,1 m	3,5 m
	150 + KV	4,1 + 0,01 m pour chaque kilovolt au- delà de 150	3,5 m + 0,01 m pour chaque kilovolt au- delà de 150

Dégagement horizontal des câbles électriques aériens par rapport à la face supérieure du rail au point d'inter- section avec la voie ferrée - Courant continu	Nature du câble	Dégagement	
	Câbles conducteurs nus	Voie principale	Voie d'évitement
	0,75-100 KV	2,8 m	2,2 m
	100-150 KV	3 m	2,5 m
	150-200 KV	3,3 m	2,7 m
	200-250 KV	3,5 m	2,9 m
	250-300 KV	3,7 m	3,1 m
	300-350 KV	4 m	3,4 m
	350-400 KV	4,2 m	3,6 m
	400-450 KV	4,4 m	3,8 m

Câbles électriques aériens
Distance horizontale entre
les structures de support
et les rails

Voie
principale
2,5 m

Voie
d'évitement
1,9 m

Câbles électriques souterrains
Profondeur par rapport à la
base du rail

1,1 m

Conduit installé sous la
voie ferrée

Structure

Conduit placé dans un coffrage de béton de 75 mm d'épaisseur qui s'étend jusqu'à une distance d'au moins 2 m du rail le plus proche ou de préférence sur toute la largeur de l'emprise

Profondeur

La paroi supérieure du conduit doit se trouver à une profondeur de 450 mm par rapport à la surface de l'emprise ou au fond de la rigole latérale

Dégagement
horizontal

Les puits d'accès doivent se situer à une distance d'au moins 2,5 m des voies principales et 1,9 m des voies d'évitement

2.3 Constat

Dans cette section du rapport, les normes et règlements et les questions techniques qui déterminent l'installation des réseaux de services publics le long des Corridors ferroviaires, notamment les gazoducs, les oléoducs, les câbles électriques aériens et souterrains et les lignes de télécommunications, en particulier les fibres optiques, ont été examinés. Beaucoup des questions traitées dans cette section sont assujetties à des normes établies par l'Association canadienne de normalisation (CSA), 178, boul. Rexdale, Rexdale (Ontario) M9W 1R3, n° de téléphone (416) 747-4000.

3 Pratiques actuelles

3.1 À l'étranger

Dans le cadre de cette étude, des contacts ont été établis avec les administrations du transport ferroviaire en Allemagne et en France, afin de connaître leurs pratiques et leur expérience en ce qui concerne l'utilisation de l'emprise de la voie ferrée du train rapide comme source de recettes d'appoint. Il a été jugé utile de communiquer avec les sociétés de chemin de fer européennes parce qu'elles exploitent un vaste réseau de trains rapides et que, grâce à l'expérience qu'elles ont acquise dans ce domaine, elles pourraient préciser, les contraintes ou les problèmes dont il faut tenir compte dans l'exploitation des emprises ferroviaires au Canada et, d'autre part, les sources de recettes attribuables à cette exploitation. Des renseignements ont été fournis par l'administration ferroviaire française (Société nationale des chemins de fer), qui exploite un vaste réseau de trains rapides (train à grande vitesse ou TGV) qui ne cesse de s'accroître. Les demandes adressées à la société de chemin de fer de l'État allemand sont restées sans réponse.

D'après les renseignements fournis par la SNCF et les connaissances générales au sujet des réseaux de train rapide européens, il appert que l'utilisation des tracés de ces réseaux aux fins de la coimplantation est limitée, surtout en ce qui concerne les systèmes de communication par fibres optiques. Les questions techniques semblent être analogues à celles qui se posent en Amérique du Nord, à savoir qu'il faut disposer d'un système de tubage et d'isolation qui permette de réduire au minimum l'interférence avec le champ électromagnétique généré par les lignes de propulsion du train rapide et avec ses systèmes de communication. À souligner toutefois qu'il n'a pas été possible d'obtenir de données précises à ce sujet.

Dans ses commentaires, la SNCF estime qu'il est «impensable» qu'un tiers puisse avoir accès, aux fins de l'entretien, à la ligne de TGV et ajoute qu'en tout état de cause, la «Déclaration d'utilité publique (DUP)» ne prévoit pas la coimplantation d'autres installations dans l'emprise. Toutefois, des recommandations ont été faites récemment afin d'avoir une DUP conjointe pour une nouvelle voie ferrée et une nouvelle autoroute suivant le même tracé. Un câble de télécommunications a été installé entre les deux mais en dehors de l'emprise du TGV, ce qui fait que la SNCF n'en assume pas la responsabilité.

La SNCF loue la capacité excédentaire de ses lignes de signalisation ou de télécommunication par fibres optiques à des usagers tels que Postes et télécommunications, la police et les services douaniers (dans les zones frontalières). Elle envisage également d'installer dans ses emprises et de vendre des services de câblodistribution. La vente de ces services fait partie du mandat de son département de télécommunications qui est devenu, à compter du 1^{er} janvier 1993, une agence de télécommunications. Le cadre contractuel applicable à ce service n'a pas encore été clairement défini, pas plus que la tarification n'a été fixée.

Il n'est pas possible de faire une estimation des recettes tirées de la coimplantation en Europe, parce que les renseignements obtenus sous ce rapport sont limités. De toute façon, ces renseignements ne seraient pas applicables au contexte canadien étant donné, d'une part, la densité de population qui est beaucoup plus forte en Europe et, d'autre part, les divergences de valeurs, qu'il s'agisse des coûts élevés, de propriété ou d'acquisition.

3.2 Au Canada

Dans le cadre de l'étude consacrée à l'expérience acquise au Canada, les deux principales compagnies ferroviaires, le Canadien National et le Canadien Pacifique - VIA Rail Canada, ont été contactées, et l'on s'est renseigné sur les opérations de Ontario Northland. Les principales compagnies de services publics qui occupent des emprises de chemin de fer ont également été contactées.

Pratique actuelle

D'une manière générale, c'est seulement au cours des dix dernières années que les compagnies ferroviaires canadiennes ont pris réellement intérêt à l'utilisation de leurs emprises comme source de recettes d'appoint. Étant donné que c'est un marché qu'elles continuent à développer, les prix de location ne sont pas établis d'une manière cohérente ou selon des formules précises, varient selon les circonstances, sont l'objet de négociations et sont fixés en partie en fonction du marché local.

Les contraintes financières croissantes dont les compagnies ferroviaires doivent s'accommoder ont intensifié, au cours des quelques dernières années, leur intérêt pour l'utilisation des emprises en tant que source de recettes d'appoint. La déréglementation de l'industrie des télécommunications et le développement des systèmes de transmission par fibres optiques ont ouvert de nouvelles perspectives de débouchés et de recettes.

Indépendamment des services de transport ferroviaire, les emprises peuvent servir aux installations suivantes :

- gazoducs
- oléoducs
- lignes électriques
- câbles téléphoniques, y compris les fibres optiques
- câblodistribution
- concessions routières
- panneaux publicitaires ou de signalisation.

L'utilisation des emprises par les compagnies de services publics peut prendre deux formes : les croisements, lorsque des pipelines ou des lignes hydro-électriques, par exemple, traversent l'emprise et les installations parallèles (appelées «longitudinales» aux États-Unis), lorsque le réseau de services publics court parallèlement à l'emprise. Jusqu'à présent, les croisements ont constitué la forme la plus fréquente.

À l'heure actuelle, les réseaux de transmission par fibres optiques représentent pour les compagnies ferroviaires d'importants nouveaux débouchés ainsi que d'importantes nouvelles sources de recettes. Dans bien des cas, les réseaux de fibres optiques installés le long de l'emprise des voies ferrées peuvent être, aux termes des ententes conclues, utilisés en partie par la compagnie ferroviaire pour sa signalisation et ses communications. Les ententes de ce type profitent à la compagnie ferroviaire en lui permettant d'utiliser les techniques de télécommunication modernes dont elle a besoin sans avoir à les développer elle-même.

Inversement, si la compagnie ferroviaire adopte, de sa propre initiative, la technologie des fibres optiques pour répondre à ses besoins en matière de signalisation et de communication, la capacité excédentaire peut être louée à des entreprises de communication privées, ce qui représente un moyen d'amortir les coûts de mise à niveau du système et de tirer des recettes supplémentaires. Dans un rapport de mai 1991, MM. G.T. Fisher et J.G. Johnson de CPCS Ltd. à Montréal examinent les avantages que les compagnies ferroviaires peuvent tirer des systèmes de transmission par fibres optiques. Selon ces auteurs, les câbles de fibres optiques installés dans les emprises du chemin de fer au Canada s'étendent sur une distance globale de plus de 3 000 kilomètres, dont 2 000 en Ontario et au Québec. Le CN installe, exploite et entretient des réseaux de câbles de fibres optiques pour ses propres besoins et ceux des compagnies de télécommunication. La compagnie CP Rail autorise les entreprises de services publics à utiliser son emprise et leur laisse le soin d'installer et d'entretenir leur système.

Ces opérations se traduisent habituellement par des permis d'occupation ou par ce que l'on appelle communément des servitudes et s'accompagnent soit de frais fixes, dans le cas de croisements, soit d'un contrat, dans le cas d'installations parallèles, fondés sur une combinaison de facteurs tels que :

- la valeur du terrain déterminée en fonction de la valeur des terrains adjacents
- la négociation avec le client
- la longueur et le type de l'installation
- la concurrence.

La concurrence comprend non seulement les emprises d'autres compagnies ferroviaires, mais encore et surtout les emprises des autoroutes et des réseaux hydro-électriques. Il convient de noter en effet que la législation qui régit les servitudes des autoroutes ou des routes est plus favorable que les dispositions prévues par les lois sur les chemins de fer. En outre, les emprises des autoroutes sont plus larges et, par conséquent, offrent une plus grande marge de manoeuvre pour la coimplantation en matière d'installation et d'entretien. Cependant, les emprises des voies ferrées sont mieux protégées et contrôlées que les emprises routières, ce qui fait que les entreprises de services publics leur donnent la préférence.

Chaque entreprise de services publics ou client qui envisage d'utiliser une emprise a ses propres paramètres de conception et d'installation et ses propres normes d'accès, de construction et de retrait (voir le rapport sur la tâche 1). De même, les compagnies ferroviaires ont leurs propres conditions en ce qui concerne la nature de l'installation, les normes de construction, les procédures à suivre sur le plan du service ou de l'entretien courant et les contraintes imposées en matière d'accessibilité. Ces conditions sont établies dans le cadre des opérations ferroviaires. Elles stipulent par exemple que, sauf en cas d'urgence -- et les ententes précisent ce qu'est un cas d'urgence -- l'accès à l'emprise aux fins de l'entretien doit être préalablement autorisé par la compagnie de chemin de fer. La figure 1 de la table des matières, donne un exemple des sujets traités dans une entente type.

Du point de vue de la sécurité et de la maintenance, les réseaux de fibres optiques répondent mieux que les pipelines ou les lignes électriques aux conditions d'utilisation d'une emprise ferroviaire parce qu'ils nécessitent généralement moins d'entretien et qu'en cas de fonctionnement défectueux, l'intervention requise ne risque pas de perturber les opérations ferroviaires ou d'endommager l'emprise. Du point de vue de l'entretien, la réparation d'une

installation de services publics pourrait nécessiter l'utilisation de véhicules d'entretien, la réduction de la vitesse des trains, le recours à un signaleur, etc., selon la taille et la complexité de l'installation. Dans le cas des fibres optiques, ces inconvénients sont réduits au minimum.

L'établissement d'un tarif pour les installations parallèles à l'emprise est un processus complexe et pourtant imprécis, qui fait intervenir, comme il a déjà été indiqué, des considérations tenant au marché local, la valeur des terres adjacentes, le nombre de juridictions concernées, l'importance stratégique de la disponibilité ou de l'autorisation de l'installation, de même que les obligations sociales qui s'imposent le long des différents tronçons de l'itinéraire.

L'utilisation commune d'une emprise devrait donc, dans l'idéal, avoir une incidence minime sur les opérations ferroviaires, sur l'utilisation des terres adjacentes et sur les résidents locaux, d'où la préférence qui est donnée aux installations souterraines nécessitant un espace limité et s'accompagnant de mesures atténuantes. Pour ces raisons, les réseaux de transmission par fibres optiques constituent une cible privilégiée pour les projets de coimplantation et cadrent, d'une part, avec le désir des compagnies ferroviaires d'accroître leurs recettes et, d'autre part, avec la déréglementation de l'industrie des communications (services téléphoniques interurbains).

FIGURE 1

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Recettes

Les droits imposés par les compagnies ferroviaires canadiennes varient non seulement en fonction du type de demande (croisements ou installations parallèles, type de services publics, etc.), mais encore d'une compagnie à l'autre. Étant donné l'intérêt accru que suscite l'utilisation des emprises comme source de recettes d'appoint, les droits sont en cours de révision et, selon toute probabilité, augmenteront substantiellement.

La figure 2 donne un sommaire des droits imposés actuellement par trois compagnies ferroviaires au Canada et par quatre compagnies ferroviaires aux États-Unis. La compagnie ferroviaire n° 7 exploite le Corridor très peuplé Boston-Washington, d'où le niveau élevé des droits de coimplantation qu'elle impose. Ces droits ne s'appliquent donc pas au contexte canadien. Néanmoins, en comparant les droits imposés respectivement par les trois compagnies canadiennes et les trois autres compagnies des États-Unis, il semble possible de majorer les droits moyens applicables au Canada. La valeur définitive de ces droits dépendra évidemment, comme il a déjà été indiqué, des conditions du marché, de la concurrence et de la valeur des terres adjacentes.

Il a été difficile de déterminer le montant total des recettes attribuables à l'utilisation des emprises ferroviaires comme source de recettes d'appoint, étant donné, d'une part, la nature confidentielle et concurrentielle de ces renseignements et, d'autre part, les méthodes comptables utilisées par les compagnies ferroviaires. En effet, celles-ci ne totalisent pas ces recettes séparément. Elles les répartissent plutôt par type de services publics et par région.

À noter cependant que les recettes ne peuvent être obtenues par la compagnie ferroviaire que dans les cas où elle est propriétaire de l'emprise et où celle-ci, s'il s'agit d'un croisement, existe avant le réseau de services publics. Si le réseau de services publics est déjà en place, ce qui serait le cas au moment de l'aménagement d'une nouvelle emprise pour une ligne de train rapide, la compagnie ferroviaire ne pourrait pas s'attendre à tirer des recettes du croisement de sa ligne avec le réseau de services publics. Elle devrait plutôt passer un accord avec l'entreprise de services publics concernée ou obtenir à cette fin un droit d'usage.

Constat

Les compagnies ferroviaires canadiennes continuent de chercher des débouchés pour l'utilisation de leurs emprises. Leurs besoins de recettes supplémentaires et les perspectives ouvertes par la déréglementation de l'industrie des communications les incitent à exploiter ce marché.

Les principaux utilisateurs visés sont les entreprises de services publics : gazoducs, oléoducs, réseaux de transmission par fibres optiques, etc.

La coimplantation prend la forme de croisements ou d'installations parallèles, les croisements étant les plus fréquents.

Les droits d'occupation, imposés actuellement sous forme de droits de servitude, varient selon le type d'installation et de services publics. Ils fluctuent considérablement et dépendent largement de la valeur des terres adjacentes. Ce marché étant en cours de développement,

les droits ne sont pas établis de manière cohérente et présentent d'importantes fluctuations. Il est toutefois probable qu'ils seront majorés de façon à correspondre en moyenne aux droits imposés par certaines compagnies ferroviaires du Canada et des États-Unis.

FIGURE 2
SOMMAIRE DES DROITS IMPOSÉS DANS LE CADRE DE L'UTILISATION DES EMPRISES FERROVIAIRES
EN TANT QUE SOURCE DE RECETTES SUPPLÉMENTAIRES

Voie ferrée	CROISEMENTS ¹					INSTALLATION PARALLÈLE ²	
	INSTALLATION SOUTERRAINE				INSTALLATION AÉRIENNE		
	Câble téléphonique	Câble électrique	Câble porteur	Conduit	Câble	Câble électrique aérien ³	Câble souterrain ⁴
1. (Canadienne)	450 \$	450 \$	450 \$	450 \$	450 \$	42 150 \$	6 000 \$
2. (Canadienne)	280	280	280	200	465	4 800	2 000
3. (Canadienne)	1 575	1 575	1 575	1 575	1 680	15 975	8 025
4. (Américaine)	1 100	1 600	1 600	1 600	1 100	60 100	6 100
5. (Américaine)	2 300	2 300	2 300	2 300	2 300	2 300	2 300
6. (Américaine)	1 375	4 300	4 300	2 900 - 4 300	3 875	22 400	22 400
7. (Américaine)	11 200	12 900	14 600	12 900 - 16 200	15 400	37 000	4 600

¹ Par croisement et pour un terme de 20 ans

² Coût par mille et pour un terme de 20 ans

³ Valeur du terrain - 30 000 \$

⁴ Valeur du terrain - 3 000 \$

4 Évaluation du marché

Pour évaluer les recettes susceptibles d'être tirées de l'utilisation commune de l'emprise du train rapide, certaines compagnies ferroviaires du Canada et des États-Unis, de même que les principales entreprises de services publics qui occupent déjà des emprises de chemin de fer ont été contactées, et les trois principales options technologie-emprise examinées relativement à la ligne de train rapide ont servi de prémisses.

Étant donné la multiplicité des variables et facteurs qui peuvent influencer sur les prévisions, l'évaluation des recettes potentielles part d'une série d'hypothèses touchant notamment le coût des terrains, le nombre d'entreprises de services publics et les chances que ces entreprises utilisent l'emprise du train rapide. À ce sujet, la présente section fournit plus de détails. Tout changement dans ces hypothèses se répercutera sur les prévisions de recettes.

Pratique actuelle

Comme il est indiqué dans la section 3, les principales compagnies ferroviaires du Canada et des États-Unis louent une partie de leur emprise afin d'accroître leurs recettes. Les principaux locataires sont les entreprises de services publics (électricité, communications, pipelines, etc.) et l'espace dont ils acquièrent le droit d'usage sert à des installations qui traversent l'emprise (croisements) ou courent parallèlement à la voie ferrée. Dans le cas d'un croisement, le prix de location se compose d'un droit annuel auquel s'ajoutent des frais d'administration. Il fait l'objet d'un accord pluriannuel, habituellement sur une période de vingt ans, et varie selon le nombre de croisements ou d'empiétements.

En ce qui concerne les installations parallèles, le prix de location est fondé sur la longueur et la valeur foncière de l'emprise occupée. Cette valeur correspond à la valeur estimative des terres adjacentes, majorée de frais d'administration ou autres. Ce processus influe, dans une grande mesure, sur le marché local, c'est-à-dire, d'une part, la valeur foncière proprement dite et, d'autre part, la nature de l'espace loué ainsi que les fins pour lesquelles il est loué. Par exemple, dans une région rurale éloignée, le nombre de résidents, d'entreprises ou d'administrations locales avec lesquels il faudrait composer, si l'emprise devait être louée pour l'installation d'un gazoduc ou d'un oléoduc, serait très limité. Par contre, si la voie ferrée se trouve à proximité d'un écosystème fragile - marécages, refuge d'oiseaux, etc. -, la location éventuelle de l'emprise pourrait provoquer de vives réactions, voire des objections, ce qui aurait probablement une incidence négative sur le prix de location.

Il n'a pas été possible de quantifier les recettes que les compagnies ferroviaires tirent de la location des emprises, principalement parce qu'il s'agit de renseignements de nature confidentielle et concurrentielle, et aussi parce que, pour les compagnies ferroviaires, ce domaine d'activité est relativement nouveau et semble n'avoir pris de l'importance, du point de vue organisationnel, que très récemment. Cela étant, les compagnies ferroviaires ont de la difficulté à estimer les recettes totales provenant de la location des emprises parce qu'elles ne cumulent pas séparément dans leur système comptable les recettes perçues à ce titre.

Ainsi, pour les besoins de la présente étude, les sources de recettes et les méthodes d'établissement des droits et des tarifs, lesquelles ont servi de base à cette évaluation du marché et des recettes, ont été examinées en fonction d'un certain nombre d'hypothèses.

Hypothèses

Pour l'analyse et l'estimation des recettes potentielles de l'utilisation de l'emprise du train rapide, les hypothèses suivantes ont été examinées :

- les nouveaux débouchés susceptibles de se présenter sur le marché de la coimplantation sont attribués aux réseaux de transmission par fibres optiques ou de communication;
- l'installation de câbles électriques aériens serait autorisée le long de l'emprise du train rapide (installation parallèle);
- le calcul des recettes est fondé sur l'utilisation intégrale des kilomètres d'emprise «admissibles»;
- les kilomètres d'emprise admissibles sont soit nouveaux, soit existants et acquis;
- les croisements se présentent à raison d'un croisement par dix kilomètres et servent soit aux pipelines, soit aux câbles électriques;
- les coûts des terrains sont fondés sur les valeurs moyennes résultant de l'analyse effectuée par Delcan et contenus dans le rapport provisoire n° 3 - Estimation des coûts, soit 500 000 \$ l'hectare dans les zones urbaines et 5 000 \$ l'hectare dans les zones rurales. Le kilométrage dans les zones urbaines a été évalué à partir du sommaire des distances kilométriques qui figure dans le rapport provisoire n° 2 - Analyse détaillée du tracé;
- aucune recette n'est tirée d'une nouvelle emprise ferroviaire qui croise une emprise de services publics existante;
- toutes les recettes sont estimatives et constituent des chiffres NETS, étant donné que les coûts d'entretien seraient supportés par l'entreprise de services publics;
- les recettes estimatives et les droits sont exprimés en dollars de 1993.

Marché potentiel

Comme il est indiqué à la section 3, les principaux débouchés pour la location des emprises sont attribués aux réseaux de transmission par fibres optiques ou de communication. Il se pourrait qu'une certaine demande ayant trait aux réseaux de pipelines (oléoducs ou gazoducs) se manifeste, mais ce débouché dépend fortement des besoins futurs de cette industrie, lesquels sont actuellement incertains. En effet, il semble que le réseau de base de pipelines est maintenant complet et peut répondre aux besoins futurs de ce marché. Indépendamment de ce facteur, l'intérêt porté à n'importe quelle emprise de train rapide sera subordonné dans une large mesure au tracé final et à la constitution (propriété continue ou non) de la ligne de train rapide.

Les panneaux publicitaires constituent une autre source de recettes, à condition d'être parfaitement visibles à partir de réseaux routiers parallèles ou de zones (telles les zones urbaines) très peuplées. Étant donné qu'actuellement, il y en a relativement peu d'exemples, cette source de recettes a été négligée dans le cadre de la présente étude.

Dans l'examen du marché potentiel de la coimplantation, deux facteurs sont essentiels. Le premier est la date d'achèvement et de mise en service de la ligne de train rapide. L'hypothèse selon laquelle la ligne ne serait opérationnelle que vers la fin du siècle ou dans environ sept ans à compter de la date du présent rapport a été émise.

Le deuxième facteur est le tracé choisi ou la technologie adoptée. Dans ce contexte, le tracé et la technologie sont interdépendants, en ce sens que la technologie adoptée détermine le choix du tracé.

En ce qui concerne la date d'achèvement de la ligne de train rapide, la période de sept ans, qui est relativement longue, pourrait constituer un obstacle étant donné que les possibilités d'intéresser les entreprises de services publics, et plus particulièrement celles qui utilisent les fibres optiques, à une nouvelle emprise de chemin de fer sont limitées. Selon toute probabilité, les emprises existantes, ferroviaires et autres, répondent aux besoins de ces entreprises en leur offrant des liaisons optimales entre les principales zones urbaines. Un tracé de train rapide généralement parallèle aux emprises de chemin de fer existantes risquerait de ne pas intéresser ces entreprises parce qu'il ne constituerait pas un nouvel itinéraire. Le seul moyen d'attirer ces entreprises serait de mettre à leur disposition, par exemple, un tracé plus direct et plus court entre Ottawa et Toronto, de façon à leur permettre de réaliser des économies. Toutefois, dans ces situations, le coût de réinstallation devrait être compensé soit par un prix de location plus bas, soit par d'autres moyens. Par conséquent, il se peut qu'à compter du moment où la ligne de train rapide sera opérationnelle ou du moins, lorsque la compagnie d'exploitation de cette ligne sera propriétaire de son emprise et pourra la donner en location, les possibilités d'en tirer des recettes d'appoint soient minimales.

Le tracé final de la ligne de train rapide est une question connexe aussi importante que la question des recettes potentielles.

Les trois principaux tracés examinés représentent une combinaison d'emprises nouvelles, d'emprises existantes achetées et d'emprises existantes partagées avec d'autres compagnies. Le tableau 3 montre la répartition de ces composantes. L'option technologie-tracé 3 (300 km/h sur nouvelle emprise) comporte la plus grande longueur d'emprise nouvelle. L'option 1 (200 à 250 km/h sur emprise existante) comporte la plus courte emprise nouvelle mais la plus longue emprise acquise.

Du point de vue des recettes, et en tenant compte de l'hypothèse selon laquelle les compagnies ferroviaires actuelles auront satisfait, d'ici la fin du siècle, les besoins des entreprises de services publics et des propriétaires de réseaux de fibres optiques sur le plan de l'utilisation des emprises ferroviaires, l'acquisition d'emprises existantes pour le train rapide pourrait générer des recettes immédiates à condition qu'elle s'accompagne de droits de jouissance sur les recettes existantes.

Comme il a déjà été indiqué, les recettes générées par un nouveau tracé pourraient être limitées parce que ce dernier serait en grande partie parallèle aux emprises existantes. En

outre, tout nouveau tracé déterminé par la technologie ferroviaire choisie traversera des zones rurales ou, en mettant les choses au mieux, la périphérie des zones urbaines. Étant donné que les coûts d'utilisation de l'emprise pour des installations parallèles sont basés sur les coûts des terrains et plus particulièrement des terrains adjacents, les terrains ruraux et les terrains situés à la périphérie des zones urbaines ont généralement une valeur relativement plus basse, ce qui se traduit par des prix de location inférieurs.

La figure 4 montre les coûts représentatifs par hectare de terrain dans les zones urbaines traversées par chacune des options de tracé, avec une estimation du coût moyen par hectare de terrain dans les zones rurales (un hectare équivaut approximativement à 2,5 acres). Ces valeurs sont tirées de l'analyse des coûts des terrains effectuée dans le cadre de l'étude du tracé du train rapide. Le coût moyen de l'hectare est estimé à 400 000 \$ (dollars de 1993) dans les villes de taille moyenne (Windsor, London, etc.) et à 600 000 \$ à Toronto et à Montréal. Le coût moyen de l'hectare dans les zones rurales est de 5 000 \$. Il s'ensuit que la proportion des terres rurales par rapport aux terres urbaines dans l'option technologie-tracé choisie a une forte incidence sur les recettes potentielles.

La figure 5 montre la répartition des terrains urbains et ruraux pour les différentes options de tracé et selon que l'emprise est nouvelle, nouvelle intégrée à une emprise existante, partagée ou existante et acquise.

Pour l'estimation des recettes, comme il a été indiqué plus haut, seules les emprises nouvelles et les emprises existantes acquises peuvent produire des recettes, étant donné qu'elles seraient les seules assujetties au contrôle de l'exploitant du train rapide. Ainsi, les kilomètres qui appartiennent à ces catégories peuvent être considérés comme «admissibles aux fins de la coimplantation». Ils sont indiqués à la figure 5 pour les zones rurales et les zones urbaines. L'option de tracé 1 comporte la plus longue emprise urbaine (324 km). L'option 3 comporte la plus courte emprise urbaine mais la plus longue emprise rurale, caractéristique qui cadre avec la technologie applicable.

FIGURE 3
CARACTÉRISTIQUES DE L'EMPRISE DE LA LIGNE
DE TRAIN RAPIDE

	Option de tracé de train rapide		
	1	2	3
Nouvelle EMPRISE	268 km	556 km	1 049 km
Emprise nouvelle intégrée à une EMPRISE existante	254	110	15
EMPRISE existante partagée	281	223	135
EMPRISE existante acquise	446	332	57
LONGUEUR TOTALE DE L'EMPRISE	1 249 km	1 221 km	1 256 km
Zones urbaines	324 km	267 km	182 km
Zones rurales	925 km	954 km	1 074 km

Source : Ébauche de rapport final - Évaluation préliminaire du tracé et étude des coûts, juin 1993

FIGURE 4
TRAIN RAPIDE
VALEUR DES TERRAINS SELON LE TRACÉ

Zone	Option			Valeur estimative des terrains \$/hectare
	1	2	3	
Zone urbaine :				
Windsor	14 km	14 km	0 km	400 000 \$
London	48	48	0	400 000
Hamilton-Oshawa	145	126	93	600 000
Belleville	10	0	0	250 000
Kingston	10	0	0	250 000
Ottawa	31	31	31	500 000
Montréal	58	40	40	600 000
Québec	8	8	8	400 000
LONGUEUR DE L'EMPRISE URBAINE	324 km	267 km	172 km	500 000*
LONGUEUR DE L'EMPRISE RURALE	925 km	954 km	1 074 km	500 000*
LONGUEUR TOTALE DE L'EMPRISE	1 249 km	1 221 km	1 246 km	

* Valeur moyenne

Source : Rapport provisoire n° 2, Analyse détaillée du tracé, mai 1993.

Estimation des recettes de coimplantation

La figure 6 montre une estimation des recettes pour chaque option technologie-tracé du train rapide, et ce, pour les zones rurales et urbaines et pour chaque type de coimplantation (croisement ou installation parallèle).

Les recettes potentielles globales sur une période de vingt ans, compte tenu des hypothèses qui ont servi à l'élaboration des estimations, sont de 57,5 millions de dollars pour l'option 1 et de 69,5 millions de dollars pour les options 2 et 3, ce qui représente des recettes annuelles d'environ 2,9 millions de dollars et de 3,5 millions de dollars respectivement.

Comme il est indiqué dans le cadre de l'examen des possibilités de coimplantation, l'un des principaux déterminants est la compatibilité du tracé du train rapide avec les besoins de l'utilisateur en puissance. À moins que le tracé ne crée une liaison qui n'est pas déjà offerte par une emprise concurrente ou qu'il ne procure des avantages tels qu'une réduction de la distance, les recettes susceptibles d'être générées par la location de l'emprise seront limitées. Examinée sous cette perspective, l'option 3, qui comporte la plus longue emprise rurale mais qui reproduit dans une large mesure le tracé d'emprises existantes, semble offrir le moins de débouchés.

En ce qui concerne les recettes par kilomètre, l'option de tracé 1 offre le meilleur rendement, soit 80 000 \$ sur une période de vingt ans, parce qu'elle comporte la combinaison emprise rurale/emprise urbaine la plus favorable. De ce point de vue, c'est l'option 3 qui offre le rendement le plus faible, soit 57 000 \$.

En faisant une estimation des recettes futures à court, moyen et long termes, compte tenu des renseignements disponibles jusqu'à ce jour et de la tendance du marché, il est permis d'affirmer que les recettes potentielles atteindront probablement leur niveau maximum au cours d'une période de deux à trois ans après l'inauguration du service de train rapide et la prise de possession de l'emprise. Tout accroissement ultérieur des recettes dépendra dans une large mesure soit du développement de technologies nouvelles nécessitant l'usage d'une emprise spécialisée, soit de l'obligation des entreprises de services publics d'étendre leurs installations pour répondre à une demande croissante. Ces conditions sont imprévisibles dans l'immédiat.

FIGURE 5

CARACTÉRISTIQUES DES EMPRISES ET

VALEUR DES TERRAINS

	Option de tracé du train rapide					
	1		2		3	
	Zone urbaine	Zone rurale	Zone urbaine	Zone rurale	Zone urbaine	Zone rurale
Nouvelle EMPRISE	19 km	249 km	75 km	481 km	77 km	972 km
Nouvelle EMPRISE intégrée à une emprise existante	34	220	0	110	0	15
EMPRISE existante partagée	206	75	166	57	101	34
EMPRISE existante acquise	65	381	26	306	17	40
TOTAL	324 km	925 km	267 km	954 km	195 km	1 061 km
Nombre total de kilomètres admissibles aux fins de la coimplantation	84 km	630 km	101 km	787 km	94 km	1 112 km
Valeurs moyennes des terrains (par hectare)	500 000 \$	5 000 \$	500 000 \$	5 000 \$	500 000 \$	5 000 \$

Source : Rapport provisoire n° 3 - Estimation des coûts

FIGURE 6
RECETTES ESTIMATIVES DE LA COIMPLANTATION
DANS L'EMPRISE DU TRAIN RAPIDE SELON LES OPTIONS DE TRACÉ

POSTES	Options de tracé du train rapide					
	1		2		3	
	Zone rurale	Zone urbaine	Zone rurale	Zone urbaine	Zone rurale	Zone urbaine
EMPRISE admissible (km)	630	84	787	101	1 112	94
Installation parallèle :						
Câble électrique (aérien) Recettes/km	6 320 \$	294 000 \$	6 320 \$	294 000 \$	6 320 \$	294 000 \$
Câble (souterrain) Recettes/km	6 320	294 000	6 320	294 000	6 320	294 000
Recettes TOTALES (milliers de dollars)	7 963,2	49 392	9 947,7	59 388	14 055,7	55 272
Croisements :						
Nombre (1/10 km)	63	8	79	10	111	9
Recettes/km/croisement	1 575	1 575	1 575	1 575	1 575	1 575
Recettes TOTALES (milliers de dollars)	99,2	12,6	124,4	15,8	174,8	14,2
RECETTES TOTALES*	8 062,4	49 404,6	10 072,1	59 403,8	14 230,5	55 286,2
TOTAL GÉNÉRAL DES RECETTES (MILLIERS DE DOLLARS)*	57 500 \$		69 500 \$		69 500 \$	
RECETTES PAR KILOMÈTRE*	80 000 \$		78 000 \$		57 000 \$	
RECETTES ANNUELLES (MILLIERS DE DOLLARS)	2 900 \$		3 500 \$		3 500 \$	
RECETTES ANNUELLES PAR KM	4 000 \$		3 900 \$		2 900 \$	

* Sur 20 ans

Constat

Les compagnies de chemin de fer canadiennes et américaines louent une partie de leurs emprises aux compagnies d'électricité, de communication et de pipeline, afin de tirer des recettes d'appoint. La coimplantation prend la forme de croisements ou d'installations parallèles.

Les principaux débouchés potentiels en matière de coimplantation sont offerts par des entreprises qui exploitent des réseaux de transmission par fibres optiques. Toutefois, à compter du moment où le train rapide deviendra opérationnel, les possibilités de débouchés offertes par ces entreprises risquent d'être limitées parce que leurs besoins pourront avoir été satisfaits par les emprises des voies ferrées existantes.

Les recettes susceptibles d'être tirées de la coimplantation de l'emprise du train rapide dépendent de plusieurs facteurs :

- la compatibilité du tracé avec les exigences des compagnies de services publics;
- la propriété et la continuité de l'emprise du train rapide, celle-ci pouvant se composer de tronçons nouveaux et de tronçons existants;
- le fait que l'acquisition d'une emprise existante par l'exploitant du train rapide devrait s'accompagner du droit de jouissance des contrats de location existants et des recettes connexes;
- une nouvelle emprise ne peut être intéressante que dans la mesure où elle se révèle plus avantageuse que les emprises déjà utilisées (par exemple, en réduisant la distance);
- les recettes potentielles sont déterminées par les valeurs des terrains adjacents et les négociations avec les clients et sont inversement proportionnelles à la longueur du tronçon rural;
- il est difficile de déterminer les recettes globales tirées de la coimplantation par les compagnies ferroviaires actuelles parce qu'elles ne les cumulent pas séparément. Par ailleurs, les renseignements de ce type sont confidentiels.

Compte tenu de ces facteurs et des autres hypothèses énoncées dans le présent rapport, les estimations des recettes de coimplantation, en dollars de 1993, pour chaque option de tracé du train rapide sont les suivantes :

<u>Option</u>	<u>Recettes totales (sur 20 ans)</u>	<u>Recettes par km admissible</u>	<u>Recettes annuelles par km admissible</u>
1	57 500 000 \$	80 000 \$	4 000 \$
2	69 500 000 \$	78 000 \$	3 900 \$
3	69 500 000 \$	57 000 \$	2 900 \$

Du point de vue des recettes totales, l'option de tracé 3 produira les recettes les plus élevées, dépassant légèrement l'option 2. Cependant, du point de vue des recettes par kilomètre, l'option de tracé 1 est la plus rémunératrice.

Comme il a précédemment été indiqué, ces estimations sont fondées sur l'utilisation intégrale des kilomètres admissibles, y compris les kilomètres qui représentent les emprises existantes acquises. Étant donné qu'il n'a pas été possible de connaître les recettes que les compagnies ferroviaires tirent à présent de l'emprise qui serait acquise par l'exploitant du train rapide, les estimations ci-dessus pourraient être différentes des chiffres réels actuels.

Le gestionnaire du projet de train rapide devrait déterminer quelle proportion de la ligne de train rapide serait utilisée comme source de recettes d'appoint, en se reportant aux recettes par kilomètre mentionnées ci-dessus.

5 Conclusions

Le présent rapport a passé en revue les pratiques adoptées par les principales compagnies ferroviaires au Canada et aux États-Unis en ce qui concerne l'utilisation de leurs emprises en tant que sources de recettes d'appoint, a examiné les questions techniques liées à cette utilisation et a analysé les recettes susceptibles d'être tirées de l'emprise d'une ligne de train rapide.

Voici les principales conclusions de cette étude :

- les principales compagnies de chemin de fer du Canada et des États-Unis utilisent leurs emprises aux fins de la coimplantation et cherchent activement à développer ce marché en tant que nouvelle source de recettes;
- la clientèle se compose des principales entreprises de services publics - gaz, pétrole et électricité - et, plus récemment, des compagnies de télécommunications (téléphone) qui utilisent les fibres optiques;
- le principal marché de la coimplantation réside dans les systèmes de transmission par fibres optiques, mais ce marché sera probablement saturé d'ici quelques années;
- techniquement, l'installation des réseaux de services publics est réglementée par des associations de normalisation établies telles que la CSA (pour les gazoducs) et l'ONT (pour les oléoducs et les réseaux hydro-électriques, et par le Code canadien de l'électricité pour les installations particulières;
- dans le contexte du train rapide, les recettes éventuelles de la coimplantation seront limitées à cause du calendrier des travaux de construction et de la date de disponibilité de la ligne (d'ici sept ans au moins), date à laquelle les besoins des entreprises de services publics seront probablement satisfaits;
- un certain nombre de facteurs auront une incidence sur les recettes potentielles de la coimplantation. Ces facteurs s'ajoutent à la situation globale du marché dont les plus importants sont : l'option de tracé choisie; la valeur des terres attenantes à l'emprise; la proportion de zones urbaines et de zones rurales; la longueur de l'emprise existante achetée aux compagnies de chemin de fer; les droits de perception des recettes de la coimplantation au moment de la cession et le montant de ces recettes;
- les recettes estimatives de la coimplantation, en dollars de 1993, pour chacune des trois options de tracé de l'emprise du train rapide se présentent comme suit :

<u>Option</u>	<u>Recettes totales (sur 20 ans)</u>	<u>Recettes par km admissible</u>	<u>Recettes annuelles par km admissible</u>
1	57 500 000 \$	80 000 \$	4 000 \$
2	69 500 000 \$	78 000 \$	3 900 \$
3	69 500 000 \$	57 000 \$	2 900 \$

- l'option de tracé 1 est la plus rémunératrice selon les estimations parce qu'elle prévoit une répartition plus avantageuse entre les zones rurales et les zones urbaines.

ANNEXES

- A Normes régissant l'implantation des services publics
- B Lignes directrices pour les croisements avec les installations de Interprovincial Pipe Line Inc.
- C Exigences et normes d'Amtrak pour l'implantation du réseau de pipelines
- D Spécifications pour l'installation de réseaux de câbles et de conduites dans les propriétés d'Amtrak

ANNEXE A

- Normes régissant l'implantation des services publics

APPENDIX A

Regulations Affecting the Location of Utilites

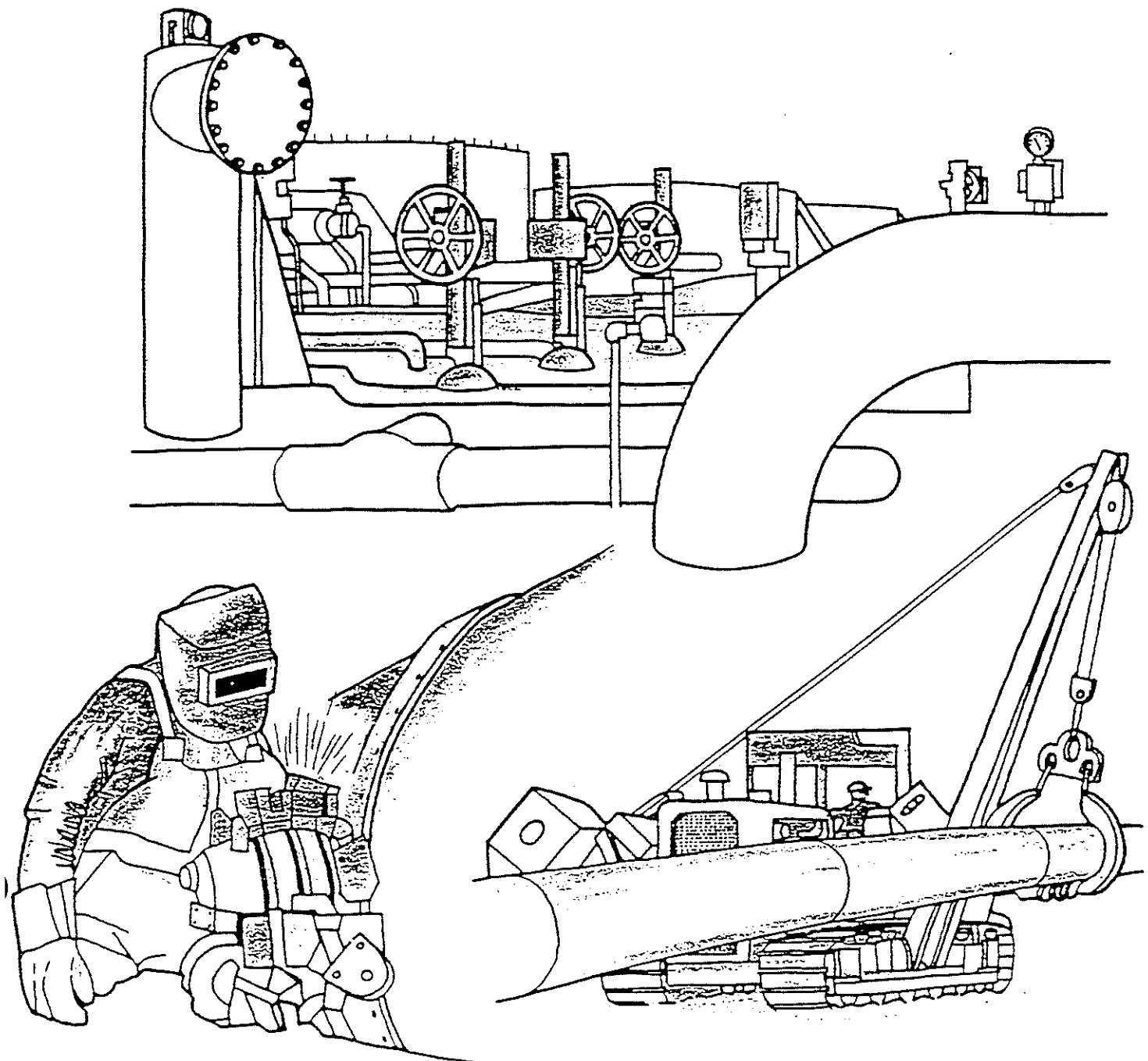
- **CSA Z184 M92 Gas Pipeline Systems**
- **CSA C22.3 No. 1-M87 Overhead Systems**
- **CSA C22.3 No. 1-M1979 Overhead Systems and Underground Systems**



CAN/CSA-Z184-M92 **Gas Pipeline Systems**

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- (c) limits on the height of the inside and outside weld flash of electric welded pipe; and
- (d) an upper limit on yield strength.

5.5.2.4

The pipeline system designers shall consider the torsional, tensile, and compressive strengths of the mechanical interference fit joint; the effect of torsional and bending loads on the joint.

5.5.2.5

Pipeline systems with mechanical interference fit joints shall not be subjected to service conditions that would adversely affect the performance of the joint.

5.5.2.6

Mechanical interference fit joints shall not be used to join dissimilar pipe materials.

5.5.3 Threaded Connections

5.5.3.1

The use of threaded pipe-to-pipe and pipe-to-component connections on permanently buried installations shall not be permitted, except for service connections to cast-iron distribution lines and auxiliary connections (such as drains, valve body bleeds, or instrumentation taps) directly into components.

5.5.3.2

Except as allowed by Clause 5.5.3.1, threaded connections shall not be used on pipe sizes larger than

- (a) 114.3 mm OD; or
- (b) 60.3 mm OD with a maximum operating pressure greater than 3500 kPa.

5.6 Cover and Underground Clearance for Steel Pipe

5.6.1 Cover Requirements

5.6.1.1 General

The cover requirements for pipelines and casings shall be as follows:

- (a) buried gathering lines, transmission lines, distribution lines, and casings shall be installed with a minimum cover of 60 cm, unless otherwise required or permitted herein;
- (b) it shall be permissible to install buried gathering lines, transmission lines, and distribution lines operating at hoop stresses less than 30% of the specified minimum yield strength of the pipe and located within private rights-of-way, private thoroughfares, sidewalks, or parkways with less than the minimum cover of 60 cm if it is considered that external damage to the pipe will not be likely to occur;
- (c) where underground structures or adverse sub-surface conditions prevent the installation of gathering lines, transmission lines, or distribution lines with the minimum cover, it shall be permissible to install such pipelines with less cover if they are provided with additional protection to withstand anticipated external loads; and
- (d) service lines shall be installed in accordance with the requirements of Clause 7.5.1.

5.6.1.2 Pipelines Within Railway, Highway, Road, and Street Rights-of-way

5.6.1.2.1

Pipelines that are intended to operate at hoop stresses of less than 30% of the specified minimum yield strength of the pipe and cross or are located within the rights-of-way of highways, roads, or streets shall meet the applicable cover requirements of Clauses 5.6.1.1 and 7.5.1. Pipelines that are intended to operate at hoop stresses of less than 30% of the specified minimum yield strength of the pipe and cross or are located within the rights-of-way of railways shall meet the cover requirements specified for pipelines operating at higher hoop stresses in Clause 5.6.1.2.2(b).

5.6.1.2.2

Pipelines that are intended to operate at hoop stresses of 30% or more of the specified minimum yield strength shall meet the following cover requirements:

(a) Where practicable, the depth of cover within the rights-of-way of highways, roads, or streets shall not be less than 75 cm, measured from the top of the carrier and any casing pipe. Where practicable, pipelines located within 7 m of the edges of the travelled surface of highways, roads, or streets, measured at right angles to the centreline of the travelled surface, shall be so constructed that the difference in elevation from the travelled surface to the top of the carrier and any casing pipe is not less than 120 cm. However, where it is not practicable to provide such depths of cover, special design and construction procedures shall be used to protect the highways, roads, streets, and pipelines from physical damage.

(b) Where practicable, the depth of cover within railway rights-of-way shall not be less than 75 cm, measured from the top of the carrier or casing pipe. Where practicable, pipelines located within 7 m of the centreline of the outermost track, measured at right angles to the centreline of the track, shall be so constructed that for uncased installations the difference in elevation from the top of the carrier pipe to the base of the rail is not less than 200 cm, and for cased installations the difference in elevation from the top of the casing to the base of the rail is not less than 120 cm. Where it is not practicable to provide such depths of cover, special design and construction procedures shall be used to protect the railways and pipelines from physical damage.

5.6.2 Underground Clearance

The following underground clearance requirements shall apply:

(a) Where practicable, there shall be at least 30 cm of clearance between any pipeline and any other known underground structure that it parallels, but in no case shall the clearance be less than 5 cm.

(b) Where practicable, there shall be at least 5 cm of clearance between any pipeline and any other known underground structure that it crosses; where a clearance of at least 5 cm is not practicable, the pipeline shall be protected from damage that might result from the proximity of the other structure.

(c) Precautions shall be taken to prevent electrical contact with, or the imposition of external stresses from or on, any other underground structure.

shall be at least 50 mm greater than the outside diameter of the carrier pipe. For carrier pipe 168.3 mm OD or larger, the inside diameter of the casing pipe shall be at least 75 mm greater than the outside diameter of the carrier pipe.

(c) Carrier pipe shall be held clear of the casing pipe by properly designed supports, insulators, or centering devices, so installed as to preclude the transmission of excessive external loads to the carrier pipe.

(d) The ends of casings shall be suitably sealed to the outside of the carrier pipe. Venting of sealed casings is not mandatory; however, where vents are installed, they shall be protected from the weather to prevent water from entering the casing. Where casing seals of a type that will retain more than 35 kPa pressure between the casing and the carrier pipe are installed, and vents are not used, provision shall be made to relieve any internal pressure before carrying out maintenance work.

(e) Casing pipe under highways, roads, and streets shall be of sufficient length to absorb all of the external loading from the road bed at the point of crossing.

(f) Casing pipe under railways shall extend a distance, measured at right angles to the centreline of the track, of at least 7 m beyond the centreline of the outermost track, 0.6 m beyond the toe of slope, or 1.0 m beyond the ditch line or area that may be affected by normal ditch cleaning operations, whichever is the greatest.

(g) The least nominal wall thickness for steel casing pipe used in railway, highway, road, and street crossings shall be in accordance with the requirements of Table 5.5.

Table 5.5
Least Nominal Wall Thickness for Steel
Casing Pipe in Cased Crossings and Carrier
Pipe in Uncased Crossings

Pipe outside diameter, mm	Least nominal wall thickness, mm	
	Highways, roads, and streets	Railways
88.9	3.2	3.2
101.6	3.2	3.2
114.3	3.2	3.2
141.3	4.0	4.0
168.3	4.8	4.8
219.1	4.8	4.8
273.1	4.8	4.8
323.9	4.8	4.8
355.6	4.8	5.6
406.4	4.8	5.6
457	4.8	6.4
508	4.8	7.1
559	5.6	7.9
610	6.4	8.7
660	6.4	9.5
711	6.4	10.3
762	6.4	10.3
813	6.4	11.1

(Continued)

10.10.5

Where existing pipelines are to be crossed by unimproved public roads, hard surfaced roads, highways, public streets, or railways, the pipelines in such locations shall be either upgraded to meet the requirements of Clauses 5.3 and 5.4 or subjected to

- (a) an engineering assessment in accordance with the requirements of Clauses 10.10.1(a) and (b); and
- (b) a detailed engineering analysis of all loads expected to be imposed on the pipeline during construction and operation of the crossing, and the resulting combined stresses in the pipeline.

10.10.6

Where the engineering assessment described in Clause 10.10.5(a) reveals that the pipeline is in satisfactory condition, it shall be permissible to use any crossing design (such as casing, change in pipe specification, suitable depth of cover, or load distributing structure) that results in combined pipe stresses in accordance with the requirements of Clause 5.19, as determined from the detailed engineering analysis described in Clause 10.10.5(b).

10.11 Evaluation and Repair Procedures for Steel Pipeline Systems Operating at Hoop Stresses of 30% or More of the Specified Minimum Yield Strength of the Pipe**10.11.1 General****10.11.1.1**

Where imperfections are found in steel piping, evaluations shall be made in order to determine its suitability for continued service.

10.11.1.2

Where the pipe is determined to be subjected to significant secondary stresses, such stresses shall be considered when the suitability of damaged pipelines for continued service is being assessed.

10.11.1.3

Excavation of piping suspected of containing imperfections and its subsequent permanent or temporary repair, if required, shall be performed after the piping is depressurized or at an operating pressure that is considered to be safe for the proposed work.

10.11.1.4

Evaluations shall include inspection by methods capable of detecting cracks associated with imperfections.

10.11.1.5

External coatings that conform to the requirements of Clause 9.2.8 shall be applied following cleaning, evaluation, and repair operations.

10.11.1.6

Where piping is not qualified for continued service at the established maximum operating pressure due to the presence of defects, either the maximum operating

30°C; however, it shall be permissible for service risers to operate between 30°C and 50°C for short periods of time as a result of ambient conditions.

11.2.2.3

Wall thicknesses of polyethylene pipe shall be not less than the applicable minimums specified in CSA Standard CAN/CSA-B137.4. Pipe on which saddle fusions will be performed shall have minimum wall thicknesses of 4.2 mm or greater.

11.2.3 Design Pressures of Fittings

Design pressures of fittings shall be not less than the design pressures of the pipe with which they are used.

11.2.4 Valves

Valve installations shall be designed to protect the pipe material against excessive torsional or shearing loads when the valve or shut-off is operated, and from any other secondary stresses that might be exerted through the valve or its enclosure. Valves made of plastic shall comply with the requirements of ANSI Standard B16.40.

11.2.5 Protection from Hazards

Piping shall be designed in accordance with the applicable requirements of Clause 5.9.

11.2.6 Cover and Crossing Requirements

11.2.6.1 Cover Requirements for Distribution Lines

The cover for distribution lines shall be in accordance with the requirements given for steel pipe in Clause 5.6.1.

11.2.6.2 Cover Requirements for Service Lines

The cover for service lines shall be in accordance with the requirements of Clause 7.5.1.

11.2.6.3 Cover Requirements Within Highway, Road, and Street Rights-of-Way

Cover requirements for pipelines with standard dimension ratios up to and including SDR 11 shall be in accordance with the applicable requirements given for steel pipelines in Clause 5.6.1.2. For pipelines with standard dimension ratios greater than SDR 11, cover requirements shall be determined by calculations.

11.2.6.4 Cover Requirements Within Railway Rights-of-Way

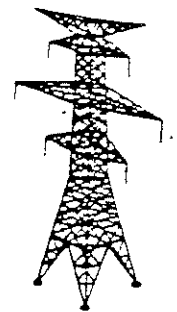
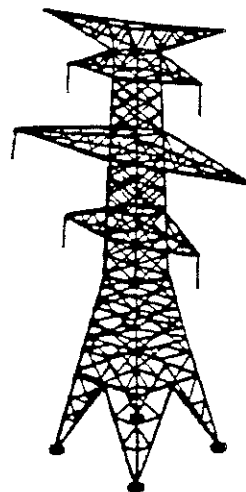
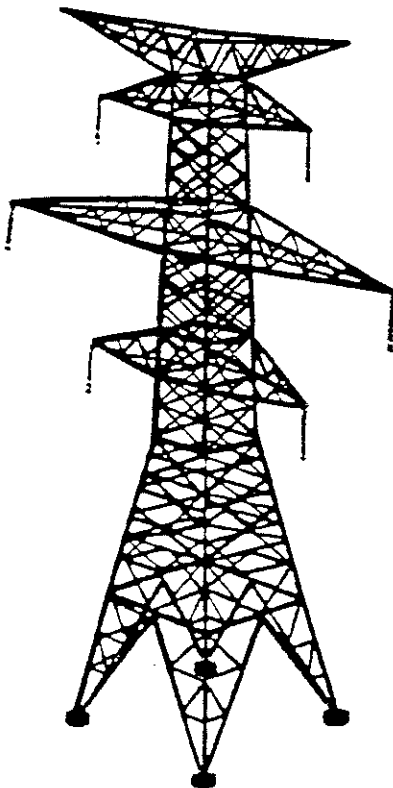
Pipelines within railway rights-of-way shall have cover in accordance with the applicable requirements given for steel pipelines in Clause 5.6.1.2, except where the pipelines cross under the tracks. Uncased pipeline crossings shall be so constructed that the base of the rails is not less than 152 cm above the top of the carrier pipes. Where casings are used, the cover shall be in accordance with the requirements of Clause 5.6.1.2.2(b).

11.2.6.5 Casing Design

Where pipelines are cased, casings shall be designed in accordance with the requirements given for steel pipelines in Clause 5.7.4.

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elevation of this mark shall be tied (levelled) into bench marks or similar types of permanent markers established in bedrock or in the concrete foundation of towers, or as established by the surveyor. The bench marks must be recorded along with the time and date. Where possible, the bench marks and other permanent markers established should in turn be tied into Geodetic Survey of Canada bench marks or horizontal control markers, or into those of the Canadian Hydrographic Service.

4.3.3.2 Basic Clearances

The minimum vertical clearances of wires and conductors above navigable water shall be as specified in Table 3 except that:

- (a) for areas where vessel heights are known to exceed the reference vessel height at the time of design, the required clearance in Table 3 shall be increased by the difference between the taller vessel and the reference vessel height shown in Table 3.
- (b) for elevation above 1000 m and where voltages exceed 50 kV, the clearances specified in Table 3 shall be increased by 1% for each 100 m or any part in excess of 1000 m above mean sea level.

4.3.4 Maximum Height of Wires and Equipment Above Ground in the Vicinity of Airports

The maximum height of wires and equipment in the vicinity of airport runways is limited. The heights of wires, supporting structures, and equipment on land adjacent to, surrounding, or near an airport in Canada are subject to the regulations of Transport Canada and are not covered by this Standard.

4.4 Horizontal Design Clearances of Wires and Conductors from Railway Tracks

4.4.1

Where wires and conductors are along a railway track or tangent to a curved track and where, under maximum sag conditions, the wires and conductors provide less than the minimum vertical clearance above rails required by Clause 4.3.1, minimum horizontal clearances shall be provided in accordance with Clauses 4.4.2 and 4.4.3. This minimum horizontal clearance shall be the distance between the vertical projection of the inside edge of the top of the nearest rail and the nearest position of the wire under the conditions of swing specified in Clause 4.2.7.

4.4.2

Where there is no curvature of the railway tracks, the horizontal clearances shall be as specified in Table 6.

4.4.3

At a point of curvature of the railway track, the horizontal clearances shall be as specified in Table 6 plus an increment of 25 mm for each degree of curvature and, in addition, where the wire is closer to the low side of tracks that are at different elevations a further increment of 2.5 mm for each millimetre of super-elevation. (The total of these two increments will not exceed 0.75 m, and 0.75 m may be used in place of calculations, if desired.)

4.5 Horizontal Separations of Supporting Structure from Railway Tracks

Note: *Side separations, as specified in Clauses 4.5.1 to 4.5.5, are not customary construction separations but are minimum separations for circumstances where greater separations cannot be obtained. To allow working space for normal maintenance operations, the Railway does not ordinarily permit poles, guys, etc., to be placed on the railway right of way less than 9 m from the track centreline where space permits. On narrower rights of way, structures and guys must be placed as far as possible from the centreline of the nearest track.*

4.5.1

Any part of a supporting structure not complying with the vertical clearance requirements of Clause 4.3.1 shall be provided with minimum horizontal separations from railway tracks in accordance with Clauses 4.5.2 to 4.5.5. The minimum horizontal separations shall be the distance between the vertical projection of the inside edge of the top of the nearest rail and the nearest position of the structure.

4.5.2

Where there is no curvature of the railway tracks, the minimum horizontal separations shall be as specified in Table 7 increased, where applicable, to meet the requirements of Clauses 4.5.4 and 4.5.5.

4.5.3

At a point of curvature of the railway tracks, the minimum horizontal separation shall be as specified in Table 7, plus the increment required by Clause 4.4.3, and increased where applicable to meet the requirements of Clauses 4.5.4 and 4.5.5.

4.5.4

At loading sidings, sufficient space shall be left for a driveway in accordance with the stated needs of the Railway.

4.5.5

Horizontal separations shall, in all cases, be great enough to permit the unobstructed view of signals, signs, and similar equipment.

4.6 Horizontal Separations of Supporting Structures from Fire Hydrants, Street Corners, and Curbs**4.6.1 Horizontal Separation from Fire Hydrants**

Supporting structures (including guys or attachments) that are less than 2 m above the top of the hydrant shall have a minimum horizontal separation from the hydrant of 1 m.

4.6.2 Horizontal Separation from Street Corners

Supporting structures, including guys, shall be set as far as practicable from the beginning of curvature.

4.6.3 Horizontal Separation from Curbs**4.6.3.1**

Structures shall be set at least 150 mm from the edge of the curb, measured away from the travelled portion of the roadway.

4.6.3.2

Where crossarms and other attachments such as guys provide less than the minimum vertical separation above roads required for guys in Clause 4.3.1, such attachments shall have the minimum horizontal separation specified in Clause 4.6.3.1.

4.7 Clearances of Wires, Conductors, and Equipment from Buildings, Signs, Bridges, Swimming Pools, and Similar Plant**4.7.1 General**

Wires and cables shall not interfere with the normal use of balconies, doors, fire escapes, windows, permanent ladders, catwalks, etc.

4.7.2 Clearances of Supply Conductors from Buildings When Attached

Where the permanent attachment of supply conductors to buildings is necessary (as for an entrance), the minimum clearance of the conductors from the surface of buildings shall be as listed in Table 8 and apply under the following conditions:

- (a) vertical clearances apply under conditions of maximum sag of the conductor;
- (b) horizontal clearances apply when the conductor is in the position of swing as calculated according to Clause 4.2.7.

4.7.3 Clearances of Wires and Conductors Passing By or Over Buildings, Signs, Billboards, Lamp and Traffic Signs, Standards, and Antennas (Not Attached)**4.7.3.1 Ladder Space**

Where buildings exceed three storeys (or 15 m) in height, and where it is necessary to raise ladders for fire fighting (ie, the local fire department practice does not exclude the use of ladders), overhead lines shall be arranged where practical so that a clear space or zone at least 2 m wide is left either adjacent to the building or beginning not more than 2.5 m from the building.

4.7.3.2 Basic Clearances

The minimum horizontal and vertical clearances from wires and conductors to buildings, signs, and similar plant shall be as specified in Table 9 and apply under the following conditions:

- (a) clearances apply to any part of a building, including balconies, fire escapes, antennas and their supporting structures, and other permanent fixtures;
- (b) vertical clearances apply under conditions of maximum sag of the wire or conductor;
- (c) horizontal clearances apply when the wire or conductor is in the position of swing as calculated according to Clause 4.2.7;
- (d) guy wires, communication cables, and drop wires shall not be allowed to rub buildings or other plant.

4.7.3.3 Application of Clearances

In the following explanation the word "building" is intended to refer to any of the plant covered by Clause 4.7.3.2.

Table 2 (Concluded)

Location of wires or conductors	Guys, messengers, span, and lightning protection wires; communication cables	Trolley contact conductors and associated span wires; trolley feeders 0-750 V when paralleled by trolley contact conductors	Open supply conductors and service conductors, alternating current*, minimum clearances in metres								
			0 to 750 V	Over 0.75 to 22 kV	Over 22 to 50 kV	Over 50 to 90 kV	Over 90 to 120 kV	Over 120 to 150 kV	Over 150 to 250 kV	Over 250 to 300 kV	Over 300 kV
	Col. I	Col. II	Col. III	Col. IV	Col. V	Col. VI	Col. VII	Col. VIII	Col. IX	Col. X	Col. XI
Alongside land likely to be travelled by road vehicles†						5.5	5.8	6.1	6.1 plus 0.01 m for each kilovolt over 150 kV	7.1 plus 0.07 m for each kilovolt over 250 kV	10.6 plus 0.025 m for each kilovolt over 300 kV
Over driveways to residences and residence garages for vehicles not exceeding 2.4 m in height	3.7	3.7	3.7	4.75	5.2	5.5	5.8	6.1	6.1 plus 0.01 m for each kilovolt over 150 kV	7.1 plus 0.07 m for each kilovolt over 250 kV	10.6 plus 0.025 m for each kilovolt over 300 kV
Alongside roads and highways in areas unlikely to be travelled by road vehicles (with no overhang) and within 1.5 m of the limit of the right of way**	3.0	NA	3.4	4.15	4.6	4.9	5.2	5.5	5.5 plus 0.01 m for each kilovolt over 150 kV	6.5 plus 0.07 m for each kilovolt over 250 kV	10.1 plus 0.025 m for each kilovolt over 300 kV
Over walkways or ground normally accessible to pedestrians only††	2.5	NA	3.1	3.4	3.7	4.0	4.3	4.6	4.6 plus 0.01 m for each kilovolt over 150 kV	5.6 plus 0.01 m for each kilovolt over 250 kV	6.1 plus 0.01 m for each kilovolt over 300 kV
Above top of rail at railway crossings	7.3	6.7	7.3	7.6	8.1	8.4	8.7	9.0	9.0 plus 0.01 m for each kilovolt over 150 kV	10 plus 0.01 m for each kilovolt over 250 kV	10.5 plus 0.01 m for each kilovolt over 300 kV

Note: Above 250 kV (line-to-ground) the specified clearances are minimum and are based on horizontal configuration of conductors where induced electrostatic steady-state currents are low. Other types of construction with double-circuit vertical construction may require larger clearances to keep steady-state currents to the same safe minimum values.

*For dc voltages below 750 V, use Columns II and III of Table 2.

†Where communication wires or communication cables run along alleys, this clearance may be reduced to 4 m.

Table 4
Minimum Vertical Design Clearances Above
Ground or Rails, Direct Current
 (See Clauses 4.3.1 and 4.7.4.1.)

Open supply line conductors (direct current)—minimum clearances in metres									
Location of conductors	0.75 to 100 kV*	Over 100 to 150 kV	Over 150 to 200 kV	Over 200 to 250 kV	Over 250 to 300 kV	Over 300 to 350 kV	Over 350 to 400 kV	Over 400 to 450 kV	Over 450 kV
	Col. I	Col. II	Col. III	Col. IV	Col. V	Col. VI	Col. VII	Col. VIII	Col. IX
Over land likely to be travelled by road vehicles, including highways, streets, lanes, alleys, and driveways (other than to residences or residence garages)	5.8	6.0	6.3	6.5	6.7	6.9	7.2	7.4	To clearance in Col. VIII add 0.005 m for each kilovolt over 450 kV
Over the right of way of underground pipelines	5.8	6.0	6.3	6.5	6.7	6.9	7.2	7.4	
Alongside and within the limits (with no overhang) of streets and highways in densely populated areas	5.8	6.0	6.3	6.5	6.7	6.9	7.2	7.4	
Over or alongside farmland likely to be travelled by vehicles	5.8	6.0	6.3	6.5	6.7	6.9	7.2	7.4	
Alongside land likely to be travelled by road vehicles	5.8	6.0	6.3	6.5	6.7	6.9	7.2	7.4	
Over driveways to residences or residence garages	5.6	5.9	6.1	6.3	6.6	6.8	7.0	7.2	
Alongside roads and highways in areas unlikely to be travelled by road vehicles (with no overhang) and within 1.5 m of the limit of the right of way†	5.5	5.7	6.0	6.2	6.4	6.6	6.9	7.1	
Over walkways or ground normally accessible to pedestrians only‡	4.6	4.8	5.0	5.3	5.5	5.7	6.0	6.2	
Above top of rail on railway crossing	8.8	9.1	9.3	9.5	9.8	10.0	10.2	10.4	

*For dc voltages below 750 V, use Columns II and III of Table 2.

†This is ground generally adjacent to fences and accessible to small vehicles but not likely to be travelled by high road vehicles or high farm machinery.

‡Seasonal conditions may dictate additional clearances.

Table 6
Minimum Horizontal Design Clearances Between
Wires and Railway Tracks
 (See Clause 4.4.)

			Minimum clearances in metres	
Wire closest to tracks			Main tracks	Sidings
Guys; messengers; communication, span, and lightning protection wires; communication cables			2.5	1.9
Open supply line conductors and service conductors of 0—750 V and effectively grounded continuous metallic sheathed cables of all voltages			2.5	1.9
Alternating current	Open supply line conductors and cables other than those having an effectively grounded continuous metallic sheath	Over 0.75—22 kV	2.7	2.1
		Over 22—50 kV	3.2	2.6
		Over 50—90 kV	3.5	2.9
		Over 90—120 kV	3.8	3.2
		Over 120—150 kV	4.1	3.5
	Supply conductors over 150 kV		4.1 plus 0.010 m for each kilovolt over 150 kV	3.5 plus 0.010 m for each kilovolt over 150 kV
	Direct current	0—750 V	2.5	1.9
		Over 0.75—100 kV	2.8	2.2
		Over 100—150 kV	3.0	2.5
		Over 150—200 kV	3.3	2.7
		Over 200—250 kV	3.5	2.9
		Over 250—300 kV	3.7	3.1
		Over 300—350 kV	4.0	3.4
		Over 350—400 kV	4.2	3.6
		Over 400—450 kV	4.4	3.8
		Over 450 kV	4.4 plus 0.005 m for each kilovolt over 450 kV	3.8 plus 0.005 m for each kilovolt over 450 kV

Table 7
Minimum Horizontal Separations from Supporting
Structure to Railway Tracks
 (See Clause 4.5.)

Tracks	Minimum horizontal separation in metres
Main tracks (straight, level runs)	2.5
Sidings (straight, level runs)	1.9

Table 8
Minimum Design Clearances of Supply Conductors
Attached to Buildings
 (See Clause 4.7.2.)

Conductor attached to building*		Minimum clearance in metres			
		Horizontal to normally inaccessible surface	Horizontal to readily accessible surface	Vertical to normally inaccessible surface	Vertical to readily accessible surface
0 to 750 V	Insulated or grounded	0	1.0	1.0	2.5
	Enclosed in effectively grounded metallic sheath	0	0	0	0
0 to 750 V	Neither insulated nor grounded, nor enclosed in effectively grounded metallic sheath	0.08	1.0	1.0	2.5
Over 0.75 to 5 kV	Not enclosed in effectively grounded metallic sheath	0.15	1.2	1.2	2.7
	Enclosed in effectively grounded metallic sheath	0	0	0	0
Over 5 to 22 kV	Not enclosed in effectively grounded metallic sheath	0.3	1.5	1.5†	3.0†
	Enclosed in effectively grounded metallic sheath	0	0	0	0

(Continued)

Table 25
Minimum Grades of Construction for Crossings
 (See Clauses 5.3.2, 6.8.1.1, 6.8.2, 6.8.3, and 6.9.1.)

Item at lower level	Grade of construction		
	Minimum grade where the conductors, messengers, or cables at the upper level are:		
	Communi- cation	0—750 V	Over 750 V
Railway control facilities and tracks	1	1	1
Limited and controlled access highways	2	2	2
Roads and highways—general	3	3	3
Pipelines and waterways	3	3	3
Aerial tramways	1	1	1
Other private or public property	3	3	3
Communication			
Cable	3	3	1*
Open wire in general	3	3	1*
Drop wire	3	3	3
Supply			
0—750 V	2†	3	2‡
Over 750 V	1†	2	2

*The grade of construction may be Grade 2 where one of the following conditions is complied with:

- (a) the supply and communication have coordinated protection;
- (b) where coordinated protection is not practicable, the supply conductors have a breaking strength of at least 13 kN; or
- (c) the supply conductors are enclosed in effectively grounded continuous metallic sheathed cable.

†The communication line may be Grade 3 where the supply conductors are in cable with effectively grounded continuous metallic sheath.

‡Where the supply conductors at the upper level are in effectively grounded continuous metallic sheathed cable, Grade 3 construction may be used.

Table 26
Minimum Grades of Construction for Proximities
 (See Clauses 5.3.3, 6.8.1.1, 6.8.2, 6.8.3, and 6.9.1.)

In proximity to	Minimum grade of construction		
	Communi- cation	Conductors 0—750 V or effectively grounded continuous metallic sheathed supply cables of all voltages	Conduc- tors over 750 V
Railway control facilities and tracks	1	1	1
Limited or controlled access highways	2	2	2
Roads and highways—general	3	3	3
Pipelines and waterways	3	3	3
Aerial tramways	1	1	1
Other private or public property	3	3	3
Communications			
Cable	3	2	1*
Open wire in general	3	2	1*
Drop wire	3	3	3
Supply			
0—750 V	2	3	2†
Over 750 V	1	2	2

*The line may be Grade 2 if the supply and communications have coordinated protection.

†Where the supply conductors at the upper level or the supply conductors creating the proximity are in effectively grounded continuous metallic sheathed cable, Grade 3 construction may be used.

**Canadian Standards
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**OVERHEAD SYSTEMS
and UNDERGROUND
SYSTEMS**

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7.18.2 Selection of Insulators

In selecting insulators to be used for any line, consideration in determining the test voltage rating shall be given to the conditions under which the line will operate, as follows:

(a) Whether a system operates in areas of intermittent rains, moderate lightning, and very little or no contamination; or

(b) Whether operating conditions are more severe than those set forth in item (a) above, due to the extent of the system, the prevalence of exceptionally severe lightning, bad atmosphere due to chemical fumes, dust, salt, fog, or other foreign matter, or to a long dry season with heavy dust accumulation followed by moisture.

7.18.3 Protection Against Arcing

When installing the insulators and conductors, such precautions as are sanctioned by good practice shall be taken to prevent, as far as possible, any arc from forming or to prevent any arc that might be formed from weakening or burning any parts of the structures, insulators, or conductors.

8. Underground — General**8.1 General**

Clause 8 of this Standard deals with requirements that are applicable to both direct buried and duct and manhole systems. Clauses 9 and 10 deal specifically with direct buried and duct and manhole systems, respectively. In cases where the underground system is a combination of each of these two systems (e.g., the case of a direct buried cable crossing under a highway, railway, etc., in duct), the appropriate Clauses of 9 and 10 shall apply.

8.2 Definitions and Limitations

8.2.1 In the underground Clauses of this Standard the definition in Clause 8.2.2 and the voltage limitations of Clause 8.2.3 shall apply.

8.2.2 *Swimming pool* means any one of the following types of pools, whether it is constructed above or below grade:

(a) A pool constructed in such a manner that it cannot be readily disassembled for storage;

(b) A pool constructed in such a manner that it may be disassembled for storage and reassembled to its original integrity;

(c) A therapeutic pool;

(d) A wading pool;

(e) A decorative pool that could be used as a wading pool, is larger than 1.5 m in any dimension, and is readily accessible to the public.

8.2.3 Voltage limitations are as follows:

(a) Communication cables are deemed to be cables used for the transmission of information by means of electric current. If such cables contain circuits that operate at voltages exceeding 150 V line-to-ground or 300 V between any two points of the circuit, and the transmitted power exceeds 150 W under normal operating conditions or fault conditions, the requirements of Clause 3.8 shall apply;

Note: Telephone, telegraph, railway-signal, messenger-call, fire-alarm, police alarm, community television, and other systems conforming with the above are included.

(b) Supply cables are those used for transmitting electric energy, and operating at a voltage (ac or dc) of 120 V or higher, but not exceeding 150 kV.

8.3 Location**8.3.1 General Location**

Underground supply and communication systems shall be located so as to cause, or be subject to, the least disturbance practicable. Railway tracks and underground structures, including catch basins, pipelines, etc., shall be avoided where practicable.

8.3.2 Location of Above-Ground Facilities

Above-ground facilities associated with the underground system, such as service pedestals, equipment housings, cable riser poles, etc., shall be located so as to be subject to the least exposure practicable to vehicular or other foreign damage. The live parts of such equipment shall not be exposed to the public. Above-ground facilities shall provide safe access and operating space.

8.3.3 Standard Location

Pipelines, supply, and communication facilities should occupy a standard allocated position on the street allowance and on private property. For a typical arrangement, see Appendix B.

8.3.4 Ducts

The ducts between adjacent manholes, or other outlets, shall be laid as straight and direct as conditions will permit.

8.3.5 Manholes

8.3.5.1 Manhole openings shall be located so as to provide safe and convenient access. Where this is not possible, special safety precautions shall be taken.

8.3.5.2 The location shall be so chosen as to avoid the possibility of other underground structures passing through the manhole.

8.3.6 Steam Pipelines

Steam pipelines close to cables can cause a damaging overheating of the cable, and this effect shall be taken into account in addition to the separations stipulated elsewhere in this Standard.

8.3.7 Induced Voltages and Currents

When there is a parallel between supply cables and communication circuits or metallic pipelines (especially those with insulating coverings) adequate precautions shall be taken to minimize any hazard due to induced voltages and currents.

8.3.8 Crossings

Where it is necessary for one underground system to cross over or under another underground system, the crossing shall be made at right angles, or as nearly so as circumstances will permit.

8.4 Identification of Underground Plant

8.4.1 Marking of Plant Locations

When located along or across railways (and other important rights-of-way), underground plant shall be marked above ground as permanently as possible, using visual means such as a post, pedestal, or labels on above-ground equipment. In other locations accessible to the public and where conditions permit, the presence of main underground plant should be similarly indicated.

Note: It is recommended that maps or records of sufficient accuracy be maintained to locate and identify main underground plant. The location, depth of burial, and type of plant should be recorded.

8.4.2 Cables of One Utility

Where there are buried cables of different circuits, close to one another, identification shall be provided on all cables at each location where the cables emerge from the earth.

Exception: Identification need not be provided on each individual cable where several cables, all operating at a nominal voltage below 750 V (phase-to-phase), emerge from the earth at the same location.

8.4.3 Identification of Cables in Manholes

Cables shall be permanently identified by tags or other means at each manhole or other permanent opening of the underground system. Where the duct formation entering and leaving the manhole is the same, the cables should be installed in corresponding ducts.

Exception: This requirement does not apply where all cables in the system are communication cables and owned by the same communication utility.

8.4.4 Identification of Apparatus Connected in Multiple

Where transformers, regulators, or other similar apparatus not located in the same manhole operate in such a way that low-voltage feedback can result in excitation of the high-voltage side of the equipment, special tags, diagrams, or other suitable means shall be used to indicate that fact.

8.5 Associated Equipment

8.5.1 Communication Equipment

Above-ground communication equipment shall be so designed and located that there is ready access to it by communication utility personnel.

8.5.2 Supply Equipment

Supply equipment, if it is exposed to the public, shall be tamperproof and any access doors shall be provided with some form of locking device.

8.5.3 Joint-Use Equipment

Equipment that is used jointly by the supply and communication utilities shall have the supply section separate from the communication section. There shall be no access to the supply section through the communication section or vice versa.

8.6 Construction of Underground Systems

8.6.1 General

The reliability of an underground system is dependent upon its design, how it is installed, and how it is operated. It shall have adequate load capacity for normal and emergency conditions without risk of damage to nearby underground facilities. The facilities provided for switching, grounding, etc., shall be adequate for and consistent with the requirements for the safe operation of the system. It is important that sound engineering practices be employed in the installation of the systems.

8.6.2 Excavating

8.6.2.1 Excavating shall be done in such a manner and with such safeguards as to minimize the risk to the public, to the workmen involved, and to existing underground structures. Every effort shall be made to shore the trench against cave-ins and to protect the workmen in the trench against injury from falling earth or stones. Regulations calling for specific precautions to be taken shall be followed, where they exist.

8.6.2.2 All work on railway, highway, or other rights-of-way shall be done in co-operation with the appropriate authority and at such time and in such manner as to cause the least interference with the proper and safe use or operation of the property, tracks, roadway, or other facility involved.

8.6.2.3 When crossing under railways, no bracing shall extend above the base of rail or be attached in any way to the rail or ties. Excavated material from railway roadbeds shall be so placed as not to interfere with traffic in any way. Ballast material shall be kept separate and free from earth if the ballast material is to be reused.

8.6.3 Backfilling

8.6.3.1 In general cases, the trench shall be backfilled to the grade line in layers of backfill not exceeding 300 mm, and each layer shall be thoroughly compacted until no further settlement is apparent.

8.6.3.2 On roadways, highways, airports, or similar rights-of-way, the trench shall be backfilled to the top of the subgrade in layers of backfill not exceeding 150 mm, and each layer shall be thoroughly compacted with mechanical tampers until no further settlement is apparent. Surfacing, paving, and all other surfaces shall be replaced as required.

8.6.3.3 When railway roadbeds are crossed, if a trench is used, it shall be backfilled to the top of the subgrade with backfill material in layers not exceeding 150 mm, and each layer thoroughly compacted with suitable mechanical tampers until no further settlement is apparent. The track ballast shall be replaced under railway supervision.

8.6.3.4 Regulations in certain areas may require that special backfilling materials be used and that special methods of compacting be applied.

8.6.4 Installation of Mechanical Protection

8.6.4.1 General

Mechanical protection when in flat form shall be wide enough to extend at least 50 mm beyond the cables or ducts on each side. Normally, flat mechanical protection shall not be in direct contact with the cables or ducts but shall be separated by a 75-mm layer of sand or earth. The material used shall not corrode or react with the cable or duct material. The dimensions and type of material used shall provide adequate strength and not fracture during installation or after backfilling.

8.6.4.2 Examples

Examples of mechanical protection are:

- (a) Cable brick;
- (b) Concrete slabs with a minimum thickness of 50 mm;
- (c) Treated planks at least 40 mm thick;
- (d) Poured concrete with a minimum thickness of 50 mm;
- (e) Concrete encased ducts;
- (f) Thick wall duct;
- (g) Steel or iron pipe;
- (h) Certain types of plastic duct;
- (i) Steel armour on cables.

It is recognized that varying degrees of mechanical protection are provided by these examples. For the more arduous duty and that duty involving reduced burial depth, concrete encased duct, steel or iron pipe, or concrete thicker than 50 mm shall be used.

8.6.5 Surface Grade

When underground systems are installed, the surface should be in its final graded condition. If this is not possible, the final grade shall be determined and adequate provision made with respect to final depth of burial, placing of surface-mounted installations, etc. Every effort shall be made to prevent future grading operations from changing the depth of cover over the cables, in order to avoid inadequate depth of burial.

8.6.6 Risers

8.6.6.1 Separation Between Risers of Communication and Supply Systems

If it is necessary to install risers for communication systems and risers for supply systems on the same pole, they shall be placed on different quadrants of the pole and grouped in such a manner that they do not interfere with the use of pole steps or lineman's climbers. On structures other than poles the separation between risers of communication and supply systems shall be great enough to permit maintenance of each plant without interference. When located on streets or highways, risers shall be placed so as to be in the location safest from damage by traffic.

Note: It is recommended that placing risers for communication systems and risers for supply systems on the same pole be avoided where practicable.

8.6.6.2 Mechanical Protection of Supply Cables

All riser cables of supply systems shall be protected by a covering that gives suitable mechanical protection for the full length of the run from at least 0.3 m below the surface of the earth.

Exception: Supply riser cables having a grounded metallic sheath or concentric neutral require no further protective covering above the 2.5 m level for non-joint-use poles. On poles jointly used with communication, the protective covering shall be extended to at least 1 m above the communication plant.

8.6.6.3 Mechanical Protection of Supply Grounding and Neutral Conductors

On non-joint-use poles, grounding and neutral conductors of supply systems shall be protected by a covering that gives suitable mechanical protection from at least 0.3 m below the surface of the earth to 2.5 m above. On poles jointly used for supply and communication plant, the protective covering shall be extended to at least 1 m above the communication plant.

8.6.6.4 Mechanical Protection of Communication Cables and Conductors

Although communication riser cables and conductors do not need mechanical protection for considerations of safety, adequate protection is required to prevent damage or service interruptions.

8.6.6.5 Insulation Covering for Supply Grounding and Neutral Conductors

In addition to the mechanical protection stipulated in Clause 8.6.6.3, supply grounding and neutral conductors shall be insulated or covered with a suitable insulating protective covering, to minimize the exposure of utility personnel to such grounded objects. The covering may provide the mechanical protection of Clause 8.6.6.3 if desired. On metallic structures, this insulating covering or insulation is not required.

8.6.6.6 Grounding of Riser Pipes and Guards

All exposed metallic riser pipes and guards in contact with supply cables shall be grounded, unless such cables are covered with a grounded metallic sheath.

8.6.7 Installation and Jointing of Cables

8.6.7.1 General

Cables installed in underground systems shall be designed for this purpose and for the system in which they are used. Terminations and all associated material and equipment shall have a voltage rating suitable for the phase-to-phase voltage of the system. In an underground system avoidance of leakage current is important and if this does occur, positive operation of the protective devices is essential.

All metallic sheaths and concentric neutrals shall be capable of carrying, without damage, the expected fault currents for the expected time of operation of the overcurrent devices protecting the cable.

8.6.7.2 Installation

Care should be taken to avoid damage to cables caused by too great a pulling tension or by dragging the cables over sharp objects in the trench or irregularities in the ducts. The minimum bending radius at turns, at entrances to equipment, and in ducts and manholes shall be adequate for the type of cable being installed.

- 8.6.7.3 Protection Against Moisture**
At joints and terminals, protection shall be provided so that moisture will not enter the cable.
- 8.6.7.4 Bonding Cable Sheaths**
Metallic sheathed cables shall be bonded and grounded at suitable intervals with a conductor of suitable size, electrolytic conditions permitting. Except as specified elsewhere in this Standard, supply cable sheaths need not be bonded to communication cable sheaths.
- 9. Underground — Direct Buried Systems**
- 9.1 Separations**
- 9.1.1 General**
Direct buried supply and communication cables, individually or together, shall in general not be installed in the same vertical plane with other underground systems. A minimum horizontal separation of 300 mm shall be obtained. Where such horizontal separation cannot be obtained, extra precaution shall be taken to ensure the maximum possible separation and to prevent future contact.
- 9.1.2 From Structures**
Supply and communication cables should have as great a horizontal separation from duct lines and the underground portion of overhead structures, such as fences, poles, or buildings, unless they are riser cables attached to these structures, as conditions permit but preferably not less than 300 mm.
- 9.1.3 From Swimming Pools**
- 9.1.3.1** Supply and communication cables (except for bonding conductors or conductors supplying electrical equipment associated with the swimming pool) shall have the minimum horizontal separation from the inside walls of the swimming pool as shown in Table 37.
- 9.1.3.2** For voltages above 22 kV, a special engineering study shall be made to determine the effects of the pool installation.
- 9.1.3.3** If the separations shown in Table 37 cannot be obtained, the requirements of Clause 10.1.3 shall apply.

Table 37 (Page 100)—Revise to read:

Table 37
Minimum Cable Separations from Swimming Pools

Type of Installation	Minimum Separation in Metres
Communication cables	1.5
Supply cables:	
0 — 750 V	1.5
Over 750 V — 15 kV	3
Over 15 — 22 kV	4

- 9.1.4 From Propane Tanks**
There shall be a minimum horizontal separation of 1.5 m from propane tanks of 7600 L aggregate capacity or larger to underground communication or supply cable.
Note: This requirement is similar to that included in CGA Standard B149.2, Installation Code for Propane Burning Appliances and Equipment.
- 9.1.5 From Pipelines**
When laid parallel to, along, or near underground pipelines, supply and communication cables shall maintain a horizontal separation from the pipelines of at least 300 mm. Where these separations cannot be obtained, extra precaution shall be taken to ensure the maximum possible separation and to prevent future contact. If communication and/or supply cables and pipelines share the same trench, the above horizontal separation shall be obtained with the pipeline preferably at a lower level.
- 9.1.6 Crossing Pipelines**
When approaching a crossing, the facility that is installed at the greater depth shall, where practicable, be in the lower position at the crossing. A minimum separation of 300 mm of well-tamped backfill shall be maintained at the point of crossing; where this is not practicable, extra precaution shall be taken to ensure the maximum possible separation and to prevent future contact. The cable or pipeline shall be installed at a uniform depth for the full width of any right-of-way concerned.
- 9.1.7 Between Cables in Separate Trenches**
In case of separate ownership, the horizontal separation between supply cables, between communication cables, or between supply and communication cables that are not installed in a common trench shall be 300 mm.
- 9.1.8 Between Cables in a Common Trench, Excluding Installations at Random Separation**
Note: For installations at random separation, see Clause 9.1.9.
- 9.1.8.1 Communication Cables and Supply Cables 750 V (Phase-to-Phase) or Less**
Although some separation is desirable, contact is permitted between communication cables, between supply cables operating at a voltage of 750 V (phase-to-phase) or less, or between communication cables and supply cables operating at the voltage of 750 V (phase-to-phase) or less.
- 9.1.8.2 Communication Cables and Supply Cables Over 750 V (Phase-to-Phase)**
Except as covered by Clause 9.1.9, the separation (horizontal or vertical) between communication cables and supply cables operating at over 750 V (phase-to-phase) shall consist of not less than 300 mm of well-tamped backfill, or 100 mm of brick, or 50 mm of concrete, or a treated wood plank 40 mm thick, or other mechanical protection of equivalent strength. Where a vertical arrangement of cables is used, the communication cables shall be in the upper position with the lower-voltage and higher-voltage supply cables progressively in the lower positions in the trench.
- 9.1.8.3 Supply Cables of the Same Three-Phase Circuit**
Contact is permitted between supply cables of the same three-phase circuit regardless of voltage.

9.1.8.4 Supply Cables of Different Voltages and Circuits

Contact is permitted between supply cables of different voltages and circuits, provided that:

(a) The operating voltage of any cable does not exceed 22 kV. For voltages higher than 22 kV, special consideration shall be given to the cable design, grounding, overcurrent protection, and available fault current;

(b) If either cable operates above a voltage of 750 V (phase-to-phase), it shall form part of a multi-grounded neutral wye system, and such cables shall have a metallic sheath or concentric neutral that is connected to the system neutral.

9.1.8.5 Other Supply Cables

Except as covered by Clauses 9.1.8.1, 9.1.8.3, and 9.1.8.4, a minimum separation (horizontal or vertical) of 150 mm of well-tamped backfill shall be obtained between supply cables. Alternatively, one or both cables may be installed in duct, with random contact permissible between a cable outside the duct and the duct.

9.1.9 Supply and Communication Cables — Random Separation

Separation between supply and communication cables for supply system voltages above 750 V (phase-to-phase) is desirable, but either random separation or contact on a continuous basis is permissible, provided that:

(a) Supply systems are effectively grounded and the operating voltage does not exceed 22 kV;

(b) The supply cables form part of a multi-grounded neutral wye system and are equipped with either a grounded bare concentric neutral or grounded bare metallic sheath. In those locations where there is an overriding risk of damage to the concentric neutral or sheath, such as in corrosive earth or rocky areas, or due to the possibility of electrolytic corrosion with equipment tanks associated with the underground system, the concentric neutral or sheath shall be protected by a jacket. The application of an external jacket on concentric neutral power cables shall be subject to mutual agreement by the parties concerned.

9.1.10 Cable Crossings**9.1.10.1 General**

For the cable types of Clauses 9.1.8 and 9.1.9 the separations stipulated shall be obtained at the crossings. For Clause 9.1.7 the separations obtained at the crossings shall be as stipulated in Clause 9.1.8. A minimum of 75 mm of well-tamped backfill is, however, preferred to a direct contact.

9.1.10.2 Supply and Communication Cables

When the separation consists of treated wood plank 40 mm thick, 50 mm of concrete, or 100 mm of brick, it shall extend along the route of the supply cable at least 600 mm in both directions from the point of crossing. Preferably, supply cables shall cross beneath communication cables.

9.2 Depth of Burial**9.2.1 General**

Communication and supply cables shall be buried at a sufficient depth below the surface of the earth or bottom of ditches to minimize the probability of damage.

Note: In deciding the depth of burial, the following factors should be considered: the possibility of deep digging; deep frost-line conditions; special soil conditions; vibration from heavy traffic. Because of any of these conditions, greater depths than those indicated below, or mechanical protection, may be required.

9.2.2 Communication Cables

Communication cables shall be buried below the surface of the earth or bottom of ditches to a minimum depth of 600 mm, except that for drop cables, or for burial under parkways and lawns, this figure may be reduced to 450 mm. Greater depths may be required when roadways are crossed.

9.2.3 Supply Cables

Supply cables shall be buried below the surface of the earth or bottom of ditches to a minimum depth of 750 mm, except that, for cables not in excess of 750 V (phase-to-phase), this figure may be reduced to 600 mm. Under roadways the minimum depth for all voltages shall be increased to 1 m.

9.2.4 Cable Crossings

At cable crossings a reduction of 75 mm in the above burial depths is permissible, provided the minimum depths are obtained on either side of the cable crossing.

9.2.5 Reduced Burial Depth

In some instances the above depths are not practicable, in which case reduced burial depths may be used:

(a) If adequate mechanical protection over the cable is installed as provided in Clause 9.4; or

(b) By agreement between the parties concerned.

9.3 Electrical Protection**9.3.1 Supply Cables****9.3.1.1 Supply Cables Operating at a Voltage in Excess of 750 V (Phase-to-Phase)**

These cables shall have continuous effectively grounded metallic sheath or concentric neutral capable of carrying without damage the maximum current that could develop in case of a cable fault.

9.3.1.2 Overcurrent Protection

Protection in case of faults on cables operating above a voltage of 750 V (phase-to-phase) shall be provided and selected, so that as fast a clearing time as practicable will be obtained.

There shall be no more than two automatic regulated reclosings before the faulted cable is de-energized; except for cables (e.g., station feeders) supplying overhead systems, which require more than two automatic reclosures.

9.3.1.3 Grounding

Grounding shall be provided for underground circuits and associated equipment. All exposed non-current-carrying metallic parts associated with the underground system shall be effectively grounded. This includes metal poles and the reinforcing steel of concrete poles.

9.3.2 Communication Cables

Communication cables that contain supply circuits operating at voltages exceeding 150 V line-to-ground or 300 V between any two points of the circuit, the transmitted power exceeding 150 W, and are used exclusively for the supply of communication circuits shall have continuous effectively grounded metallic shields or sheaths capable of carrying, without damage, the maximum current that could develop from a fault within the cables; and the supply circuits will be promptly de-energized in case of a cable fault.

9.3.3 Supply Cables Over 750 V (Phase-to-Phase) and Communication Cables in a Common Trench

These shall be installed as required by Items (a) to (d) below:

(a) Communication protective devices shall be adequate for the voltages and currents that may be impressed on them should there be a contact between the communication and supply conductors;

(b) At each transformer location, the metallic sheath or shield of communication cables shall be interconnected with available supply primary and secondary neutrals and supply cable sheaths, and the whole shall be effectively grounded. If this does not provide a connection between the communication cable sheath or shield and the primary neutral within 300 m of each communication terminal, additional connections shall be made to meet this requirement;

(c) At equipment ground locations other than transformers, adequate grounding of communication cables and supply secondary pedestals shall be made to the secondary neutral;

(d) Supply and communication cables at less than 300-mm separation, including random separation, or continuous contact, shall meet the requirements of co-ordinated protection.

9.4 Mechanical Protection**9.4.1 General**

9.4.1.1 Mechanical protection to cables shall be employed, except for the deviation allowed under Clause 9.2.5, wherever:

- (a) Reduced depth of burial is required; or
- (b) There is a strong likelihood of deep digging.

9.4.1.2 To facilitate cable replacement and to minimize traffic-vibration damage, mechanical protection in the form of pipe or duct should be used when roads, railways, or paved areas are crossed.

9.4.2 Crossing Railways

9.4.2.1 Provision shall be made so that the maintenance of the cables can be carried out without disturbing the track ballast.

9.4.2.2 Supply cables shall be protected for the full width of the right-of-way by one of the following examples of mechanical protection:

- (a) Cable brick;
- (b) Concrete slabs with a minimum thickness of 50 mm;

(c) Treated plank at least 40 mm thick;

(d) Poured concrete with a minimum thickness of 50 mm;

(e) Concrete encased duct;

(f) Thick wall duct;

(g) Steel or iron pipe; or

(h) Certain types of plastic duct.

Any combination of these protections may be used, but if a pipe or duct is used under the tracks, it shall extend at least 2 m beyond each outside rail.

If type (e), (f), (g) or (h) mechanical protection is used, the requirements of Clause 10.4 shall apply.

9.4.2.3 Communication cables may be installed without any form of mechanical protection. Where a pipe or duct is used, it shall extend at least 2 m beyond each outside rail.

9.5 Railway Crossings

9.5.1 Supply and communication cables shall be located at a depth of not less than 1.1 m below the base of the rails. Where this depth is not obtainable, a reduced depth may be permissible but in no case shall the cables be less than 150 mm below the bottom of the ballast section, which is subject to working or cleaning, and in no case less than 450 mm below the base of the rail. The requirements for mechanical protection are stated in Clause 9.4.

9.5.2 Terminals and above-ground supply and communication facilities shall be located off the railway right-of-way. Where this is not practicable, the distance from the gauge side of the nearest rail to the nearest face of terminal poles and above-ground facilities shall be not less than 2.5 m, except that at sidings the distance may be not less than 1.9 m. At loading sidings, sufficient space as required shall be left for a driveway. When necessary for super-elevation, track curvature, the unobstructed view of signals and signs, etc., the Railway may require greater minimum distances than those specified above. These requirements do not apply to terminals and above-ground facilities associated with railway communication and signal circuits or with railway electric power circuits of 750 V (phase-to-phase) or less.

9.6 Construction**9.6.1 Installation of Cables****9.6.1.1 General**

While under some circumstances it is desirable to "snake" cables during installation, they must not be kinked. At terminations, or where earth settlement is likely, adequate slack should be provided in the cables to prevent damage.

9.6.1.2 Ploughing of Cables

Supply and communication cables may be buried by ploughing individually or simultaneously, provided the separations and depths of burial stipulated in Clauses 9.1 and 9.2 are obtained.

9.6.2 Cable Trench

The trench shall be as straight as possible, with the bottom clean and free of any projecting stones. Depending upon the importance of the installation, a sand or screened earth bedding below and over the cables may be desirable. However, for all cables, a bedding of sand or backfill free of stones at least 75 mm deep above and below the cables, or a duct, shall be used in rocky ground or shale. Ridges or sharp changes in grade of the trench bottom, which could cause a "pressure point" on the cable, shall be avoided. When crossing other trenches or locations where earth settlement is likely, the trench bottom shall be well compacted or some type of mechanical reinforcement used to minimize future cable movement.

9.6.3 Entering Buildings

All cable entrances into buildings, subways, or other enclosed public areas shall be adequately sealed around the cable to prevent the entry of gas or water into the building.

10. Underground — Duct and Manhole Systems**10.1 Separations****10.1.1 General**

The duct line shall in general not be installed directly above or below other underground systems. Where it is necessary for a duct line to cross over or under another underground facility, the crossing shall be made at right angles or as nearly so as circumstances will permit, and shall have as great a vertical separation as circumstances will permit but not less than 150 mm. A duct line paralleling another underground system or other underground structures shall have as great a horizontal separation as circumstances permit but not less than 300 mm. Where the above separations cannot be obtained, extra precaution shall be taken to ensure the maximum possible separation and to prevent future contact.

10.1.2 From Pipelines

When laid parallel to, along, or near underground pipelines, duct systems shall maintain a horizontal separation from the pipelines of at least 300 mm. Where these separations cannot be obtained, extra precaution shall be taken to ensure the maximum possible separation and to prevent future contact. If duct systems and pipelines share the same trench, the above horizontal separation shall be obtained, with the pipeline preferably at a lower level.

When approaching a crossing, the facility that is installed at the greater depth shall, where practicable, be in the lower position at the crossing. A minimum separation of 300 mm of well tamped backfill shall be maintained at the point of crossing; where this is not practicable, extra precaution shall be taken to ensure the maximum possible separation and to prevent future contact. The duct system or pipeline shall be installed at a uniform depth for the full width of any right-of-way concerned.

10.1.3 From Swimming Pools

10.1.3.1 Where supply cables (except for bonding conductors or those conductors supplying electrical equipment associated with the swimming pool) are installed in a concrete encased plastic duct bank, the minimum horizontal separations between the inside walls of the swimming pool and the nearest face of the duct bank shall be as shown in Table 38. For supply cables

Installed in other types of duct banks, the minimum separations shown in Table 37 shall apply.

10.1.3.2 Communication cables installed in a duct bank prescribed in Clause 10.4 shall have the minimum separations shown in Table 38.

10.1.3.3 For voltages above 22 kV a special engineering study shall be made to determine the effects on the pool installation.

Table 38
Minimum Duct Separations from Swimming Pools

Type of Installation	Minimum Separation in Metres
Communication cables	0.75
Supply cables:	
0 — 750 V	0.75
Over 750 V — 15 kV	1.5
Over 15 — 20 kV	2

10.1.4 From Propane Tanks

There shall be a minimum horizontal separation of 1.5 m from propane tanks of 7600 L aggregate capacity or larger to the nearest face of the underground duct bank.

Note: This requirement is similar to that included in CGA Standard B149.2, Installation Code for Propane Burning Appliances and Equipment.

10.1.5 Iron or Steel Pipe as a Duct

Where iron or steel pipe is used as a duct, it shall not be laid in contact with water, gas, steam, or other metallic pipe systems. Where the separation is less than 50 mm, the metallic duct shall be adequately separated from other metallic pipe systems by a barrier of suitable electrical insulating material, to minimize any current transfer that could give rise to electrolytic corrosion, or they shall be electrically bonded together at the point of least separation.

10.2 Depth of Burial

The distance between the top of a duct system and the top of the pavement or other surface under which the system is constructed shall be sufficient to protect the system from damage. Where practicable, a minimum cover of 600 mm shall be used when the system is or is likely to be subject to road traffic and 450 mm in other locations; where these depths cannot be obtained, other protection shall be used or the duct shall be encased in concrete. Particular legislation exists in some areas calling for specific depths of cover to be provided.

10.3 Railway Crossings**10.3.1 Duct Material and Construction**

Duct material and construction shall be as specified in Clause 10.4, with the exception of preformed or cast multiple ducts, which shall be encased with 75 mm of concrete for at least 2 m beyond each outside rail, but preferably for the full width of the right-of-way.

10.3.2 Depth Below Base of Rail

The top of all duct banks shall generally be located at a depth of not less than 1.1 m below the base of the rails. Where this depth is not obtainable, a reduced depth is permissible but in no case shall the top of the duct banks be less than 150 mm below the bottom of the ballast section, which is subject to working or cleaning, and in no case less than 450 mm below the base of the rail.

Where unusual conditions exist or where proposed construction would interfere with existing construction, a greater depth than specified above may be required.

10.3.3 Depth Below Surface of the Earth

In no case shall the top of the duct bank be less than 450 mm below the surface of the earth or the bottom of ditches.

10.3.4 Horizontal Distance from Rails

Manholes and handholes as well as above-ground terminal facilities such as terminal poles, pedestals, housings, etc. shall be located off the railway right-of-way. Where this is not practicable, a reduced distance is permissible, but in no case shall the distance from the gauge side of nearest rail to the nearest face of above-ground facilities, manholes, and handholes be less than 2.5 m, except that, at sidings, the distance shall be not less than 1.9 m. At loading sidings, sufficient space as required shall be left for a driveway. When necessary for super-elevation, track curvature, unobstructed view of signals and signs, etc., the Railway may require greater distances than those specified above.

These requirements do not apply to terminals and above-ground facilities associated with railway communication and signal circuits or with railway electric supply circuits of 750 V (phase-to-phase) or less.

10.3.5 Ducts Enclosed in Steel Pipes

The steel pipes shall be of a minimum wall thickness as specified in orders of the appropriate railway regulatory authority and shall extend at least 2 m beyond each outside rail, but preferably the full width of the right-of-way.

10.4 Construction of Duct Banks**10.4.1 General**

An underground duct bank may consist of one or more ducts:

- (a) Encased in concrete;
- (b) Enclosed in steel pipe;
- (c) Requiring no additional protection;
- (d) With additional protection.

10.4.2 Materials

Ducts shall be of such material, size, finish, and mechanical strength as to facilitate the installation and maintenance of cables. The mechanical strength may be inherent in the material or be achieved by some form of encasement. See CSA Standards C22.2 No. 134, Fibre Conduit, C22.2 No. 135, Asbestos-Cement Conduit, B196.1, Plastic Underground Power Cable Ducting, and B196.3, PVC Underground Telecommunication Cable Ducting.

10.4.3 Ducts Encased in Concrete

10.4.3.1 For normal construction in firm soils, ducts encased in concrete shall be separated from each other by at least 25 mm of concrete, and the duct bank shall be completely encased in concrete at least 50 mm thick; except that duct banks for the exclusive use of communication cables do not require separation of the ducts by concrete, providing the duct bank has adequate strength. Further protection, including steel reinforcing, may be required in fluid soils or other special circumstances. Concrete shall have a minimum strength of 20 MPa after 28 days.

10.4.3.2 At railway crossings, ducts shall be separated from each other by at least 25 mm of concrete, and the duct bank shall be completely encased in concrete at least 75 mm thick. Where the width of the duct bank exceeds 550 mm, additional strength may be required. The encasement shall extend at least 2 m beyond each outside rail, but preferably for the full width of the right-of-way. Concrete shall have a minimum strength of 20 MPa after 28 days.

10.4.4 Ducts Enclosed in Steel Pipe

10.4.4.1 When ducts are placed in a steel pipe, the space between the ducts and pipe shall be sealed at the ends of the pipe to prevent the entry of water.

10.4.4.2 Where ducts are to be occupied by supply cables, consideration shall be given to the prevention of overheating of the supply cables. Filling the space between the ducts and pipe with material of good thermal conductivity may assist in this.

10.4.5 Ducts Requiring No Additional Protection

10.4.5.1 Ducts with no additional mechanical protection may be placed in a trench, augered, or pushed, providing that sufficient mechanical strength is inherent in the duct material. At railway crossings where physical and chemical conditions permit, not more than two ducts, each not exceeding 100 mm in inside diameter, or one large-bore corrugated steel duct or reinforced concrete pipe, may be augered, pushed, or laid in the earth beneath the roadbed without any form of protection. At such railway crossings where the duct is placed by augering, the diameter of the hole shall not exceed the outside diameter of the duct by more than 25 mm. Backfill shall be rammed lightly around the outside surface of the duct at each end.

Such ducts at railway crossings shall extend at least 2 m beyond each outside rail, but preferably for the full width of the right-of-way.

10.4.5.2 Multiple ducts preformed or cast into a unit may be placed in an open trench, augered, or pushed, providing that sufficient strength is inherent in the material to withstand the loading to which it will be subjected.

10.4.6 Ducts with Additional Protection

Examples of mechanical protection are:

- (a) Cable brick;
- (b) Concrete slabs with a minimum thickness of 50 mm;
- (c) Treated planks at least 40 mm thick;

- (d) Poured concrete with a minimum thickness of 50 mm;
- (e) Concrete encasement;
- (f) Steel or iron pipe.

It is recognized that varying degrees of mechanical protection are provided by these examples. For the more arduous duty and that duty involving reduced burial depth, concrete encasement, steel or iron pipe, or concrete thicker than 50 mm shall be used.

10.4.7 Grading of Ducts

Where it is necessary for the ducts to drain, the grade of the ducts shall be from the high point in the line to one or both adjacent manholes, and such grade shall be not less than 1:400. Ducts terminating at buildings shall be graded to drain away from the building to the manhole. Where drainage to a manhole is impracticable, a drainage pocket shall be provided at the low point of the duct run.

10.4.8 Settling

Ducts shall be suitably reinforced or laid on a suitable foundation of adequate bearing strength where the condition of the soil might otherwise allow duct settlement.

10.4.9 Backfilling

Concrete-encased conduit may be backfilled and tamped before the concrete has taken its initial set. Where this is not practicable, backfilling shall be postponed for at least 24 hours. On warm sunny days, however, it is advisable to retard the evaporation of water from the concrete.

10.5 Construction of Manholes

10.5.1 Strength

The design and construction of manholes and handholes shall provide sufficient strength to sustain the loads that may reasonably be imposed on them.

10.5.2 Dimensions

Except as provided for in Items (c) and (d), the inside dimensions of manholes shall be not less than:

- (a) Length and Width — 1.1 m, provided that a clear working space of not less than 0.9 m can be obtained;
- (b) Headroom — 1.8 m, except in manholes where the edge of the roof opening is within 0.3 m of each side of the manhole;
- (c) These dimensions may be reduced in manholes used exclusively for communication system equipment and cables and in all handholes;
- (d) These dimensions do not apply to subsurface chambers so designed that the equipment housed therein is accessible from the surface of the earth.

10.5.3 Duct Entrances into Manholes

Ducts terminating in manholes, handholes, or other permanent openings of underground systems, shall be provided with an effective shield or bushing, or the surface at the duct entrance shall be so shaped as to provide a smooth outlet.

10.5.4 Drainage

Where drainage is into sewers, suitable traps shall be provided to prevent the entrance of sewer gas into the manhole. Where such drainage is not practicable, a sump shall be provided in the floor to facilitate drainage or pumping. Where danger of flooding exists, back-water valves should also be provided.

10.5.5 Roof Openings

Round access openings to any manhole shall be not less than 600 mm in diameter. Rectangular openings shall be not less than 500 mm × 600 mm, except that these dimensions may be reduced in the case of handholes.

10.5.6 Frames and Covers

10.5.6.1 Manholes and handholes shall be provided with frames and covers of sufficient strength to sustain such loads as may be imposed on them.

10.5.6.2 The covers shall have facility for removal and should be suitably marked to indicate ownership.

10.5.6.3 The covers shall be mechanically fixed in place or be of sufficient weight to discourage unauthorized removal.

10.5.7 Hardware

10.5.7.1 Pulling eyes should be installed in the walls of manholes opposite each duct bank entrance, as required, to assist in pulling in cables.

10.5.7.2 The walls of manholes shall be equipped as required with suitable devices to support adequately the cables and splices.

10.5.8 Ventilation

10.5.8.1 Standard Manholes

Manholes housing supply cables shall be vented to the air. Several holes in the cover may be used for this purpose.

10.5.8.2 Special Manholes

Adequate outside ventilation shall be provided for manholes that contain supply equipment and those from which any openings exist into subways entered by the public. Where such manholes house transformers, sectionalizing switches, or regulators, etc., the ventilators shall be cleaned at necessary intervals.

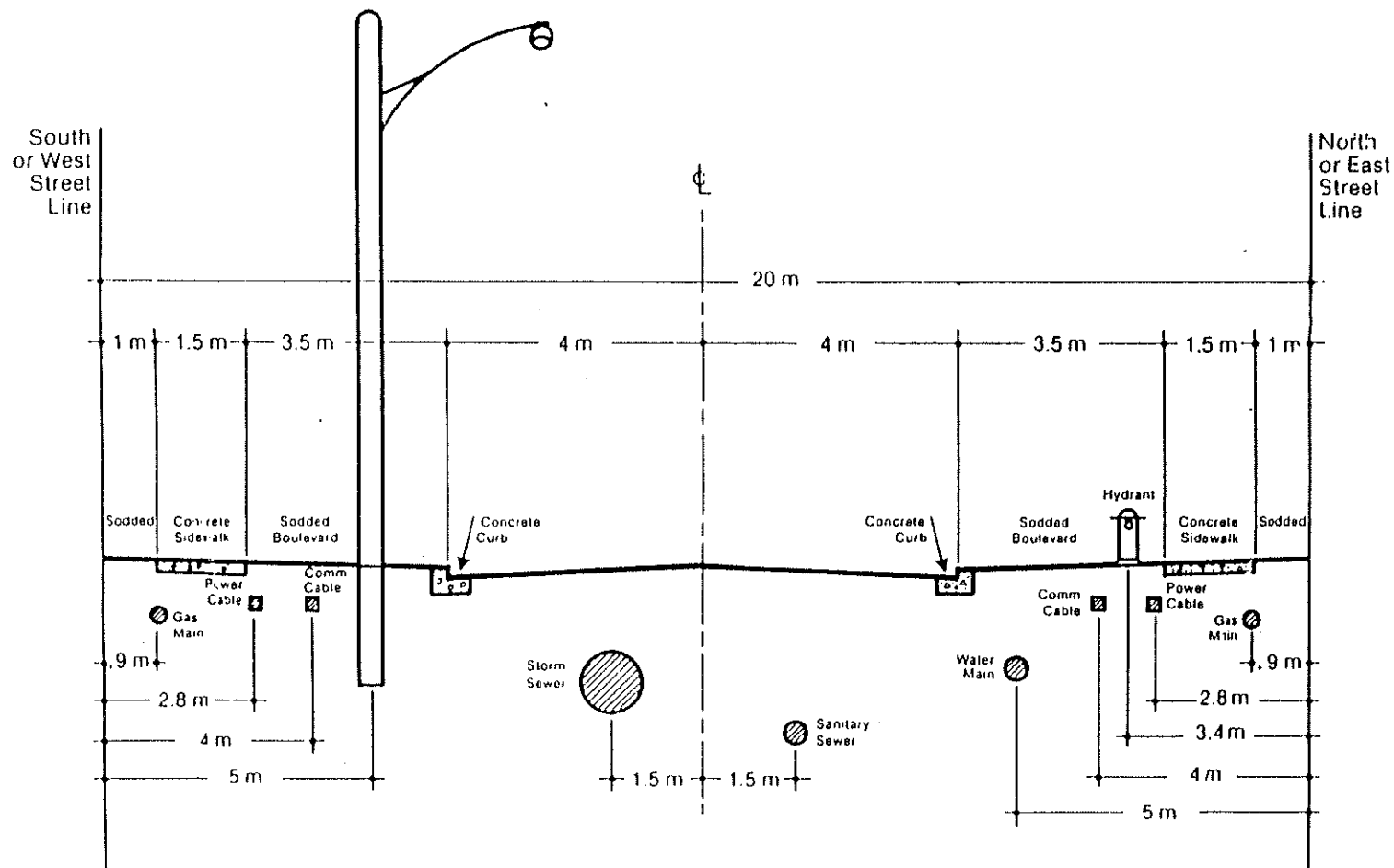
10.5.9 Backfilling

10.5.9.1 Backfilling around concrete manholes poured in place shall be delayed until the concrete has set, to allow the safe removal of the forms and the safe loading of the manhole.

10.5.9.2 Concrete made with normal Portland cement should be allowed to set for not less than 72 hours.

Concrete made with high early strength cement should be allowed to set for not less than 24 hours.

Appendix B



Note: Dimensions shown are examples only and may vary for each municipality.

Figure B1
Typical Street Location of Various Services

ANNEXE B

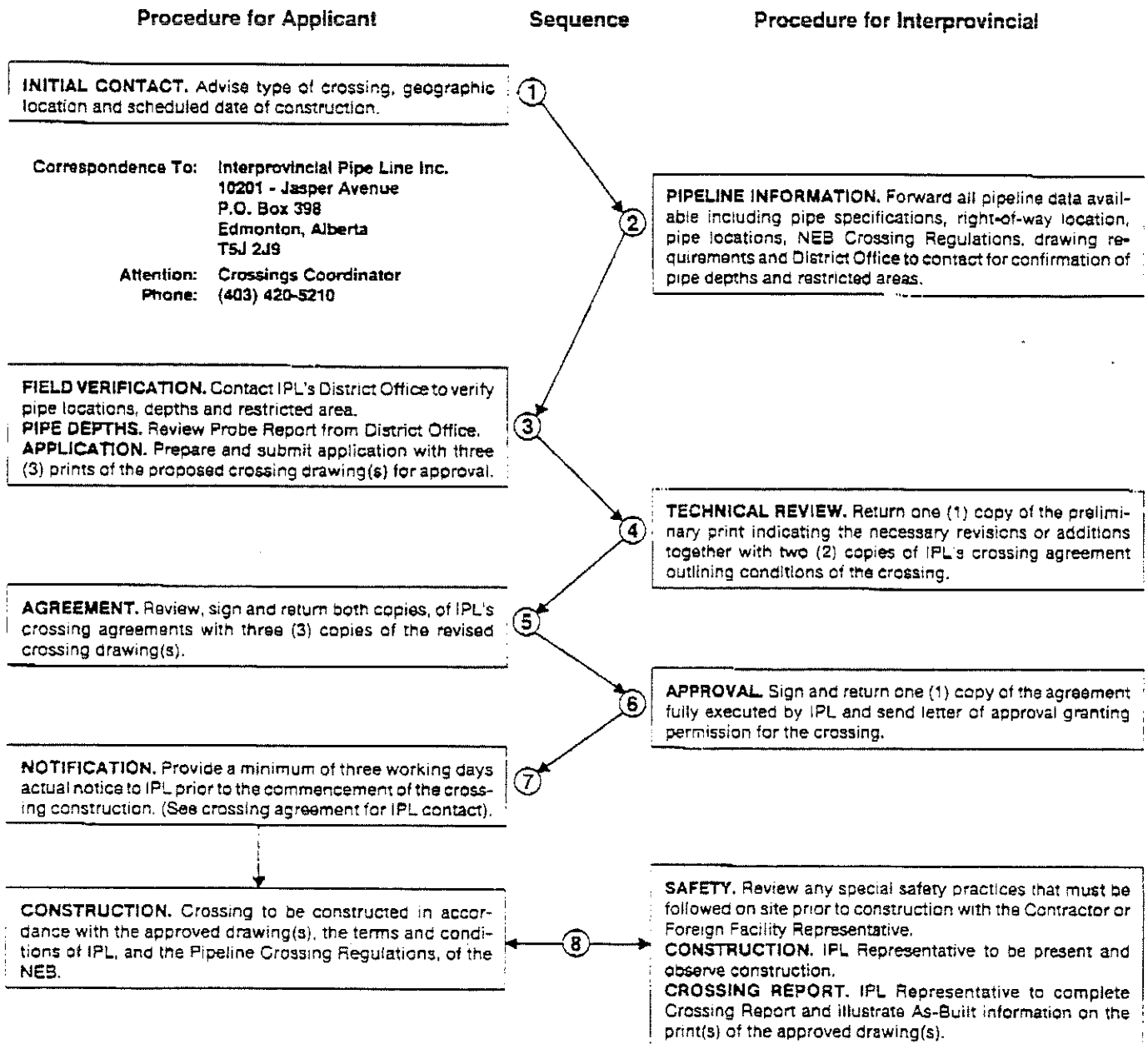
- Lignes directrices pour les croisements avec les installations de Interprovincial Pipe Line Inc.

GUIDELINES

For Application to Cross Facilities of Interprovincial Pipe Line Inc. (IPL)

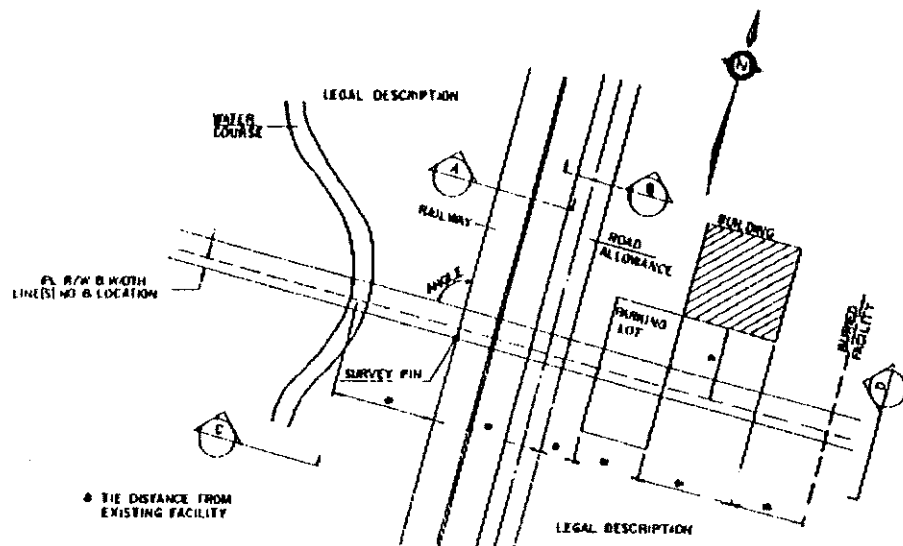


(For Details Refer to Section 112 of the National Energy Board Act (NEB)
and The Pipeline Crossing Regulations, of the NEB.)

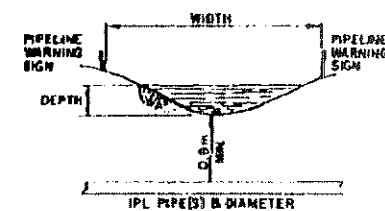


NOTE: Should the Applicant (Facility Owner) be denied permission to cross or considers the terms and conditions imposed by IPL to be inappropriate, after remediation the Applicant (Facility Owner) may make application for leave to cross to The National Energy Board at:

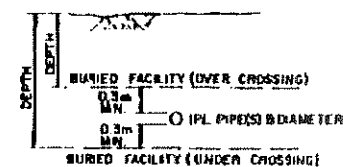
National Energy Board
311 - 8th Avenue S.W.
Calgary, Alberta
T2P 3H2
Phone: (403) 299-3665



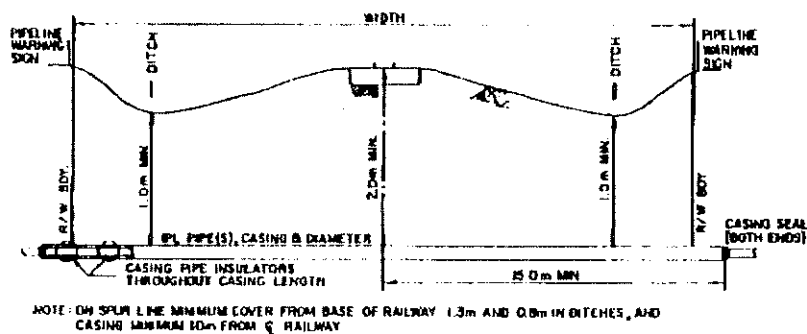
LOCATION PLAN



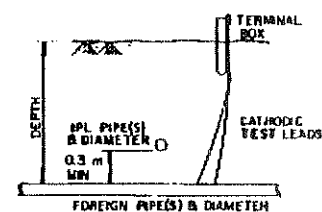
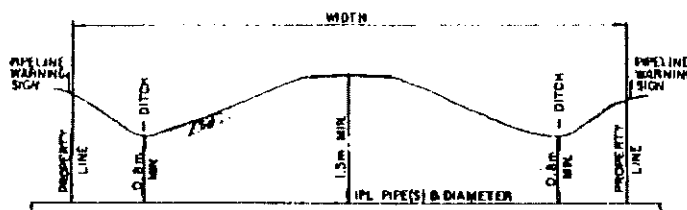
TYPICAL WATER COURSE CROSSING



TYPICAL FACILITY CROSSING



TYPICAL MAIN LINE RAILWAY CROSSING

TYPICAL TEST LEAD CONNECTION
(STEEL PIPELINES)

TYPICAL ROAD CROSSING

NOTE:
1. "CAUTION HIGH PRESSURE PIPELINES"
2. IPL REPRESENTATIVE MUST BE
PRESENT DURING CONSTRUCTION.

THIS DRAWING IS FOR REFERENCE ONLY. ACTUAL SITE
DETAILS OR REQUIREMENTS MAY VARY

Interprovincial Pipe Line Inc. Interprovincial Pipe Line (NW) Ltd.			
EDMONTON	ALBERTA	CANADA	
TYPICAL CROSSING DETAILS			
DRAWN BY	DATE 30.8.88	APPR	<i>L.C. Foster</i>
CHECK	APPR	APPR	
SCALE NOT TO SCALE	APPR		<i>B. J. L. Foster</i>
C-102-5052-0-0			

**Interprovincial Pipe Line Inc.
Interprovincial Pipe Line (NW) Ltd.**



DRAWING REQUIREMENTS FOR THIRD PARTY CROSSINGS

This represents the minimum information required when preparing drawings for crossing approvals. Dimensions on drawing(s) may be in Imperial or metric (if metric, one decimal point).

The applicant should contact the pipeline company at an early date for information and to discuss requirements with respect to the proposed crossing.

1. **Drawing with Revision Number and Date.**
2. **North Arrow**
3. **Complete Land Description**
4. **Plan view, show and identify:**
 - a. pipeline(s), pipeline markers, and right-of-way; location of pipeline(s) within right-of-way.
 - b. facilities (including all curbs, footings, guard rails, guy wires, poles, fences, etc.) with tie dimensions to lot or survey line (preferably along pipeline and or right-of-way boundary) and crossing angle. Crossing angle should be as close to 90° as possible.
 - c. lot lines, road limits.
 - d. location of cathodic test lead terminal box (if applicable).
 - e. for parking lots, storage yards: nearest building with tie dimension to nearest pipeline and or right-of-way boundary.
 - f. for parking lots, storage yards: describe barrier preventing access to unaffected right-of-way (eg. fence or concrete curb).
5. **Profile View**
 - a. for surface structures: along pipeline(s) with highest elevation.
 - b. for underground facilities: along facility.
 - c. pipeline(s) and depth of cover.
 - d. facilities and protective devices with minimum clearances from each to the pipeline(s) (minimum clearances: roads/parking lots/storage yards - 1.3m; railways - 2.0m; ditches - 0.8m; underground utilities - 0.3m).
 - e. all underground facilities must maintain the same elevation across the entire width of the right-of-way except for gravity type facilities.
6. **Specifications of Pipeline(s) being Crossed**
 - a. give diameter(s)
 - b. give diameter(s) of casing (if applicable)
 - c. Warning statement eg. "Caution High Pressure Pipeline(s)"
 - d. details of any protective devices for pipelines (concrete slabs, casings, pads, temporary structures, etc.) if requested by the company and shown on the plan and profile.
7. **Facilities Description**
 - a. roads, parking lots, storage yards: wheel loading, surface, subgrade, name or number designation of roads (if any), materials to be stored (if any).
 - b. fences: height, material, post locations (1.5m minimum from pipeline).
 - c. ditches, open drainage systems: depth, width - top and bottom (existing and proposed), name or designation (if any).
 - d. underground facilities: materials; diameter; maximum voltage; pressure; conduit structure - duct size, use and configuration - size and reinforcement (if any).

NOTES: The above information should be incorporated into all drawing(s) used for construction or a specific crossing drawing(s) must be prepared for approval. These drawing(s) must be available for reference on site.

For Reference, a typical crossing drawing of these minimum requirements is attached.

ANNEXE C

- Exigences et normes d'Amtrak pour l'implantation du réseau de pipelines

5-11-89
C.E. 4

11/1/89

SPECIFICATIONS
FOR
WIRE, CONDUIT AND CABLE OCCUPATIONS
OF
NATIONAL RAILROAD PASSENGER CORPORATION
PROPERTY

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1. SCOPE:

A. These specifications apply to the design of electric transmission wires and cables (power or communication) which are to be located over, under, across or upon Railroad property and facilities and tracks owned by others over which the Railroad operates its equipment.

2. APPLICATION FOR OCCUPANCY

A. Individuals, corporations, municipalities (known as the owner) desiring occupancy of Railroad property by such wire or cable occupations must agree, upon approval of the construction details by the Office of the Chief Engineer of Railroad, to execute an appropriate occupational agreement and pay any required fees and/or rentals outlined therein.

B. Application for an occupancy shall be by letter addressed to: Real Estate Department, National Railroad Passenger Corporation, 60 Massachusetts Avenue, N.E., Washington, D.C. 20002 giving the following:

- (1) Name of individual, corporation or municipality desiring the occupancy.
- (2) Complete mailing address of applicant.
- (3) Name and title of person who will sign the agreement.
- (4) The State in which the applicant is incorporated.

C. All applications shall be accompanied with eight (8) copies of all construction plans and three (3) copies of specifications and computations concerning the proposed occupancy.

3. APPROVAL OF PLANS

A. No entry upon Railroad property for the purpose of conducting surveys, field inspections, obtaining soil information, or any other purpose associated with the design and engineering of the proposed occupancy, will be permitted without a proper entry permit (Form CE-17) prepared by the Chief Engineer of the Railroad or his designated representative and executed by the applicant. It is to be clearly understood that the issuance of such a permit does not constitute authority to proceed with the actual construction which cannot begin until a formal agreement is finally executed by the Railroad Company and permission is received by the owner from the designated inspection agency of the Railroad to proceed.

3. Plans for proposed wireline or cable occupations shall be submitted to and meet the approval of the Chief Engineer of Railroad prior to start of construction. These plans are to be prepared in sizes as small as possible and are to be folded to an 8 1/2 inch by 11 inch size (folded dimensions) with a 1 1/2 inch margin on the left-hand side and a 1 inch margin on the top so that they can be secured in a file at the upper left-hand corner and still be unfolded to full size without being removed from the file.

Also, after folding, the title block and other identification of the plans shall be visible without the necessity of unfolding at the lower right-hand corner. Each plan shall bear an individually identifying number and an original date, together with subsequent revision dates, clearly identified on the plan so as to be readily apparent as to just what revisions were made and when.

All plans are to be individually folded and where more than one plan is involved, they shall be assembled into complete sets before submission to the Railroad.

C. Plans shall be drawn to scale and show the following:
(See Plates I, II, III, IV and V, hereto attached).

- (1) Plan view of crossing or occupation in relation to all Railroad facilities. (See Plate I).
- (2) Location of wire or cable (in feet) from nearest Railroad Mile Post, center line of a Railroad bridge (giving Bridge Number), or center line of an existing or former passenger station. In all cases, the name of the County in which the proposed facilities are located must be shown. In States where Townships, Ranges and Sections are used, give distance in feet to the nearest Section line and identify the Section number, Township and Range.
- (3) Profile of ground on center line of pole or tower line, showing clearances between top of rail and bottom of sag, as well as clearances from bottom wire or cable to top wire or cable of the Railroad's transmission, signal and communication lines, catenary, and third rail when present. If none of these facilities are in existence at the point of crossing, the plan should so indicate. Actual under-clearances are to be shown. (See Plate V for the required clearances).

- (4) Show all known property lines. If wires, cables or conduits are within public highway limits, such limits should be clearly indicated with dimensions from center line.
- (5) The plan must be specific, as to:
 - a. Base diameter, height, class and bury of poles. Poles shall be set no closer than 16'0" from face of pole to center line of nearest track. When necessary, however, each location will be analyzed to consider speed, traffic, etc.
 - b. Number of, size and material of power wires, as well as number of pairs in communication cables.
 - c. Nominal voltage of line.
 - d. Number of, location, size of, material of anchors and all guying for poles and arms.

NOTES: Double cross-arms are required on poles adjacent to track. Any tower designs must be accompanied by engineering computations and data.

4. CONSTRUCTION REQUIREMENTS

A. Power and communication lines shall be constructed in accordance with "Safety Rules for the Installation and Maintenance of Electric Supply and Communication Lines, National Electrical Safety Code Handbook, Part 2," (current issue), except as outlined in item 3 (c), Page 2 and except that casing pipes to contain power or communication wires or cables having an outside diameter of over four (4) inches shall be constructed in accordance with the current issue of Amtrak's "Requirements and Specifications for Pipeline Occupancy", USA, ENG 1604 dated Nov., 1987.

B. Under special conditions, Railroad will give consideration to occupations on its catenary structures, subject to the approval of the Chief Engineer, and the Railroad's policy governing such matters.

5. LONGITUDINAL OCCUPATIONS

Wires and cables running longitudinally along Railroad right of way shall be constructed as close to Railroad property lines as possible. For electrical power wires and cables with voltages of 34,500 or over and communication cables containing over 1800 pairs, the following information must be submitted in addition to the detail of the pole top configuration as called for on Plate IV of these specifications:

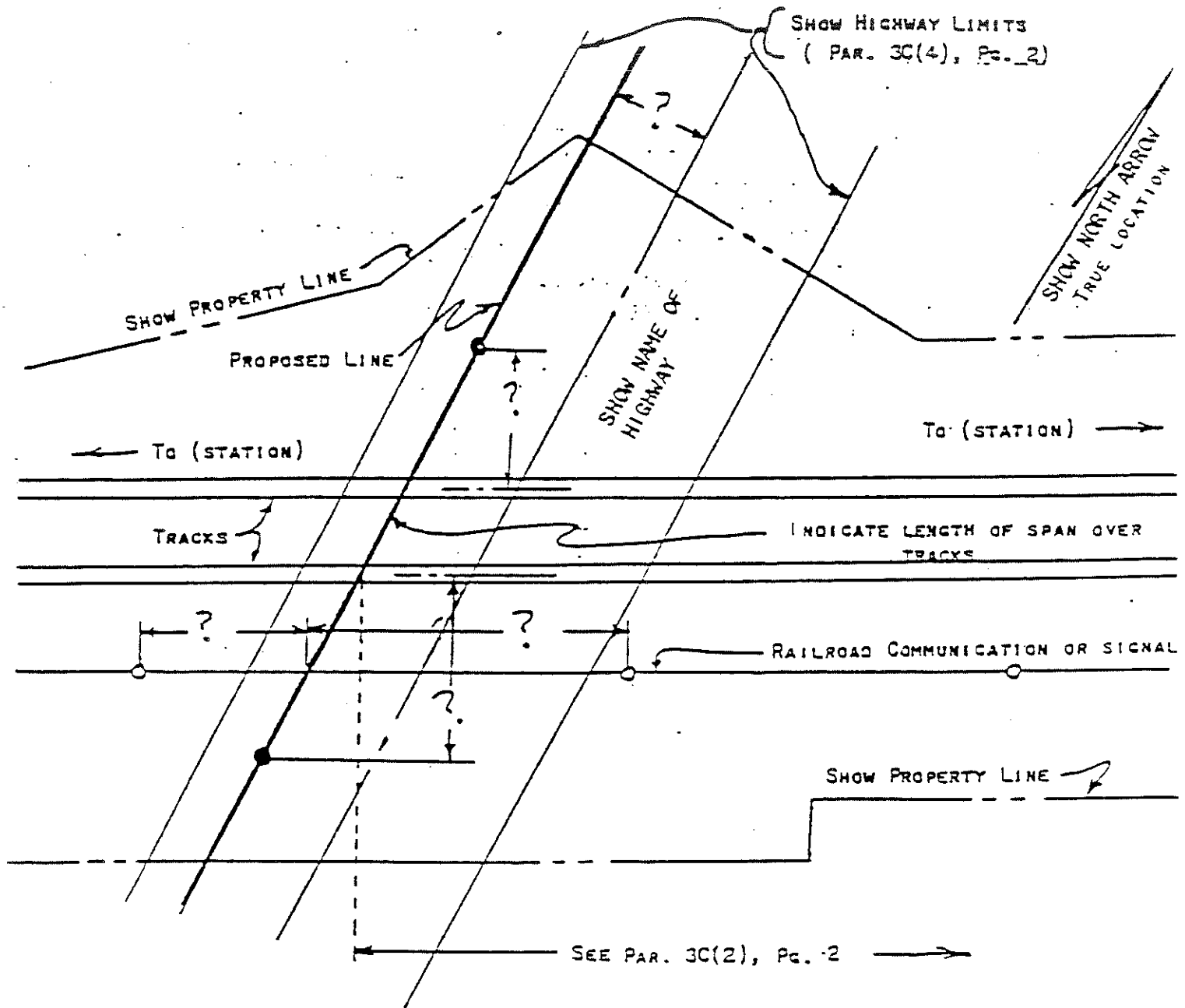
- a. Voltage of circuit (s) or number of pairs.
- b. Phase of electrical circuit (s).
- c. Number of electrical circuits.
- d. Size (AWG or CM) and material of wires or cables.
- e. Length of spans clearly indicated on drawing.

Any facilities overhanging Railroad property must have approval of the Railroad and appropriate rental charges will be applied.

6. INDUCTIVE INTERFERENCE

On agreements covering longitudinal occupations, provisions will be included that the applicant will provide appropriate remedies, at his own expense, to correct any inductive interference with Railroad facilities.

INFORMATION TO BE SHOWN ON PLAN SECTION OF DRAWINGS
 WHEN FACILITY IS A CROSSING

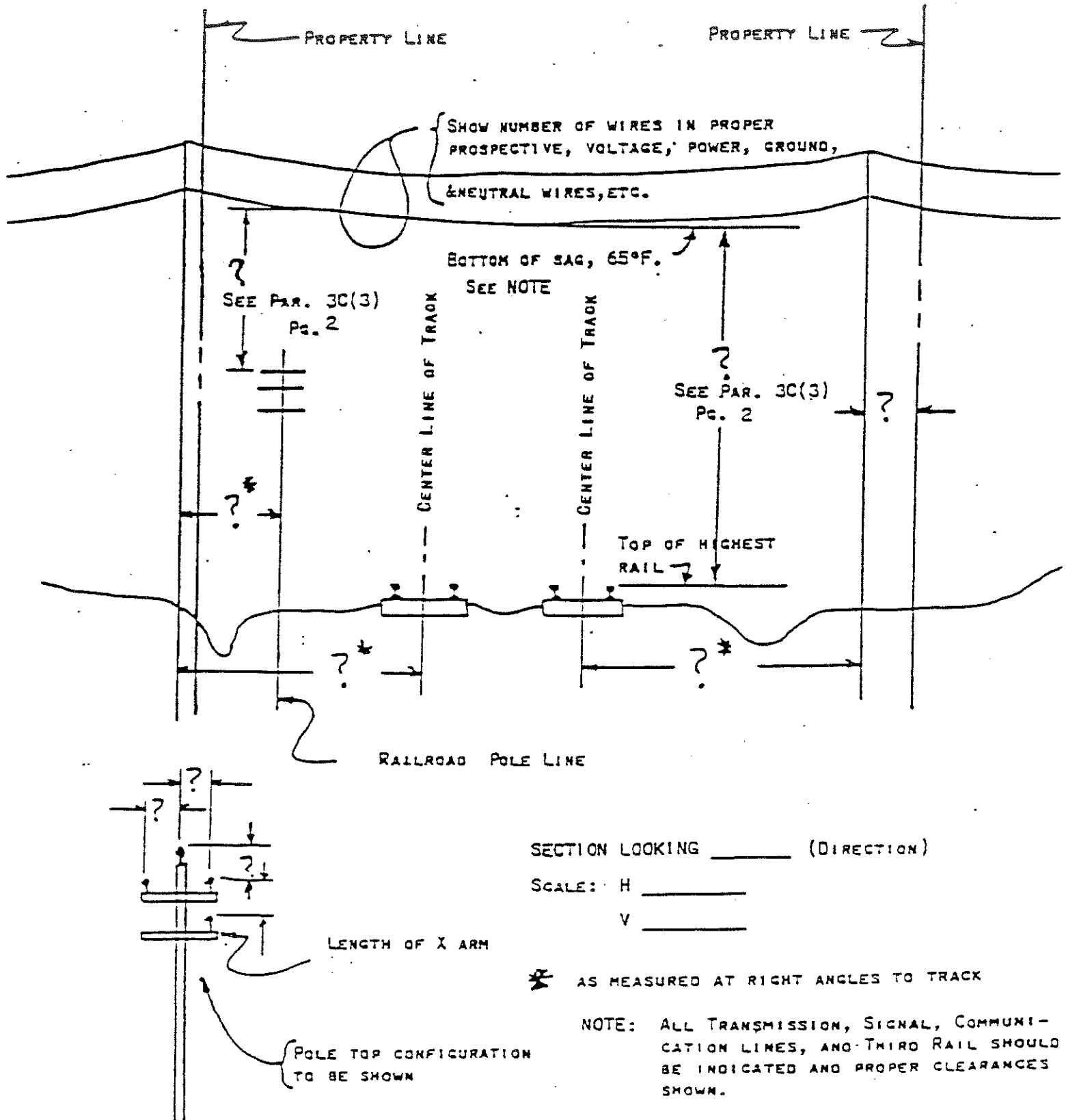


SCALE OF DRAWING TO BE SHOWN

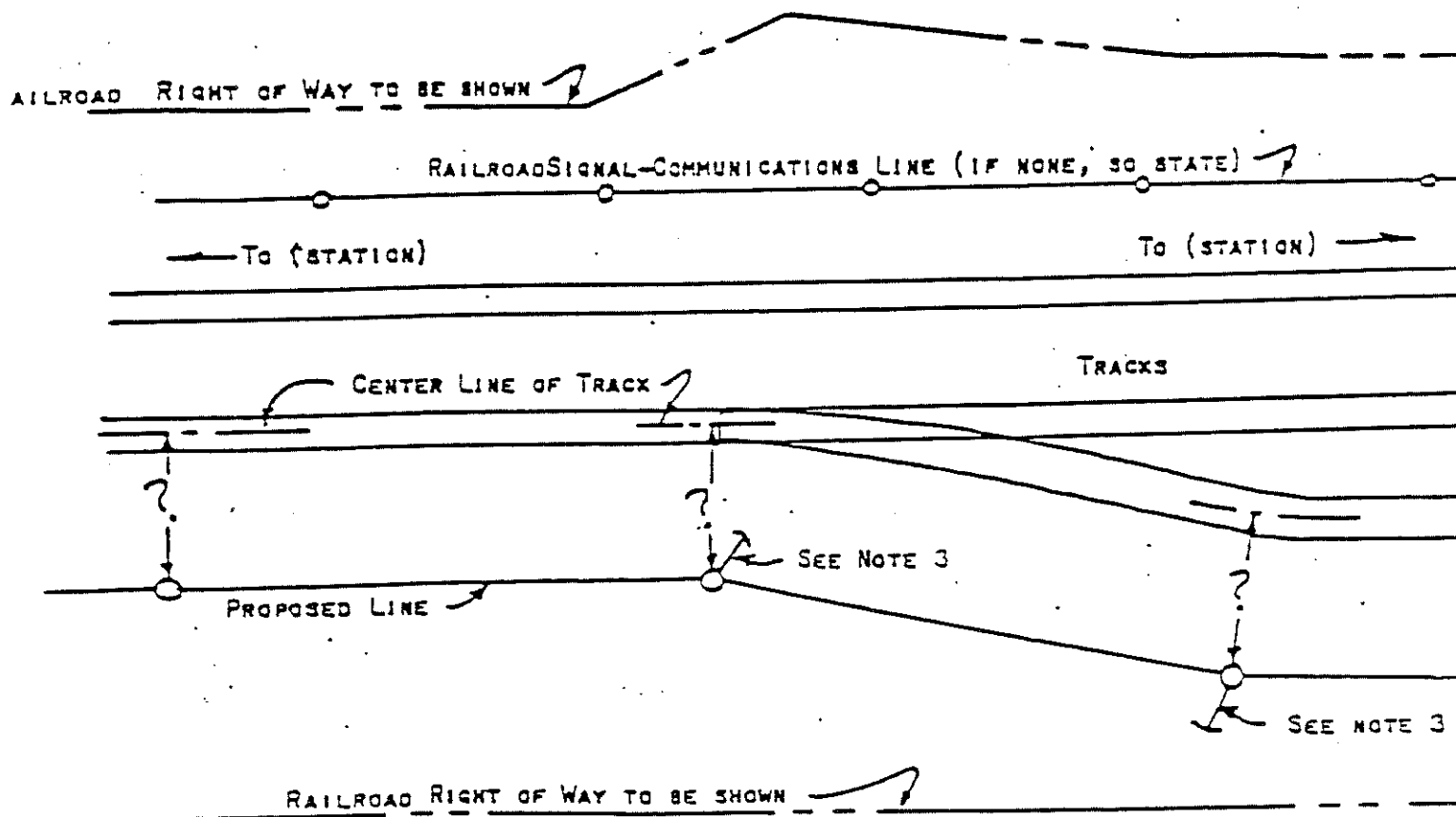
NOTE: IF THE PROPOSED LINE IS TO SERVE A NEW DEVELOPMENT, A MAP SHOWING THE AREA IN RELATION TO ESTABLISHED AREAS AND ROADS IS TO BE SENT WITH THE REQUEST.

IF THE PROPOSED LINE IS NOT WHOLLY (OR PARTIALLY) WITHIN HIGHWAY LIMITS, THE INFORMATION IS REQUIRED AS SHOWN ON THIS PLATE.

INFORMATION TO BE SHOWN ON PROFILE SECTION OF
DRAWINGS - IN CASES OF CROSSINGS



INFORMATION TO BE SHOWN ON PLAN SECTION OF DRAWINGS
IN CASES OF LONGITUDINAL OCCUPATIONS

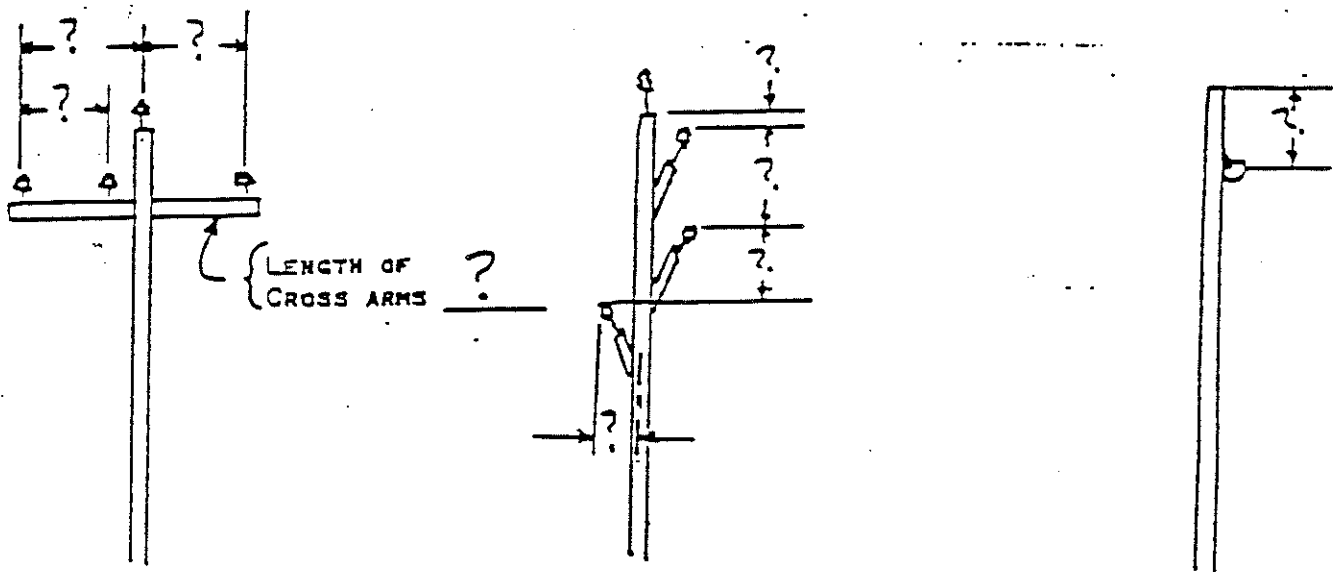
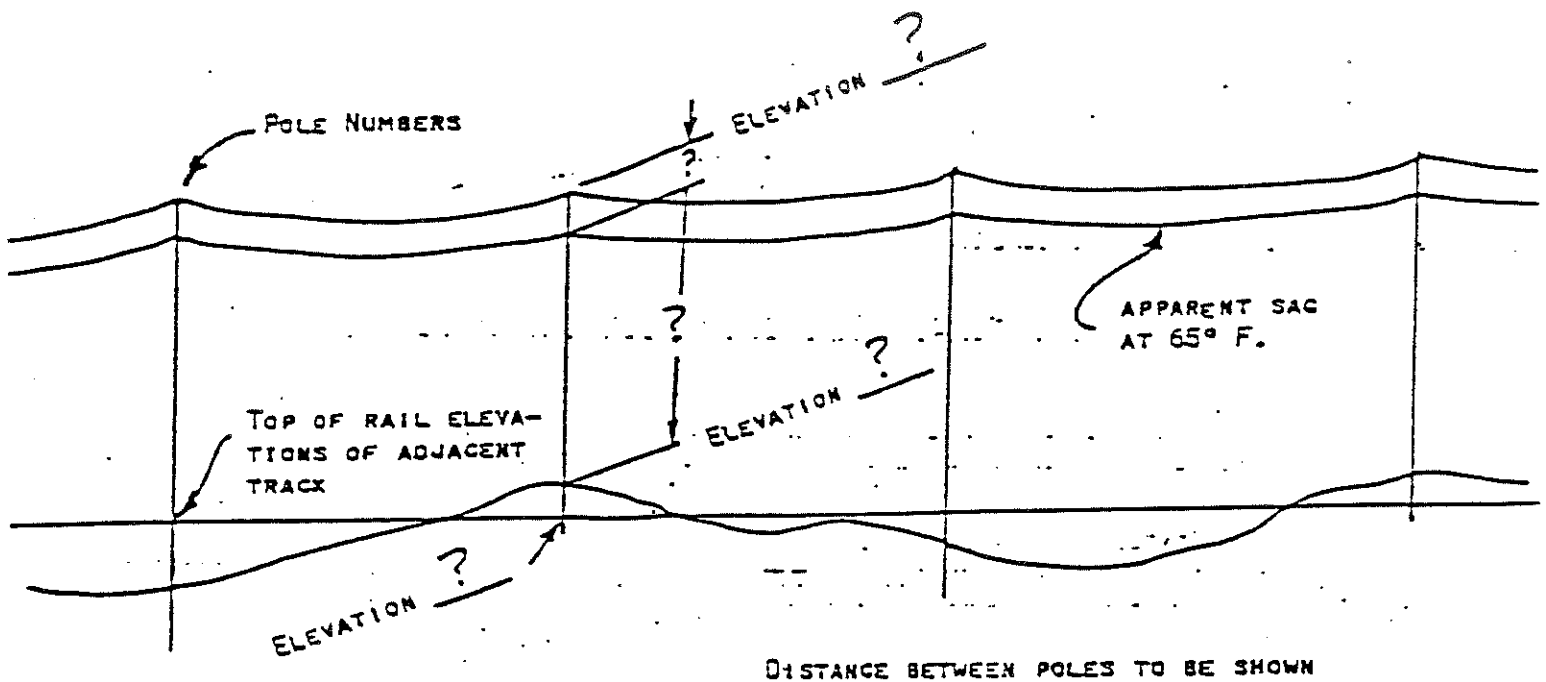


SCALE OF DRAWING TO BE SHOWN

SHOW NORTH ARROW
TRUE LOCATION

- NOTE:
- (1) EACH END OF THE LINE MUST SHOW MEASUREMENTS AS CALLED FOR IN PAR. 3C(2), Pg. 2.
 - (2) IF POWER LINE CROSSES ANY TRACK, THEN THE INFORMATION SHOWN ON PLATE I IS ALSO REQUIRED.
 - (3) WHERE ANCHOR GUYS ARE REQUIRED, SEE PAR. 3C(3), Pg. 2
 - (4) THE DISTANCE BETWEEN EACH POLE IS TO BE SHOWN
 - (5) ASSIGNED POLE NUMBERS TO BE SHOWN AT EACH POLE

INFORMATION TO BE SHOWN ON PROFILE SECTION OF DRAWINGS
 IN CASES OF LONGITUDINAL OCCUPATIONS



POLE TOP CONFIGURATION TO BE SHOWN SIMILAR TO SAMPLES ABOVE

NOTE: IF POWER LINE CROSSES ANY TRACK, THEN INFORMATION SHOWN ON PLATE II IS ALSO REQUIRED

PLATE V

<u>VOLTAGE</u>	<u>OVERHEAD CLEARANCE</u> (Top of Rail to Bottom of Sag)
0-750	27'0"
751-15,000	28'0"
15,001-50,000	30'0"
69,000	30'8"
115,000	32'2"
138,000	33'0"
345,000	39'10"
500,000	45'0"
745,000	53'2"
765,000	53'10"

Calculation is 30'0" + 0.4" per 1,000 volts over 50,000 volts.

ANNEXE D

- Spécifications pour l'installation de réseaux de câbles et de conduites dans les propriétés d'Amtrak

USA,ENG 1604

NOV., 1987

REQUIREMENTS & SPECIFICATIONS
FOR
PIPELINE OCCUPANCY



NATIONAL RAILROAD PASSENGER CORPORATION

RECOMMENDED:

H. F. Longhelt
DEPUTY CHIEF ENGINEER

APPROVED:

G. Ellis
ASST. VICE PRESIDENT &
CHIEF ENGINEER

RECOMMENDED:

R. D. Johnson
ASST. CHIEF ENGINEER
DESIGN & CONSTRUCTION

PIPELINE OCCUPANCY
REQUIREMENTS AND SPECIFICATIONS
Northeast Corridor

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02860	Pipeline Occupancy, General Criteria	5 Pages
02861	Carrier Pipe	4 Pages
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PLATE II	TYPICAL SECTION
PLATE III	TYPICAL SECTION AND PROFILE (LONGITUDINAL OCCUPATION)
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PLATE VI	PRITEC PIPE COATING
PLATE VII	SERVI-WRAP P-500 PIPE INSULATION
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* * * *

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10/87
1604

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* * * *

SECTION 01100 GENERAL REQUIREMENTS

1.01 DESCRIPTION OF WORK LOCATION

- A. These Specifications apply to the design and construction of pipelines carrying flammable and non-flammable substances and to casings over 4-inches in diameter containing pipelines, wires, or cables, under, across or along Railroad property, facilities and tracks or tracks owned by others over which the Railroad operates its equipment.

1.02 DEFINITIONS

- A. The terms "Amtrak" or "Railroad" are used synonymously throughout these specifications, and refer to the National Railroad Passenger Corporation, Office of the Chief Engineer, 400 North Capitol Street, NW, Washington, DC 20001.
- B. The term "Chief Engineer" refers to the Amtrak Chief Engineer or his designated representative.
- C. The term "Applicant" refers to individuals, Corporations, or Municipalities desiring occupancy of railroad property by a pipeline.
- D. The term "Occupant" refers to individuals, corporations or municipalities who have a current agreement with the Railroad to occupy an existing pipeline under, across or along Railroad property.

1.03 REFERENCED STANDARDS AND SPECIFICATIONS

- A. Wherever standards or specifications issued by a recognized industry association or regulatory body are referenced in these Specifications, the reference shall be interpreted as incorporating the referenced standard or specification in total into these Specifications as applicable. In the event of a difference between referenced standard or specifications and these Specifications, the more stringent shall govern.
- B. Technical Reference Abbreviations - Whenever in these Specifications the following terms, or pronouns in place of them, may be used, the intent and meaning shall be interpreted as follows:

ANSI - AMERICAN NATIONAL STANDARDS INSTITUTE, INC.
1430 Broadway
New York, NY 10018

ASTM - AMERICAN SOCIETY FOR TESTING AND MATERIALS
1916 Race Street
Philadelphia, PA 19103

AREA - AMERICAN RAILROAD ENGINEERING ASSOCIATION
50 F Street, N.W.
Washington, D.C. 20001

AWWA - AMERICAN WATER WORKS ASSOCIATION, INC.
6666 W. Quincy Avenue
Denver, CO 80235

CSI - CONSTRUCTION SPECIFICATIONS INSTITUTE

NACE - THE NATIONAL ASSOCIATION OF CORROSION ENGINEERS
Houston, TX 77026

1. When reference is made to the specifications or standards of any of the above organizations, federal agencies, trade associations, or others, reference is made to the edition current as of the date of approval of application for pipeline occupancy.

1.04 PERMIT TO ENTER RAILROAD PROPERTY

- A. No entry upon railroad property for the purpose of conducting surveys, field inspections, obtaining soil information, or any other purpose associated with the design and engineering of the proposed occupancy, will be permitted without a proper entry permit (Amtrak Form CE-17) prepared by the Chief Engineer and executed by the Applicant.
- B. The issuance of such an entry permit does not constitute authority to proceed with the actual construction which cannot begin until a formal agreement is finally executed by the Railroad and written permission is received by the Applicant from the designated inspection agency of the Railroad to proceed.
- C. All persons entering railroad property must first attend an Amtrak safety orientation class conducted by the Amtrak Safety Department.

1.05 WORK ON RAILROAD PROPERTY

- A. The safety and continuity of operation of trains shall be of the first importance. The Applicant shall arrange the work so that trains will be protected and safeguarded at all times. Whenever the work may affect the safety and movement of trains, the method, sequence and time schedule of performing such work shall be submitted to the Chief Engineer for approval 30 days in advance to allow for proper coordination and sequencing of the work by the Applicant.

- B. In the event the work affects other railroads or transit authorities, all contacts with them shall be made by the applicant.
- C. The Applicant waives all claims against Amtrak for delays or any interference occasioned by railroad traffic.
- D. All Applicant-designed temporary construction on railroad property, whether such property belongs to either Amtrak or to other railroads, shall be designed in accordance with the appropriate railroad criteria and all construction performed on, under, or over railroad property will be subject to the inspection and approval of the Chief Engineer.
- E. At least twenty-one days advance written notice shall be given to the Chief Engineer prior to the entering upon, or commencing of any work on, under or over railroad property.
- F. Amtrak will furnish such qualified flagman, signalman, or protection men, other than crossing watchmen, as may be required to insure complete protection of train operations and railroad facilities. The need for this type of service will be determined by the Chief Engineer on the basis of railroad regulations and the Applicant's approved construction schedule. No work shall proceed without proper protection on the site.
- G. All expenses incurred in connection with protection of railroad facilities by railroad employees will be borne by the Applicant. Billings for such services or expenses, including labor, materials and equipment will be made directly to the Applicant for payment.
- H. During construction, railroad traffic shall be maintained at all times without interruption, except when interruption is approved in advance, in writing, by the Chief Engineer.
- I. All operations shall be conducted so as not to interfere with, interrupt, or endanger the integrity of railroad facilities. All work on and near railroad property shall be conducted in accordance with railroad safety rules and regulations. The Applicant shall secure and comply with the Railroad safety rules and shall give written acknowledgement to the Railroad that they have been received, read, and understood by the Applicant and his employees. Operations will be subject to Railroad inspection at any and all times.
- J. All cranes, lifts, or other equipment that will be operated in the vicinity of the Railroad's electrification and power transmission facilities shall be electrically grounded as directed by the Railroad, and/or required by OSHA.

- K. At all times when the work is being progressed, a field supervisor for the work with no less than 12 months experience in the operation of the equipment being used shall be present. If boring, drilling, or similar machines are being used, the machine operator also shall have no less than 12 months experience in the operation of the equipment being used. Certification of the above is to be submitted to the Chief Engineer upon request.
- L. Whenever equipment or personnel are working closer than 15 feet to the centerline of an adjacent track, that track shall be considered as being obstructed. Insofar as possible, all operations shall be conducted no less than this distance. Operations closer than 15 feet to the centerline of a track shall be conducted only with the permission of, and as directed by, a duly qualified railroad employee present at the site of the work. [The contractor shall erect a temporary fence, or other barrier, 15 feet from the centerline of near track as directed by the Chief Engineer or his authorized representative].
- M. Crossing of tracks at grade by equipment and personnel is prohibited except by prior arrangement with, and as directed by, the Railroad's Chief Engineer.
- N. All tunneling, jacking and boring operations within Railroad influence lines (see Plate II) will be done continuously on a 24 hour/day basis, until the operation is completed to minimize Railroad exposure to construction hazards.

1.06 COORDINATION

- A. The Applicant shall coordinate his work with his contractors, sub-contractors, utility companies, governmental units, Amtrak, and any other affected railroads or transit authorities with regard to site access, establishment and use of temporary facilities, work schedules, and other elements of the specified work which require interfacing with others.

1.07 LAYOUT OF WORK

- A. The Applicant shall lay out his work true to lines and grades indicated on the drawings and shall be responsible for all measurements in connection therewith. The Applicant will be held responsible for the execution of the work to such lines and grades indicated on the approved construction Drawings or such other lines and grades as may be directed or established by the Chief Engineer.

1.08 INDEMNIFICATION

- A. The Applicant shall indemnify and hold harmless Amtrak, its officers, employees, agents, successors and assigns, regardless of any negligence on their part, from and against any and all loss, damage, claims, demands, action, suits at law or in equity judgements, liability or expenses, including attorneys' fees, for damages for personal injury, including death, to any person whatsoever, and for damage to property of any person whatsoever, including loss or destruction or loss of use thereof, arising out of any accident or occurrence, howsoever caused, directly or indirectly, in the course of or as a consequence of work performed by the Applicant, its officers, employees, agents, contractors or subcontractors. If any part of this section shall be held unlawful, invalid or unenforceable, that part shall be deemed deleted and without prejudice to the lawfulness, validity and enforceability of the remaining parts hereof.
- B. In any and all claims against Amtrak or any of its officers or employees by any employee of the Applicant, any contractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification obligation under this action shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the Applicant or any contractor under workmen's compensation acts, disability benefit acts or other employee benefit acts.

1.09 INSURANCE

- A. Before being permitted to start work, applicant must provide satisfactory evidence of minimum financial responsibility to Amtrak's Tax and Insurance Office, or other designated office, with regard to financially protecting Amtrak during construction operations.
- B. Refer to PLATE VIII of these Specifications for information with regard to Amtrak's Insurance Requirements.

1.10 SCIENTIFIC OR HISTORIC ARTIFACTS

- A. The Applicant shall immediately notify the Chief Engineer of discovery of scientific or historical artifacts and shall protect same until identified and removed by the appropriate authorities exercising jurisdiction.

1.11 RECORD DOCUMENTS

- A. The Applicant shall furnish Amtrak with one reproducible copy of each approved Construction Drawing, marked to indicate all changes and deviations from same and annotated as "As Built" and dated and signed by applicant.
- B. All project record documents shall be received and accepted by Amtrak prior to or at the final inspection.

* * END OF SECTION * *

SECTION 01300 SUBMITTALS

1.01 APPLICATION FOR OCCUPANCY

- A. Individuals, Corporations and Municipalities (referred to as the "Applicant") desiring occupancy of railroad property by such pipe line occupations will be required, upon approval of the construction details by the Chief Engineer, to execute an appropriate occupational agreement and pay any required fees and/or rentals outlined therein.
- B. Application for an occupancy shall be by letter addressed to the Manager Pipe & Wire Agreements, Real Estate Department - National Railroad Passenger Corporation, 400 North Capitol Street, N.W., Washington, D.C. 20001, (cc: to Senior Director, Engineering Construction, 6th Floor, 2000 Market Street, Philadelphia, PA 19103). The Application letter shall include:
 - 1. Name of Individual, Corporation or Municipality desiring the occupancy.
 - 2. Complete mailing address of applicant.
 - 3. Name and title of person who will sign the agreement.
 - 4. The State in which the applicant is incorporated, if applicable.
- C. All applications shall be accompanied with eight (8) copies of all proposed construction plans and three (3) copies of specifications and computations concerning the proposed occupancy.

1.02 SUBMISSION OF CONSTRUCTION PLANS AND SPECIFICATIONS

- A. Plans for proposed pipeline occupations shall be submitted to and meet the approval of the Chief Engineer prior to start of construction. These plans are to be prepared in sizes as small as possible and are to be folded to an 8-1/2 inch by 11-inch size (folded dimensions) with a 1-1/2 inch margin on the left hand side and a 1-inch margin on the top so that they can be secured in a file at the upper left hand corner and still be unfolded to full size without being removed from the file.
 - 1. After folding, the title block and other identification of the plans shall be visible at the lower right hand corner. Each plan shall bear an individual identifying number and an original date, together with subsequent revision dates, clearly identified on the plan so as to be readily apparent as to just what revisions were made and when.

2. All plans are to be individually folded and where more than one plan is involved, they shall be assembled into complete sets before submission to the Railroad. Plans that are approved must include the Railroad File Number assigned by the Railroad.
- B. Draw plan to scale and show the following (see attached Plates I, II, III, & IV).
1. Plan view of proposed pipeline in relation to all Railroad facilities including in electrified territory, catenary pole foundations and guy anchors. The C&S Duct Line and other underground facilities shall be located by the applicant by hand excavation in the presence of a designated Railroad employee. (see Plates I, II & III).
 2. Location of pipe (in feet) from nearest Railroad milepost, centerline of a Railroad bridge (giving bridge number), or centerline of an existing or former passenger station. In all cases, the name of the County in which the proposed facilities are located must be shown. In States where Townships, Ranges, and Sections are used, give distance in feet to the nearest Section line and identify the Section number, Township and Range.
 3. Profile of ground on centerline of pipe from field survey showing relationship of pipe and casing to ground level, tracks and other facilities (see Plate II). For longitudinal occupations, the profile of adjacent track or tracks must be shown (see Plate III).
 4. All Railroad property lines. If pipeline is in a public highway, the limits of the right-of-way for the highway shall be clearly indicated with dimensions from centerline of the highway.
 5. The angle of crossings in relation to centerline of tracks.
 6. Location of valves or control stations of the pipeline.
 7. Complete "Pipe Crossing Data Sheet", (Plate IV), and put on plan.
- C. The plan must be specific (both on Railroad property and under tracks that are not on Railroad property) as to:
1. Method of installations (see Section 02862).
 2. Size and material of casing pipe.
 3. Size and material of carrier pipe.

- D. The three (3) required items specified in paragraph "C" above shall not have an alternative. Any application received indicating such options will not be processed. Once an application is approved by the Chief Engineer., no variance from the plans, specifications, method of construction, etc., as approved in the occupancy document will be considered or permitted without the imposition by the Railroad of additional handling charges.
- E. Location and dimensions of jacking, boring, or tunneling pits shall be shown with details of their sheeting and shoring. If the bottom of the pit excavation nearest the adjacent track intersects a line from a point 4.5 feet horizontally from center line of adjacent track at the plane of the base of rail drawn on a slope of 1-1/2 horizontal to 1 vertical; submit design and details of the pit construction to the Railroad for approval, complete with computations prepared by a Registered Professional Engineer. In any event, the face of the pit shall be no less than 25 feet from adjacent track, unless otherwise approved by the Chief Engineer. Pits shall be fenced, lighted, and otherwise protected as directed by the Chief Engineer.
- F. All plans and computations, including plans and computations submitted by contractors, shall bear the seal of a Registered Professional Engineer licensed in the state in which the work is being performed. If not so imprinted, they will be given no further consideration.
- G. Computations for all structures involving the support or protection of Railroad track, embankment and facilities shall be prepared by and bear the seal of a Registered Professional Engineer licensed in the state in which the work is being performed and shall be submitted with the construction plans.
- H. When computer calculations are included with design calculations the following documentation shall be furnished as a minimum:
 - 1. A synopsis of the computer program(s) stating briefly required input, method of solution, approximations used, second order analysis incorporated, specifications or codes used, cases considered, output generated, extent of previous usage or certification of program(s) and program(s) author.
 - 2. Identification by number, indexing and cross referencing of all calculation sheets, including supplemental "long-hand" calculation sheets.
 - 3. Fully identified, dimensioned, and annotated diagram of each member or structure being considered.

4. Clear identification and printing of all input and output values, including intermediate values if such values are necessary for orderly review.
 5. Identification of the processing unit, input/output devices, storage requirements, etc., if such supplemental information is significant and necessary for evaluation of the submittal.
- I. Specifications shall conform to Construction Specifications Institute (CSI) 16 Division, 3-part Section Format.
 - J. If other than American Railway Engineering Association (AREA), American Society for Testing and Materials (ASTM), or American National Standards Institute (ANSI) specifications are referred to for design, materials or workmanship on the construction plans and specifications for the work, then copies of the applicable sections of such other specifications referred to shall accompany the construction plans and specifications for the work.

* * END OF SECTION * *

SECTION 01500 TEMPORARY FACILITIES AND CONTROLS

1.01 REQUIREMENTS OF REGULATORY AGENCIES

Applicant shall:

- A. Obtain and pay all costs for all permits as required for installation and maintenance of temporary facilities and controls. Applicant shall maintain such permits in force throughout duration of use or requirement for item for which each permit was obtained.
- B. Comply with all applicable Federal, State and local codes, regulations and ordinances and those of American Railroad Engineering Association.
- C. Comply with regulations and requirements of all utility or service companies from which temporary utilities or services are obtained, and pay all costs incurred therewith.

1.02 INSTALLATION AND COORDINATION-GENERAL

Applicant shall:

- A. Install all temporary facilities and controls in a neat and orderly manner.
- B. Make structurally and functionally sound throughout.
- C. Construct temporary facilities and controls to give continuous service and to provide safe working conditions.
 - 1. Enforce conformance with applicable standards.
 - 2. Enforce safe practices.
- D. Modify, extend or relocate temporary facilities and controls as work progress requires.
- E. Locate temporary facilities and controls to avoid interference with, or hazards to:
 - 1. Work or movement of railroad personnel or traffic.
 - 2. Vehicular traffic.
 - 3. General Public.
 - 4. Work of other contractors.
- F. Obtain easements as may be required across non-Amtrak property, and pay all costs (if any) in connection therewith.
- G. Materials for temporary facilities and controls must be adequate for the purpose intended and shall not violate requirements of applicable codes and shall not create unsafe conditions, and must be approved by the Chief Engineer.

1.04 SANITARY FACILITIES

- A. Prior to starting the work, the Applicant shall furnish for use of his contractors and the work, necessary toilet conveniences, secluded from public observation. They shall be kept in a clean and sanitary condition and comply with the requirements and regulations of the area in which the work is performed.

1.05 LIGHT AND POWER

- A. Applicant shall make his own arrangements for obtaining temporary light and power as required for the work, and shall maintain such temporary facilities in a proper and safe condition, including compliance with applicable codes.

1.06 TEMPORARY WATER

- A. Applicant shall make his own arrangements for obtaining all temporary water service as required for the Work.

1.07 TEMPORARY TRAFFIC CONTROLS

- A. Applicant shall cooperate with the directives of the Chief Engineer regarding vehicular traffic control, and provide any temporary controls or devices required to eliminate or minimize congestion or obstruction of vehicular traffic caused by the work, including use of designated routes of ingress and egress from the work area.

1.08 TEMPORARY WORK AND STORAGE AREAS

- A. The areas designated by the Chief Engineer as the Temporary Parking, Work and Storage Area(s) will be provided to the Applicant in accordance with the terms of the Occupancy Agreement. Additional space, if required, shall be obtained by the Applicant at no cost to Amtrak.
- B. All designated temporary parking, work and storage areas used by the Applicant shall be restored to their original condition prior to completion of the Work, unless specifically waived by the Chief Engineer.

1.09 POLLUTION ABATEMENT CONTROLS

- A. Conduct operations in a manner to minimize pollution of the environment surrounding the area of work by every means possible. Specific controls shall be provided as follows:
 - 1. Vehicles: All vehicles and material transport trucks leaving the site and entering paved public streets shall be cleaned of mud and dirt clinging to the body and wheels of the vehicle. Trucks arriving at or leaving the site with materials shall be loaded in a

manner which will prevent dropping of materials or debris on the streets. Spills of materials in public areas shall be removed immediately at no cost to the Railroad.

2. Waste Materials: No waste or erosion materials shall be allowed to enter natural or man-made water or sewage removal systems. Erosion materials from excavations, borrow areas or stockpiled fill shall be contained within the work area. The Applicant shall develop methods for control of waste and erosion which shall include such means as filtration, settlement and manual removal to satisfy the above requirements. Do not dispose of machinery lubricants, fuels, coolants, and solvents on the site.
 3. Burning: No burning of waste shall be allowed without prior written permission. In cases where permission is granted, burning shall be conducted in accordance with the regulations of the appropriate Jurisdictional Agency.
 4. Dust Control: The Applicant shall at all times control the generation of dust by his operations. Control of dust is mandatory and shall be accomplished by water sprinkling or by other methods approved by the Chief Engineer.
 5. Noise Control: The Applicant shall take every action possible to minimize the noise caused by his operation. When required by agencies having jurisdiction, noise producing work shall be performed in less sensitive hours of the day or week as directed by the Chief Engineer or as required by local ordinance.
- B. For all piping carrying non-potable liquids, gases or other pollutants, submit a program for pollution control to the Chief Engineer for his approval prior to beginning operations.

1.10 PROTECTION OF PERSONS AND PROPERTY

A. Safety Requirements

1. The Applicant shall be responsible for ensuring that the most stringent provisions of the applicable statutes and regulations of the political subdivision in which the work is being performed, and the Department of Labor-Occupational Safety, Health Administration provisions, pertaining to the safe performance of the work are observed and further, that the methods of performing the work do not involve undue

danger to the personnel employed thereon, railroad employees, the public, or to public and private property. Should charges of violation of any of the above be issued to the Applicant in the course of the work, a copy of each charge shall immediately be forwarded to the Chief Engineer. The Applicant shall immediately take corrective action to remedy the complaint and shall pay all fines and penalties levied against him.

2. The Applicant shall erect and maintain, as required by existing conditions and progress of the work, all reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent utilities.
- B. Safety of Persons and Property - The Applicant shall take all reasonable precautions for the safety of, and shall provide all reasonable protection to prevent damage, injury or loss to:
1. All employees on the Work and all other persons who may be affected thereby.
 2. All the Work and all materials and equipment to be incorporated therein, whether in storage on or off the site, under the care, custody or control of the Contractor or any tier of sub-contractor associated with the Project.
 3. Other property at the site or adjacent thereto, including walks, pavements, roadways, structures, and utilities not designated for removal, relocation or replacement in the course of construction. Any damage to such items shall be restored to original condition by the Applicant at no cost to the Railroad.
- C. First Aid
1. Maintain adequate first aid supplies at the site as prescribed by Federal, State, or Local codes and regulation.
- D. Use of Explosives
1. The use of explosives will not be permitted.
- E. Site Security
1. Maintain a secure work site protecting the Railroad's interests and property from claims arising from trespass, theft and vandalism.
 2. The Applicant shall permit access to the site only to his employees or contractors working on the site and to those persons having business with the Applicant related to the Work or to others as may be authorized by the Chief Engineer.

3. The Applicant shall provide such security measures as he may require to protect his tools, equipment and property and that of his subcontractors (if any) from damage, theft or vandalism.

1.11 VERMIN CONTROL

- A. Do not permit food scraps, lunch bags, food wrappers or other items which would attract rats or other vermin to be left laying around the site. Deposit such items in closed, rat-proof metal containers for disposal on a regular basis.

1.12 RUBBISH AND DEBRIS REMOVAL

- A. Neatly pile rubbish and debris resulting from the Work in a single location on the site and remove from this location at least once a week and legally disposes of same off the site. Remove on a more frequent basis if such rubbish or debris interferes with railroad activities, the work of others or creates a fire or safety hazard.
- B. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains or upon the site.
- C. Do not dispose of wastes into streams or waterways.

* * END OF SECTION * *

SECTION 02860 PIPELINE OCCUPANCY GENERAL CRITERIA

1.01 GENERAL REQUIREMENTS

- A. Pipelines under Railroad tracks and across Railroad operating right-of-way shall be encased in a larger pipe or conduit called the casing pipe as indicated in Plate II.
- B. Casing pipe will be required for all pipelines carrying oil, gas, petroleum products, or other flammable or highly volatile substances under pressure, and all non-flammable substances which, from their nature or pressure, as determined by the Chief Engineer, might cause damage if escaping on, under, over, or near Railroad property.
- C. For non-pressure sewer or drainage crossings where the installation can be made without interference to Railroad operations, as determined by the Chief Engineer, the casing pipe may be omitted when the pipe strength is capable of withstanding Railroad loading hereinafter specified.
- D. The casing pipe shall be laid across the entire width of the right-of-way. Casing pipe shall extend beyond the right-of-way when the right-of-way line on either side of the tracks is less than the minimum length of casing specified in Section 02862, Para. 1.02-E.
- E. Pipelines laid longitudinally on railroad right-of-way shall be located as far as practicable from any tracks or other important structures and as close to the Railroad property line as possible. If located within 25 feet of the centerline of any track or closer than 45 feet to nearest point of any bridge, building or other important structure, the carrier pipe shall be encased (see also Section 02862 Para. 3.01 and Plate III).
- F. Pipelines shall be located, where practicable, to cross tracks at approximate right angles thereto, but preferably at not less than 45 degrees.
- G. Pipelines shall not be placed within a culvert, under Railroad bridges, nor closer than 45 feet to any portion of any Railroad bridge, building, or other important structure, except in special cases, and then by special design, as approved by the Chief Engineer.
- H. Pipelines carrying liquified petroleum gas shall, where practicable, cross the Railroad where tracks are carried on embankment.
- I. Any replacement or modification of an existing carrier pipe and/or casing shall be considered a new installation, subject to the requirements of these Specifications.

- J. Where laws or orders of public authority prescribe a higher degree of protection than specified herein, then the higher degree so prescribed shall be deemed a part of these specifications.
- K. Pipelines and casings shall be suitably insulated from underground conduits carrying electric wires on Railroad property.

1.02 INSPECTION AND TESTING

- A. For pipelines carrying flammable or hazardous materials ANSI Codes B 31.8 and B 31.4, current at time of constructing the pipeline, shall govern the inspection and testing of the facility on Railroad property, except that proof-testing of strength of carrier pipe shall be in accordance with the requirements of ANSI Code B 31.8 for location Classes 2, 3, or 4 or ANSI Code B 31.4, as applicable, for all pipelines carrying oil, liquified petroleum gas, natural or manufactured gas, and other flammable substances.

1.03 CATHODIC PROTECTION

- A. Cathodic protection shall be applied to all pipelines and casings carrying flammable substances.
- B. Where casing and/or carrier pipe is cathodically protected by other than anodes, the Chief Engineer shall be notified and suitable test shall be made, witnessed by the Railroad to insure that other Railroad structures and facilities are adequately protected from the cathodic current in accordance with the recommendations of Reports of Correlating Committee on Cathodic Protection, current issue by the National Association of Corrosion Engineers.

1.04 SOIL INVESTIGATIONS

- A. For all pipe crossings 36 inches in diameter and larger under tracks, and at other locations, the Chief Engineer will require soil borings, or other soil investigations be made to determine the nature of the underlying material. The location and method of soil boring or other soil investigations must be submitted to the railroad for approval. (See Section 01100 and 01300 relative to Procedures)
- B. For pipe crossings less than 36 inches in diameter under tracks, and at other locations, as the Chief Engineer may require soil borings or other approved investigations may be required when, in the judgment of the Chief Engineer, they are necessary to determine the adequacy of the design and construction of the facilities. The location and method of soil boring or other soil investigations must be submitted to the railroad for approval.

- C. Borings shall be made on each side of the tracks, on the centerline of the pipe crossing, and as close to the tracks as practicable. (See Sections 01100 and 01300 relative to Procedures)
- D. Soil borings shall be in accordance with the current issue of the American Railway Engineering Association Specifications, Chapter 1, Part 1, "Specifications for Test Borings." Soils shall be investigated by the split-spoon and/or thin-walled tube method and rock by the Coring method specified therein, as appropriate.
- E. Soil boring logs shall clearly indicate All of the following:
 - 1. Boring number as shown on boring location plan.
 - 2. Elevation of ground at boring, using same datum as the pipeline construction plans.
 - 3. Description of soil classification of soils and rock encountered.
 - 4. Elevations or depth from surface for each change in strata.
 - 5. Identification of where samples were taken and percentage of recovery.
 - 6. Location of ground water at time of sampling and, if available, subsequent readings.
 - 7. Natural dry density in Lbs./Sq.ft. for all strata.
 - 8. Unconfined compressive strength in Tons/Sq.ft. for all strata.
 - 9. Water content (Percent). Liquid limit (Percent) and Plastic limit (Percent).
 - 10. Standard penetration in Blows/ft.
- F. The location of the carrying pipe and casing shall be superimposed on the Boring logs before submission to the Chief Engineer.
- G. Soil investigation by auger, wash, or rotary drilling methods are not acceptable.
- H. Soil Boring logs shall be accompanied by a plan drawn to scale showing location of borings in relation to the tracks and the proposed pipe location, the elevation of ground surface at each boring, and the elevation of the base of rail of the tracks.

1.05 SUPPORT OF TRACKS

- A. When the jacking, boring or tunneling method of installation is used, and depending upon the sizes and location of the crossings, the existing soil conditions and elevation of ground water, temporary track supporting structures shall be installed at the direction of the Chief Engineer and at the expense of the Applicant.

- B. The type of temporary track supporting structures to be installed shall be approved by the Chief Engineer.
- C. Unless otherwise agreed, all work involving rail, ties and other track material will be performed by the Railroad's employees at the Applicant's expense.
- D. Track supports shall be supplied by the applicant and delivered to a site approved by the Railroad. Provisions for unloading will be provided by the Applicant at no expense to the Railroad. The Applicant will provide necessary labor to handle the material for pre-installation inventory.
- E. Prior to the start of construction the applicant must deliver a stock pile (minimum 10 tons) of approved railroad ballast to an area designated by the railroad at the project site.

1.06 PIPELINES ON BRIDGES

- A. Pipelines carrying flammable substances or non-flammable substances which by their nature might cause damage if escaping on or near railroad facilities or personnel, shall not be installed on bridges over railroad tracks or bridges carrying railroad tracks.
- B. In special cases when it can be demonstrated to the Chief Engineer's satisfaction that such an installation is necessary and that no practicable alternative is available, the Chief Engineer may permit the installation and only by special design approved by him.
- C. Pipelines on bridges shall be so located as to minimize the possibility of damage from vehicles, railroad equipment, vandalism and other external causes. They shall be encased in a casing pipe. Where appropriate, permanent barriers shall be constructed at each end of the bridge to prevent trespassers from crossing the bridge via the pipe casing.

1.07 BONDING AND GROUNDING OF PIPELINES IN ELECTRIFIED TERRITORY

- A. Carrier pipe shall be enclosed in a metal casing that is isolated from carrier pipe by approved insulators having a dielectric value of not less than 25 KV. that provide an air gap between carrier pipe and casing of not less than 2 inches.
- B. Carrier pipe supporting hangers, mountings or cradles shall provide an insulation value of not less than 25 KV. and an air gap of not less than 2 inches between casing and any portion of mounting assembly.
- C. Casing shall be bonded to Railroad's return at each end through bridge steel or direct when girders are of non-conductive material, conforming to Amtrak Drawing E.T.

11200 C (Details for Power Bonding of Structures), and Plate V.

- D. Pipeline may be pre-coated as per the attached H.C. Price Co. "Pritec" Specification revised October 23, 1978 or approved equal (Plate VI).
- E. Pipeline may be field wrapped as per the attached suggested procedures to hand wrap field joints with Servi-wrap P.500 or approved equal. Minimum of two wraps required - see Plate VII.
- F. Fiberglass conduit made by the Ciba - Geigy Corp. known as Dualoy T & D conduit is also acceptable as an isolation means subject to approval of the Chief Engineer.
- G. Any grounding or isolation methods used must have a minimum dielectric value of 25,000 volts.

1.08 ABANDONED PIPELINES AND/OR FACILITIES

- A. For all pipe crossings under track or near other railroad structures, the owner of the pipeline shall notify the Chief Engineer, in writing, of the intention to abandon such pipeline. Upon abandonment, the carrier pipe shall be removed and the casing shall be filled with cement grout, compacted sand or other material as may be approved by the Chief Engineer. If it is impracticable to remove the carrier pipe then the carrier must be filled along with the annular space between the casing and carrier.
- B. Facilities other than pipelines will be removed or altered at abandonment to the satisfaction of the Chief Engineer.

1.09 DRAINAGE

- A. Occupancies shall be designed, and their construction shall be accomplished, so that adequate and uninterrupted drainage of Railroad right-of-way is maintained. If, in the course of construction, it may be necessary to block a ditch, pipe or other drainage facility, the Contractor shall install temporary pipes, ditches or other drainage facilities as required to maintain adequate drainage, as approved by the Chief Engineer. Upon completion of the work, the temporary drainage facilities shall be removed and the permanent facilities restored.
- B. Water may not be pumped or disposed of on Railroad Right of Way unless discharged into an existing drainage facility and providing discharge does not cause erosion.

* * END OF SECTION * *

SECTION 02861 CARRIER PIPE

PART 1 GENERAL

1.01 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Inspection and Testing - Section 02860, Art. 1.02.
- B. Cathodic Protection - Section 02860, Art. 1.03.
- C. Bonding and grounding of pipelines in electrified territory - Section 02860, Art. 1.07.
- D. Casing Pipe - Section 02862, Entire Section.
- E. Miscellaneous General Criteria - Section 02860, Art. 1.01.

1.02 DESIGN CRITERIA

- A. If the maximum allowable stress in the carrier pipe on either side of the occupancy of Railroad property is less than as specified in Section 02860, Art. 1.01 above, the carrier pipe on Railroad property shall be designed at the same stress as the adjacent carrier pipe.
- B. Requirements for carrier pipe under Railroad tracks shall apply for a minimum distance equal to that of the casing pipe as specified in Section 02862.
- C. Carrier pipes within a casing shall be designed according to Railroad Specifications as if they were not encased.
- D. All pipes, ditches and other structures carrying surface drainage on Railroad property and/or crossing under Railroad tracks shall be designed to carry the run-off from a one hundred (100) year storm. Computations indicating this design and suitable topographic plans, prepared by a Registered Professional Engineer, licensed in the state in which the work is being performed shall be submitted to the Chief Engineer for approval. If the drainage is to discharge into an existing drainage channel on or under Railroad right-of-way, an hydraulic analysis of the existing structures must be included. Submit with the computations formal approval of the proposed design by the appropriate governmental agency.

PART 2 PRODUCTS

- 2.01 GENERAL - All pipes shall be designed for the external and internal loads to which they will be subjected. The dead load of earth shall be considered 120 pounds per cubic foot. Railroad live loading shall be Cooper's E-80 with 50% added for impact. In any event on Railroad property or where Railroad loading will be experienced, the following shall be the minimum requirements for carrier pipes:

- A. Reinforced concrete pipe - ASTM Spec. C-76, Class V, Wall C.
- B. Ductile Iron Pipe - ANSI Spec A21.51, Class 6.
- C. Cast Iron Pipe - For Culverts and Gravity Sewers - ASTM Spec. A-716 Extra Heavy.

2.02 OIL AND GAS PIPES

- A. Pipelines carrying oil, liquefied petroleum gas, natural or manufactured gas and other flammable products shall conform to the requirements of the current ANSI B 31.4, with Addenda, Liquefied Petroleum Transportation Piping Systems," ANSI B 31.8, "Gas Transmission and Distribution Piping Systems," and other applicable ANSI Codes, except that the maximum allowable stresses for design of steel pipe shall not exceed the following percentages of the specified minimum yield strength (multiplied by the longitudinal joint factor) of the pipe as defined in the ANSI Codes:
 - 1. Steel pipe within a casing, under Railroad tracks, across Railroad rights-of-way, and longitudinally on Railroad rights-of-way. (The following percentages apply to hoop stress):
 - a. Seventy-two percent for installation on oil pipelines.
 - b. Fifty percent for pipelines carrying liquefied petroleum gas and other flammable liquids with low flash point.
 - c. Sixty percent for installations on gas pipelines.
 - 2. Steel pipe without a casing laid longitudinally on Railroad rights-of-way or on Railroad property. (The following percentages apply to hoop stress):
 - a. Sixty percent for installations on oil pipelines.
 - b. Forty percent for pipelines carrying liquefied petroleum gas and other flammable liquids with low flash point.
- B. Design computations showing compliance with the requirements of Paragraph 2.02 A above, and prepared by a Registered Professional Engineer licensed in the state in which the work is being performed, shall accompany the application for occupancy.

- 2.03 CAST IRON PIPE - for water and other materials under pressure, shall conform to the current ANSI specifications A-21 Series 21/45 Iron strength with plain end, compression type or mechanical joints. The strength to sustain external Railroad and other loadings shall be computed in accordance with the current ANSI A-21.1 "Thickness Design of Cast Iron Pipe".

- 2.04 VITRIFIED CLAY PIPE - ASTM Spec. C-700, Extra Strength.

- 2.05 CORRUGATED METAL PIPE - AREA Spec. Chapter 1, Part 4.
- 2.06 ASBESTOS CEMENT PIPE -
Non-pressure: ASTM Spec. C-428, Cl. 5000 Min.
Pressure: AWWA Spec. C-400, Cl. 150 Min.
- 2.07 OTHER - Other miscellaneous piping not specified above shall be as approved by Chief Engineer.
- 2.08 SHUT-OFF VALVES
- A. Provide accessible emergency shut-off valves at each side of the railroad within distances and at locations as directed by the Chief Engineer.
 - B. Where pipelines are provided with automatic control stations and within distances approved by the Chief Engineer, no additional valves will be required.
- 2.09 SIGNS
- A. Prominently identify all pipelines (except those in streets where it would not be practical to do so) at rights-of-way by durable, weatherproof signs located over the centerline of the pipe. Mark pipelines at undercrossings on both sides of track. Signs shall show the following:
 - 1. Name and address of pipeline Owner.
 - 2. Contents of Pipe.
 - 3. Pressure in Pipe.
 - 4. Depth below grade at point of sign.
 - 5. Emergency telephone in event of pipe rupture.
 - 6. RR File Number.
 - B. For pipelines running longitudinally on Railroad property, place signs over the pipe (or offset) appropriately marked at all changes in direction of the pipeline. Locate such signs so that when standing at one sign, the next adjacent marker in either direction is visible. In no event shall pipeline identification signs be placed more than 500 feet apart, unless otherwise directed by the Chief Engineer.
 - C. Submit details of signs (materials, size, method of support, etc.) to the Chief Engineer for approval with the application.

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PART 3 EXECUTION

3.01 INSTALLATION

- A. Install carrier pipes in accordance with approved Construction Drawings, requirements of this specification, and all applicable codes and ordinances.
- B. Install carrier pipes with sufficient slack so that they are not in tension.

* * END OF SECTION * *

SECTION 02862 CASING PIPE

PART 1 GENERAL

1.01 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Miscellaneous General Criteria - Section 02860.
- B. Carrier Pipe - Section 02861.

1.02 DESIGN CRITERIA

- A. Casing pipe and joints shall be of metal and of leakproof construction.
- B. Casing pipe shall be designed for the earth and/or other pressures present, and for railroad live load. The dead load of earth shall be considered 120 pounds per cubic foot. Railroad live load shall be Cooper E-80 with 50% added for impact.
- C. The inside diameter of the casing pipe shall be such as to allow the carrier pipe to be removed subsequently without disturbing the casing or the roadbed. For steel pipe casings, the inside diameter of the casing pipe shall be at least two (2) inches greater than the largest outside diameter of the carrier pipe joints or couplings, for carrier pipe less than six (6) inches in diameter; and at least four (4) inches greater for carrier pipe six (6) inches and over in diameter.
- D. For flexible casing pipe, a minimum vertical deflection of the casing pipe, of 3% of its diameter plus 1/2 inch, shall be provided so that no loads from the roadbed, track, traffic or casing pipe itself are transmitted to the carrier pipe. When insulators are used on the carrier pipe, the inside diameter of the flexible casing pipe shall be at least two (2) inches greater than the outside diameter of the carrier pipe for pipe less than eight (8) inches in diameter; at least 3-1/4 inches greater for pipe 8 inches to 16 inches, inclusive, in diameter; and at least 4-1/2 inches greater for pipe 18 inches and over in diameter. In no event shall the casing pipe diameter be greater than is necessary to permit the insertion of the carrier pipe.
- E. Casing pipe under Railroad tracks and across Railroad rights-of-way shall extend the GREATER of the following distances, measured at right angles to centerline of track:
 - 1. Across the entire width of Railroad right-of-way (See Section 02860, Paragraph 1.01, D.)
 - 2. Three (3) feet beyond ditch line.
 - 3. Two (2) feet beyond toe of slope.

4. A minimum distance of 25 feet each side from centerline of outside track when casing is sealed at both ends.
5. A minimum distance of 45 feet from centerline of outside track when casing is open at both ends.
6. The distance 1.5 times the depth of invert of casing as indicated on plate II.
- F. If additional tracks are constructed in the future, the casing shall be extended correspondingly at the expense of the Applicant.
- G. Table of Live Loads.

LIVE LOADS, INCLUDING IMPACT, FOR VARIOUS HEIGHTS OF COVER
FOR COOPER E 80

<u>COVER(FT)</u>	<u>LOAD(PSF)</u>	<u>COVER(FT)</u>	<u>LOAD(PSF)</u>	<u>COVER(FT)</u>	<u>LOAD(PSF)</u>
2	3800	10	1100	20	300
5	2400	12	800	30	100
8	1600	15	600		

1.03 PROTECTION AT ENDS OF CASING

- A. Casings for carriers of flammable substances shall be suitably sealed to the outside of the carrier pipe. Details of seals shall be shown on the plans.
- B. Casings for carriers of non-flammable substances shall have both ends of the casing blocked up in such a way as to prevent the entrance of foreign material, but allowing leakage to pass in the event of a carrier break.
- C. Where ends of casings are at or above ground surface and above high water level, they may be left open, provided drainage is afforded in such a manner that leakage will be conducted away from railroad tracks and structures.

1.04 VENTS

- A. Sealed casings for flammable substances shall be properly vented. Vent pipes shall be of sufficient diameter, but in no case less than two (2) inches in diameter, and shall be attached near each end of the casing and project through the ground surface at right-of-way lines or not less than 45 feet (measured at right angles) from centerline of nearest track.
- B. Vent pipes shall extend not less than four (4) feet above the ground surface. Top of vent pipe shall have a down-turned elbow, properly screened, or a relief valve. Vents in locations subject to high water shall be extended above the maximum elevation of high water and shall be supported and protected in a manner approved by the Chief Engineer.

- C. Vent pipes shall be at least four (4) feet (vertically) from aerial electric wires.
- D. When the pipeline is in a public highway, street-type vents shall be installed.

PART 2 PRODUCTS

- 2.01 STEEL PIPE - minimum yield strength of 35,000 psi. Smooth wall pipes with a nominal diameter of over 54 inches will not be permitted. When steel casing pipe is used, the ends shall be beveled with a single V-groove for field welding. Pipe joints shall be butt welded by a certified welder with a full penetration weld on the outside circumference of the pipe. The single V-groove butt weld shall conform to the latest A.W.S. Welding Code.

TABLE OF MINIMUM WALL THICKNESS FOR STEEL CASING PIPE
(for Information Only)

<u>Nominal Thickness-Inches</u>			<u>Nominal Thickness-Inches</u>		
<u>Coated or Cathodically Protected</u>	<u>Uncoated and Un-protected</u>	<u>Nominal Diameter Inches</u>	<u>Coated or Cathodically Protected</u>	<u>Uncoated and Un-protected</u>	<u>Nominal Diameter Inches</u>
0.375	0.375	22&Under	0.469	0.532	34-36
0.375	0.407	24	0.500	0.563	38-42
0.375	0.438	26	0.564	0.626	48
0.406	0.469	28-30	0.625	0.688	54
0.438	0.501	32			

- 2.02 CAST IRON PIPE - may be used for a casing, provided the method of installation is by open trench only. Cast iron pipe shall conform to ATSM Specification A-716, Extra Heavy. The pipe shall be of the mechanical joint type or plain end type with compression type couplings.
- 2.03 CORRUGATED METAL PIPE AND CORRUGATED STRUCTURAL PLATE PIPE - may be used for casing only when emplaced by the open-cut method. Jacking or boring through Railroad embankment is not permitted. Pipe shall be asbestos-bonded, bituminous coated and shall conform to American Railway Engineering Association Specifications Chapter 1, Part 4.
- 2.04 REINFORCED CONCRETE PIPE - shall conform to ASTM Specification C-76, Class V, Wall C. It shall be used only in the open cut and jacking methods of installation.

If concrete pipe is to be jacked into place, it must be smooth wall with grout holes tapped for no smaller than 1-1/2 inch

pipe, spaced at approximately 3 feet around the circumference and approximately 4 feet longitudinally cast into the pipe at manufacture. Immediately upon completion of jacking operations, the installation shall be pressure grouted as specified in Paragraph 3.02, C, 3 below.

- 2.05 TUNNEL LINER PLATES - shall be four flange and otherwise conform to American Railway Engineering Association Specifications Chapter I, Part 4. In no event shall the liner plate thickness be less than 0.1046 inches. Tunnel liner plates are to be used only to maintain a tunnelled opening until the carrier pipe is installed, and after the carrier pipe is installed, the annular space between the carrier and liner must be filled with 1:6 cement grout or lined with 6 inches of concrete, reinforced with 6x6-6/6 wire mesh for tunnels up to 108 inches in diameter. Required thickness of lining for larger tunnels will be determined by span and structural analysis. Manufacturer's Shop Detail plans and manufacturer's computations showing the ability of the tunnel liner plates to resist the jacking stresses shall be submitted to the Chief Engineer for approval.

PART 3 EXECUTION

3.01 DEPTH OF INSTALLATION

- A. Casing pipe under Railroad tracks and across Railroad rights-of-way shall be not less than 5-1/2 feet from base of rail to top of casing at its closest point, except that under secondary or industrial tracks this distance may be 4-1/2 feet as approved by the Chief Engineer. On other portions of rights-of-way where casing is not directly beneath any track, the depth from ground surface or from bottom of ditches to top of casing shall be not less than three (3) feet, unless otherwise specified herein.
- B. Pipelines laid longitudinally on Railroad rights-of-way 50 feet or less from centerline of track, shall be buried not less than five (5) feet from ground surface to top of pipe for pipelines carrying oil, gas, petroleum products, or other flammable or highly volatile substances under pressure and all non-flammable substances which by their nature or pressure in the judgment of the Chief Engineer may be hazardous to life or property. For pipelines carrying water, sewage and non-flammable substances, the distance from surface of ground to top of pipe may be four (4) feet. Pipelines should be a minimum of three (3) feet from existing ditches and C&S duct lines.
- C. Pipelines are considered to be subject to Railroad loading and shall require a casing or be of special design approved by the Chief Engineer when within the line of track live load influence as shown on Plate III.

- D. Where pipeline is laid more than 50 feet from centerline of track, the minimum cover shall be at least three (3) feet.

3.02 CONSTRUCTION

- A. Casing pipe shall be so constructed as to prevent leakage of any substance from the casing throughout its length, except at ends of casing where ends are left open, or through vent pipes when ends of casing are sealed. Casing shall be installed so as to prevent the formation of a waterway under the Railroad, and with an even bearing throughout its length, and shall slope to one end (except for longitudinal occupancy).
- B. Installations by open trench method will be permitted only with the approval of the Chief Engineer and Division General Superintendent and shall comply with American Railway Engineering Association Specifications, Chapter 1, Part 4, "Installation of Pipe Culverts".
- C. Installation of casing pipe will be performed only by contractors who have demonstrated to the satisfaction of the Chief Engineer that they have had previous successful experience with casing installations by the method chosen. Casing pipes shall be installed by one of the following methods:
1. Jacking
 - a. This method shall be in accordance with American Railway Engineering Association Specifications, Chapter 1, Part, "Jacking Culvert Pipe through Fills." This operation shall be conducted without handmining ahead of the pipe and without the use of any type of boring, auguring, or drilling equipment.
 - b. Bracing and backstops shall be so designed, and jacks of sufficient rating used, so that the jacking can be progressed without stoppage (except for adding lengths of pipe) until the leading edge of the pipe reaches the location where the invert elevation intersects the Track Live Load Influence Line as shown on Plate II and as described in Section 01300., para. 1.02-E.
 - c. During jacking, an earth plug 1.5 times the diameter of casing is to be maintained at all times. Unless otherwise approved by the Chief Engineer, jacking operations shall be conducted continuously on a 24 hour a day basis until the jacking operations are completed.
 2. Drilling - This method employs the use of an oil field type rock roller bit or a plate bit made up of individual roller cutter units which is solidly welded

to the pipe casing being installed and which is turned as it is advanced. The pipe is turned for its entire length from the drilling machine through to the ground being drilled. A high density slurry (oil field drilling mud) is injected through a small supply line to the head which acts as a cutter lubricant. This slurry is injected at the rear of the cutter units to prevent any jetting action ahead of the pipe. The drilling machine runs on a set of steel rails and is advanced (thus advancing the pipe) by a set of hydraulic jacks. The method is the same whether earth or rock is being drilled. Methods of similar nature shall be submitted to the Chief Engineer for approval. Unless otherwise approved by the Chief Engineer, drilling operations shall be conducted continuously on a 24 hour a day basis until the drilling operations are completed.

3. Tunneling

- a. Tunneling operations shall be conducted as approved by the Chief Engineer. Care shall be exercised in trimming the surface of the excavated section in order that the steel liner plates fit snugly against undisturbed material. Excavation shall not be advanced ahead of the previously installed liner plates any more than is necessary for the installation of the succeeding liner plate. The vertical face of the excavation shall be supported as necessary to prevent sloughing. At any interruption of the tunneling operation, the heading shall be completely bulkheaded. Unless otherwise approved by the Chief Engineer, the tunneling shall be conducted continuously, on a 24-hour basis until the tunnel liners extend at least the distance 1.5 times the depth of invert from end of tie of last track.
- b. While driving tunnel, tight breasting must be maintained on the upper 180° of the face and, depending on soil conditions, the lower 180°. On any shutdowns (under or beyond railroad influence line, see plate II), the entire face will be fully breasted and packed with hay.
- c. The tail void shall be filled with pea gravel (or other approved material) simultaneously with each advancement of the shield.
- d. An ample supply of hay and/or sand bags must be kept at the site to fill any voids caused by the removal of large stones or other obstructions extending outside the shield.

- e. A uniform mixture of 1:6 cement grout shall be placed under pressure behind the liner plates, in addition to the previously placed pea gravel. Grout holes, tapped for no less than 1-1/2 inch pipe and spaced 3 feet ± around the tunnel liner, shall be placed in every other ring, or an equal number of grout plugs evenly spaced in every ring. Grouting shall start at the lowest hole and proceed upwards. A threaded plug shall be installed in each grout hole as the grouting is completed at that hole.
 - f. Grouting shall be kept as close to the heading as possible, using grout stops behind the liner plates, if necessary. Grouting shall proceed as directed by the Chief Engineer, but must be executed at a minimum of every 24 hours and in no event shall more than six lineal feet of tunnel be progressed beyond the grouting.
4. Tunneling Shields
- a. All pipes 60 inches and larger in diameter shall be emplaced with the use of a tunneling shield, unless otherwise approved by the Chief Engineer. Pipes of smaller diameter may also require a shield when, at the sole discretion of the Chief Engineer, soil or other conditions indicate its need.
 - b. The shield shall be of steel construction, designed to support railroad track loading as specified in Paragraph 1.02 B herein, in addition to other loadings it must sustain. The advancing face shall be provided with a hood, extending no less than 20 inches beyond the face and extending around no less than the upper 240° of the total circumference. Installations made with liner plates shall be provided with a full 360° shield. It shall be of sufficient length to permit the installation of at least one complete ring of liner plates within the shield before it is advanced for the installation of the next ring of liner plates. The annular space between the inside diameter of the tail section of the shield and the outside diameter of the tunnel liner or pipe must not exceed 1" around the periphery.
 - c. It shall be adequately braced and provided with necessary appurtenances for completely bulkheading the face with horizontal breastboards, and arranged so that the excavation can be benched as may be necessary. Excavation shall not be advanced beyond the edge of the hood, except in rock.

- d. Manufacturer's Shop Detail plans and manufacturer's computations showing the ability of the tunnel liner plates to resist the jacking stresses shall be submitted to the Chief Engineer for approval.
 - e. For jacking reinforced concrete pipe, the shield shall be fabricated as a special section of reinforced concrete pipe with the steel cutting edge, hood, breasting attachments, etc., cast into the pipe. The wall thickness and reinforcing shall be designed for the jacking stresses.
 - f. Grout holes tapped for no less than 1-1/2 inch pipe, spaced at approximately 3 feet centers around the circumference of the shield (or the aforementioned special reinforced concrete section) and no more than 4 feet centers longitudinally shall be provided.
 - g. Detail plans sufficient to determine the adequacy of the Shield, accompanied with design calculations prepared by a Registered Professional Engineer, shall be submitted to the Chief Engineer for approval and no work shall proceed until such approval is obtained.
5. Boring.
- a. This method consists of pushing the pipe into the fill with a boring auger rotating within the pipe to remove the spoil. When augers, or similar devices, are used for pipe emplacement, the front of the pipe shall be provided with mechanical arrangements or devices that will positively prevent the auger from leading the pipe so that there will be no unsupported excavation ahead of the pipe. The auger and cutting head arrangement shall be removable from within the pipe in the event an obstruction is encountered. The over-cut by the cutting head shall not exceed the outside diameter of the pipe by more than one-half inch. The face of the cutting head shall be arranged to provide reasonable obstruction to the free flow of soft or poor material.
 - b. The use of water or other liquids to facilitate casing emplacement and/or spoil removal is prohibited.
 - c. Plans and descriptions of the auger stop arrangement to be used shall be submitted to the Chief Engineer for approval, and no work shall proceed until such approval is obtained and the arrangement is inspected in the field by the Railroad.

WORK STARTED PRIOR TO THIS INSPECTION WILL BE
HALTED AND THE INSTALLED CASING ABANDONED
IN PLACE IN ACCORDANCE WITH SECTION
02860, PARAGRAPH 1.08

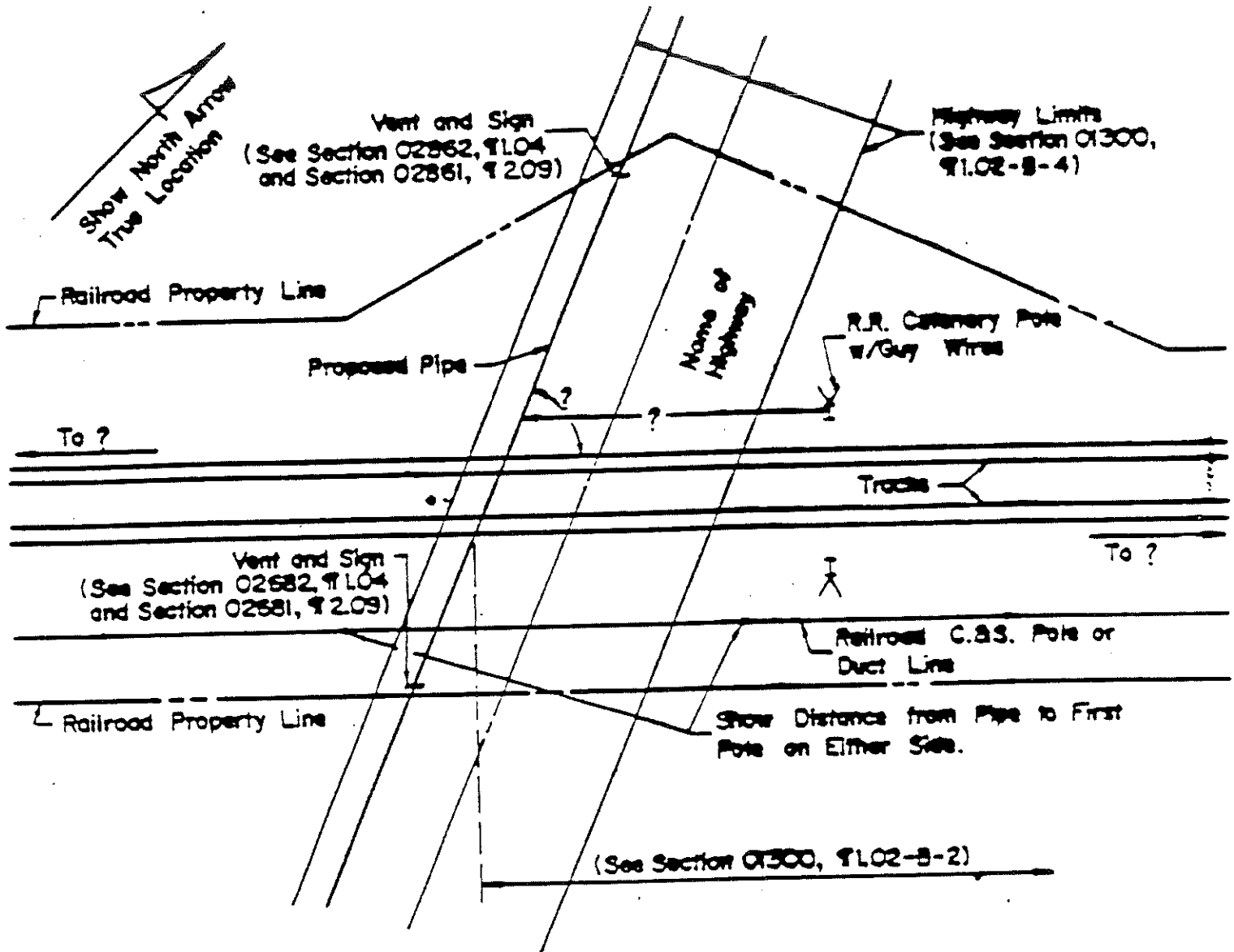
- d. Any method which employs simultaneous boring and jacking or drilling and jacking for pipes over 8 inches in diameter which does not have the above arrangement WILL NOT BE PERMITTED. For pipes 8 inches and less in diameter, augering or boring without this arrangement may be considered for use only as approved by the Chief Engineer.
- D. If an obstruction is encountered during installation to stop the forward action of the pipe, and it becomes evident that it is impossible to advance the pipe, operations will cease and the pipe shall be abandoned in place and filled completely with grout.
- E. Bored or jacked installations shall have a bored hole essentially the same as the outside diameter of the pipe plus the thickness of the protective coating. If voids should develop or if the bored hole diameter is greater than the outside diameter of the pipe (plus coating) by more than approximately 1 inch, grouting or other methods approved by the Chief Engineer shall be employed to fill such voids.
- F. Pressure grouting of the soils or freezing of the soils before or during jacking, boring, or tunneling may be required at the direction of the Chief Engineer to stabilize the soils, control water, prevent loss of material and prevent settlement or displacement of embankment and/or tracks. Grout shall be cement, chemical or other special injection material selected to accomplish the necessary stabilization. The Grouting Contractor shall be a specialist in the field with a minimum of five (5) continuous years experience of successfully grouting soils.
- G. The materials to be used and the method of injection shall be prepared by a Registered Professional Soils Engineer, or by an experienced and qualified company specializing in this work and submitted for approval to the Chief Engineer before the start of work. Proof of experience and competency shall accompany the submission.
- H. When water is known or expected to be encountered, pumps of sufficient capacity to handle the flow shall be maintained at the site and, upon approval of the Chief Engineer to operate them, they shall be in constantly attended operation on a 24-hour basis until, in the sole judgment of the Chief Engineer, their operation can be safely halted. When dewatering, close

observation shall be maintained to detect any settlement or displacement or railroad embankment, tracks, and facilities.

- I. The dewatering system shall lower and maintain the ground water level a minimum of two (2) feet below the invert at all times during construction by utilizing well points, vacuum well points, or deep wells to prevent the inflow of water or water and soil into the heading. Ground water observation wells may be required to demonstrate that the dewatering requirements are being complied with.
- J. Proposed methods of dewatering must be submitted to the Chief Engineer for approval prior to implementation. The discharge from the dewatering operations in the vicinity of the Railroad shall be carefully monitored, and if in the opinion of the Chief Engineer, there is an excessive loss of fine soil particles at any time during the dewatering process, the dewatering will be halted immediately. The dewatering operation cannot resume until the unsatisfactory condition is remedied to the satisfaction of the Chief Engineer.

* * END OF SECTION * *

INFORMATION TO BE SHOWN ON PLAN SECTION OF DRAWING



NOTE:

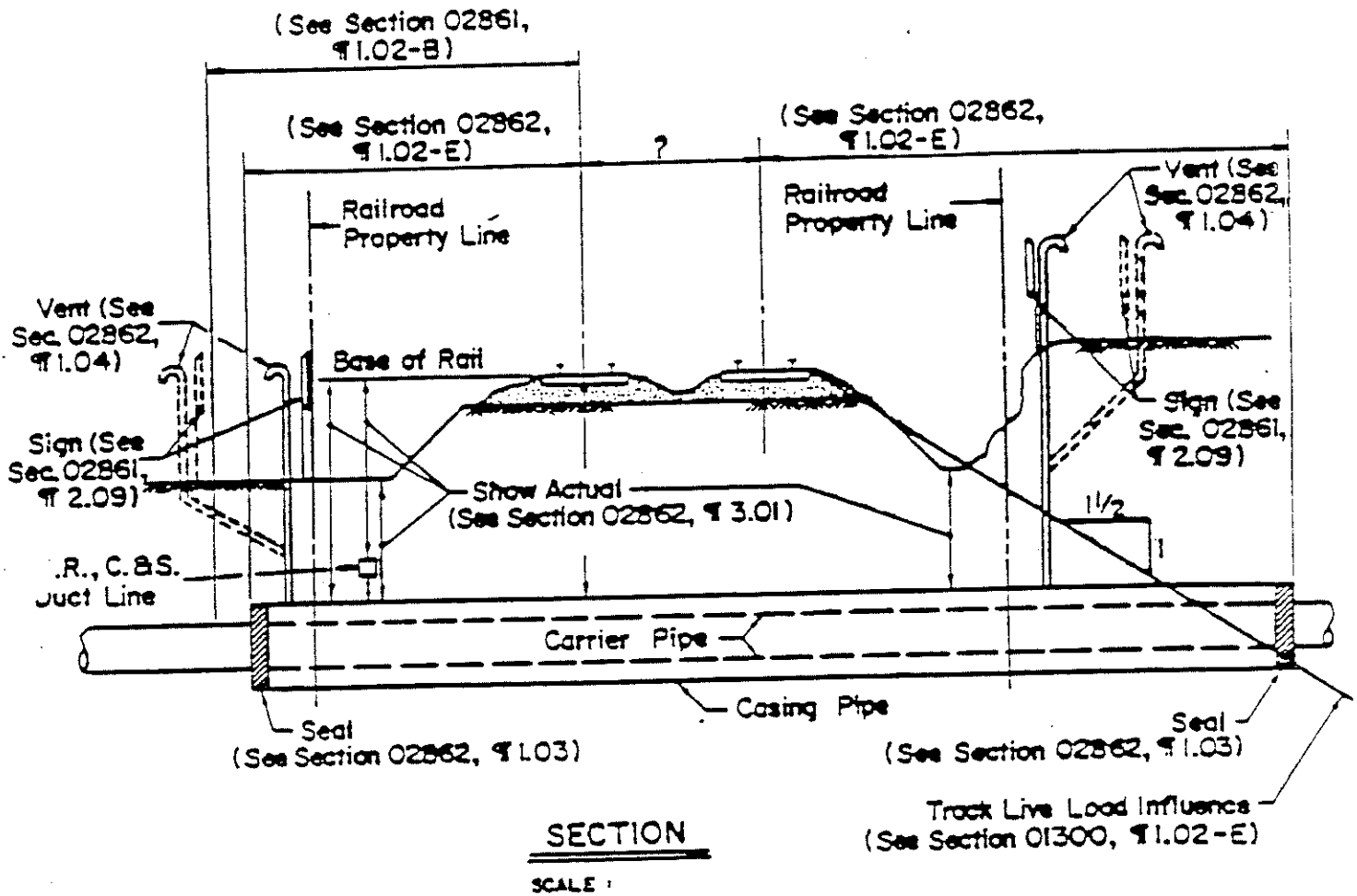
If Manholes are Placed on Railroad Property, Details of same, with Clearances to near Raits are to be shown on the Drawings.

If the Proposed Pipe is to serve a new Development, a Map showing the Area in Relation to Established Areas and Roads is to be sent with the Request.

If the Proposed Pipe is not wholly within Highway Limits, the same Information is Requires shown on this Plate.

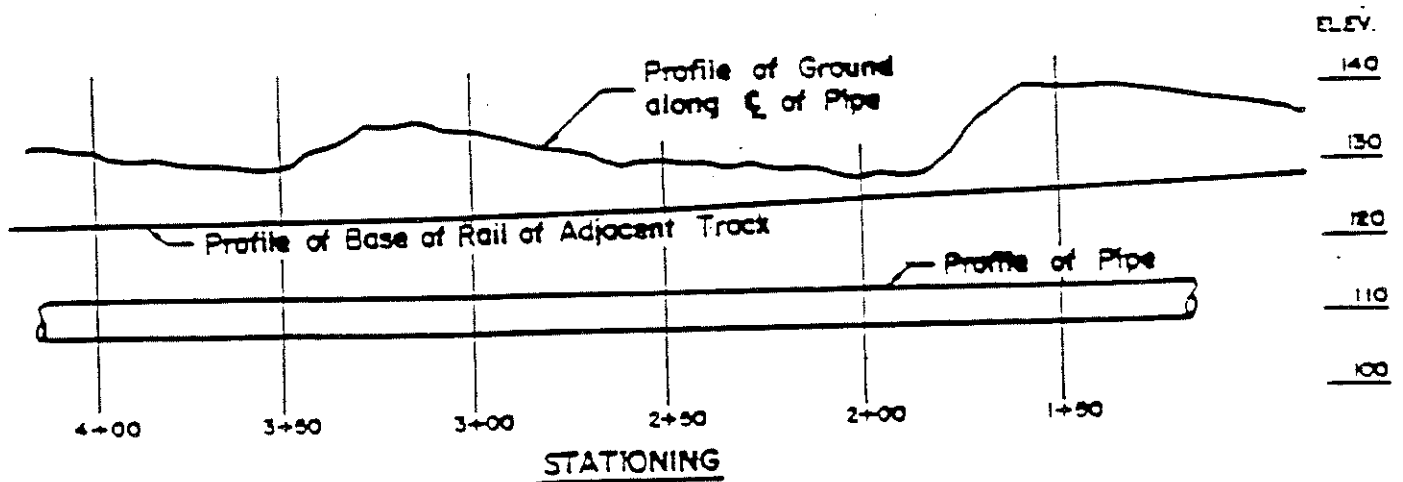
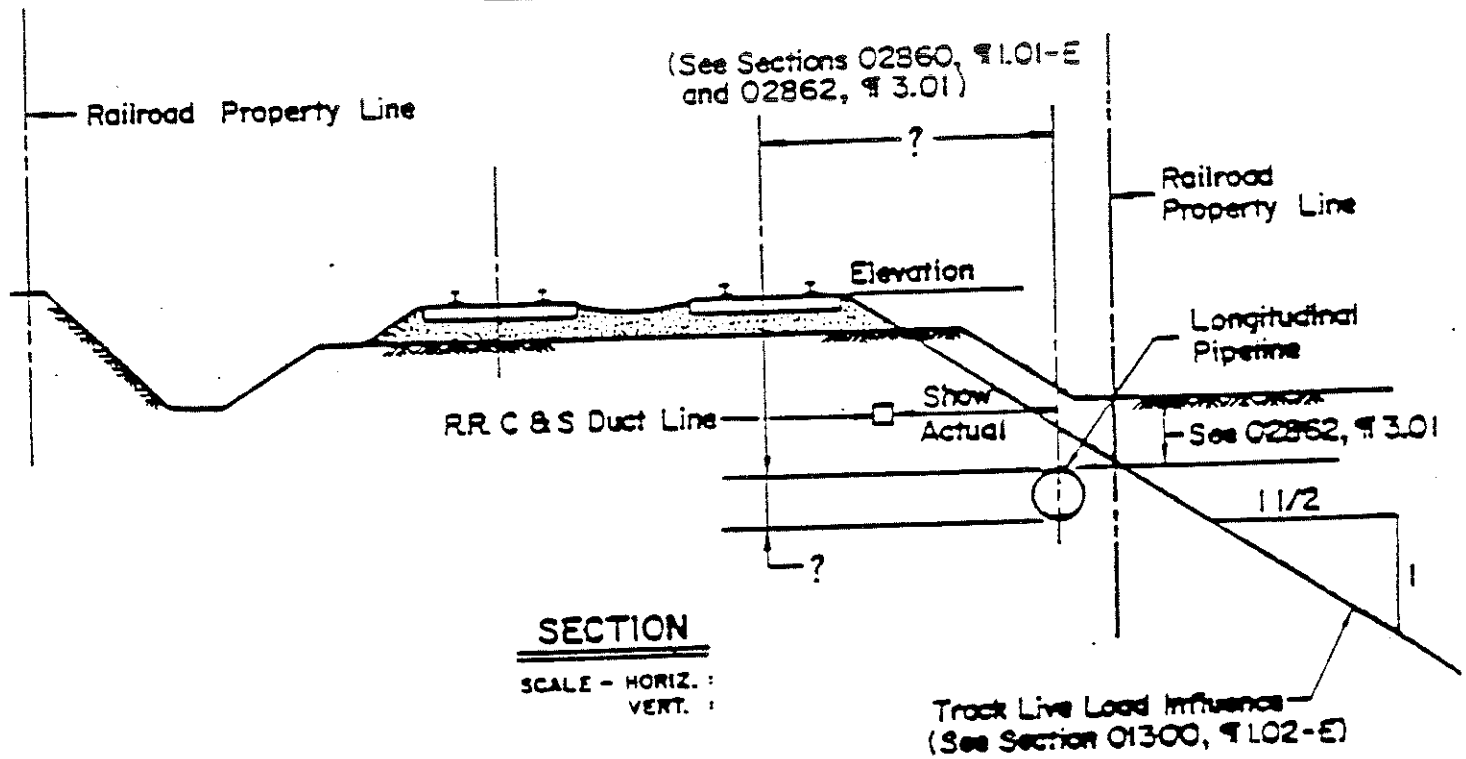
PLATE II

1604



INFORMATION TO BE SHOWN ON PROFILE SECTION OF DRAWING

LONGITUDINAL OCCUPANCY



PROFILE - (See Section 01300, ¶ 1.02-B-3)

SCALE - HORIZ. :
VERT. :

PIPE CROSSING - DATA SHEET

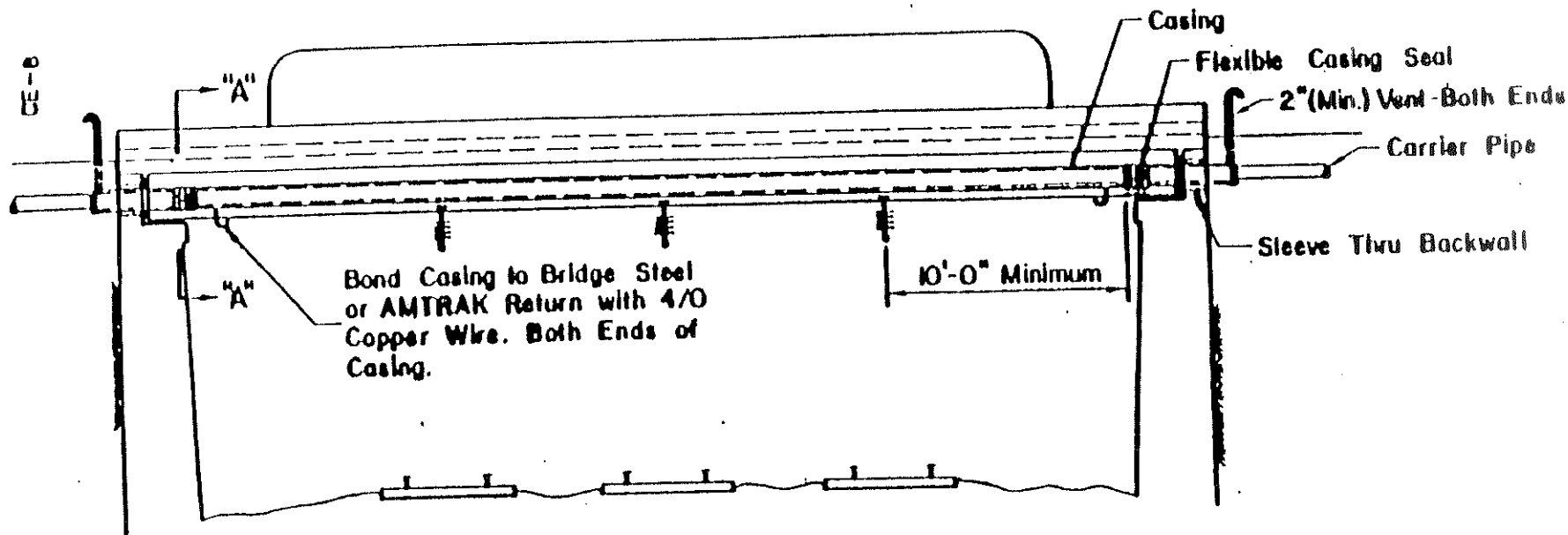
PLATE IV

1504

In addition to plan and profile of crossing, drawings submitted for Railroad's approval shall contain the following information:

	Pipe Data	
	Carrier Pipe	Casing Pipe
Contents To Be Handled		
Normal Operating Pressure		
Normal Size of Pipe		
O.S. Diameter		
I.S. Diameter		
Wall Thickness		
Weight Per Foot		
Material		
Process of Manufacture		
Specification		
Grade or Class		
Test Pressure		
Type of Joint		
Type of Coating		
Details of Cathodic Protection		
Details of Seal or Protection at Ends of Casing		
Method of Installation		
Character of Subsurface Material At the Crossing Location		
Approximate Ground Water Level		
Source of Information on Subsurface Conditions (Borings, Test Pits or Other)		

NOTE: Any soil investigation made on railroad property or adjacent to tracks be carried on under the supervision of Railroad Company's Chief Engineer.



ELEVATION
SCALE: 3/32" = 1'-0"

NOTE:
Pritec (TM), or Approved Equal, may be used in Lieu of 25 KV Dielectric Suspension Type Insulator. (See Plates VI & VII)

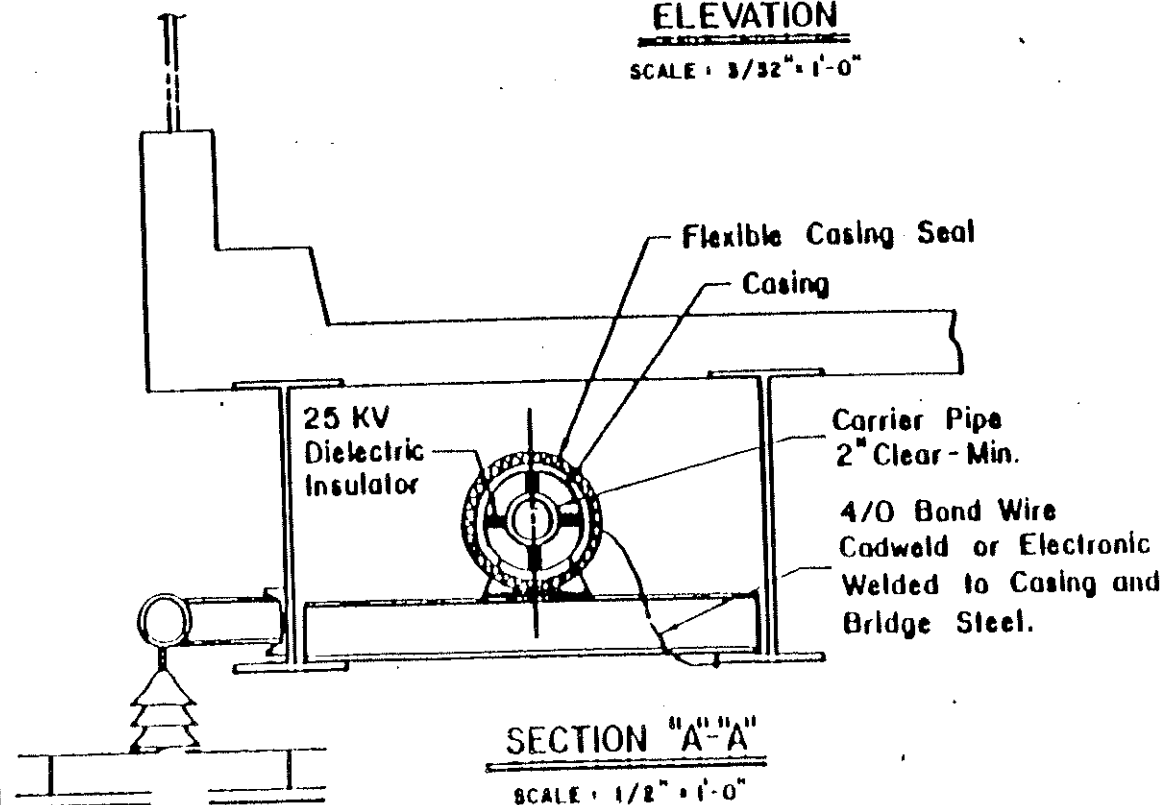


PLATE V

SPECIFICATIONS FOR BONDING AND
GROUNDING OF PIPELINES IN
ELECTRIFIED TERRITORY

H. C. PRICE CO.
PIPE COATING SPECIFICATION FOR USE ON
AMTRAK RAILROAD BRIDGES

REVISED
October 23, 19

1.0 Scope

This specification covers material requirements, and application procedures for the application of an extruded butyl and an extruded polyethylene pipe coating for protection against external corrosion while possessing high electrical strength to withstand electrical stress if it comes in contact with rail power lines.

2.0 Material Selection

Butyl rubber adhesive material shall be approved by Midwest Research Institute, Kansas City, Missouri. Polyethylene shall be high molecular weight resin such as Phillips TR 418B or equal, possessing tough, impact-resistant and resistant to environmental stress cracking properties.

3.0 Preparation of Surfaces

3.1 Pipe should be ordered bare, free of mill preservatives.

3.2 The exterior of the pipe shall be free of all mill scale, rust, rust preventatives, or other foreign matter. This shall be accomplished by thoroughly blasting the pipe's surface with a sand, grit, or shot to a NACE No. 3 Commercial blast cleaned surface finish. "A NACE No. 3 is a surface from which all oil, grease, dirt, rust scale, and foreign matter have been completely removed and all rust, mill scale, and oil paint have been removed except for slight shadows, streaks, or discolorations caused by rust stain or mill scale oxide binder. At least two-thirds of the surface area shall be free of all visible residues and the remainder shall be limited to light discoloration, slight staining, or light residues mentioned above. If the surface is pitted, slight residues of rust or paint are found in the bottom of pits. "1

4.0 Coating

A 20 mil thickness of hot butyl rubber adhesive shall be extruded spirally around the pipe in two layers. Immediately after the adhesive, a 60 mil thickness of virgin black polyethylene shall be extruded spirally around the pipe in three layers producing a bonded coating with a thickness of 80 mils (nominal thickness less 10% tolerance).

5.0 Testing

5.1 Pipe coating shall be 100% inspected for pinholes and holidays immediately after application with holiday detector adjusted to provide sufficient voltage to produce a spark through a pinhole in the coating (20 KV ac).

5.2 Repairs to small holidays may be made by using Servi-Wrap P-500 Pipe Wrap material approved for this purpose. Repairs will be reinspected with a holiday detector.

5.3 Defective external coating shall be recoated to meet all requirements of this specification, at the expense of the applicator.

NACE T-10 D-8 Proposed NACE Standard Recommend Practice for "Application of Organic Coatings to the External Surface of Steel Pipe for Underground Service

SUGGESTED PROCEDURES TO HAND WRAP FIELD JOINTS AND FITTINGS FOR
PRITEC (R) PIPE COATING USING SERVI-WRAP P-500 PIPE WRAP OR
EQUIVALENT TO PROVIDE A DIELECTRIC OF 25,000 VOLTS MINIMUM.

1. SURFACE PREPARATION: Surface must be clean and dry. Wire brush to remove any loose rust and scale, dust or dirt. Oil and grease are to be removed with a suitable safety approved solvent such as trichlorethylene.
2. PRIMING: A compatible primer such as Servi-Wrap primer should be applied at a rate of approximately 400 Sq. Ft. per gallon. Prime the entire surface to be wrapped beginning 4" to 6" back from the mill applied PRITEC (R) coating. Let primer dry before applying Servi-Wrap.
3. TAPE APPLICATION: Servi-Wrap is applied by removing release paper and spirally wrapping under tension with a 55% overlap. On fittings or uphill sections of pipeline, start at the bottom or lower section and work up. First apply a wrap over the weld seam for extra protection. On the initial turn, double wrap while maintaining tension. On the final lap, a double wrap should be applied but the second lap should be without tension and the tape ends should be pressed into position.
4. INSPECTION: Tape should be applied in a smooth workmanlike manner and no wrinkles are permitted. Pipe coating shall be 100% inspected for pinholes and holidays with an approved holiday detector adjusted to provide sufficient voltage to produce a spark through a pinhole in the coating (approximately 15 KV ac.).

GRACE

PLATE VII

1 of 2
1604

Construction Products Div

SERVI-WRAP® P-500

COLD APPLIED, SELF ADHESIVE, ANTI-CORROSION PIPE WRAP

EXCEPTIONAL ADHESION
DUAL SEAL OF PROTECTION
FAST AND SIMPLE TO APPLY

DESCRIPTION

SERVI-WRAP P-500 is a tough, pliable, waterproof pipe wrap. It provides a dual seal of a "cross laminate," high density polyethylene film combined with a thick, factory-controlled layer of adhesive-consistency, bituminous rubber compound. SERVI-WRAP P-500 is supplied in rolls interwound with a special release paper which protects the adhesive surface until ready for use.

ROLL SIZE

Length - 30 l. f. or to order
Width - 2", 4", 6", 9" or to order up to 36"

TYPICAL PHYSICAL PROPERTIES

Property	Value	Test Method
Color	Dark Grey-Black	
Thickness	Compound 40 Mils Film 8 Mils Total 48 Mils	
Tensile Strength	5800 psi	ASTM D-882-56T
Elongation at Break	293%	ASTM D-882-56T
Impact Resistance (1)		
Single Layer	19 Kg. Cm.	ASTM G-14
Double Layer	71	
Puncture Resistance (2)	118 lbs.	ASTM E-154
Adhesion to Steel - Initial	6 lbs./in.	DIN30670 Modified
30 Min.	8 lbs./in.	
Adhesion to Self - Initial	3 lbs./in.	
30 Min.	4 lbs./in.	
Permeance - Perms (3)	0.05 Max.	ASTM E-96 Method B
Pliability (4)	Pass	ASTM C-711
Exposure to Fungi		
In Soil - 16 Weeks	Unaffected	
Alkali & Acid Resistance	Excellent	
Dielectric Breakdown	17,900 Volts	ASTM D-149
Resistance to Cathodic Disbondment	Excellent	ASTM G-8
Conformability	Very Good	
Operating Temperature Range	-25°F. to 150°F.	
Application Temperature Range	40°F. to 120°F.	

- Notes: (1) Film Break
(2) Stretched by Blunt Object
(3) Grains/Sq. Ft./Hr./In. Hg
(4) 180° Bend Over 1/4" Mandrel @ -35°F.

APPLICATION INSTRUCTIONS

1. The pipe surface should be completely free of rust, scale, weld spatter, grease, dirt, dust and oil. It must be completely dry at time of application.
2. The dry pipe surface should be primed with one coat of quick drying SERVI-WRAP PRIMER. The Primer should be completely dry at the time of application of the SERVI-WRAP P-500. No primer is needed when wrapping pipe insulation.
3. Peel back the release paper from the first 9 inches of SERVI-WRAP P-500 and begin wrapping (adhesive side of wrap to pipe surface). Remove the release paper as the SERVI-WRAP P-500 is applied.
4. Pull the wrap tightly to ensure a snug fit to the surface being covered.
5. Overlap successive winds at least 1 inch, or more as specified, maintaining tight, continuous contact with both pipe, and the overlapped membrane. The end lap should be a minimum of 6".

SERVI-WRAP PRIMER

A quick drying (2 to 5 minutes) brush applied primer which is usually required prior to application of all grades of SERVI-WRAP.

Package:	1 - Gal. and 5 - Gal. Cans
Coverage:	300 Sq. Ft. per Gallon

SERVI-WRAP MOLDING PUTTY

Cold applied plastic putty designed for hand molding around bolted flanges, certain types of valves, etc. to provide a suitable profile for wrapping.

Color:	Black
Package:	50-lb. Packs
Filling Capacity:	18.5 Cu. In. per Lb.

CONSTRUCTION PRODUCTS DIVISION, W. R. GRACE & CO.
P. O. BOX 2585, HOUSTON, TEXAS 77001 713/223-8333

June 6, 1977



We hope the information given here will be helpful. It is based on our best knowledge, and we believe it to be true and accurate. Please read all statements, recommendations or suggestions herein in conjunction with our conditions of sale which apply to all goods supplied by us. We assume no responsibility for the use of these statements, recommendations, or suggestions, nor do we intend them as a recommendation for any use which would infringe any patent or copyright.

INSURANCE REQUIREMENTS
NATIONAL RAILROAD PASSENGER CORPORATION
(AMTRAK)

Revised as of April 1987

DEFINITIONS: Whenever in these Special Provisions or in the plans or contract documents the words "Company", "Railroad", or "Amtrak" are used, the same shall mean National Railroad Passenger Corporation.

INSURANCE: The contractor shall procure and maintain, at his own cost and expense, during the entire period of performance of the Project, the types of insurance specified below. The contractor shall submit a certificate of insurance giving evidence of the required coverages, prior to commencing work. All insurance shall be procured from insurers authorized to do business in the jurisdiction where operations are to be performed. The contractor shall require all subcontractors to carry the insurance required herein, and contractor may, at his option, provide the coverage for any or all subcontractors, and if so, the evidence of insurance submitted shall so stipulate. In no event shall work be performed until the required certificate(s) of insurance have been furnished. If the insurance provided is not in compliance with the requirements listed below, Amtrak maintains the right to stop work until proper evidence is provided. The insurance shall provide for 30 days prior written notice to be given to Amtrak in the event coverage is substantially changed, cancelled or non-renewed.

- A. WORKERS' COMPENSATION INSURANCE: A policy complying with the requirements of the statutes of the jurisdiction(s) in which work will be performed, covering all employees of the contractor. Employer's Liability coverage with limits of liability of not less than \$500,000 each accident or illness shall be included.
- B. GENERAL LIABILITY INSURANCE: A policy issued to and covering liability imposed upon the contractor with respect to all work to be performed and all obligations assumed by the contractor, under the terms of this permit. Products-completed operations, independent contractors, and contractual liability coverages are to be included, and all railroad exclusions are to be deleted.

Amtrak is to be named as an additional insured with respect to operations to be performed and the policy shall contain a waiver of subrogation against Amtrak, its employees or agents. Coverage under this policy, or policies, shall have limits of liability of not less than \$2 million per occurrence, combined single limit for bodily injury, (including disease or death), personal injury and property damage (including loss of use) liability.

- C. AUTOMOBILE LIABILITY INSURANCE: A policy issued to and covering the liability of the contractor arising out of the use of all owned, non-owned, hired, rented or leased vehicles which bear, or are required to bear, license plates according to the laws of the jurisdiction in which they are to operated, and which are not covered under the contractor's General Liability Insurance. The policy shall name Amtrak as an additional insured with respect to operations to be performed in connection with this permit, and shall contain a waiver of subrogation against Amtrak, its employees or agents. Coverage under this policy shall have limits of liability of not less than \$1 million per occurrence, combined single limit, for bodily injury, and property damage liability.
- D. RAILROAD PROTECTIVE LIABILITY INSURANCE: The Contractor shall provide, with respect to the operations he or any of his subcontractors perform within 50 feet vertically or horizontally of railroad's tracks, Railroad Protective Liability Insurance, AAR-AASHTO (ISO/RIMA) Form, in the name of National Railroad Passenger Corporation. The policy shall have limits of liability of not less than \$2 million per occurrence, combined single limit, for Coverages A and B, for losses arising out of injury to or death of all persons, and for physical loss or damage to or destruction of property, including the loss of use thereof. A \$6,000,000 annual aggregate may apply.

If coverage is provided on the London claims-made form, the following provisions shall apply:

1. The limits of liability shall be not less than \$3 million per occurrence, combined single limit. A \$9 million annual aggregate may apply.
2. Declarations Item 6, Extended Claims Made Date, shall allow an Extended Claims Made Period no shorter than the length of the original policy period plus one year.
3. If equivalent, or better, wording is not contained in the policy form, the following endorsement must be included:

It is agreed that "Physical Damage to Property" means direct and accidental loss of or damage to rolling stock and their contents, mechanical construction equipment or motive power equipment, railroad tracks, roadbed, catenaries, signals, bridges or buildings.

E. CLAIMS-MADE INSURANCE: If any insurance specified above shall be provided on a claims-made basis, then in addition to coverage requirements above, such policy shall provide that:

1. Policy retroactive date coincides with or precedes the contractor's start of work (including subsequent policies purchased as renewals or replacements).
2. Contractor will make every effort to maintain similar insurance for at least two years following project completion, including the requirement of adding Amtrak as an additional insured.
3. If insurance is terminated for any reason, contractor agrees to purchase an extended reporting provision of at least two years to report claims arising from work performed in connection with this permit.
4. Policy allows for reporting of circumstances or incidents that might give rise to future claims.

All insurance specified above shall remain in force until all work to be performed is satisfactorily completed, all contractor personnel and equipment have been removed from railroad property, and the work has been formally accepted. Failure to carry or keep such insurance in force as stipulated shall constitute a violation of the project contract.

The Contractor shall furnish to Amtrak the original of the policy for Railroad Protective Liability Insurance and a Certificate of Insurance for all other coverages fifteen days prior to commencing work. The fifteen-day advance notice of coverage may be waived in situations where such waiver will benefit Amtrak, but under no circumstances should the Contractor actually begin work without providing evidence of insurance. Such evidence of insurance shall be sent to Mr. R. D. Johnson, Assistant Chief Engineer-Design and Construction, 2000 Market Street, Philadelphia, Pennsylvania 19103. Work may not proceed on Amtrak property until all insurance requirements have been met to the satisfaction of Amtrak Assistant Chief Engineer-Design and Construction or his duly authorized representative.

For the following types of activities: core borings, field surveys and appraisals, routine bridge inspections, minor maintenance and repair of bridges, bridge painting, erection or removal of billboard signs, replacement or removal of billboard advertisement, installation or removal of pipe and wire, and minor station maintenance, repair or construction, the permittee may request that Amtrak waive the requirement to provide the Railroad Protective Liability Insurance specified in paragraph D above.

As a condition of the waiver of the obligation to provide the above Railroad Protective Liability Insurance, the Permittee agrees to pay Amtrak _____ dollars (). This fee is in addition to the consideration paid for the preparation of this permit.