1961–1977

National Electrical Safety Code

Interpretations

1961—1977 inclusive

May 9, 1978 *SH07112*

National Electrical Safety Code Committee, ANSI C2

National Electrical Safety Code

Interpretations

1961—1977 inclusive

Second Printing
May 1983

The previous printing of these interpretations was designated as ANSI/IEEE C2 61-77. The document is otherwise unchanged.

Published by

Institute of Electrical and Electronics Engineers, Inc
345 East 47th St., New York, N.Y. 10017

ABSTRACT

This edition includes official interpretations of the National Electrical Safety Code as made by the Interpretations Subcommittee of the National Electrical Safety Code Committee, ANSI C2.

Key words: electric supply stations, overhead electric supply and communication lines, underground electric supply and communication lines, clearances to electric supply and communication lines, strength requirements for electric supply and communication lines.

Contents

Foreword

In response to repeated public inquiries and requests from C2 Committee members, the IEEE C2 Secretariat arranged for publication of Interpretation Requests received and Interpretations made by the National Electrical Safety Code Subcommittee on Interpretations. The original requests have been lightly edited to remove extraneous matter and focus on the C2 problem presented. Some illustrations have been redrawn for publication. With these exceptions, requests are in the form received. The period covered begins with the first request received for the 6th edition of Part 2 (IR 92, May 1961) and ends with the last interpretation issued in 1977, (IR 212).

Interpretations in the C2 archives beginning with number 11 through 78 (Nov 1955) were compiled as a mimeographed set (except for 23 of these, for which there is no record); distribution of this document is unknown to the present Secretariat. Interpretations 79 (Jan 1956) through 91 bearing on the 5th and prior editions have not yet been indexed or prepared for publication.

National Electrical Safety Code Interpretations
Introduction

General: Interpretations are prepared by the National Electrical Safety Code Interpretations Subcommittee in response to formal requests received by the NESC Secretariat.

This volume contains all interpretations requested on the NESC 6th Edition concerning Section 9, Grounding Methods, and Part 2, Overhead Lines, along with those on the 1977 Edition through December 1977. It also contains all interpretations made on Part 1, Electric Supply Stations, during the period 1973-77 inclusive and on Part 3, Underground Lines, during the period 1973 through 1977 inclusive. Before 1970 Part 3 covered different material; no interpretation requests were received on Part 3 during the period 1961-1970.

Arrangement: This compilation includes a numerical index arranged in order of interpretation number, showing the rule number and topic covered. This will be convenient for location of the text if only the interpretation request number is available.

Interpretation requests and interpretations quoted in full are arranged according to the primary rule number. Applicable cross references are inserted appropriately if a request covers several rules. If illustrations were provided, they follow the Interpretation Request text. In the 1977 Edition some changes were made in the rule numbers. Exact correspondence between editions does not exist in some cases. 1977 Edition Interpretations are so identified.

The request date refers to the date on the original letter request. The Interpretation date is the date of the response letter.

Procedure for Requesting an Interpretation: Requests for interpretation should be addressed to:

Secretary
National Electrical Safety Code Committee, ANSI C2
IEEE Standards Office
345 East 47th Street
New York, NY 10017

Requests for interpretations should state:

A. The rule number in question

B. The applicable conditions for the case in question (provide a drawing, photo, or sketch if needed for clarification)

C. The problem for which clarification is requested

Requests, including all supplementary material must be in a form that is easily reproduced. If suitable for Subcommittee consideration, requests will be sent to the Interpretations Subcommittee. After consideration by the Subcommittee, which may involve many exchanges of correspondence, the inquirer will be notified of the Subcommittee's decision. Decisions will be published from time to time in cumulative form and may be ordered from IEEE.

Interpretations are issued to explain and clarify the intent of specific rules and are not intended to supply consulting information on the application of the Code. The Interpretations Subcommittee does not make new rules to fit situations not yet covered.

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(May 19, 61)	92	Meaning of "supply cables having an effectively grounded continuous metal sheath, or insulated conductors supported on and dabled together with an effectively grounded messenger." Spacer cable.	230C
(Apr 13, 62)	93	Clearance between multi-grounded neutral and communication service drop.	238D
(Mar 5, 62) (Mar 27, 62) (Aug 6, 62) (Aug 8, 62)	94	Plastic guy guards.	282E
(Nov 14, 62)	95	Spliced and stub pole definitions; extension at top of pole.	261A4(g)
(Dec 7, 62)	96	Clearance to parallel line.	234B
(Feb 14, 63)	97	Guy grounding; upper end effectively grounded vs. anchor end ground.	282H
(Feb 21, 63)	98	Clearance — horizontal and vertical — from buildings.	234C4
(Mar 14, 63)	99	Definition of fixed supports.	232A3
(Apr 22, 63)	100	Insulators in guys.	283B2
(Sept 13, 63)	101	Clearance between line conductors and span or guy wires.	235A, Table 9
(Oct 11 and 22, 63)	102	Clearance between line conductors and guy of EHV guyed tower.	235A3, Table 9
(Nov. 12, 63)	103	Constant to be added to storm loading for messenger supported cable.	251
(Dec 31, 63)	104	Grounding point on 3-wire delta systems — corner or midpoint of one phase.	92B

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(June 15, 64)	105	Placement of communication cable above effectively grounded luminaires with drip loops.	238E4
(Jan 6, 64)	106	44 kV 3ϕ transformer bank fuse protection.	165
(Feb 24, 64)	107	Grounding of transformer tank with tank grounded arrester, via a spark-gap, etc.	97C 93A, B
(Apr 2, 64	108	Longitudinal strength of towers — Grade B construction.	261A3(b)
(Apr 24, 64)	109	Joint use 7.2kV/communications-cable joint use poles; insulated strand, self-supporting communications cable.	242
(May 14, 64)	110	Conductor vertical spacing with post insulators.	238A, Table 11
(May 26, 64)	111	Grade B crossing spans in a grade C supply line.	242, Table 15
(June 30, 64)	112	Final condition of a conductor — to determine vertical clearance — storm loading and long term creep.	234A1
(Nov 12, 64)	113	Clearance of conductor from building.	234C4(a)
(Aug 2, 65)	114	Clearance of HV conductors around circuit breakers.	114
(Aug 4, 65)	115	13.8 kV distribution clearance with horizontal post insulators without crossarms.	238 Table 11
(Aug 31, 65)	116	Guy guard — on guys to ground anchors — in areas where stock runs.	282E

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(Sept 17, 65)	117	(a) Clearance between supply conductors and signs.	23
		(b) Clearance between pad-mounted transformers and gas metering equipment.	
(Sept 8, 65)	118	Nine questions concerning grounding conductor.	
		(1) Mechanical protection for interconnected (arrester and neutral) grounding lead.	239C 97C1(b) and (c)
		(2) Required number of grounding connections.	97C1(c)
		(3) Allowable omission of mechanical protection. (4) Allowable omission of protective covering.	239C and 97C1(b) and (c)
		(5) Method of grounding magnetic mechanical protection. (6) Method of grounding nonmagnetic mechanical protection.	93C1, 97A1 and 239C
		(7) Mechanical protection for interconnected (arrester and neutral) grounding lead.	97C1(c) and 239C
		(8) Number of grounds.	92B
		(9) Allowable interconnection of grounding neutrals.	97C
(Sept 2, 65)	119	Insulator electrical strength.	272
(Dec 3, 65)	120	Clearance between highway lighting standards and transmission lines.	243B
(Dec 13, 65)	121	(a) Sag — with or without creep.	232A

Request Date	*IR Number*	*Subject*	*Rule*
		(b) Clearance over cultivated field.	
(Feb 17, 66)	122	(a) Definition of "promptly deenergized".	242A, Table 15, note 3
		(b) Deflection, unbalanced pull: should dissimilar ice loadings be considered?	261A6b
		(c) Crossing of power and communications lines.	261D5
(Mar 7, 66)	123	Minimum clearance for spacer cable on messenger under heavy loading conditions.	232
(Feb 22, 67)	124	Substation conductor clearance to building.	114A1 and 234C4(a)
(Dec 23, 66)	125	Distinction between urban and rural.	232A
(Feb 1, 68)	126	(a) Grounded neutral clearance to ground.	230D, 232A Table 1, 232B
		(b) Ground neutral clearance to building.	230D 234C4
		(c) Spaces and ways accessible to pedestrians.	232A, Table 1
(Feb 28, 68)	127	Clearance between supply conductors, communication and CATV cables.	238
(Apr 15, 68)	128	Meaning of "closely latticed poles or towers".	280A2(b)
	129 through 150	Numbers not assigned	
(Nov 15, 73)	151	Crossarm; Definition and status of integrated conductor support assemblies	261D
	152	Number not assigned	
(Dec 17, 73)	153	Nonmetallic pipe protection for risers	239C
(Jan 29, 74)	154	Clearances from buildings; Meaning of voltage	234C, Table 4
(Feb 5, 74)	155	Cable burial depth	353D

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(Oct 17, 73)	156	Clearances from buildings; Meaning of voltage	234C, Table 4
(Feb 25, 74)	157	Antenna conflicts	Def.
(Dec 18, 72)	158	Clearance for line	234
(Apr 11, 74)	159	Clearances applicable to building construction site	232A
(May 14, 74)	160	Clearances — Wires on different supports, voltages 50 kV; also above ground or rails	233B2 232B2
(May 15, 74)	161	Height of fence	110A
(May 17, 74)	162	Definition of "constant potential" in grades of construction	242, Table 15
(May 21, 74)	163	Grounding of guys	282H
(May 29, 74)	164	"Immediate vicinity of a fault" as applied to damage withstanding capability of underground cable	330D
(Aug 22, 74)	165	Basic clearance — Wires above ground; "Accessible to pedestrians only"	232A
(Nov 1, 74)	166	Grounded neutral; Definition of 4 grounds per mile	97C1(c)
(Oct 15, 74)	167	Compact transmission lines, status with respect to NESC 1973 edition, especially when jacking for hot line maintenance is taken into account	235A, Table 6
(Dec 11, 74)	168	Clearance of power lines above sprinkler heads over farm orchard	232A, Table 1
(Dec 12, 74)	169	Clearance, CATV cable above vacant lot	232A
(Feb 25, 75)	170	Direct buried cable near swimming pool	351C1

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(Mar 19, 75)	171	Communication cable burial depth	353D
(May 21, 75)	172	Clearance to building	234C4
(May 29, 75)	173	Clearance, line to adjacent steel structure; Voltage definition	234B1 234C, Table 4
(Sept 29, 75)	174	Clearance to building and guarding	234C4
(Sept 30, 75)	175	Clearance between conductors in substations	235A, Table 6
(Dec 15, 75)	176	Climbing space	236
(Dec 18, 75)	177	Fence height	110A
(Jan 22, 76)	178	Clearance to ground at high conductor temperature	232
(Feb 5, 76)	179	Guy guards; meaning of "traffic"	282E
(Feb 3, 76)	180	Construction grade of line; Effect of additional loading	261A4
(Mar 8, 76)	181	Application of *K*-factors	251 252
(June 1, 76)	182	Guy guard; Placement on guy in field	282E
(May 17, 76)	183	Fiberglass rod; Acceptability in lieu of steel	282B 282D
(June 10, 76)	184	Allowable pole loading	261A1
(June 29, 76)	185	Unfenced, pad-mounted equipment; Meaning of two procedures	381G
(Oct 21, 76)	186	Clearance to building	232A 234C4(a) 234C1(a)
(Mar 29, 77)	187	Clearance above ground in orchard	232A, Table 1
(June 24, 77)	188	Guy guards in relation to definition of "guarded".	282E
(Feb 18, 77)	189	Clearance of neutral to building.	234C4a(1) Table 4
(May 23, 77)	190	(a) Requirements for disconnect switch.	173C, 170, 171

Request Date	*IR Number*	*Subject*	*Rule*
		(b) Energized switch blade.	
(Mar 23, 77)	191	Foundation strength for steel pole structure.	261B
(Mar 24, 77)	192	Clearance to energized parts in substation.	124
(Apr 18, 77)	193	Outside substation. (a) vertical clearance to live parts (b) definition of voltage	114A;114C1
(May 9, 77)	194	Intent of term "proximate facilities".	212
(May 10, 77)	195	Clearance required for communication conductors over roads.	232A
(July 14, 77)	196	Neutral grounding for buried concentric neutral cable with semi-conducting sheath.	35CB
(July 1, 77)	197	Clearance to roads; high temperature transmission lines.	232B2d(2)
(July 12, 77)	198	Clearance to chimney; meaning of attachments.	234C4(a)
(July 14, 77)	199	Meaning of "readily climbable".	280A1b
(July 8, 77)	200	Application of extreme wind loading.	250C
(July 27, 77)	201	(a) Implication of retrofitting. (b) Fence height.	102B 110A
(Aug 23, 77)	202	Supply cable requirements, OR vs AND.	230C
(Aug 25, 77)	203	Increased clearances for long span or sag — applicability to horizontal clearances.	234F2c and d
(Sept 13, 77)	204	Grounding — pole butt plates.	94B4b
(Sept 3, 1977)	205	Electrostatic effects	234F1c

Numerical Listing by Interpretation Request (IR) Numbers

Request Date	*IR Number*	*Subject*	*Rule*
(Sept 15, 77)	**206**	CATV cable clearance.	232A, Table 1
(Oct 3, 77)	**207**	Transmission line clearances Meaning of "maximum conductor temperature for which the line is designed to operate" with respect to designed for, but unplanned contingencies.	232B2d
(Oct 31, 77)	**208**	Neutral clearance to to bridge.	234D1, Table 234-2
(Oct 31, 77)	**209**	Vertical clearance at supports.	235C1, Table 235-5
(Oct 31, 77)	210	Clearance from line conductors at supports. (a) Meaning of minimum clearance (b) Clarification of "voltages are between conductors" (c) Reason for additional clearances on joint poles	235E1, Table 235-6
(Nov 4, 77)	211	(a) Omission of fiber stress calculation point formerly stated in 6th Edition, 261A4a,b. (b) Meaning of "other supported facilities."	261A2b,c 260C
(Nov 11, 77)	212	Grounding of supporting structures.	215C1

Grounding Methods for Electric Supply and Communication Facilities

Section 9.

92B

Grounding point on 3-wire delta systems — corner or midpoint of one phase.

REQUEST (Dec 31, 63) IR104

Our specific question is in regard to the sentence in the fourth paragraph of Rule 92B which reads, "In two-wire single-phase and in two- or three-phase systems the ground shall be made at that point of the system which brings about the lowest voltage to ground."

Attached for your reference is a copy of a Metering Drawing (Fig IR 104-1) and a copy of a Grounding Connection Drawing (Fig IR 104-2) for grounding transformers and services on rural lines. On the Metering Drawing the transformer ground connection is made at the corner of the three-phase three-wire delta secondary as shown in the schematic drawing at the top of the page. On the Grounding Drawing the transformer ground connection is made at the corner of the three-phase three-wire delta secondary in Diagram No 3 of this drawing. The meter, main disconnect, starter and motor are also connected to the neutral ground at the corner of the delta.

The Rule 92B seems to say that the ground connection shall be made at the midpoint of the winding of one of the transformers to bring about the lowest voltage to ground. For a 480 V three-phase delta transformer bank with mid-point grounding, the voltages to ground would be 416, 240 and 240.

The attached drawings show the ground connection made at the end of two windings at the corner of the delta which brings about higher voltages to ground. For a 480 V three-phase delta transformer bank with corner grounding the voltages to ground would be 480 and 480.

According to our interpretation the rule 92B seems to prohibit the attachment of the ground conductor at any point other than the mid-point of one of the transformers in a three-phase delta connection.

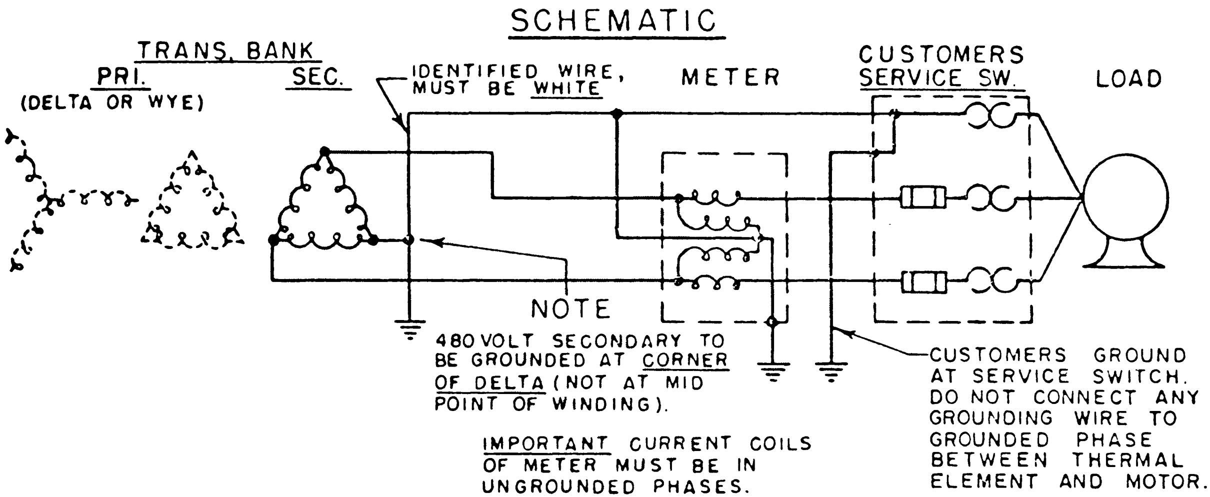

SCHEMATIC
TRANS. BANK
PRI.
(DELTA OR WYE)
SEC.
IDENTIFIED WIRE, MUST BE WHITE
METER
CUSTOMERS SERVICE SW.
LOAD
NOTE
480 VOLT SECONDARY TO BE GROUNDED AT CORNER OF DELTA (NOT AT MID POINT OF WINDING).
IMPORTANT CURRENT COILS OF METER MUST BE IN UNGROUNDED PHASES.
CUSTOMERS GROUND AT SERVICE SWITCH. DO NOT CONNECT ANY GROUNDING WIRE TO GROUNDED PHASE BETWEEN THERMAL ELEMENT AND MOTOR.

Fig IR 104-1

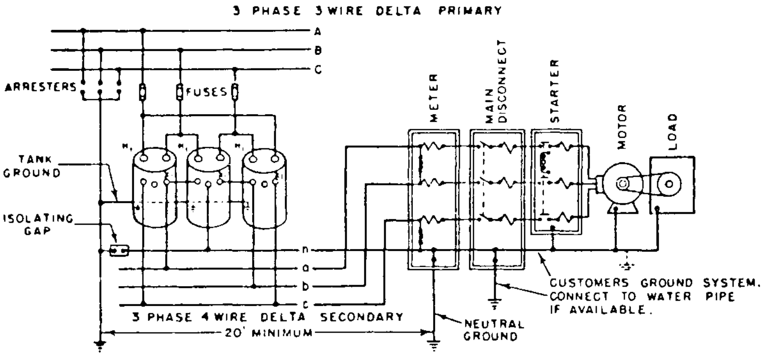


DIAGRAM NO. 1

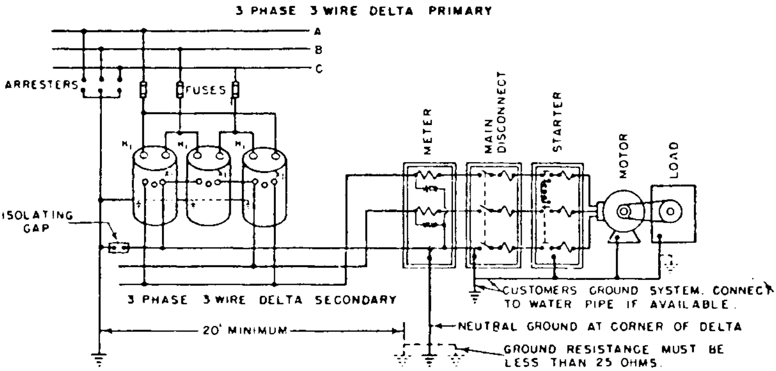


DIAGRAM NO. 3

Fig IR 104-2

INTERPRETATION (Apr 14, 64)

Rule 92B requires that where alternating current secondaries are to be grounded, the ground shall be made at that point on the secondary system which brings about the lowest voltage to ground. In a 3 phase, 4 wire system, this point would be the neutral conductor. Where a 3 phase, 3 wire system is used, however, any one of the 3 phase wires could be grounded to meet this requirement. In other words, the rule does not *require* grounding nor does it require that such grounding be on a neutral of a secondary system or that the neutral be brought out for this purpose. Where only three wires are available on the *system* and the system is to be grounded, any one of the phase wires can constitute the grounding conductor, providing it meets the requirements of Rule 93 with reference to continuity, identification, etc.

Number of grounds required on secondary.

REQUEST (Sept 9, 65) IR 118(8)

If a secondary from a transformer is grounded at three individual services to a continuous underground water piping system, does paragraph 92B require that an additional ground connection be made at the transformer or at another point on the secondary system that is *not* an *individual service* ground?

INTERPRETATION (Apr 66)

No final interpretation found in the records. The consensus of the committee reponses appears to be:

The first paragraph of Rule 92B seems to be clear that the answer to this question is *Yes*. Regardless of the number of individual services that are grounded the secondary *system* shall have "at least one *additional* ground connection at the transformer or elsewhere".

93A, B See IR for Rule 97C, IR 107

94B4b

Grounding — pole-butt plates.

REQUEST (Sept 13, 77) (1977 Edition) IR 204

In Rule 94B4b when referring to pole butt plates, the Code states "the plates shall be not less than 1/4 inch thick if of ferrous metal, and not less than 0.06 inch thick if of nonferrous metal. Further, the minimum plate area exposed to the soil shall be 0.5 square feet." It appears, however, that the Code is referring to systems with only 4 to 8 grounds/mile. Is there an exception to this minimum plate size if there is grounding at every pole? Is it the intent of the Code to have a certain number of pounds of copper per mile? (Also, it should be noted that some manufacturers' catalogues show "REA approved" pole butt plates that have less plate area and are thinner than those specified in the Code.)

INTERPRETATION (Oct 19, 77)

To the best of our knowledge there is no exception to the minimum size requirement for plate used as grounding electrodes. Also, there is no intention to have a certain number of pounds of copper per mile of line.

* * * *

Since the request referred to "REA Approved", we quote for your information, the following from an REA member of the Interpretations Committee.

"For information purposes, REA does not "approve" any materials. We include certain items in a "List of Materials Acceptable for Use on Systems of Electrification Borrowers." Pole butt plates are listed under a category called "Grounds, Pole (for system grounds see ground rods)." Although we recognize that the pole protection butt plates, as well as anchors and other metal, do contribute to lowering the neutral resistance to ground, we do not count them as the system grounds which are required by Rules 96A3, 97C, etc."

96A3 See IR for Rule 350B, IR 196

97C
See IR for Rule 350B, IR 196

Grounding of transformer tank with tank grounded arrester, via a sparkgap, etc.

REQUEST (Feb 24, 64) IR 107

We note the words "*if made*" in the first sentence. We would, there, like to know whether this connection between the arrester ground and the secondary grounded conductor can be eliminated.

Our installations in question consist of a poletop distribution transformer with self-contained arresters on the side which discharge directly to the transformer tank. We connect a wire from a driven ground rod to this transformer tank through a spark gap due to our safety rule to leave transformer tanks ungrounded. Another ground rod is used at least 20 ft from the above one mentioned, and we connect this to the secondary neutral conductor. We then connect these two grounds together through a *second* spark gap.

Our present concern is to determine whether this second spark gap connection between the two grounds can be eliminated entirely. If so, we could discontinue the use of one spark gap and associated wire at each transformer installation.

INTERPRETATION (May 7, 64)

Rule 97C2 does not require an interconnection, it merely specifies that if an interconnection is made, certain requirements must be met (that is, it shall be through a spark gap, etc.). This is why phrases "may be interconnected" and "interconnection, if made" are used in 97C1 and 97C2, respectively.

However, the use of a spark gap in the ground lead from the primary lightning arrester (method you have outlined in the second paragraph of your letter) is a violation of the Code. See Rule 93A and 93B4.

Allowable interconnection of grounds — primary arrester, primary neutral and secondary neutral.

REQUEST (Sept 9, 65) IR 118(9)

(9) Is it the intent of paragraph 97C to permit the interconnection of primary arrester grounding conductor and secondary neutral if the primary is of the multi-grounded type and the secondary has no connection to a continuous underground water-piping system and the secondary does not have the number of grounds specified in 97C1(c)? (. . .USDA-REA Bulletin: The information contained in the paragraph numbered 1 on page 4 of this bulletin indicates that a multi-grounded neutral would comply with NESC however, this appears confusing from the wording of 97C.)

REA BULLETIN 161-19, pg 4 Sept 1958. (extract)

PRIMARY GROUNDING: There are safety rules and regulations for grounding circuits and equipment associated with voltages above 600 volts. Some of these rules and regulations were developed to meet certain circuit conditions. As rural primary distribution circuits are generally of the multi-grounded neutral design, there are special requirements for grounding of the various items of equipment. Likewise, there are additional rules that apply to ungrounded, or delta, circuits. Of major interest to those concerned with transformer installations are the following:

(1)* *When a multi-grounded primary neutral is present* at a transformer installation, the primary lightning arresters may be grounded to the transformer tanks and through additional connections to the multi-grounded primary neutral, the secondary neutral, and the driven ground rod.

(2)* *When a multi-grounded primary neutral is not present* at a transformer installation, the primary lightning arresters *shall not* be grounded to the secondary neutral except under the following conditions:

(a) When the grounded secondary conductor has elsewhere a grounding connection to a continuous metallic underground water piping system.

(b) When the grounded secondary conductor is part of a multi-grounded secondary neutral system, of which the neutral has at least four ground connections in each mile of line in addition to a ground at each service.

(3)* *When a multi-grounded primary neutral is not present* at the transformer installation and conditions equivalent to 2(a) or 2(b) do not exist, the secondary *must be interconnected* to the lighting arrester ground *through a spark gap* having a 60 hertz breakdown voltage not to exceed 10 kV, and there shall be at least one other ground on the grounded secondary conductor at least 20 feet distant from the lightning arrester ground rod.

---

*National Electrical Safety Code, Rule 97C
National Electrical Code, Article 250, Paragraph 2632 (1956 edition)

INTERPRETATION (Apr 66)

(9) No final interpretation found in the records. The consensus of committee reponses appears to be:

It is not clear from the question whether or not this refers to a common neutral system, although a "multigrounded" type of primary generally implies a common neutral system. Since it is stated that the secondary neutral has no connection to a continuous under-ground water-piping system, Rule 97C1(c) would apply. If the secondary neutral is *not* common with the primary neutral and does not have the number of grounds specified in Rule 97C1(c), interconnection is not permissible except through a spark gap as per Rule 97C2. However, if the secondary neutral *is* common with the primary neutral, Rule 285C would require that the common neutral have the required number of grounds and therefore solid interconnection *would* be permissible under Rule 97C1(c).

97C1(b) and (c) See also Rule 239C, IR 118 (1), (3), (4) and (7)

97C1(c)

Required number of grounding connections.

REQUEST (Sept 3, 65) IR 118(2)

(2) If a common secondary and primary neutral is not employed and the secondary is only a small fraction of a mile in length, what is the minimum number of secondary ground connections (in addition to those at each individual service plus the direct grounding connection at the arrestor) required by the provisions of paragraph 97C1(c)?

INTERPRETATION (Apr 66)

Rule 97C1(c) states that the secondary neutral and primary neutral may or may not be common. If not, and the secondary is less than a mile in length, it would seem that the secondary should still have at least four ground connections in addition to a ground connection at each individual service and in addition to the direct earth grounding connection of the arrester. Otherwise, interconnection, if employed, should be through a spark gap (Rule 97C2). The reasons for the multiple grounds are to eliminate, as far as possible, the danger from the failure of individual grounding conductors and to obtain a low ground resistance.

Grounded neutral, definition of four grounds per mile

REQUEST (Nov 1, 74) IR 166

. . .In one mile of 7200/12470Y distribution line with grounded neutral four customers are served, each from an individual 12470Y/7200 grounded to 120/240 volt transformer with tank mounted lightning arrester. The secondary neutral at each service is connected to the primary neutral, to the transformer tank, and to a driven ground rod at the customer's meter. A driven ground rod is installed at the base of each transformer pole and connected to the primary neutral by No 4 copper wire.

The question: Are four additional grounds on the neutral required, or do the eight grounds listed (four customer service grounds, plus four pole base grounds) meet the requirements of the Code.

INTERPRETATION (Dec 10, 74)

The line described in your letter meets requirements of the National Electrical Safety Code, Rule 97C1(c). No additional grounds are required by this rule for such a line.

Rules for the Installation and Maintenance of Electrical Supply Stations and Equipment

Part I

(Sections 10-19)

102B

Implication of retrofitting.

REQUEST (July 27, 77) IR 201(a)

I would like an interpretation of the following:

(a) 102. Application of the Rules and Exemptions

B. Intent of Rules

Is there any inference here as to retrofitting existing installations where there are *no* alternations, reconstructions, or extensions?

Comment:

It would be most useful if a statement similar to 91B2 were added in 102 (assuming that it is proper).

INTERPRETATION (Oct 19, 77)

Rule 102B does not require retrofitting where there are no alterations, reconstructions or extensions.

110A

Fence height

REQUEST (May 15, 74) IR 161

The basic question may be stated: In Rule 110A, is the one-foot barbed wire extension part of the minimum of seven feet in height of the fence, or is it in addition to the seven feet thus making an overall height of eight feet?

WORDING FROM COMMITTEE
MAKING REVISION PROPOSAL FOR PART 1 (Sept 13, 74)

> Metal fences and gates, when used to enclose electrical supply stations having energized electrical conductors or equipment that can be reached by trespassers, shall have a minimum of seven feet of fabric in height plus a one foot extension carrying three or more strands of barbed wire.

* * * *

REQUEST (Dec 18, 75) IR 177

Part of 110A:

> Metal fences, when used to enclose electrical supply stations having energized electrical conductors or equipment that can be reached by trespassers, shall be a minimum of seven feet in height and shall be effectively grounded. Other types of construction such as nonmetallic material shall present equivalent barriers to climbing or other unauthorized entry.
>
> *NOTE:* It is recommended that, where permissible, a one-foot extension, carrying three strands of barbed wire, be used above the fence fabric, either as an outside or inside the fence overhang as a vertical extension of the fence to obtain the desired overall height.

Our question is submitted by a sketch (Fig IR 177-1) showing three methods used with the one-foot extension above the existing six-foot chain link fence. The majority of the installation would be using Method A. Can Method B or C be used? Because of the angle of the fence bracket there is a slight reduction in vertical height. Method B gives added protection in preventing easy access to climbing the fence.

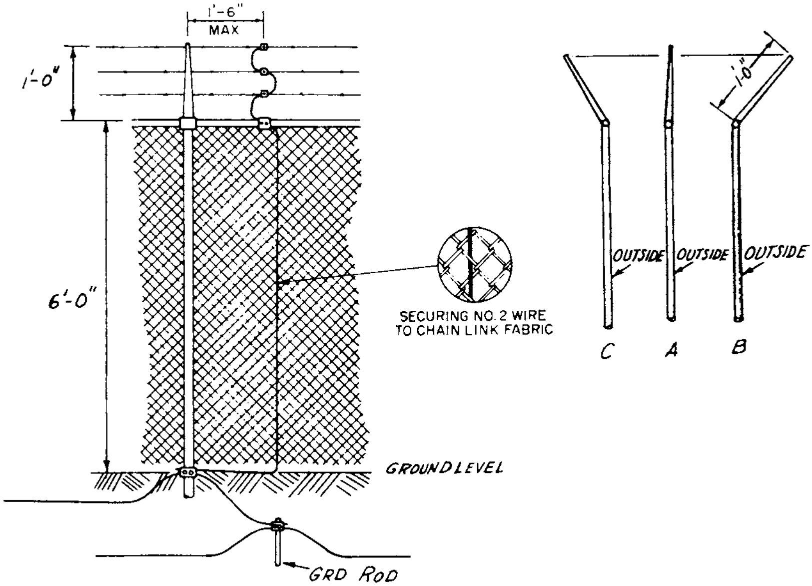

1'-6"
MAX
1'-0"
6'-0"
SECURING NO. 2 WIRE
TO CHAIN LINK FABRIC
GROUND LEVEL
GRD ROD
1'-0"
OUTSIDE
OUTSIDE
OUTSIDE
C
A
B

Fig IR 177

INTERPRETATION (Feb 4, 76)

The intent of Rule 110A is to require seven feet of fence mesh. Barbed wire extensions are not permitted in some localities. Where barbed wire extensions are permitted by local laws or regulations, any one of the three methods shown in Fig 177-1 may be used on top of a seven-foot fence mesh. Use of barbed wire is recommended in the note associated with the rule but is not mandatory. A combination of six feet of fence mesh plus a one-foot barbed wire extension in any of the three positions shown does not meet the intent of Rule 110A.

* * * *

REQUEST (July 27, 77) IR 201(b)

(b) 110. General Requirements

A. Enclosure of Equipment

Is it the intent of the indented section and the note to allow the use of six feet of fence fabric plus one foot of barbed wire extension to meet the minimum of seven feet in height listed in the indented section?

Comment:

If the barbed wire is not part of the permissible fence height, the note should stop after "...vertical extension..."

INTERPRETATION (Oct 19, 77)

The intent of Rule 110A is to require seven feet of mesh whether a barbed wire extension is or is not used.

114

Clearance of HV conductors around circuit breakers.

REQUEST (Aug 2, 65) IR 114

The following photographs show the illustration of oil circuit breakers in the main substation of the. . .Complex. . ., Florida.

The voltage at the terminals of these circuit breakers is 13 800 V phase to phase, and 7960 V phase to ground. The minimum clearance between the live parts and the work platform (ground level) is 7ft 8 in. The circuit breakers are located in a fenced area controlled by properly qualified persons and accessible only to such persons.

In view of these conditions, is this installation in violation of Section 114 of the National Electrical Safety Code?

INTERPRETATION (Oct 7, 65)

A 7ft 8 in vertical clearance from unguarded live parts of 13 800 V phase-to-phase equipment to a walkway in a substation does not meet Code requirements. Rule 114 requires either a 9ft 1 in vertical clearance, a 3 ft 7 in horizontal clearance or a guard. (Dimensions involve interpolation and are therefore approximate).

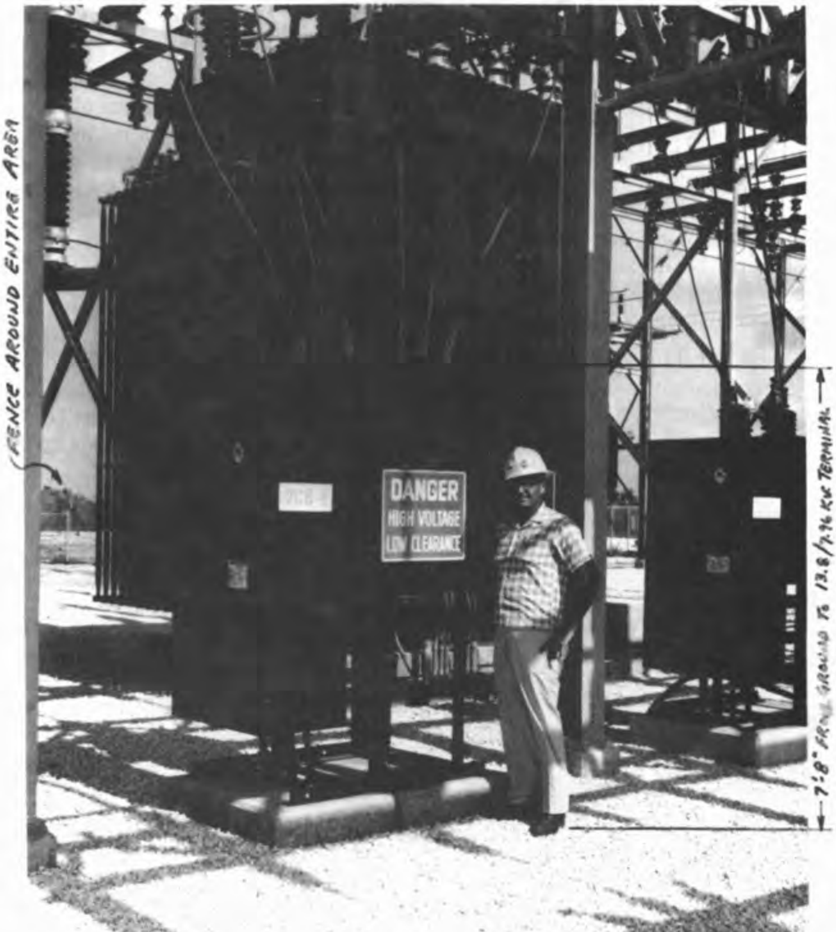

FENCE AROUND ENTIRE AREA
DANGER
HIGH VOLTAGE
LOW CLEARANCE
7'-8" FROM GROUND TO 13.8/7.96 KV TERMINAL
SUBSTATION - LC-39
SPACE CENTER, FLORIDA.

Fig 114-1

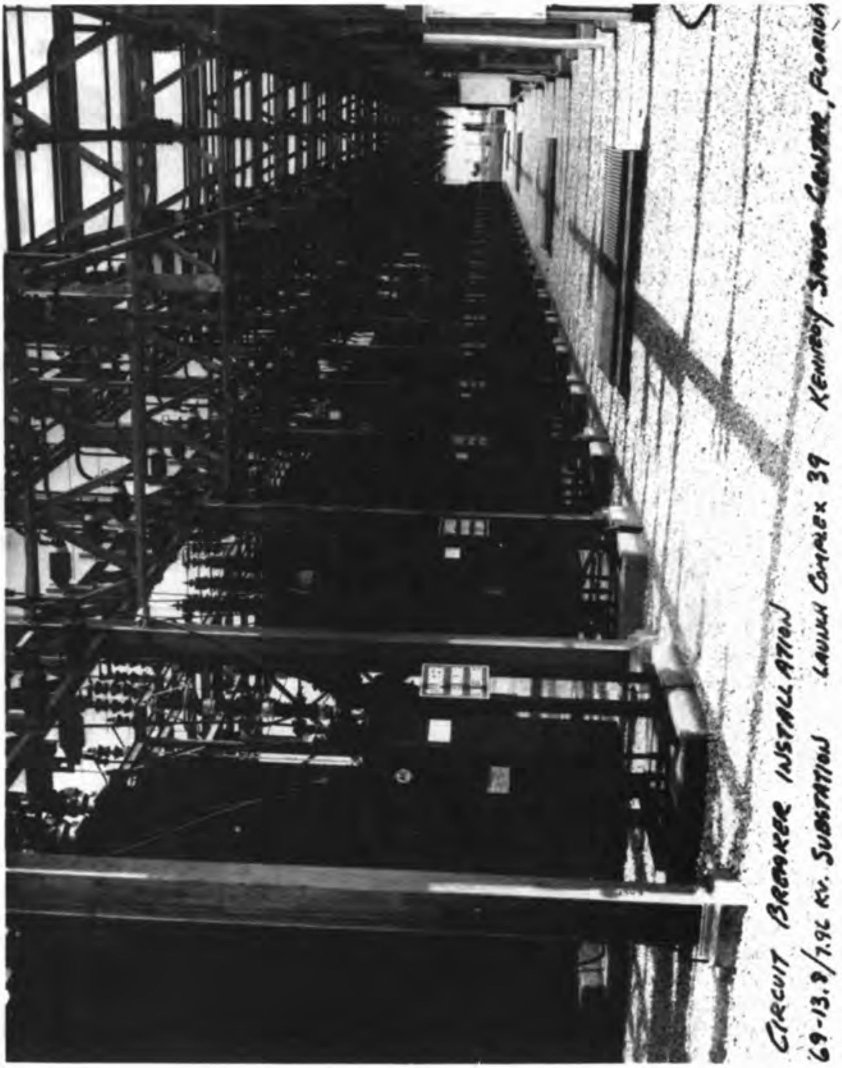

CIRCUIT BREAKER INSTALLATION
69-13.8/7.96 KV. SUBSTATION LAUNCH COMPLEX 39 KENNEDY SPACE CENTER, FLORIDA

Fig 114-2

Outdoor substation
(a) vertical clearance to live parts
(b) definition of voltage.

REQUEST (Apr 18, 77) (1948 Edition) IR 193

This is a request for clarification of Rules 114A and 114C1 in the 1948 Edition. . . .The reason we are asking clarification on this old rule has to do with a situation in which ownership of some outdoor substations is changing. The substations were constructed in the time period during which the above mentioned rule was in effect.

The situation for which clarification is requested involves the vertical clearance of live parts on the bushings of outdoor power circuit breakers. The circuit breakers are in outdoor substations which are enclosed in seven foot fences with all entrances locked and which carry danger signs. The circuit breakers operate in 3-phase, 4-wire, grounded neutral, wye connected circuits. The nominal voltage of the circuits is 7500/13 000 volts. The circuit neutrals are solidly grounded and meet standard criteria for *effectively grounded circuits.*

Now the questions about these installations are:

(a) Can rule 114A be interpreted to require the vertical clearance to live parts on these circuit breakers to be 7' 6" plus 5" OR must the vertical clearance be 8'6" plus 7"? (Plus 5" is derived by interpolating between 6,600 volts at 4" and 11 000 volts at 6". Plus 7" is derived by interpolating between 11 000 volts at 6" and 22 000 volts at 9").

(b) Can rule 114C1 be interpreted to mean that the live parts of circuit breakers installed in an outdoor substation, which substation is completely enclosed in a 7 foot chain link fence with pad locked gates and warning signs, are guarded by *isolation* so that the requirements of 114A and/or Table 2 do not apply? (The area inside the fence is accessible to qualified personnel only).

It seems to us that the interpretation of question 1 hinges upon whether the phrase "for voltage up to 7500 volts" should mean *phase to ground* voltage or *phase to phase* voltage for an *effectively grounded* system.

INTERPRETATION (June 24, 77)

(a) Rule 114A of the Fifth Edition of the National Electrical Safety Code requires a vertical clearance of 9 ft 1 inch from any permanent supporting surface for workmen. The Fifth Edition did not distinguish between grounded and ungrounded circuits.

(b) Rule 114C1 cannot be interpreted to mean that live parts in a fenced substation are guarded by isolation. Rule 100 (Scope of the Rules) indicates that the rules apply to situations where installations are under the control of and are accessible only to qualified persons.

114A1A [and 234C4(a)]

Substation conductor clearance to building.

REQUEST (Feb 22, 67) IR 124

[The company in question] installed on their private property one Allis Chalmers 750 kVA Transformer, Model X5106A, Serial No. 1819316, and one General Electric Pyranol Transformer, 300 kVA, Model NP-152238, Serial No. B-326722; three #2/RR-15 kV electrical service lines; nine 350 MCM/RH out-put lines; and eight 500 MCM/RH out-put lines.

The conductor from the city transmission lines was run underground to the site of the transformers. The in-put lines carried 12.5 kV and its voltage was transformed down to 440 voltage by one transformer and 220 by the other. All conductors entered and exited within the circumference of a storm fence some eight feet in height which surrounded the transformers on three sides. The door to the enclosure was kept locked and a sign of danger, high voltage, was affixed to the door as well as to the transformers. The remaining side of the enclsoure was formed by the wall of the building.

The wall and roof of the building forming the fourth side is approximately fourteen feet high at all points of the building. No means of access to the roof were available except by putting in place a transportable ladder.

The conductor lines coming out of the potheads came to a point approximately level with the roof and one in-put line came within about eighteen inches of the roof enroute to the transformer. These connecting conductors were not insulated.

The open wires were more than eight and one-half feet above the surface of the ground. There was no apparent supporting surface for workmen underneath the wires. There is no occasion for any adjustment or examination of the wires which are exposed while in service and, consequently, no need for accessible working space in the proximity of the edge of the roof closest to the wires.

The premises of the company were not open to unauthorized persons. The two transformers together with their input and output lines were all within the boundaries of a storm fence on three sides and the wall on the fourth side, the fence being some seven feet back from any part of the transformer or the conduit leading to and away from it.

I would like to pose the question whether a proper interpretation of Section 114 of Part 1 of the Safety Code would find the existence of the transformer and its accoutrements in violation thereof. Secondly, would Part 2, having to do with the Installation and Maintenance of Electric Supply Lines, be applicable to the connector conductor which comes within eighteen inches of the roof. This conductor is an open wiring in the yard and a span of the wiring is substantially less than twenty feet and the precautions required for stations were, we believe, observed.

It would seem that the definition of an electric supply line would eliminate the application of Part 2 to the situation described. It would likewise seem that in view of the fact that the installation is isolated and not accessible according to the definitions provided by the Code that no clearance in excess of the guard zones as provided by Section 114(b) of Part 1 would be required since there would be no occasion for workmen to approach the wires and the conductors and the insulators on which they rest from the roof for the purpose of adjustment of examination; hence no need for a working space.

INTERIM COMMENT (Mar 13, 67)

The National Electrical Safety Code Committee will not determine whether any specific installation or equipment does (or does not) meet the intent of the Code. This would have to be done by an expert who inspected the specific installation.

(Chairman). . .requesting members of the Interpretations Committee to interpret the question shown below.

Are unguarded conductors (which are not attached to a building) coming out of potheads (which are within an electrical supply station*) at approximately roof level and which are approximately 18 inches from the roof (the "roof" not being within the electrical supply station**) in violation of either Rule 234C4(a) and table 4 (See page 69 of NBS Handbook 81) or Rule 114A(1) (See 43 of NBS Handbook H30 or page 33 of NBS Handbook H31)?

*I believe that it is obvious that the transformer, etc. are within an "electrical supply station."

**I assume from the letter that this statement is accurate.

The letter states that the roof is not a supporting surface for workmen. If this is true, there is no violation of Rule 114A(1). However, the Interpolations Committee must determine if Rule 234C4(a) applies.

INTERPRETATION (Apr 67)

No final interpretation found in the records. The only interpretations committee response in file:

If it is assumed that the roof in question is not considered a permanent supporting surface for workmen, I agree with the statement in your March 18 letter that there is no violation of Rule

114A1. In addition, it might be considered, under the provisions of Rule 114C1, that this station was guarded by "isolation".

With reference to the question of whether or not Rule 234C4(a) and Table 4 apply in this case, Rule 200A states that Section 20 rules apply to "electric supply lines" and the first paragraph of definition 44 would include the conductors in question.

I do not believe the second paragraph of definition 44 excludes thse particular conductors because, by bringing the 12.5 kV line within 18 inches of the roof, "all the precautions required for stations" are not observed.

In other words, Rule 234C4(a) and Table 4 apply and the horizontal clearance for a 12.5 kV conductor to the roof (assuming the circuit is an effectively grounded circuit) should be 3 feet. Note that Table 4 is for spans of 0 to 150 ft., so the fact that span length of the conductor in question is less than 20 feet is immaterial.

124

Clearance to energized parts in substation.

REQUEST (Mar 24, 77) IR 192

I would very much like an interpretation or clarification of Fig 1 and Table 2 as it applies to exposed energized part of an apparatus bushing on the top of a transformer, circuit breaker, regulator, or a recloser within the confines of a fenced-in electrical power substation. Some of our 15 kV class apparatus are of marginal heights to provide the full 9 feet, 0 inches required by Table 2 without elevating them. However, in many cases the vertical height plus the horizontal distance from the side of the tank to the bushing would combine to give us 9 feet. We have allowed this based on Rule 124, paragraph A1. Where it states, "unless their location gives sufficient horizontal or vertical or a combination of these clearances to eliminate the possibility of accidental human contact." Also, we feel that the bushing is shielded from accidental contact by the tank of the apparatus.

This interpretation has been questioned by some of the members of our engineering staff. Your comments pertaining to the specific rule, its applicability, and our interpretation would be greatly appreciated.

INTERPRETATION (May 23, 77)

If the pad which supports the equipment will allow a person to stand on it without conscious effort, we believe it must be considered a 'permanent supporting surface for workmen.' If this is the case, it is apparent that the insulation fails to meet the requirements of Rule 124.

If this is not the case, it is reasonable to include the height of the pad as part of the required vertical distance. However, we do not believe that the arithmetic sum of the vertical and horizontal distances is appropriate since the human body is more likely to follow something akin to the taut string distance rather than right angle bends. Note also that if the tank is considered as a railing type of guard, the installation still fails to meet Rule 124.

165

44 kV 3ϕ transformer bank fuse protection.

REQUEST (Jan 6, 64) IR 106

The substation consists of three 167 kVA single phase transformers connected delta-delta with a primary voltage of 43.8 kV and a secondary voltage of 2.4 kV.

The three 44 kV primary fuses and holders were obsolete and had been rebuilt and would not receive standard fuse links. Because of this fuse wire was used in lieu of fuse links. On February 10, 1963 two of the 44 kV fuses, fuse barrels and holders were completely destroyed and in most part were blown from the supporting structure. There were signs of extreme heat to the fuse parts. This happened during a wind storm with some moisture and a likely cause for the outage could not be found.

On two prior occasions during storms the primary fuses had operated, at which time fuse wire was used, and in both cases the cause of the outage could not be determined. In both cases the fuse barrels were damaged by heat and new fuse barrels were hand made and service was restored by using fuse wire.

Our questions to you are as follows:

(1) Is the use of fuse wire for the use described approved by the National Electrical Safety Code?

(2) Would the rebuilding and changing of the primary fuses so that standard fuse links were not usable be in violation of the National Electrical Safety Code?

(3) Would the primary fuse installation as described provide correct protection for the three 167 kVA transformers?

(4) Any other comments would be appreciated.

INTERPRETATION (Feb 25 and Apr 14, 64)

The National Electrical Safety Code specifies that leads to substation transformer primaries be protected from excessive current by "suitable" fuses or automatic circuit breakers without specifying the type or material. The exact design is left to engineering judgment as to what constitutes adequate protection in any particular case. The Interpretations Committee is not in a position to pass engineering judgment on matters beyond specific Code requirements.

Rule 165 (p. 68 of NBS Handbook H30 covers the matter discussed in your letters. Those enforcing the Code would probably have to determine if a particular type or construction of fuse is "suitable" and therefore in conformance with the Code.

173C, 170, 171

(a) Requirement for disconnect switch.
(b) Energized switchblade.

REQUEST (May 23, 77) IR 190

Fig IR-190 shows a partial one-line diagram for a 69 kV switching and substation.

At the location designated 1, the diagram indicates there is not a disconnecting means from the source. Does Part 1, Section 17, paragraph 173C require a disconnecting means?

At the location designated 2, the diagram indicates the switch blade remains energized in the open position. Does paragraph 170, 171, or 173C require the switch blade not be energized in the open position?

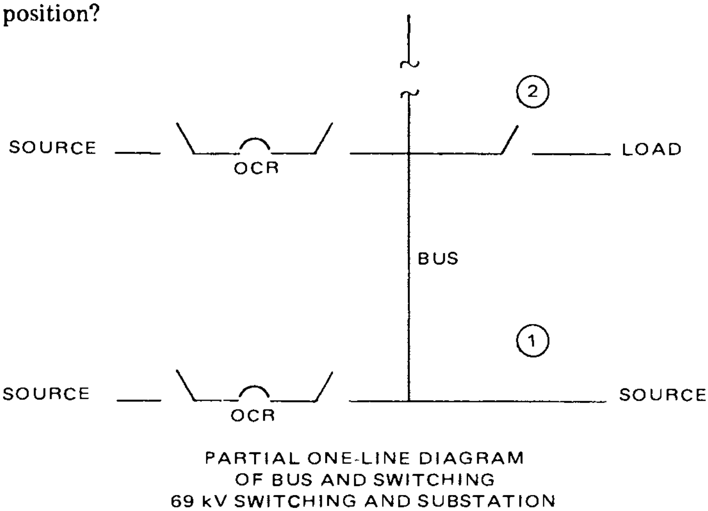


Fig IR 190.

INTERPRETATION (Mar 8, 77)

Rule 173C does not require a disconnecting means at the location designated "1" in the 69 kV substation diagram. This rule requires a disconnecting means if work is to be done on equipment without protective grounds. Rule 123C permits working without protective grounds only at 23 kV or less. Rule 173C does not, therefore, apply at voltages in excess of 25 kV.

With respect to your question regarding energized switch blades, Part I of the code contains no rule which forbids energized switch blades when the switch is in the open position.

Safety Rules for the Installation and Maintenance of Overhead Supply and Communication Lines

Definitions of Special Terms

Part 2

(Sections 20-28)

Definitions

Antenna conflict (Part 2)

REQUEST (Feb 25, 74) IR 157

Our Company is interested. . .interpretations that the Committee on Interpretations has made relative to the definition in the National Electrical Safety Code of an antenna conflict, as defined. . . in Part 2, definition 14. We are particularly interested in how the Committee feels about how such conflicts can be resolved or are they resolve when said antenna is firmly secure.

INTERPRETATION (Sept 26, 74)

With respect to your request for previous interpretation regarding antenna conflicts, we do not know of any. In any event, there are no rules in the current edition of the National Electrical Safety Code which deal with antenna conflicts.

The term "antenna conflict" was introduced in the mid 20's in the Fourth Edition of the Code. At that time, there were rules which dealt with antenna conflicts. These rules were contained in the then existing Part 5 of the Code. However, Part 5 was removed from the NES Code in the mid 60's, but the definition was, by oversight, left untouched. Thus, it has no meaning in terms of the current issue (C2.2-1960) of the Code and will be deleted in the next edition.

200C See IR for Rule 234, IR 158

201A See IR for Rule 232A, IR 195

212

Intent of term "proximate facilities".

REQUEST (May 9, 77) (1977 Edition) IR 194

I would like to request an Interpretation or clarification of a section of the 1977 edition. The paragraph in question is located at the bottom of page 106 in subsection 212 — Induced Voltages.

While it seems that this subsection addresses induced voltages on communication lines only, it may be inferred that this covers any object susceptible to induced voltage. Taken in context, the term "proximate facilities" seems to imply *only* communications facilities. However, if it was the intent of this section to include all susceptible objects, that is, barns, farm vehicles, fences, etc., the effect on Electric Utilities would be very different.

Please give me an interpretation of what was intended to be included in "proximate facilities" — only communication lines, or any object susceptible to induced voltage from the electric field of a nearby transmission line?

If *any and all* susceptible objects are included, then it would seem that an Electric Utility would have responsibilities to the public when building an EHV or UHV Transmission Line, not previously defined by the NESC.

INTERPRETATION (June 24, 77)

Rule 212, Induced Voltages, was intended to apply only to supply lines and communications facilities.

215C1

Grounding of supporting structures.

REQUEST (Nov 11, 77) IR 212

See page 108 C1. . .Supporting structures. . .shall be effectively grounded.

See page 102. . .definition — supporting structure.

Question: Is it the intent of the code that metal towers for transmission line supporting structures be effectively grounded to limit E step and E touch exposure potentials according to the equations on page 29 of the 1977 edition (National Electrical Safety Code) C2.

INTERPRETATION (Dec 1977)

Rule 96A1 is intended to apply to grounding electric supply stations. Use of the step and touch potential formulas for the grounding of transmission line towers is not required by the code.

Section 23

(a) Clearance between supply conductors and signs.
(b) Clearance between pad-mounted transformers and gas metering equipment.

REQUEST (Sept 17, 65) IR 117

(a) What minimum clearances are required for electric supply lines over a self-supporting sign (such as is frequently installed at gasoline service stations near the front property line)?

(b) What minimum clearances are required between pad-mounted transformers and above ground exposed gas metering and regulation equipment? The transformers are supplied by direct-buried supply cables, and all equipment is located out-of-doors.

We would appreciate your comments on these two situations for supply voltages of 5 through 50 kV.

INTERPRETATION (Nov 18, 65)

These questions involve areas which are not covered by the Code in its present form.

230C

Supply cables having an effectively grounded continuous metal sheath, or insulated conductors supported on and cabled together with an effectively grounded messenger. Spacer cable

REQUEST (May 19, 61) IR 92

We have been experiencing difficulties with the electric company on the proper interpretation of the expression "supply cables having effectively grounded continuous metal sheath, or insulated conductors supported on and cabled together with an effectively grounded messenger, of all voltages. . ."

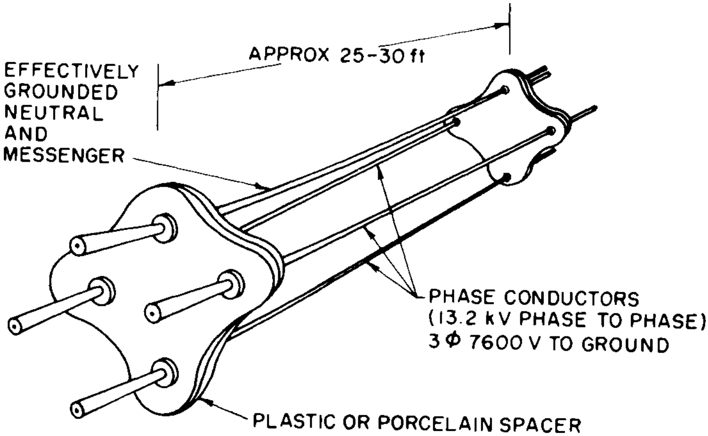
In this area the electric companies are using two types of aerial construction in addition to the regular open wire type of construction for primary circuits. The first type is known as self-supporting lashed cable construction and is similar to the type shown in Fig IR-92. The second type is self-supporting aerial spacer type construction employing a grounded messenger which supports the insulated conductors by means of insulated spacers placed at intervals in the span.

We interpret the aerial spacer type construction as being classified the same as open wire because any insulation failure will not cause de-energization of the circuit. However, the electric company wants to classify it as specially installed aerial cable under the Code.

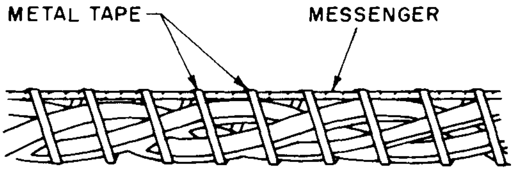
A somewhat similar discussion involves secondary circuits. Here again, two types of aerial cable are used. In the first case the conductors are lashed to a grounded messenger and treated as cable. In the second case the conductors are twisted around the grounded support wire (neutral). Here it is believed that insulation failure may or may not de-energize the circuit depending on the location and because of the low voltage involved.

The changes in the Code and the interpretation of the above will require changes in. . .Practices and Joint Use Agreements.

As the electric company. . .believe their interpreation is correct and we [the telephone company] likewise believe we are correct, it is important that an early ruling from the Committee on Interpretations be obtained. The attached memo shows the locations where the above definition appears and shows how many places for discussion arise.



SPACER CABLE



NON-METALLIC SHEATH CONDUCTORS

Fig IR 92

INTERPRETATION (Sept 64)

An interpretation concerning the expression "supply cables having effectively grounded continuous metal sheath, or insulated conductors supported on and cabled together with an effectively grounded messenger, of all voltages. . .", which appears in Rule 230C and in other Rules of the 6th Edition of the National Electrical Safety Code, was requested. The Interpretations Committee determined that the following types of cable construction, described in Mr. Smith's letter meet the intent of the above expression, wherever this expression is used in the Code. . .:

(a) Self-supporting lashed cable construction (for primary circuits)

(b) Conductors lashed to a grounded messenger and treated as a cable (for secondary circuits)

(c) Conductors twisted around the grounded support wire (neutral) (for secondary circuits)

"Self-supporting aerial spacer type construction employing a grounded messenger which supports the insulated conductors by means of insulated spacers placed at intervals in the span" (for primary circuits) does not meet the intent of the above expression.

Supply cable requirements, OR vs AND.

REQUEST (Aug 23, 77) (1977 Edition) IR 202

In ANSI C2-1977, Rule 230C, it is difficult to determine the status of triplexed service drop conductors. A portion of the rule reads "conforming to the following requirements". This can only mean total conformity since no alternates are indicated. Perhaps the meaning "conforming to *one or more* of the following requirements" was intended, because all three requirements are impossible to meet.

These same impossible requirements are also evident in Table 234-3. Two columns specify "supply cables, 0 to 750 V Meeting Rules 230C2 *and* 230C3". Perhaps the word "*or*" was intended.

INTERPRETATION (Oct 19, 77)

Rule 230C was not intended to require meeting all three of the requirements listed as one, two and three under this rule. Triplex, of course, conforms to Rule 230C.

In Table 234-3, the reference to Rule 230C2 and Rule 230C3 should read 230C2 *or* 230C3.

230D (Also 232A Table 1; 232B; 234C4)

(a) Ground neutral clearance to ground.
(b) Grounded neutral clearance to building.

REQUEST (Feb 1, 68) IR 126(a) and (b)

(a) Re National Electrical Safety Code Rule 230D: The common neutral conductor on electric systems of Rural Electric Cooperatives is designed to meet the requirements of an effectively grounded conductor. This Rule 230D then permits that neutral to have the same clearance as guys and messengers.

Now in Rule 232, Table 1, for the 3 columns headed "Open supply line wires, are wires and service drops[14]: does the footnote 14 refer only to service drops or does it refer to all 3 types of facilities? If it refers to all 3 types of facilities, then the reader refers to the first column heading labeled "Guys, messengers, communication, span, etc".

Under that [row] heading for "Spaces or ways accessible to pedestrians only" the reader finds 15 feet with footnote 7 preceding the 15. Then footnote 7 has four sub-parts. Each sub-part specifies the exact type of facility. Sub-part (3) shows as follows:

7 This clearance may be reduced to, etc.	Feet
(3) For guys	8

Is this for guys *only*, or does this 8 ft clearance also apply to effectively grounded neutral conductors? Rule 230D and footnote 14 say that an effectively grounded conductor may have the same clearance as guys and messengers. What is the voltage classification of an effectively grounded neutral?

Also does the first exception in Rule 232B mean that the effectively grounded neutral conductor is exempt from the requirement for increased clearance? If Rule 230D is applied then neutral conductors may have the same clearance as guys which are exempt.

If the aerial neutral may be as low as 8 ft or 10 ft, a dangerous condition would exist. The low conductor would be a physical hazard in spans between poles. Under normal conditions the grounded neutral is as safe electrically as a guy connected to it, but not when it is open. A lower neutral would be more subject to breaks.

We doubt that the Code intends to permit the aerial neutral (even though effectively grounded) to be so low; however, . . . the wording of the footnotes could be so interpreted.

(b) Another question is this: For clearance from buildings, what voltage class applies to an effectively grounded (aerial neutral) conductor passing by or over buildings (refer Rule 234C4)?

INTERPRETATION (June 68)

No final interpretation found in the records. The consensus of the committee responses appears to be:

(a) Rule 232, Table 1, footnote 14 applies to all three types of facilities listed in the column heading.

Rule 232, Table 1, footnote 7 was not intended to allow line conductors such as effectively grounded neutrals to be treated the same as high strength guys; mechanical strength and sag under loading performance are different.

Effectively grounded neutral conductors are not exempt from Rule 232B.

(b) Rule 234C4 does not specify any requirements for effectively grounded neutral conductors associated with circuits of 0 to 22 kV.

232

Minimum clearance for spacer cable on messenger under heavy loading conditions.

REQUEST (Mar 7, 66) IR 123

We have the problem of installing a larger spacer cable circuit in long spans on a high strength messenger. We could not determine from the 6th Edition of the National Electrical Safety Code, what minimum ground clearances we should provide for this installation under heavy loading conditions. This situation differs from the normal wire installations on poles, in that the increase in sag for spacer cables under loaded conditions is considerably greater than for open wire.

Would you give us any help in this matter? Was there some minimum ground clearance at heavy loading conditions that was used as a basis for the establishment of the 60°F clearances? We would appreciate any information you could provide which would assist us in solving this problem.

INTERPRETATION

No final interpretation found in the records. The consensus of committee responses appears to be:

For example, under Code rules it is quite possible to come up with a highway crossing clearance which, under storm loaded conditions is less than the maximum height of vehicle allowed in many states including Illinois. (Typically 13½ feet.) To illustrate this, let us consider a 1000 foot span of 8D copperweld (mentioned in Appendix 2A of H-43). This conductor undergoes a sag increase of about 15 feet under medium loading conditions. The basic clearance for a 14 kV primary conductor over a highway is 20 feet. For a midspan crossing, rule 232B requires an additional 7½ feet in the medium loading area or a 60° clearance of 27½ feet. The storm loaded clearance is therefore 27½ − 15 feet or 12½ feet.

The saving feature is of course that good engineering practice will usually locate one pole so that the point of crossing is well away from midspan. For example, with the above mentioned 1000 foot span, if the point of crossing is 100 feet from the pole, the sag increase is only 36% of what it is at midspan. Rule 232B1(b) recognizes this by permitting a reduction of 12% in the total clearance required when the point of crossing is located at 10% of the span length instead of at midspan. Under this condition the clearance required would be 24.2 feet, but the sag increase is only 36% of 15 feet or 5.4 feet. Accordingly, the storm loaded clearance would be 19.8 feet, which is not at all hazardous. Unfortunately, this decreases rapidly as the point of crossing moves toward midspan.

It seems apparent from the foregoing that a minimum ground clearance was not the controlling factor in establishing the 60° F clearances. Code rules are minimum standards and are not a substitute for good engineering judgment. Rule 200C says "Construction should be made according to accepted good practice for the given local conditions in all particlars not specified. . .in the rules." Minimum ground clearances under storm loading are particulars which are not specified in the rules. It would seem. . .that good engineering judgment and practice dictate that storm loaded clearances should be sufficient to permit the safe passage of the vehicular, pedestrian or other traffic which may be expected to pass under the line.

Clearance to ground at high conductor temperature

REQUEST (Jan 22, 76) IR 178

. . .We request. . .clarification of the meaning of the NESC requirements on basic vertical clearance above ground of high voltage power lines.

As a general practice, we have engineered our lines so that the clearances specified as minimum in the Code with 60°F, no wind — final unloaded sag were maintained at 120°F, no wind — final unloaded sag. We've done this because our ambient temperature frequently reaches 100°F in summer months and to provide some margin of safety.

We are now being urged to operate our high voltage lines at conductor temperatures approaching 200°F and are uncertain as to the intent of the Code in this area. We have reviewed the preprint of the revised Code but are not sure of the increased clearances required.

For example, if we assume a 120°F maximum ambient temperature, a 200°F maximum conductor temperature, and a 1000 foot ruling span in a medium loading district, what clearance (final unloaded) is required for a line operating at 200 kV line to ground?

INTERPRETATION (Mar 24, 76)

Rule 232 of C2.2-1960 presently specifies clearances above ground at a temperature of 60°F, a final unloaded sag, and no wind. The 60°F temperature applies to ambient, rather than conductor, temperature.

Thus the clearance requirements of Rule 232 apply at standard conditions regardless of whether the conductor temperature is 60°F or 200°F. For a 200 kV to ground conductor crossing a road, this would be 22 feet (for 50 kV) plus 0.4 in × 150 (or 60 in) plus the requirements of Rule 232B1.

The proposed revision (see C2.2-1976) now in process for C2, Part 2, Rule 232, will make it clear that the extra sag increase caused by high temperature operation of the conductors must be compensated for by providing correspondingly greater clearance when the conductor is at 60°F.

232A

(a) Sag — with or without creep.
(b) Clearance over cultivated field.

REQUEST (Dec 13, 65) IR 121

(a) We have designed a line conservatively by allowing for creep, but my point is that when it gets down to tearing out newly poured tower footings and scrapping tower leg extensions, we can still maintain that we would have met the Sixth Edition requirements without this allowance, since the definition of "final unloaded sag" in the code does not include creep. The wording of "final unloaded sag" has not been changed in the Fifth or other recent editions, before creep was normally allowed for and it is obviously an occurrence not suggested in the definition.

Therefore, I would like your opinion whether or not the Sixth Edition requires the inclusion of creep based only on what the words say. In common use today are two terms when referring to conductors, "final" and "final with creep".

(b) The second item concerned is what the words say as to the required clearance over a cultivated field. This area is not "accessible to pedestrians only" and it is not a traffic area like a road. It is my opinion that the code does not definitely state any requirement on clearance of fields.

Although road clearance of 22 ft has been used as a conservative clearance over a field, it has always been my opinion that there is no definite coverage, *based on the words of the code.* I know that sometimes 20 ft basic has been used, not the 22 ft for a road, based on the requirement for the shoulder of a road in rural areas, which is also a traffic area for cultivation equipment.

INTEPRETATION (Jan 3, 65 and Mar 28, 66)

(a) The following interpretation was issued previously. "The combined effect of both storm loading and long term creep should be considered in applying Rules 232A and 261F4."

(b) In 1944 an intepretation was made that the National Electrical Safety Code does not specify clearances over farm lands where it may be necessary to take wagons or mechanized farm machinery. This interpretation is still applicable at the present time. The National Electrical Safety Code covers this situation only by general requirements such as Rule 210, which states "All electric and communication lines and equipment shall be of suitable design and construction for the service and conditions under which they operate." Where local or state requirements exist they should, of course, be followed.

Distinction between urban and rural.

REQUEST (Dec 23, 66) IR 125

Table (1) of Rule 232A uses the following language: "Streets and Alleys in urban districts"; "Roads in rural districts" is defined in Definition #55, and urban districts in Definition #73.

In the present case the facts are as follows: The wires have no dielectric insulation, and three strand and carry between ten to fifteen thousand volts. The particular place under concern is a post where the lines run in front of a service station located on Highway 413 about five miles North of Fort Dodge, Iowa, City Limits. Located on that highway in the general area are an airport, connecting the City with Omaha, Nebraska, Des Moines, Sioux City, Mason City, Waterloo, and Dubuque, Iowa on regularly scheduled flights of passenger planes; the Fort Dodge Armory; the Public Lake; a large restaurant; many new homes, as well as a number of more minor public facilities. The closest town to Fort Dodge on this Highway, contains about 1000 persons. The second closest contains about 5000. Fort Dodge itself contains about 30 000 persons.

The question is whether the area in front of the service station would be an urban or a rural district under Rule 232A. If you cannot give a definite answer, please give the reason why.

INTERPRETATION

No final interpretation found in the records. The consensus of the interpretation committee responses appears to be:

. . .It would be very difficult to obtain a consensus as to exactly what is urban and what is rural under the existing Code definitions. For example, the "thickly settled areas" referred to in definition 73, could be defined in terms of population density, but the Code does not do this. Hence this would be a matter of judgment. Definition 73 goes on and says, "a highway, even though in the country, on which the traffic is often very heavy is considered as urban." This is an attempt to explain the phrase "or where congested traffic often occurs." But nowhere in this Code (or the Discussion either) is there a definition of what "often" means. Whether this means once a day or five times a day is a matter of judgment.

. . .The question is one which the code intended to leave up to the judgment of the persons constructing lines or the administrative authority having jurisdiction.

Clearance required for communication conductors over roads.

REQUEST (May 10, 77) (1973 Edition) IR 195

The method used by. . .in checking road clearances is to attach a whip to a vehicle and drive along residential streets measuring cables that have less than 18 feet clearance. To date, they have reported over 2000 of these low clearance, most of which are between 17 and 18 feet.

We feel that this method of determining clearance violates the intent of the National Electrical Safety Code. Specifically, our problem involves an interpretation of Rule 201A as it relates to the provisions of Rule 232A.

Many of the violations we have received involve poles which are jointly occuped with power company facilities. These cables frequently cannot be raised without either violating the clearance required from power or by replacing poles. Needless to say, replacing poles to correct these conditions would entail a considerable expenditure of capital funds.

We understand that the 60° F clearance of 18 feet specified for road crossings was intended to accommodate vehicles up to a height of 14 feet. Presumably, the extra 4 feet was partly an allowance for increased sag as a result of ice loading or high temperatures, and partly an additional safety factor of 6 inches.

It is our policy to limit all road crossing spans to a *maximum* of 150 feet. Assuming full ice and wind loading but with the temperature of 35° F instead of zero, the maximum sag increase of any of our cables in a 150 foot span is 25 inches.

Considering these facts, and recognizing the maximum legal height of vehicles in the State of Michigan is 13½ feet, we see no hazard where our facilities have a 17 foot clearance of 60° F. With a 17 foot clearance at 60° F our minimum storm loaded clearance at 30° F is 14 feet 11 inches. This results in a storm loaded clearance in Michigan of 1 foot 5 inches to the highest truck.

We realize that a 17 foot clearance above roadway surfaces at a temperature of 60° F does not comply with Rule 232A. We also realize the Interpretation Committee cannot change the rules. However, we do ask your opinion as to whether this kind of situation comes under the provisions of Rule 201A. To raise a cable from 17 feet to 18 feet appears to us to represent "an expense not justified by the protection secured."

We understand the. . .Public Service Commission. . .can issue a waiver or modify the rules (per Rule 201A) but we would like your written opinion as to whether Rule 201A was intended to or can be applied to a situation such as ours.

INTERPRETATION (June 24, 77)

Rule 201A may be invoked in any situation where there is reason to believe that the expense involved is not justified by the protection secured. We certainly see nothing in your situation that would preclude an appeal to your commission under the provisions of Rule 201A.

232A Table 1
See IR for Rule 230D, IR 126(b)

Clearances applicable to building construction site

REQUEST (Apr 11, 74) IR 159

Can you advise whether there has been an interpretation of . . . Rule 232A to determine under what category a building construction site would fall? The building would be multistory, height exceeding the maximum clearances shown in Table 1 of Rule 232A. Scaffolding, ladders, fork-lift trucks, and other vehicles and equipment would be expected to be used in the area.

INTERPRETATION (Oct 7, 74)

Clearances involving building construction sites are not covered by this Code. This was the subject of a previous interpretation dated March 12, 1963 (rule 234C4, IR 98). It was pointed out that there are too many variables which may affect clearance requirements for buildings under construction. It was felt that any set of clearances which covered the worst situation would inherently penalize other situations where different construction equipment and methods were used. Clearances from completed buildings are covered in Rule 234C. Rule 232A does not apply to building sites under construction. The U.S. Labor Department (OSHA), especially 29CFR1926, as well as most states, have regulations regarding the clearances between cranes and energized power lines.

Spaces and ways accessible to pedestrians.

REQUEST (Feb 1, 68) IR 126(c)

(c) Please comment upon spaces or ways accessible to pedestrians only". We feel that this is a matter or opinion and that such conditions change as land is subdivided, new roads are developed, roads are widened, oil company vehicles with heights up to nearly 16 ft travel widely in rural areas, houses are moved, land is graded or built up; in brief unforeseen conditions develop and accidents occur. We feel that the clearances should be increased or preferably delete this classification which is subject to rapid change. In some cases the change in a line facility occurs after the change in land usage.

If the "pedestrian only" classification is deleted, we suggest that the classification for "Public streets, alleys or roads in urban and rural districts" be amanded to cover private property.

INTERPRETATION (June 68)

No final interpretation found in the records. The consensus of the committee responses appears to be:

See rule 232A, IR 121(b)

(c) People have tried to use the section on "Spaces or Ways Accessible to Pedestrians" as a catch-all for farm land, et cetera, by ignoring the word "only" and the plain language of Notes 6, 10, 11 and 12, which make it clear that in these situations NO VEHICULAR TRAFFIC OF ANY KIND IS EXPECTED UNDER THE CONDUCTORS.

Clearance over ground, spaces accessible to pedestrians only

REQUEST (Aug 22, 74) IR 165

We are currently. . .upgrading an existing 230 kV line to 345 kV, and are desirous of obtaining an interpretation of the intent of the seventeen feet suggested for "spaces or ways accessible to pedestrians only" . . .in Table 1, Rule 232A.

We are considering the application of the seventeen-feet base to areas of pasture land, heavily covered brush, and/or timber land. Recognizing the land is accessible to all-terrain vehicles and men on horseback, is it the intent or can the Code be interpreted to classify such ground as accessible to pedestrians only?

INTERPRETATION (Nov 18, 74)

The Sixth Edition of the Code does not contain specific clearances for the kinds of land you describe. The Code covers this situation only in a general way. Rule 210, for example, states that "all electric supply and communications lines and equipment shall be of suitable design and construction for the service and conditions under which they are to be operated." The latter part of this rule would require recognition of the kind of activity which takes place in the immediate vicinity of and under the line.

Clearance to building

REQUEST (Oct 21, 76) IR 186

. . .The. . .Company. . .was the owner of a warehouse building located in its. . .Railroad Yard in. . . . It. . .operated and controlled an 11 000 volt, 3 phase transmission line which, at the locations we are concerned with, ran adjacent to and virtually parallel with the length of the warehouse building. The power for the transmission line originates. . .at the railroad's generating plant. It supplies power to track drawbridges, float bridges, workshops, and other miscellaneous buildings. When and where appropriate, transformers reduce the power for use in buildings, including lighting for the warehouse building referred to. The 11 000 volt transmission line was an open wire — it was not insulated.

I ask you to assume the above statement of facts as well as the following facts:

(1) The warehouse building is approximately 1500 feet long, approximately 60 feet in depth, and 23½ feet high.

(2) The length of the building runs north to south. The width of the building runs east to west.

(3) The building is divided into sections known and described as "stalls," which are numbered from north to south 1 through 24.

(4) Along the entire length of the building, on its east side, runs a truck loading platform which is 4 feet high and 7½ feet wide. East of and abutting that platform is a roadway used by trucks to deliver and remove freight to and from the warehouse building.

(5) In front of Stall 17, on the east side of the building, the lowest and nearest transmission line (which virtually parallels the length of the building) is 27½ feet above the roadway and 10 feet from the east wall of the warehouse building; that is, if a straight line or plumb were dropped from the lowest overhead transmission line in front of Stall 17 to the roadway below, it would touch the roadway at a point 10 feet beyond (east of) the wall of the building (as measured at ground level) and 2 feet 6 inches from the outer (east) edge of the platform.

(6) North of Stall 17, the lowest and nearest transmission line is affixed to a tower or pole (Pole 749) at a height of 33½ feet above the level of the roadway and 10 feet from the east wall of the building (assuming the east wall line was extended upward in a straight line to that height, that is, 32½ feet).

(7) South of Stall 17, the lowest and nearest transmission line is affixed to the under portion of the Willis Avenue bridge, which crosses over the Harlem River and then the Harlem River Yard and over the width of the building. At that point, the lowest or nearest transmission line is 22½ feet above the roadway and is 12 feet from the east wall of the building. The transmission line passes under that bridge and continues south to Pole 669.

(8) Pole 749 is approximately 100 feet north of the north side of the Willis Avenue bridge.

(9) The building, its platform, the transmission line and its supporting structure, and the roadway are all located within the Harlem River Yard, a rather large, privately owned railroad installation.

I am inquiring whether the location of the lowest 11 000 volt transmission line at Pole 749, at Stall 17, and at the Willis Avenue bridge, as described above, is or is not in conformity with the recommended clearance requirements of the National Electrical Safety Code, assuming that the Code applies.

I feel that the arrangements of the transmission line at Pole 749, at Stall 17, and at the Willis Avenue bridge locations do conform with the clearance requirements recommended by the National Electrical Code, and more specifically with Sections 232A and 234C4(a). I interpret those sections as requiring that the horizontal clearance at and below the level of the loading platform be measured from the edge of the platform a distance of 8 feet and that the horizontal clearance above the level of the platform be measured from the east wall of the building a distance of 8 feet (Section 234C4). Since the transmission line does not pass over the roof of the building at Pole 749, at Stall 17, or at the Willis Avenue bridge locations, I feel that Section 232A would govern the vertical clearances at those locations. That section would require that the transmission line be placed at a height of not less than 20 feet above the roadway (that is, public streets, alleys, or roads in urban or rural districts) and at a height of not less than 15 feet above the level of the loading platform (that is, spaces or ways accessible to pedestrians only). I enclose. . .a diagram (Fig IR 186-1) which depicts my interpretation of those sections as they relate to the assumed facts.

On the other hand, it has been claimed by others that the arrangements of the lowest and nearest transmission line at Pole 749, at Stall 17, and at the Willis Avenue bridge locations do not conform with the clearance requirements of Section 234C4(a). They urge that that section requires the minimum horizontal clearances for the height of the building be measured at ground level from the outer (east) edge of the loading platform a distance of 8 feet. Specifically, they interpret Section 234C4(a) to require that the vertical clearance be projected upwards in a straight line from 8 feet east of the loading platform to a point where it reaches roof level, at which point the line should swing in an arc in a westerly direction toward the building until it is at a level 8 feet above the level of the roof of the building. Under this interpretation, it is claimed that the lowest or nearest transmission line does not meet the Code requirements at the Stall 17 and Willis Avenue bridge locations since it is the platform, rather than the building wall, which sets the outer horizontal limits of the building at all levels. In other words, this interpretation seems to require horizontal clearances of 15½ feet from the east wall at all points above the level of the platform. I enclose. . .a diagram (Fig IR 186-2) which depicts this interpretation of the Code. I call to your attention that Fig IR 186-2 depicts an overhang at the level of the roof projecting 3 feet east of the wall of the building. It also depicts the arrangement of the transmission wire at locations south of the Willis Avenue bridge; that is, at Stall 19 and at Pole 669. For the purposes of this inquiry, please assume the existence of no overhang at the Stall 17 and the Willis Avenue bridge locations. In addition, it is not necessary to concern yourself with the Stall 19 and Pole 669 locations.

Under the assumed facts, will you please advise:

(1) Whether the arrangements of the lowest and nearest transmission line at Pole 749, at Stall 17, and at the Willis Avenue bridge comply with or violate the clearance requirements recommended in the National Electrical Safety Code.

(2) Whether it is a proper or improper interpretation of Section 234C4(a) to measure the horizontal clearance from the east or outer edge of the loading platform a distance of 8 feet and then, from that point, project that clearance line upwards in a straight line to a point where it reaches the level of the roof, which interpretation, in effect, requires a horizontal clearance of 15½ feet from the east wall of the building at locations above the level of the platform.

(3) What is the proper interpretation of Sections 232A and 234C(a) as applied to the arrangements of the lower or nearest transmission line at Pole 749, Stall 17, and the Willis Avenue bridge locations? Would you also prepare a diagram indicating how those sections should be interpreted with respect to the facts assumed?

(4) Is the transmission wire an "unguarded or accessible supply conductor" within the meaning of that term as used in Section 234C1(a)?

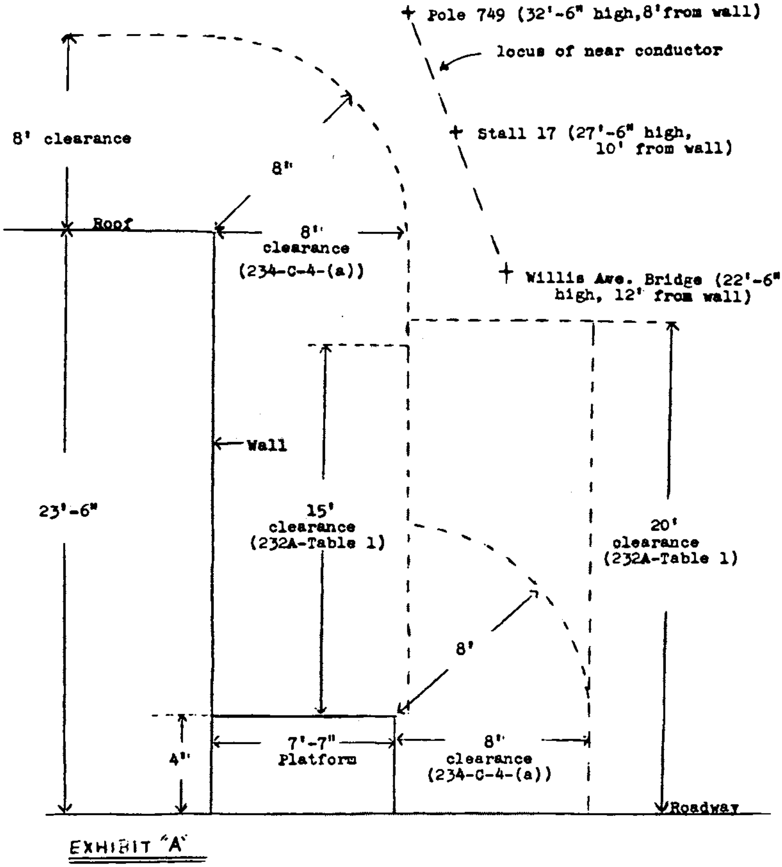

Pole 749 (32'-6" high, 8' from wall)
locus of near conductor
Stall 17 (27'-6" high, 10' from wall)
Willis Ave. Bridge (22'-6" high, 12' from wall)
8' clearance
8'
Roof
8' clearance (234-C-4-(a))
Wall
23'-6"
15' clearance (232A-Table 1)
20' clearance (232A-Table 1)
8'
4'
7'-7" Platform
8' clearance (234-C-4-(a))
Roadway
EXHIBIT "A"

Fig IR 186-1

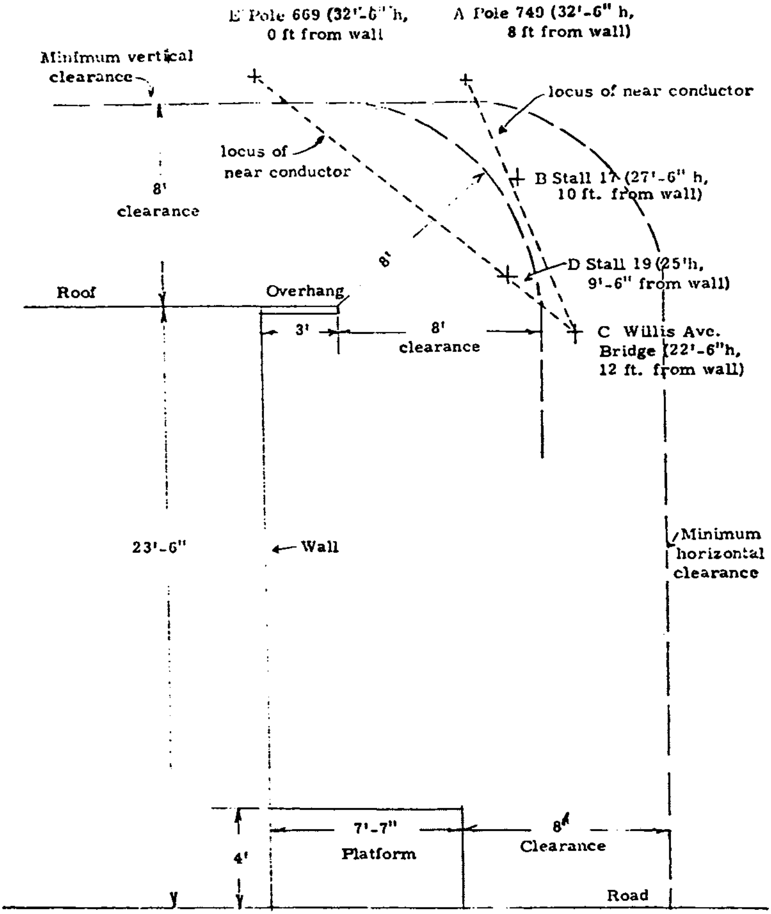


Fig IR 186-2
Cross section of warehouse building showing position of conductor nearest to building between Pole 749 and Pole 669. (Dimensions are taken from New York Fire Department reports, Penn Central answers to interrogatories, and observations at the side.)

INTERPRETATION (Dec 3, 76)

We believe that the arrangements of the lowest and nearest transmission line conductor at Pole 749, at Stall 17, and the Willis Avenue bridge meet Code requirements. However, it should be noted that the requirements of Table 4, Section 234C4(a), apply to span lengths of 150 feet and less. If the span length exceeds 150 feet, Rule 234C4(a)(2) will require greater clearance. It is assumed that the power system is either an 11 kV delta or an 11 kV to ground wye circuit with a grounded neutral.

Rule 234C4(a) does not specifically cover clearances from loading docks. The Code covers clearances from loading docks only in a general way. For example, Rule 200C calls for conformance with accepted good practice, Rule 210 requires suitable design and construction for the particular service and conditions involved. The 15 foot clearance shown in Fig IR 186-1 is the clearance required for "spaces or ways accessible to pedestrians only" by Table 1, Section 232A. However, the likely use of mechanized loading equipment, such as fork lift trucks, indicates that this clearance would not be appropriate for loading docks. Twenty feet would be a more reasonable value, assuming the mechanized loading equipment, loads involved, etc, will not exceed the legal height of highway vehicles. Rule 234C4(a) should not be interpreted as requiring 8 feet horizontally from the vertical projection of the loading platform projected to the level of the roof.

Similarly, Rule 232A, Table 1, does not apply per se to private yards used for loading and unloading trucks. However, if the trucks and their loads are the same height as the maximum legal height of trucks permitted on highways, the highway clearances of Rule 232A would be appropriate under Rule 200C or Rule 210. Rule 232A applies to span lengths not in excess of 175 feet. For longer spans, see Rule 232B.

Finally, the transmission line conductor or conductors would be considered as unguarded or accessible supply conductors within the meaning of that term as used in Rule 234C4(a).

Clearance for CATV cable above vacant lot

REQUEST (Dec 12, 74) IR 169

A question arises concerning clearance from the ground for a TV cable which I assume is classified as a community antenna television cable.

Our insureds install their TV cable below the crossarms of the Central Power and Light poles. In this particular instance, our insureds installed the TV cable on poles bordering a vacant lot, adjacent to a dead-end street as can be seen by the enclosed diagram (Fig IR 169). The vacant lot had at least 3-foot-high grass and one particular truck frequently made U-turns under the Central Power and Light wires and got back onto the main street instead of going to the end of the one-block-long dead-end street and making a proper turn onto Alamo Street to get back onto the main street.

On July 21, 1973, the truck, which is 13 feet 6 inches high, hit the TV cable which had recently been installed and caused substantial damage. What I would like to have is your opinion as to what height the community antenna television cable should be from the ground when it borders a vacant lot such as this and the lot is covered by 3-foot-high grass.

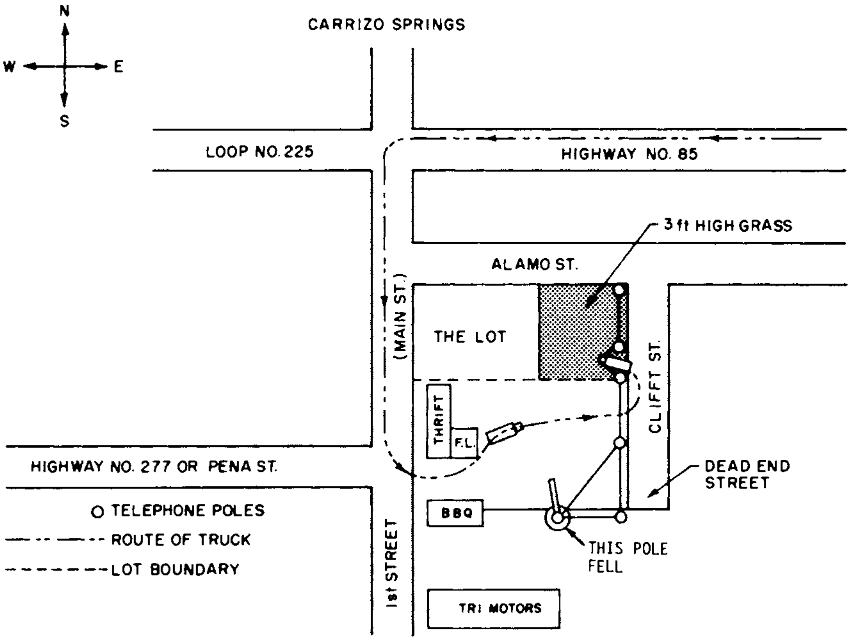

N
W
E
S
CARRIZO SPRINGS
LOOP NO. 225
HIGHWAY NO. 85
3 ft HIGH GRASS
ALAMO ST.
(MAIN ST.)
THE LOT
CLIFFT ST.
THRIFT
F.L.
HIGHWAY NO. 277 OR PENA ST.
DEAD END STREET
O TELEPHONE POLES
ROUTE OF TRUCK
LOT BOUNDARY
BBQ
THIS POLE FELL
1st STREET
TRI MOTORS

Fig IR 169

INTERPRETATION (Feb 28, 75)

Footnote 12 (associated with Table 1, Rule 232A) applies only to rural areas. Fig IR 169-1. . .strongly suggests the location of the accident would not be considered rural and footnote 12 would not apply.

Table 1 requires a clearance of 18 feet for communication cables or conductors crossing or running along and within the right of way of roads or streets in urban areas.

This may be reduced by footnotes 10, 11, or 13. The presence of a ditch, fence, or embankment, for example, would serve to justify application of footnote 10 with a permitted clearance of 8 feet. If Clifft Street were an alley, footnote 13 would apply and the required clearance would be 15 feet. Footnote 11 of course applies only to anchor guys. However, nothing in the material you submitted justifies the application of any of these footnotes. Note that all of these clearances apply under the conditions stated in Rule 232A.

CATV cable clearance.

REQUEST (Sept 15, 77) (1973 Edition) IR 206

This is a request to clarify the intent of Rule 232A, specifically Table 1.

Conditions

A community antenna TV cable crossing over a motel-restaurant parking lot which would be subject to truck traffic.

Questions

(A) Would the intent of the rule include such a parking lot under the heading, "where the wires cross over public streets, alleys or roads in urban or rural districts," Or . . .

(B) Would parking lots subject to truck traffic be excluded from clearance standards? Or, . . .

(C) Would parking lots subject to truck traffic be covered under some other rule?

INTERPRETATION (Oct 19, 77)

Rule 232A in the 1973 code does not specify the clearance required for communication facilities crossing parking lots. Rule 200C does however call for construction to be in accordance with accepted good practice. Rule 210 calls for suitable design and construction for the service and conditions under which lines are to be operated. Rule 211 requires installation and maintenance of lines to be such as to reduce hazards to life as far as practicable.

Clearance of power lines above sprinkler heads over orchard

REQUEST (Dec 11, 74) IR 168

...In Rule 232A, Table 1...pertaining to electric power lines above grounds or rails...it is provided that in the case of wires carrying 15 000 to 50 000 volts extending above "spaces or ways accessible to pedestrians only," the height must be 17 feet.

The problem situation existing here involves farm land devoted to orchard. Power lines extend above the orchard and the owner desires to install a sprinkling system for the dual purpose of irrigation and inhibiting the development of fruit buds and blossoms. The sprinkling system would be stationary but the sprinkler heads would be from 12 to 14 feet high and, thus, only a few feet from the power lines. The farmer takes the position that the regulation should be strictly construed and that the 17 feet should relate to the distance between the power line and the ground. The power company takes the position that the sprinkler cannot be installed because it would bring the sprinkler heads to a distance only a few feet below the power lines.

INTERPRETATION (Feb 28, 75)

The Sixth Edition of the Code does not prescribe clearances for the particular situation you describe. Clearances for "spaces or ways accessible to pedestrians only" do not apply since they are not intended to cover agricultural land. This is because it was recognized that the height of agricultural equipment can and does vary considerably. It was felt that requiring uniform clearances which were adequate for the highest agricultural equipment would cause unjustified expense in situations where the maximum equipment height was considerably less.

The Code covers your kind of situation only in a general sort of way. Rule 210, for example, requires "...lines and equipment to be of suitable design and construction for the service and conditions under which they are to be operated." This, of course, requires recognition of the kind of installation or activity which takes place in the immediate vicinity of and under the line.

Clearance above ground in orchard.

REQUEST (Mar 29, 77) IR 187

We would appreciate an official interpretation...regarding clearances of a 7.2 kV to ground distribution line.

The distribution line is located as shown in Fig IR 187.

In reference to 232A, Basic Clearances, Table 1, does the 15 ft minimum vertical clearance of wires above ground apply to a citrus orchard where there are no established roads or driveways?

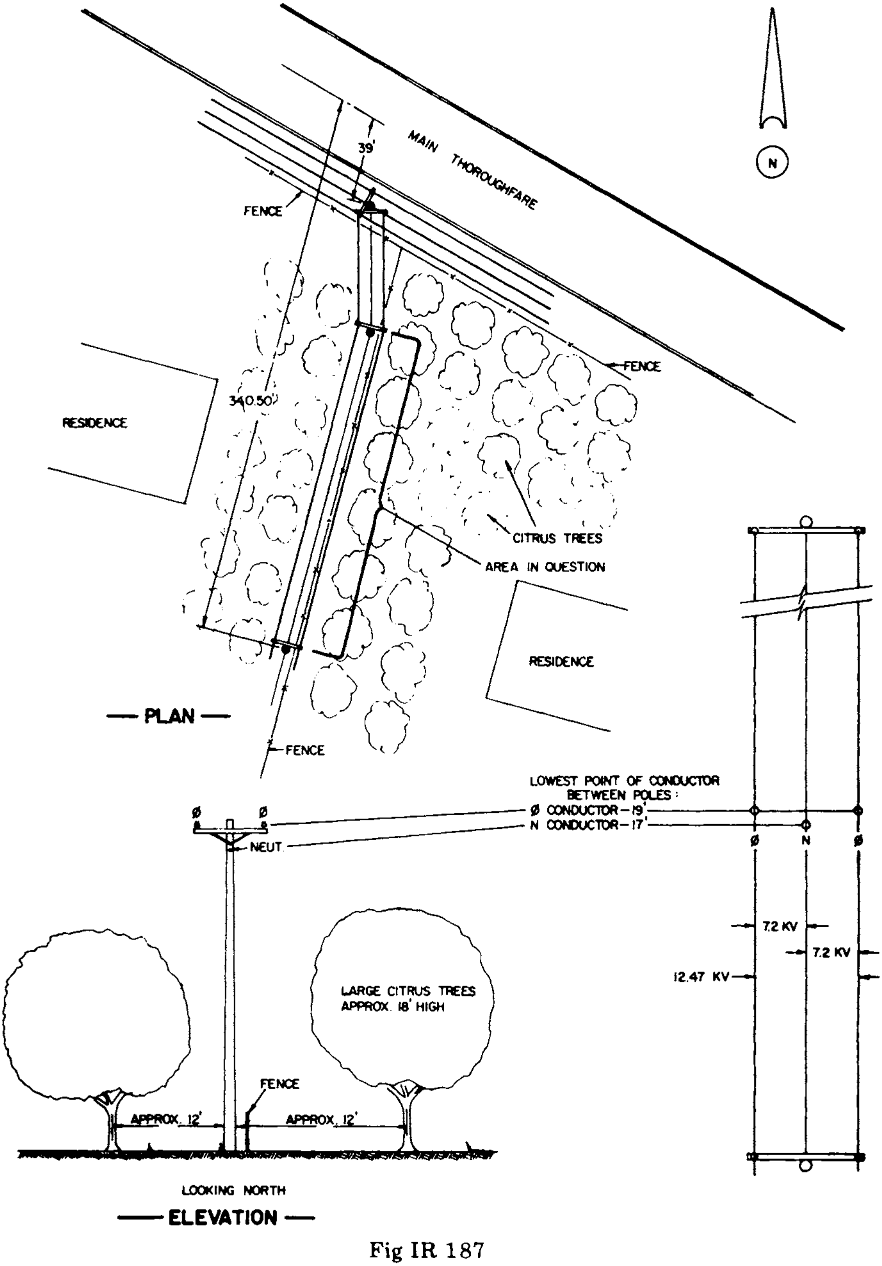

N
MAIN THOROUGHFARE
39'
FENCE
FENCE
340.50'
RESIDENCE
CITRUS TREES
AREA IN QUESTION
RESIDENCE
— PLAN —
FENCE
LOWEST POINT OF CONDUCTOR
BETWEEN POLES:
Ø CONDUCTOR – 19'
N CONDUCTOR – 17'
Ø Ø
NEUT.
Ø N Ø
7.2 KV
7.2 KV
12.47 KV
LARGE CITRUS TREES
APPROX. 18' HIGH
FENCE
APPROX. 12'
APPROX. 12'
LOOKING NORTH
— ELEVATION —

Fig IR 187

INTERPRETATION (Jan 13, 77)

The 15 ft clearance requirement of Table 1 (Rule 232A) for conductors of 750–15 000 V is for spaces or ways accessible to pedestrians only. We do not believe clearance above ground occupied by a citrus orchard falls in that category. As far as the 1973 Code is concerned, we can only refer you to some of the general rules of the Code such as Rules 200C and 210.

The new (1977) Code, however, specifies a basic clearance of 20 ft for conductors of 750–15 000 V passing over cultivated land including orchards. A footnote indicates that this clearance applies where vehicles and equipment traversing or cultivating the ground have an overall operating height of less than 14 ft.

232A3

Definition of fixed supports.

REQUEST (Mar 14, 63) IR 99

Request. . .a definition of the term "fixed supports" as it appears in rule number 232; "Vertical Clearance of Wires Above Ground or Rails". Part A; "Basic Clearances", condition number 3; "Fixed supports for the Conductor or Wire". In particular, would a single string suspension type insulator be considered a fixed support in the application of the basic clearances in Table 1.

INTERPRETATION (Apr 15, 63)

The Interpretations Committee concludes that condition 3 of Rule 232A cannot be construed to include "string suspension type insulators" referred to in the inquiry. Insulators which are free to swing, as these are (except as deadends) can hardly be considered as being fixed. As described in rule 232B3, extra clearance may be required at railroad crossings employing suspension type insulators. Other ground clearances are not affected by the use of suspension type insulators, however. The need for extra clearance at railroad crossings involving suspension insulators can, of course, be eliminated by following the provisions of rule 233B4.

It should be noted that the provisions of rule 232 governing ground clearances are paralleled in rule 233 governing wire crossing clearances. The same considerations which apply to the use of suspension insulators at railroad crossings also apply at crossings over communications lines.

The Committee further remarks that, if the inquiry is referring to a single suspension type insulator (rather than a string), the same interpretation applies as this single insulator could be free to swing and could not be considered a fixed support.

232B See IR for Rule 230D, IR 126(a)
232B2 See IR for Rule 233B2, IR 160

232B2d

Transmission line clearances. Meaning of "maximum conductor temperature for which the line is designed to operate" with respect to designed for, but unplanned contingencies.

REQUEST (Oct 3, 77) (1977 Edition) IR 207

I would appreciate your interpretation of certain wording in the National Electrical Safety Code. That section specifies that the recommended clearances to ground be maintained at the "maximum conductor temperature for which the line is designed to operate. . . ."

. . .an association of utilities has standardized three ratings for which lines are to be built in New York State. Lines are to be designed for "normal" operating conditions and two emergency operating conditions. The emergency ratings are intended for use during periods of unanticipated equipment outages or other system contingencies. The "long term emergency" rating can be utilized for up to 25 hours at a time for a total operating time not to exceed 300 hours during the life of the line. The "short term emergency" rating can be applied for not more than 15 minutes at a time with the total time not to exceed 12½ hours during the life of the line. Specific conductor temperatures are specified for each of the ratings.

Our question is whether "maximum conductor temperature for which the line is designed to operate" is intended to apply to only normal operating conditions or also to the higher temperatures which are anticipated to occur during unplanned contingencies? If intended to apply only to normal conditions, what minimum clearances should be used for contingency conditions?

INTERPRETATION (Dec 1, 77)

The increased clearances required by Rule 232B2d to compensate for extra sag caused by operation at elevated temperatures should be based upon the maximum temperature which the conductor is expected to reach. If short time emergency loading is contemplated for a line the conductor temperatures resulting from such operation should be used in applying Rule 232B2d. (It is assumed that short term loading would be more severe than long term emergency or normal loading.)

232B2d(2)

Clearance to roads; high temperature of transmission lines.

REQUEST (July 1, 77) (1977 Edition) IR 197

Our transmission people. . .have a concern regarding the 1977 Edition, Rule 232B2d(2). They feel that the new code can be interpreted to add the increase *twice.* To illustrate, their sample calculation is shown:

Minimum Clearance Above Roads, etc.
(for 240 kV — 1431 kcmil ACSR conductor)

Rule 232A — Basic Clearance — Table 232-1	22.00 ft
Rule 232B1a — [0.4 $(240 \div \sqrt{3} - 50) \div 12$]	2.95 ft
Rule 232B2d(2) — 185° F sag — 60° F sag	6.00 ft
60° F clearance	30.95 ft
185° F sag — 60° F sag	6.00 ft
185° F clearance	36.95 ft

This probably stems from the transmission design, in which they use the 185° F maximum design conductor temperature for laying out the line profile. Clearances are determined from the sag template of the conductor at this temperature.

In order to eliminate this concern, I have been asked to obtain an official letter from the Interpretations Committee with the correct method of calculating this clearance.

INTERPRETATION (Sept 29, 77)

Rule 232B2d requires increasing the 60° F clearance by the difference in sag between the maximum conductor temperature (if in excess of 120° F) and 60° F. It does not require adding twice this difference in sag.

233B2; 232B2

Clearances, wires on different supports, definition of voltage

REQUEST (May 14, 74) IR 160

We here at Metropolitan Edison Company would like to have clarification of Rule 233B2 in the National Electrical Safety Code, 1973 Edition. This rule deals with the increased clearances of wires carried on different supports for voltages in excess of 50 000 volts. Are we to assume the voltages of effectively grounded circuits to be phase to phase voltages or phase to ground voltages when entering into calculations for this increased clearance? Take, for example, this hypothetical case! We want to undercross an existing 230 kV line with a new 34.5 kV line. Both lines are effectively grounded. After carrying out the calculations of Rule 233A and Rule 233B1, we want to determine the increased clearance required by Rule 233B2. Do we use the phase to phase voltage of the higher voltage line, that is, (230 kV−50 kV) × 0.4 inch, or the phase to ground voltage of the higher voltage line, that is, ($230/\sqrt{3}$ kV−50 kV) × 0.4 inch?

Also, would your answer to the above question hold true for Rule 232B2, which is the increased clearance required for wires above ground or rails?

INTERPRETATION (Sept 27, 74)

Voltage of an effectively grounded circuit means the highest effective voltage between any conductor and ground except where indicated elsewhere. (See definition 74, Part 2.) For circuits not effectively grounded, voltage is the highest effective voltage between any two conductors. (See definition 75.)

234

Clearance to buildings and lines

REQUEST (Dec 18, 72) IR 158

We are in the process of attempting to standardize the separation of transmission lines and at the same time to maximize the use of present rights-of-way.

It would be appreciated if you would obtain an interpretation of the NESC as to the applicable provisions which would control the design of line separation as well as clearance required to edge of right-of-way assuming the existence of a building, flag pole, antenna, etc, at the conductor elevation.

...Fig IR 158 indicates a typical situation with line design assumptions and it is requested that comments regarding the controlling provision(s) or actual distances D_1, D_2, and D_3 (in relation to terms given) be solicited from NESC to clarify "in-house" interpretations.

Line design assumptions:
(1) Three double circuit 230 kV transmission lines (identical).
(2) Structures opposite each other and same height.
(3) Span: 1000 ft.
(4) 60°F final sag: Conductor, 30 ft; static, 20 ft.
(5) Maximum sag increase: Conductor, 10 ft; static, 6 ft.

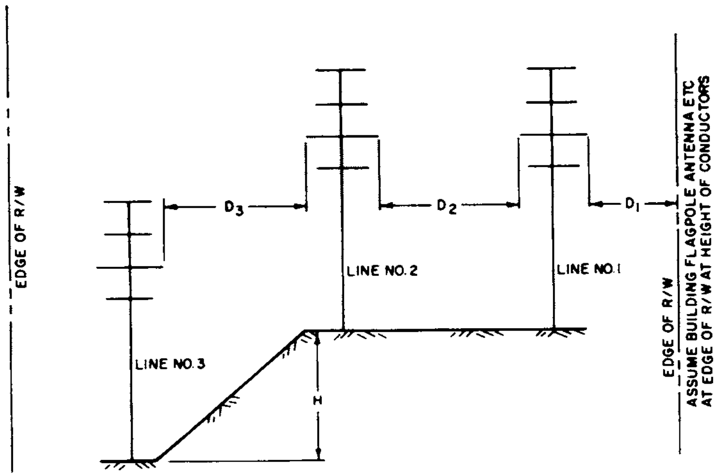


Fig IR 158
To determine D_1, D_2, and D_3 as required by the NESC.

AMPLIFICATION OF IR (W. N. Jensen) (Jan 17, 74)

As you must certainly appreciate, we are in a position of wanting to maximize the use of existing transmission rights-of-way and to minimize the width of rights-of-way for future transmission lines while maintaining compliance with the NESC.

I would appreciate hearing your thoughts on the following "in-house" interpretation of the requirements of Section 234. The statement concerning clearance contains the phase. . ."a second and conflicting line." An interpretation of the above statement might be that if the second line were not "conflicting," the requirement of Rule 234A1,2,3 would not apply. Determining "conflict" then becomes awkward because a "conflicting line" is not defined by the NESC. If one were to assume that "conductor conflict" is what the NESC refers to in the above, it would appear that "conflict" would not occur if conductor separation was greater than "$x + h/2 + 5$" as it appears in the definition of "conductor conflict" in the NESC.

In addition, you have indicated that although a 30° conductor blowout allowance and an allowance for operating voltage above nominal voltage is not required when computing clearance to buildings, it is implied in Section 200. It would be appreciated if you would be more specific concerning the implication in Section 200.

INTERPRETATION REFERENCE (W. D. Johnson) (July 26, 74)

This is a request for an interpretation concerning the separation between steel tower transmission lines on a common right-of-way. In addition to my comments of December 31, 1973, and in reply to. . .Jensen's amplification, January 17, 1974. . .I would like to offer additional comments. In my opinion, the term "a second and conflicting line" contained in Rule 234A means conductor conflict since Rule 234 deals with clearances between conductors. I do not understand the second part of the second paragraph of Jensen's amplification. It seems to me that x in the formula $x + h/2 + 5$ feet contained in Fig 1 (with the definition of antenna conflict, definition 14 in Part 2, 1973 Edition of the NESC). . .is the value required under Rule 234A2. This rule refers to the value required by Rule 235A2(a),(1), or (2) which is Table 6, 7, or 8. Definition 15, conductor conflict, in Part 2. . .mentions the values required in Tables 6, 7, or 8. Therefore, the definition of conductor conflict is based on a clearance of $x + h/2 + 5$ feet and the clearance required by Rule 234A. The conductors would always be in conflict when the clearance is the minimum value required by Rule 234A.

In regard to the 30° conductor blowout allowance that I had suggested was implied by Rule 200, the specific rule I was referring to in my letter of January 31, 1973, is Rule 230C. This rule states: "Construction should be made according to accepted good practice for the given local conditions in all particulars not specified in the rules." In my opinion, conductor blowout is a "local condition."

INTERPRETATION (Nov 19, 74)

There is general agreement that Mr. Johnson has correctly listed and explained the use of the several code rules involved [see Reference D (W. D. Johnson's letter of July 26, 1974)]. However, there are several points which should be mentioned in this connection.

One is that the Code does not contain any specific clearance requirements to the edge of the right-of-way as such. However, the Code does specify clearances to buildings, and buildings may, in some cases, eventually be erected adjacent to the right-of-way.

A second point has to do with the term "conflicting lines." Both supply and communications lines are defined in terms of conductors and their associated supporting or containing structures. Thus, it would seem to follow that the term "conflicting lines" means conductor conflict, structure conflict, or both.

It should also be noted that the "catch all" rule referred to in Mr. Johnson's letter of July 26, 1974, should be Rule 200C, not Rule 230C. Somewhat the same thought is expressed in Rule 210: ". . . lines shall be of suitable design and construction for the service and conditions under which they are to be operated."

234A1

Final condition of a conductor — to determine vertical clearance — storm loading and long term creep.

REQUEST (June 30, 64) IR 112

Within recent years it has become a fairly common practice for engineers to include consideration of long time conductor creep in computations of sags and tensions. This is because there are circumstances in which the inelastic elongation resulting from creep exceeds that resulting from the maximum loaded tension with the conductor in its initial condition. In such circumstances questions arise regarding the definition of the "final" condition of the conductor, and regarding the operating conditions under which the provisions of Rule 261F4 apply.

Ordinarily, I believe that the initial condition of a conductor has been understood to be represented by its stress-strain characteristic when stress values are held approximately 1-3 hours. Also, the final condition of a conductor has ordinarily been understood to be represented by its stress-strain characteristic after it has sustained a non-elastic elongation resulting from the maximum loaded tension while in the initial condition. In other words, the maximum loaded tension corresponds to a common point on both the initial and final stress-strain characteristics. In circumstances where the non-elastic elongation resulting from long time creep exceeds that resulting from the maximum loaded tension in the initial condition, however, there is no operating condition that is common to both initial and final stress-strain characteristics.

Specifically, clarification of the following questions is desired:

(1) What is to be considered as the "final" condition of the conductor? (Both rules 232A1 and 261F4) Is it:

(a) The condition resulting from the maximum loaded tension while the conductor is in its initial condition?

(b) Or is it the condition resulting from long time creep at normal unloaded tension in circumstances where the non-elastic elongation resulting from creep exceeds that resulting from the loading of (a) above?

(2) Under what operating condition of the conductor does the maximum tension limitation of 60 per cent (rule 261F4) apply? Is it:

(a) With the conductor in its initial condition?

(b) Or may it be after the conductor has sustained a non-elastic elongation as a result of long time creep at normal unloaded tension?

My own opinions are that:

1. For maintaining vertical clearance, (rule 232A1) the final condition should be that resulting from either maximum loaded ten-

sion or long time creep, whichever causes the greatest non-elastic elongation.

2. For maintaining the final unloaded tension limitation (rule 261F4) the final condition should be the same as that for maintaining vertical clearances, that is, it should be that resulting from either maximum loaded tension or long time creep, whichever causes the greatest non-elastic elongation.

INTERPRETATION (Jan 14, 65)

The combined effect of both storm loading and long term creep should be considered in applying Rules 232A and 261F4.

234B

Clearance to parallel line.

REQUEST (Dec 7, 62) IR 96

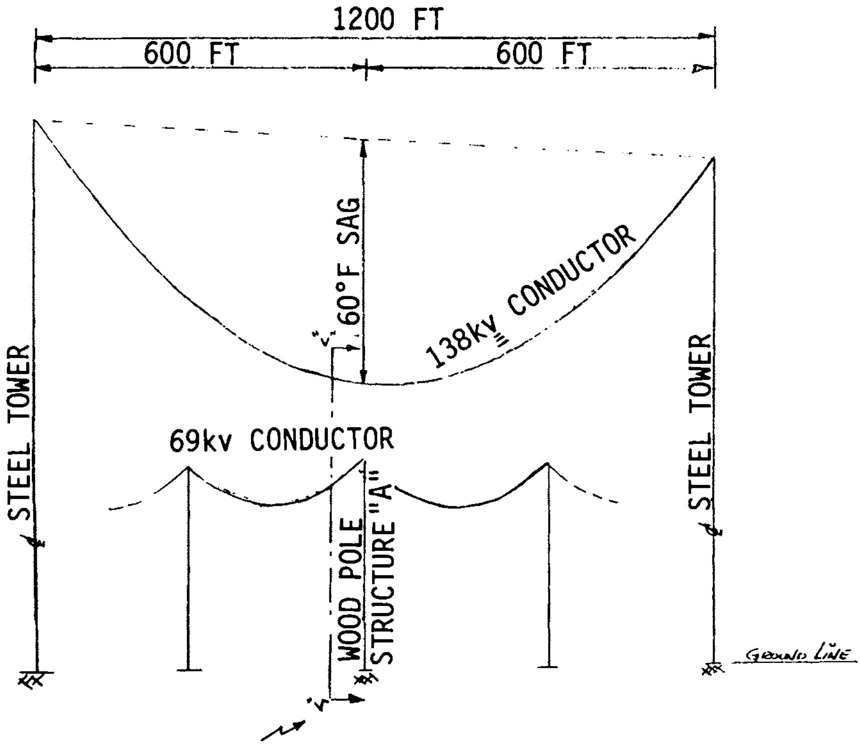
The situation involves the potential installation of a single wood pole, single circuit, 69 kV transmission line on the same right-of-way and parallel to a 138 kV steel tower transmission line. Referring to the attached Fig IR 96-1, the problem centers on the locating of structure "A" of the 69 kV line at the midspan of the 138 kV line offset horizontally 20 feet as shown in Fig IR 96-1.

Referring to Rule 234B, 2, the applicable clearance requirement in this case is dictated by the formula given in Rule 235A, 2, (a), (2); namely, that the clearance equals 0.3 inch per kilovolt + $8\sqrt{S/12}$ where "S" equals the apparent sag of the larger conductor. This formula gives a required basic clearance of 90 inches. Rule 234B2, specifies that this clearance shall be increased by 1 inch for each two feet of separation between he 69 kV structure and the nearest 138 kV structure. As the nearest 138 kV structure is 600 feet, the 90 inch basic clearance is increased by 600/2 or 300 inches giving a total clearance requirement of 390 inches or 32.5 feet.

Referring again to Fig IR 96-2, the 32.5 feet clearance requirement of the 138 kV conductor at 60°F sag, no wind, to the 69 kV structure, is shown as the red arc. As can be seen the 69 kV structure is closer than allowed and would have to be moved horizontally until it fell outside of the red clearance line. In our case, this would require the purchase of additional right-of-way. The 69 kV structure could be moved longitudinally from its location at the center of the 138 kV span to reduce the distance to the 138 kV structure; however, this requires taller poles to maintain 69 kV ground clearance requirements and creates a problem of maintaining conductor clearances as required by Rule 234A.

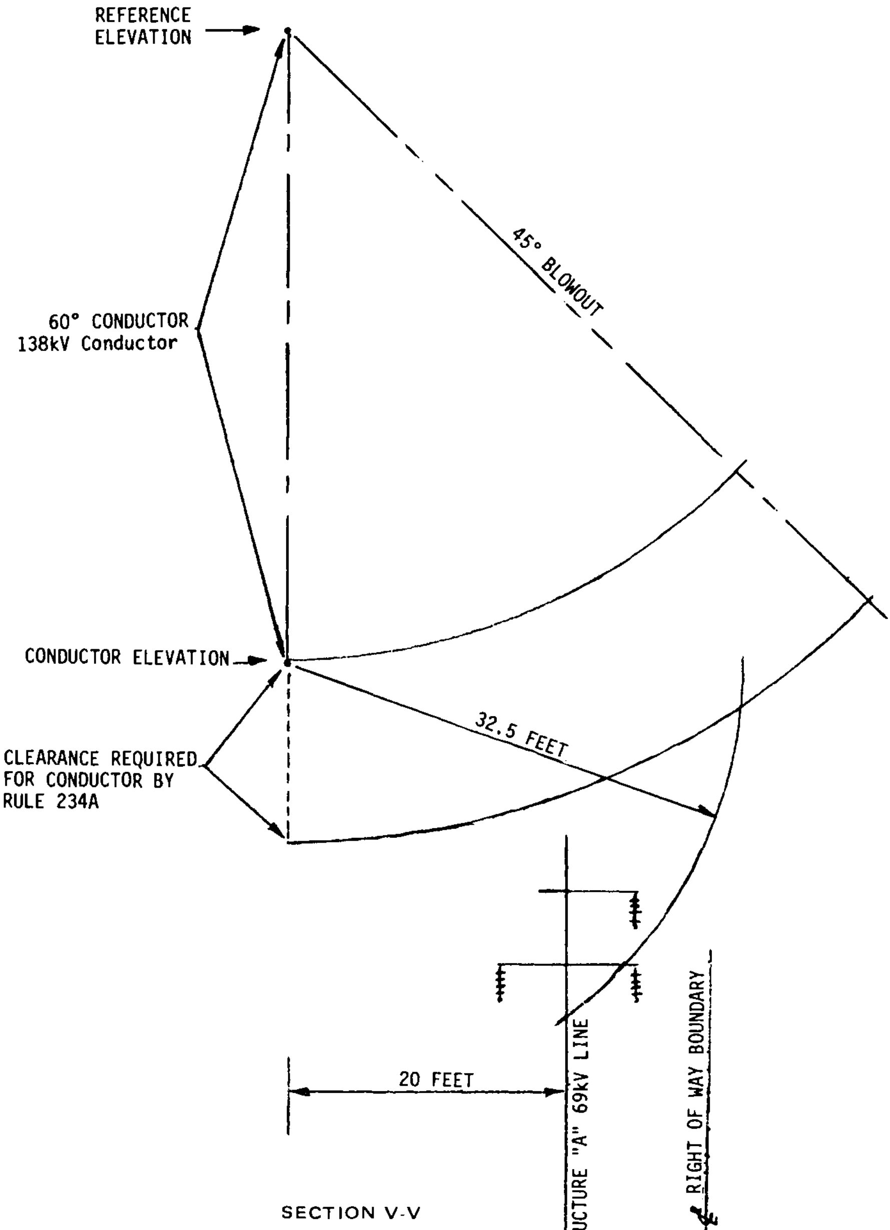
As shown on Fig IR 96-2 the location of the 69 kV structure meets the blowout clearance requirements at 45° as specified in the "Exception" clause of Rule 234A. This exception clause, which undoubtedly was added to the Fifth Edition of the code to take care of long span transmission line situations, eliminates excessive conductor clearance requirements. As no such clause exists for Rule 234B we cannot arbitrarily infer and apply such an exception. The clearance requirement appears excessive, however, especially in this case where climbing space does not enter the picture. Climbing space seems to be the prime criteria for the inclusion of the clearance requirement dealing with the distance between the supporting structures of two lines.

Since supply conductors only are involved and climbing space is sufficient, it seems that if the clearance of the 138 kV conductor to the 69 kV conductor or structure met requirements for a line crossing, sufficient clearance would be provided.



NOTE: SECTION "V" SHOWN ON (FIGURE 96-2)

Fig IR 96-1



SECTION V-V

Fig IR 96-2

INTERPRETATION (Feb 13, 63)

Your detailed and clear explanation of the problem is appreciated and the Committee feels that your understanding of Rule 234B, Section 23, as written is correct.

Because your intepretation of Rule 234B is correct, this is an instance where application of Rule 201A might be justifiable. We therefore suggest that you may wish to refer the matter for final decision to the proper administrative authority, probably the Public Service Commission of the State (or States) involved.

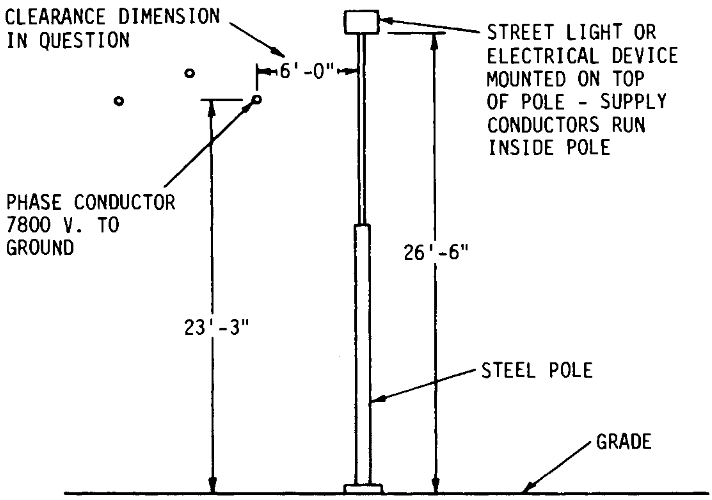
234B1; 234C, Table 4

Clearance, line to adjacent steel structure; voltage definition

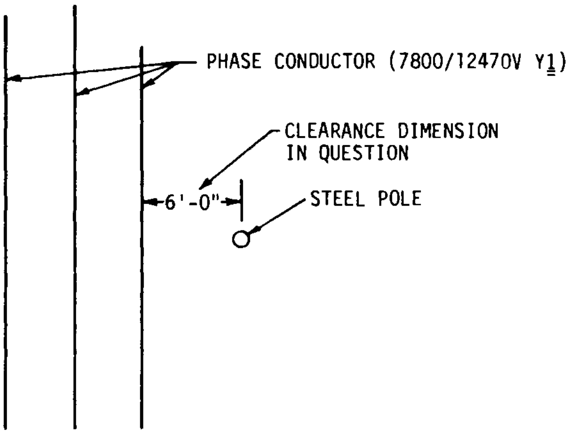
REQUEST (May 27, 75) IR 173

(1) Does Rule 234B1, "three feet if practicable," apply to the clearance between the steel pole and phase conductor of the installation shown on the attached sketch (Fig IR 173)? If not, what clearance rule is applicable to the installation?

(2) In reference to Rule 234C, Table 4, does the "voltage of supply conductors" refer to the *phase* to *ground* voltage of the *phase* to *phase* voltage of a 7200/12 470 volt grounded wye system?



ELEVATION



PLAN

Fig IR 173
Line to pole clearance.

INTERPRETATION (July 25, 75)

The requirements of Rule 234B1 apply to overhead conductors in the vicinity of street lighting poles without regard to whether the street lighting poles are fed by aerial or underground facilities. Note that Rule 234B2 may require greater clearance.

Regarding your second question, the voltage of an effectively grounded circuit is the highest effective (rms) voltage between any conductor and ground (see definition 74 in Part 2, 1973 Edition of the NESC). If the 7200/12 470 grounded wye system is effectively grounded, the voltage of the circuit for the purpose of Table 4 is 7200 volts. If it is not effectively grounded, the voltage is 12 470 volts.

234C, Table 4
See also IR for Rule 234B1, IR 173

Clearances from buildings, definition of voltage

REQUEST (Jan 29, 74) IR 154

Table 4 of Rule 234C specifies clearances based on voltage of supply conductors. Since I am concerned about grounded wye 7200/12 470 three phase, four wire systems only, I assume that "voltage" in Table 4 refers to the voltage between any conductor and ground (definition 74 of Part 2) or 7200 volts in my case. However, in previous editions of the NESC, Table 4 of Rule 234C had a note specifying "all voltages are between conductors."

Please inform me of the definition of "voltage" in Table 4 of Rule 234C.

I am often concerned over clearances between our distribution circuits and advertising signs. Does Rule 234C, Clearances from Buildings, apply to clearances from signs?

INTERPRETATION (Sept 27, 74)

Voltage of an effectively grounded circuit means the highest effective voltage between any conductor and ground except where indicated elsewhere. (See definition 74.) For circuits not effectively grounded, voltage is the highest effective voltage between any two conductors. (See definition 75.)

Clearances between supply conductors and advertising signs are not covered in the current (1973) edition of the Code.

* * * *

REQUEST (Oct 17, 73) IR 156

. . .In the National Electrical Safety Code, 1973 Edition, Section 234C4(a)(1), Table 4, titled "Clearances of Supply Conductors from Buildings," shows voltage of supply conductors in column 1 to be 300 to 8700, 8700 to 15 000, etc. We are unable to determine whether these voltages shown are phase to phase voltages or phase to neutral voltages.

In applying Table 4 in areas served by overhead 3-phase 4-wire 7200/12 470Y volt systems, the required horizontal and vertical clearances are 3 feet and 8 feet, respectively, if voltages shown in Table 4 are phase to neutral voltages; however, if the voltages shown in Table 4 are phase to phase voltages, the required horizontal and vertical clearances are 8 feet and 8 feet, respectively. Similar requirements for lines operating at 14.4/24.9Y kV differ depending on whether phase to phase or phase to neutral voltages are used in Table 4. Table 5 in Section 234D, titled "Clearances from Bridges," raises similar questions.

INTERPRETATION (Sept 27, 74)

Voltage of an effectively grounded circuit means the highest effective voltage between any conductor and ground except where indicated elsewhere. (See definition 74 of Part 2.) For circuits not effectively grounded, voltage is the highest effective voltage between any two conductors. (See definition 75.)

234C1(a) See IR for Rule 232A, IR 186

234C4

See IR for rule 230D, IR 216(b)
See also rule 232A Table 1, IR 159

Clearance — horizontal and vertical — from buildings.

REQUEST (Feb 21, 63) IR 98

We need to know if in Table 4, . . .the horizontal clearances and the vertical clearances called for are both to be maintained. That is to say, if a line overhangs the edge of a building, is it necessary, in order to meet the standard, for it to be both the proper distance above and the proper distance to the side of the building.

We, also, need to know whether or not it is intended that these horizontal and vertical clearance standards apply while the building is actually being constructed or whether or not they are intended only to apply after the building has been completed.

INTERPRETATION (Mar 8 and 12, 63)

With reference to clarification of Section 234C4 of the National Electrical Safety Code H43, (issued August 1949), we wish to mention that slight changes in this section appear in the latest revision of Part 2 that was issued November 1, 1961, as part of Handbook 81. Because the intent of this section is concerned with the safety of firemen or anyone else who may have to work in an area adjacent to normally live conductors, it is believed that the intent in writing this rule did not hinge on whether a building is being constructed or has been completed.

The revision of Rule 234C in the Sixth Edition (H81) was made to clarify the rule rather than change it, and to make it fairly clear that lines meeting the requirements for vertical clearances above buildings do not have to meet any horizontal clearance requirements.

It was also pointed out subsequent to my letter of March 8 that there are too many variables during the process of construction to establish clearances from buildings with any degree of nicety or reasonableness so that 234C requirements are definite only as applied to finished buildings. Other rules in the Code (H81) such as 200A, -B, -C; 201A, -B2, -C1, -D concern local good practice, intent, temporary and emergency waivers that place reliance on local authority.

* * * *

REQUEST (Feb 5, 65) IR 98a

Under H30, Rule 234C4(a), Conductors Passing By or Over Buildings, in Table #4, Clearance of Supply Conductors from Buildings Having Voltages Between Conductors of 8700 to 15 000 Volts, the horizontal clearance shall have a minimum of 8 ft and the vertical clearance a minimum clearance of 8 ft.

I am attaching a sketch of a residence. . .on which I have indicated the clearances from the nearest phase of a three phase, 12 470 volt overhead distribution circuit to a building. The vertical elevation of the building is indicated. . .on this map. You will note that the closest projected horizontal distance from this conductor to any part of the building, which in this case is a window sill projection, is 7.92 ft. You will also note that the vertical projected clearance to the closest part of this building is 17.57 ft.

Of course, in the revision of H32 which was revised by H81, the horizontal code clearance would only have to have been 3 ft.

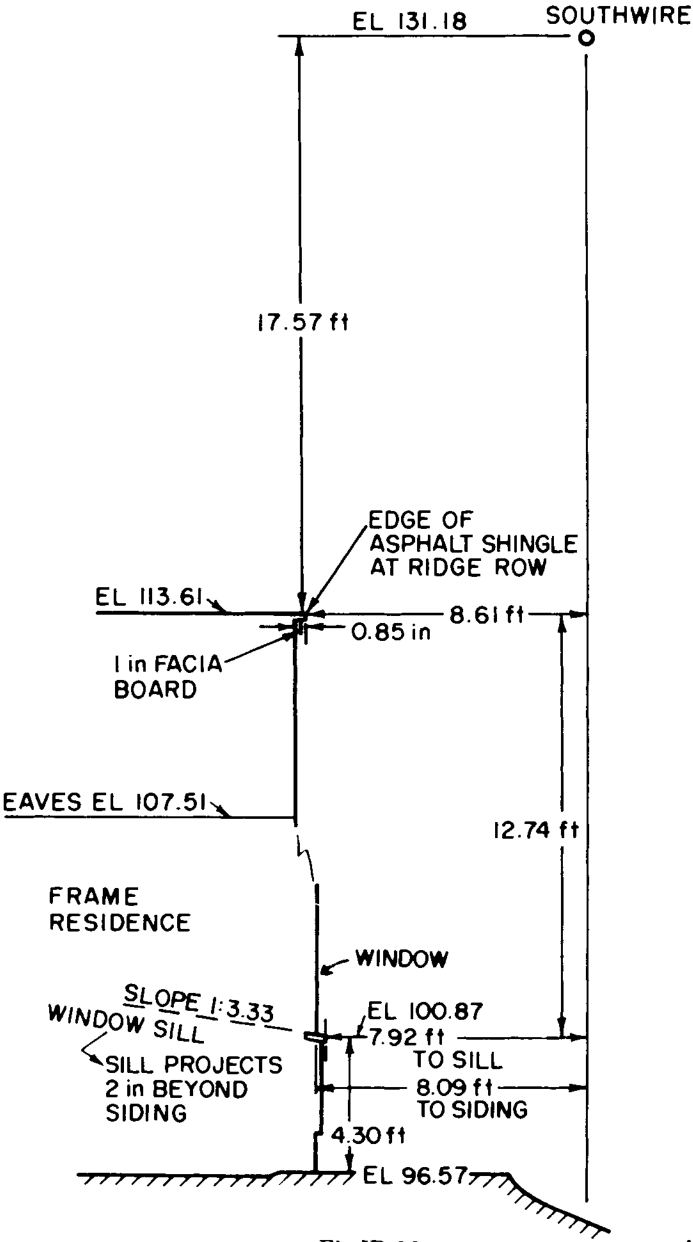


Fig IR 98

29th ST

INTERPRETATION (Feb 15, 65)

A previous interpretation of the subject rule established that lines meeting vertical clearance requirements do not have to meet any horizontal clearance requirements. Therefore, from the information submitted with your letter, it appears that clearances provided in this situation are in conformance with both the 5th Edition (NBS Handbook H30) and the Sixth Edition (NBS Handbook 81) of the National Electrical Safety Code.

Clearance to building

REQUEST (May 21, 75) IR 172

. . .Rule 234C4 lists minimum clearance of supply conductors from buildings. I seek an interpretation of this rule for the following situation.

A 33 kV line is to be constructed to pass close to the front of an existing church. The height of the church is approximately 35 feet. The 33 kV lines will be between 25 and 35 feet above ground. The church has a porch that extends for 6.6 feet from the main structure. The main roof extends approximately 1.2 feet beyond the main wall. (See Figs IR 172-1 and IR 172-2.) The church is constructed of wood and the wall will require painting.

My query is: Is the horizontal clearance of 10 feet required for 33 kV lines measured from the nearest phase line to the roof lines to the side wall or to a vertical line through the front edge of the porch? That is, in Fig IR 172-1, from which of the three vertical lines, *aa'*, *bb'*, or *cc'*, should the minimum clearance of 10 feet for a 33 kV line be measured?

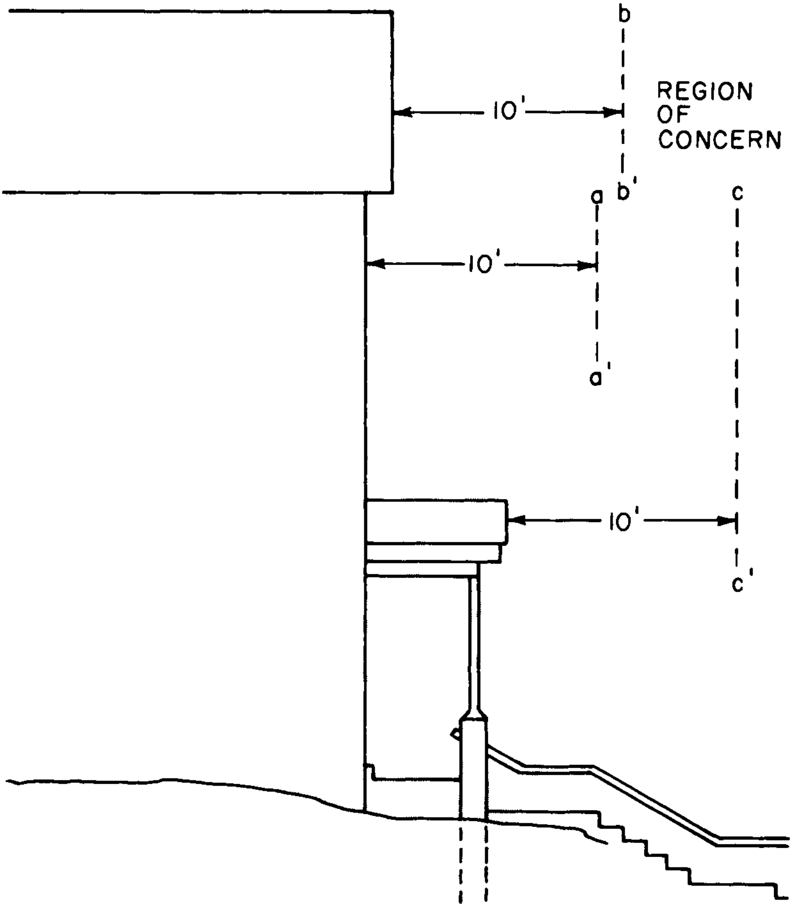


Fig IR 172-1
West elevation. (Scale: 1 inch = 5 feet.)

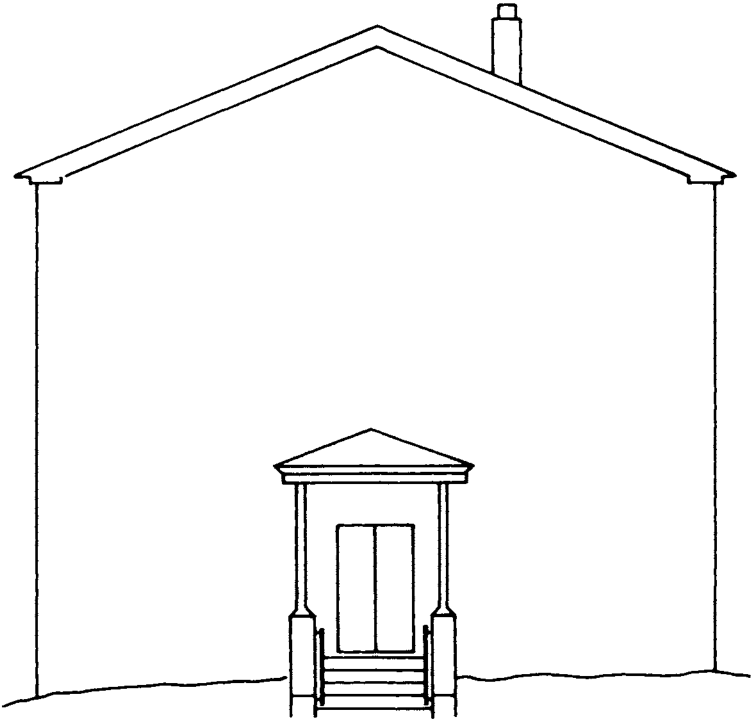


Fig IR 172-2
South elevation. (Scale: 1 inch = 5 feet.)

INTERPRETATION (July 25, 75)

The line is described as being at approximately the same level as the roof of the main structure. Thus the horizontal clearance should be measured from the roof line of the main structure. From. . .Figs IR 172-1 and IR 172-2. . .it is apparent that this places the conductors only a few feet horizontally beyond the porch.

However, horizontal clearance from the porch roof is immaterial since diagonal clearance from the edge of the porch roof must also be provided. The *minimum* horizontal, vertical, or diagonal clearance for 33 kV conductors is 10 feet.

If the span length exceeds 150 feet, Rule 234C4(a)(2) will require somewhat greater clearance. To apply this rule, the "maximum sag increase" of the conductors should be known. This information should be available from the owners of the 33 kV line.

Clearance to building and guarding

REQUEST (Sept 29, 75) IR 174

The conditions giving rise to this request deal specifically with an electrocution of an individual who was present on the veranda of an apartment complex when contact was made with supply conductors located beside said veranda.

The question is as follows: Where the clearances set forth in Table 4, Rule 234C4(a)(1), have been met but contact is still made, said contact resulting in the death of the party making contact, does subsection (2) of said rule still apply as to require the guarding of said conductors?

INTERPRETATION (Dec 16, 75)

Where the clearances required by Rule 234C4(a)(1) have been provided, Rule 234C4(b)(2) may require guarding. If an individual made *direct* contact with an energized conductor, guarding as required by Rule 234C4(b)2 is plainly indicated. On the other hand, if the contact is not direct and involved a conductive object (for example, a metal fishing pole), the contact does not, in itself, mean that provisions of Rule 234C4(b)(2) should have been followed. The rule indicates guarding is required where persons are exposed to contact with energized conductors of over 300 volts, but this does not include unusual situations where contact would be possible only by use of objects which extend a person's reach.

234C4(a)

See also IR for 114A1, IR 124; 232A, IR 186

Clearance of conductor from building.

REQUEST (Nov 12, 64) IR 113

In Table 4, the clearance of supply conductors from buildings having voltages between 300 and 8700 V shows the horizontal clearance to be 3 ft and the vertical clearance to be 8 ft.

The case I have in mind where the conductor is above the building but not directly over it; for instance, the projected horizontal clearance of the conductor is 3 ft from the building and 6 ft vertically above this 3 ft projection point. As I understand it, in order to determine if the conductor has code clearance, you would have to project out from the top of the building a distance of 3 ft horizontally and project a line vertically to the conductor and if this was below the point where the 8 ft diagonal line from the nearest point of the building intersects this vertical projected line, then it would have code clearance to the building. This would mean that the conductor at the exact top of the building would be 3 ft horizontally from the building and on the vertical line from this point to where it intersects the 8 ft diagonal line and the diagonal clearance to the building would be something less than 8 ft. I am attaching hereto Fig IR-113 which is a sketch showing what I have in mind and it is my understanding that with the conductor at this location, it would have code clearance.

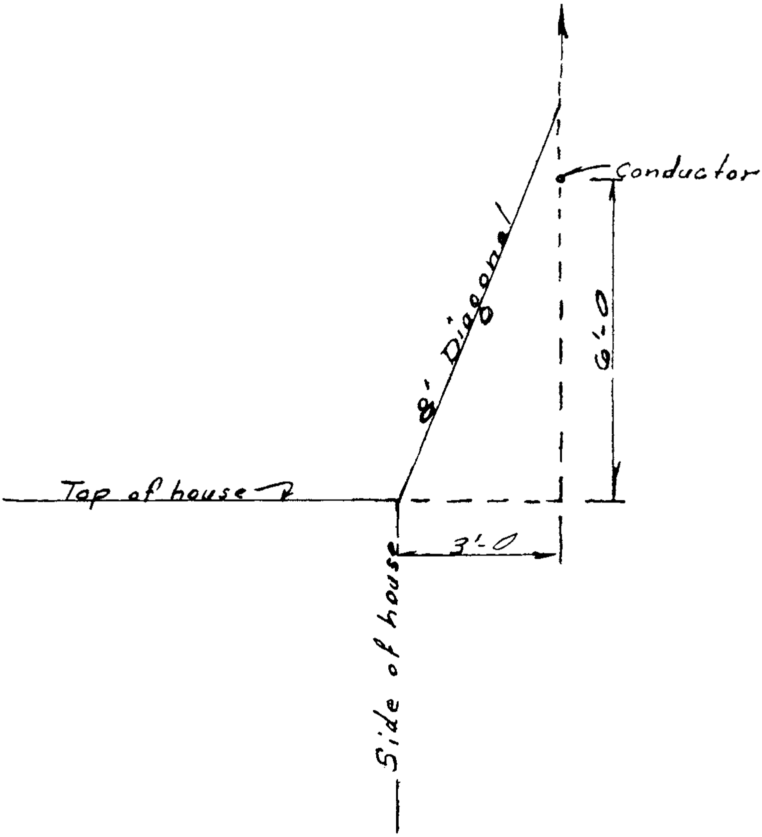


Fig IR 113

INTERPRETATION (Jan 14, 65)

The sentence "The horizontal clearance governs above the roof level to the point where the diagonal equals the vertical clearance requirement" means that for the condition shown in the sketch there is no vertical clearance requirement if the horizontal clearance requirement is met. Therefore, the conductor shown in the sketch meets the intent of this Code rule.

234C4(a)

Clearance to chimney; meaning of "attachments".

REQUEST (July 12, 77) (1973 Edition) IR 198

I submit this letter as a formal request for an interpretation.

Basically the facts are these: there is a small two-story frame house located in a residential area of a small town in Delaware. Located approximately 2-2½ feet north of the north wall of this house is a utility pole approximately 32½ feet tall, from ground to top. Side struts located near the top of this pole support two 12 000 V primary electric lines. From this pole to the next supporting pole in each director is less than 150 feet. Atop the roof of the house, straddling its peak is a chimney which rises approximately three feet above the peak of the roof. The shortest distance between the closest 12 kV primary line and the slant of the roof of the house is ten feet. The shortest distance between the closest 12 kV primary line and the chimney atop the roof is less than eight feet, measuring some seven feet. Some people are attempting to install a television antenna on top of the house, which becomes fouled in the closest 12 kV primary line.

I have attached to this letter Fig IR 198 which may assist in a better understanding of these facts.

Query: Does the chimney atop the roof of the house constitute an "attachment" within the meaning of the National Electric Safety Code section 234C4(a) such that the clearance of less than eight feet from the chimney to the 12 kV primary line violates National Electrical Safety Code 234C4(a)(1)?

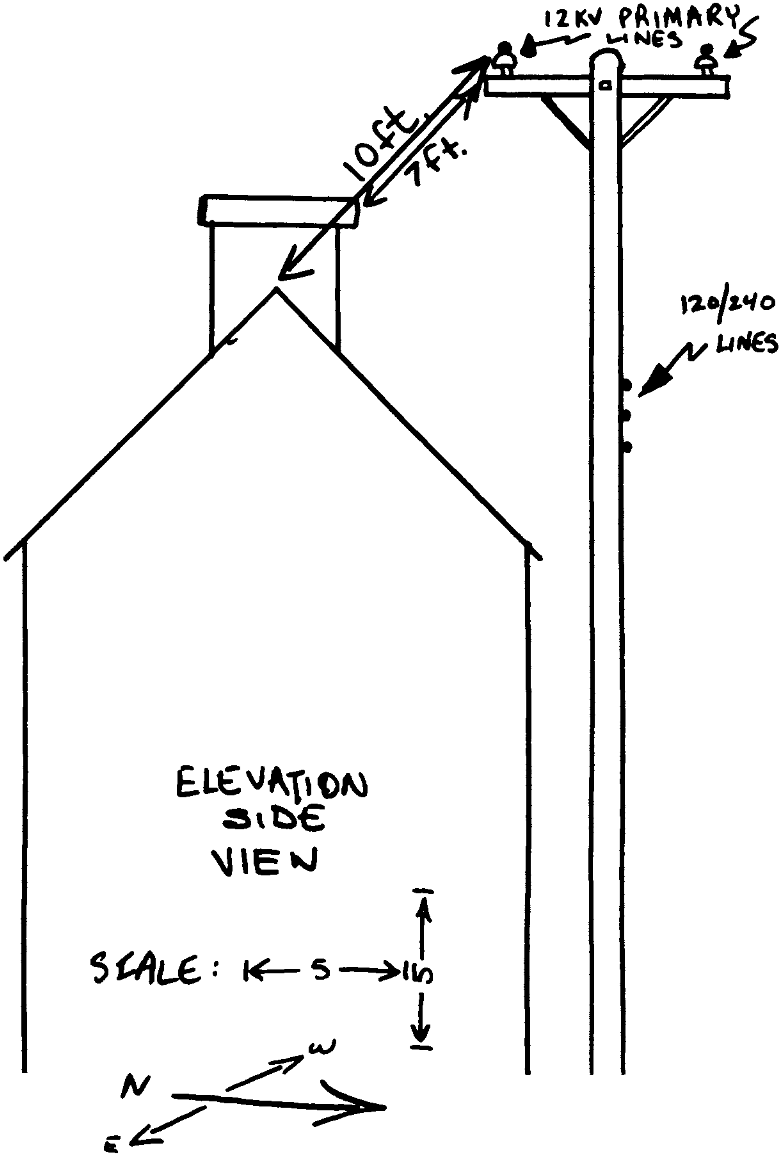

12KV PRIMARY LINES
10ft.
7ft.
120/240 LINES
ELEVATION SIDE VIEW
SCALE: 5 15
W
N
E

Fig IR 198

INTERPRETATION (Sept 29, 77)

We believe that a chimney of a residence may be considered either as a part of the structure or as an attachment to it. Rule 234C4(a) would apply in any event. Please note that the three foot horizontal clearance requirement of Table 4 applies if the primary conductors are part of a 7.2/12.5 kV wye configuration with an effectively grounded neutral. If the circuit is not effectively grounded, the horizontal requirement is eight feet.

234C4a(1) Table 4

Clearance of neutral to building.

REQUEST (Feb 18, 77) IR 189

I would like an interpretation of Rule 234C, paragraph 4(a)(1), Table 4, of Part 2 — Safety Rules for the Installation and Maintenance of Electric Supply Communication Lines. My question is relevant to the application of the paragraph to a neutral wire passing over or running adjacent to a building.

The paragraph states, "Unguarded or accessible supply conductors carrying voltages in excess of 300 volts may be run either beside or over buildings."

I would like an interpretation of the voltage range specified. It appears to me that it is implied that any supply conductor not carrying more than 300 volts is not covered in this section. Since neutral wires do not carry voltage, I would imagine that this portion of the code does not apply.

In my opinion, if the paragraph applied specifically to voltages under 300 volts, any service drop to a building would be in nonconformance with the code. In other words, any service drop to a residence at 240 volts would not be in compliance. I do not believe that this is the intent of the code.

I am actually on record as stating that since the neutral wire will not be a voltage-carrying conductor, the paragraph in question does not apply. In other words, even though it would be common sense not to have the neutral too close to a roof or the roof line of a building, either horizontally or vertically, it would not be in violation of the code if, as an example, it passed over the roof of a building at something less than eight feet.

It would appear that the intent of the code is to protect personnel on the roofs or highest points of buildings from contact with energized conductors. Again, therefore, neutral wires would not be covered under this section.

INTERPRETATION (May 23, 77)

Table 4 (associated with Rule 234C4) makes no provision for conductors carrying voltages less than 300 V. Neutrals may or may not be required to have the same clearances as their associated phase conductors depending upon how they relate to the provisions of Rule 230D.

Under that rule, certain neutrals may have the same clearances as guys and messengers. There are no specific requirements for clearance between guys or messengers. Under the 1973 Code, this is a judgment area. See Rules 200C, 210.

You may be interested to know that Rule 234C in the 1977 Code contains specific requirements for clearances between neutral conductors and buildings.

234D1, Table 234-2

Neutral clearance to bridge.

REQUEST (Oct 31, 77) (1977 Edition) IR 208

Table 234-2 provides clearances to neutral conductors meeting Rule 230E1; however, Rule 234D1, Page 146 states "This rule does not apply to guys, . . .neutrals meeting Rule 230E1. . ." Please clarify as to which applies.

INTERPRETATION (Dec 9, 77)

It is the opinion of the Interpretation Committee that the exception to Rule 234D1 applies. The column heading of Table 234-2 is in error.

234E1, Table 234-3 See 230C, IR 202

234F1c

Electrostatic effects.

REQUEST (Sept 13, 77) (1977 Edition) IR 205

Rule 234F1c states that "for voltages exceeding 140 kV alternating rms to ground, the clearances shall be increased or the electric field shall be reduced by other means, as required, to limit the current due to electrostatic effects to 5.0 milliamperes, rms, if an underground metal fence, building, sign, chimney, radio or television antenna, tank containing nonflammables or other installation, or any ungrounded metal attachments thereto were short-circuited to ground." Thus the Code allows us to solve the problem by reducing the electric field, but is grounding the object a satisfactory remedy?

INTERPRETATION (Nov 17, 77)

Rule 234F1c may be satisfied by grounding metal objects in an electrostatic field where their short circuit current to ground would otherwise exceed 5 milliamperes.

234F2c and d

Increased clearances for long span or sag — applicability to horizontal clearances.

REQUEST (Aug 25, 77) (1977 Edition) IR 203

I would like to request an interpretation or clarification of Rule 234F2 covering additional clearances for sag increases in the 1977 Edition of the National Electrical Safety Code.

Rule 234F2d states that the clearances "in Rules 234B, C, D, E and F1" be increased under the stated conditions. Rule 234B, C, D, E and F1 cover *both horizontal and vertical* clearances. Therefore, it could be reasoned that the sag increase covered in Rule 234F2d should be applied to horizontal clearances. Rule 234F2c, although it is not as definite, could also be interpreted to add the long span adder to horizontal clearances. I do not believe that this was the intent of the Code since it is somewhat illogical.

INTERPRETATION (Oct 19, 77)

Rule 234A1 specifies horizontal clearances with a six pound wind or a four pound wind and there is no mention of span length. Rule 234A-2 specifies vertical clearances at 60° F and certain specified span lengths. The adders of 234F2c and d do not apply to horizontal clearances; they only apply to vertical clearances.

235A, Table 6

Clearance between conductors in substations

REQUEST (Sept 30, 75) IR 175

In determining minimum phase-to-phase or phase-to-ground clearances in substation construction where rigid bus is used, we refer to Rule 235A, Table 6. . . . That is, we allow 12 inches for the first 8700 volts and 0.4 inches for every additional 1000 volts. This value is then corrected for altitude using ANSI C37.40-1969,[1] Section 40-2.3, Table 1. (See below.)

We find that the rule contradicts the NEMA Standards (reference to NEMA SG 6-1960,[2] Part 8). (See attached copy.)

Please review and interpret whether the National Electrical Safety Code rule is applicable to substation construction where rigid conductor is used.

[1]ANSI C37.40-1969, Service Conditions and Definitions for Distribution Cutouts and Fuse Links, Secondary Fuses, Fuse Disconnecting Switches, and Accessories, Section 40-2.3, Table 1.

[2]NEMA SG 6-1960, Power Switching Equipment.

Part of ANSI C37.40-1969:

40-2.3 Corrections for Altitudes in Excess of 3300 Feet (1000 Meters). Equipment that depends on air for its insulating and cooling medium will have a higher temperature rise and a lower dielectric value when operated at altitudes higher than 3300 feet. Correction factors for dieletric strength and rated continuous current are given in Table 1, Columns 1 and 2.

Equipment designed for standard temperature rise may be used at its normal rated continuous current without exceeding ultimate standard temperature limits provided that the ambient temperature does not exceed the ambient allowed in 40-2.1, multiplied by the factor shown in Table 1, Column 3.

Table 1
Altitude Correction

Altitude Above Sea Level		Altitude Correction Factor To Be Applied to		
Feet	Meters	Dielectric Strength	Rated Continuous Current	Ambient Temperature
		Col 1	Col 2	Col 3
3000	1000	1.00	1.00	1.00
4000	1200	0.98	0.99	0.992
5000	1500	0.95	0.99	0.980
6000	1800	0.92	0.98	0.968
7000	2100	0.89	0.98	0.956
8000	2400	0.86	0.97	0.944
9000	2700	0.83	0.96	0.932
10 000	3000	0.80	0.96	0.920
12 000	3600	0.75	0.95	0.896
14 000	4300	0.70	0.93	0.872
16 000	4900	0.65	0.92	0.848
18 000	5500	0.61	0.91	0.824
20 000	6100	0.56	0.90	0.800

NOTE: Use one correction factor from Column 2 or 3, but not both, for any one application. If the derating as determined from the table is significant, equipment of suitable higher rating should be chosen to meet requirements after the correction factor has been applied.

Part of NEMA SG 6-1960:

SG6-8.03 Phase Spacing and Electrical Clearances in Outdoor Substations

General design practice and present NEMA Standards provide phase-to-phase insulation strength considerably in excess of that provided line-to-ground. This appears proper when it is considered that there is generally a considerably greater exposure to phase-to-phase faults. Phase conductors in lines and station buses are adjacent to one another over great distances but pass grounded structures only in the vicinity of insulator stations. It is recommended that the NEMA standards for phase spacing be followed wherever possible; however, switch and bus spacing within outdoor stations may be reduced to solve special problems.

Tables 8-1 and 8-2 show recommended standard and minimum insulation spacings for outdoor switches and stations.

Authorized Engineering Information 9-17-1958.

Table 8-1
Phase-to-Phase Insulation in Outdoor Stations

Nominal Voltage Rating, kV (1)	Impulse Withstand, kV (2)	Insulator: Height, Inches (3)	Insulator: Dry Arcing Distances Inches (4)	Recommended and Minimum Phase Spacing for Horn-gap Switches and Expulsion Power Fuses, Inches (5)	Recommended Phase Spacing: Vertical Break Disconnecting Switches, Bus Supports and Power Fuses Other Than Expulsion Type, Inches (6)	Recommended Phase Spacing: Horizontal Break Disconnecting Switches, Inches (7)	Minimum Metal-to-metal Distance, All Disconnecting Switches, Bus Supports, and Rigid Conductors, Inches (8)
7.2	95	7½	5¼	36	18	30	7
14.4	110	10	7¼	36	24	30	12
23	150	12	9½	48	30	36	15
34.5	200	15	14	60	36	48	18
46	250	18	17	72	48	60	21
69	350	29	28	84	60	72	31
115	550	47	44	120	84	108	53
161	750	61½	58	168	108	156	72
230	900	76	74	192	132	192	89
230	1050	90½	88	216	156	216	105
345	1300	105	103	240	174	—	119

NOTES:

Column 1—Nominal voltage rating or air switch and bus support equipment. For selection of equipment on the basis of system voltage, see par. B of SG6.2.10.

Column 2—Impulse withstand rating associated with Column 1.

Column 3—Based upon cap and pin standard-strength insulator. For 115 kV and above, the height shown includes 3½ inch base adapter. For characteristics of all cap and pin and post-type insulators, see SG6.6.02 to SG6.6.05.

Column 4—Dry arcing distance of insulator in Column 3.

Column 5—Consistent with SG6-3.21 (also par. B of SG2.20.19 in the *NEMA Standards Publication for High-Voltage Fuses*).

Column 7—Consistent with SG6-3.21.

Column 8—Same as AIEE Committee Report, paper 54-80. These minimum clearances are for rigid energized parts. Allowances for conductor movement should be added to these minimum values.

The phase spacings in columns 6 and 7 are recommended values. It is recognized that at certain points of application these values may be reduced. Overall width of switch and bus support energized parts, angle of opening of side-break switches, etc., may allow a reduction in phase spacing. However, in no case should the resultant metal-to-metal distance between phase energized parts be less than that shown in Column 8.

Attention is called to the fact that the voltage ratings of systems having standard insulators and standard spacings must be de-rated when applications are made at altitudes in excess of 3300 feet (see SG6.2.07).

Table 8-2
Electrical Clearances in Outdoor Stations

Nominal Voltage Rating, kV (1)	Impulse Withstand, kV (2)	Insulator: Height, Inches (3)	Insulator: Dry Arcing Distance, Inches (4)	Clearance to Ground For Rigid Parts: Recommended, Inches (5)	Clearance to Ground For Rigid Parts: Minimum, Inches (6)	Recommended and Minimum Clearance between Overhead Conductors and Ground for Personal Safety, Feet (7)
7.2	95	7½	5¼	7½	6	8
14.4	110	10	7¼	10	7	9
23	150	12	9½	12	10	10
34.5	200	15	14	15	13	10
46	250	18	17	18	17	10
69	350	29	28	29	25	11
115	550	47	44	47	42	12
161	750	61½	58	61½	58	14
230	900	76	74	76	71	15
230	1050	90½	88	90½	83	16
345	1300	105	103	105	104	18

NOTES:

Column 1—Nominal voltage rating of air switch and bus support equipment. For selection of equipment on the basis of system voltage, see par. B of SG6-2.10.

Column 2—Impulse withstand rating associated with Column 1.

Column 3—Based upon cap and pin standard-strength insulator. For 115 kV and above, the height shown includes standard 3½ inch base adapter. For characteristics of all cap and pin and post-type insulators, see SG6-6.02 to SG6-6.05.

Column 4—Dry arcing distance of insulator in Column 3.

Column 5—Same as Column 3, Insulator Height.

Column 6—

Column 7—Same as AIEE Committee Report, paper 54-80. These minimum clearances are for rigid parts and conductors. Any structural tolerances or allowances for conductor movement or possible reduction in clearanes by foreign objects should be added to these minimum values.

For minimum clearances phase to phase, see Table 8-1, Column 8.

The recommended clearance to ground, Column 5, is the same as the insulator height given in Column 3. It is recognized that at certain points of application it may be necessary to reduce this value. However, in no case should the clearance be less than the minimum shown in Column 6.

Attention is called to the fact that the voltage ratings of systems having standard insulators and standard spacings must be dc-rated when applications are made at altitudes in excess of 3300 feet (see SG6-2.07).

SECRETARIAL NOTE:

The letter refers to NEMA SG6-1960. This has been superseded by NEMA SG6-1974 which has no Part 8. However, there is a Section SG6-36.10 along with Table 36-1 and 36-2 which have the same titles and cover the same subject. Copies of both are attached.

Part of NEMA SG6-1974:

SG6-36.10 Phase Spacing and Electrical Clearance in Outdoor Substations

General design practice and present NEMA Standards provide phase-to-phase insulation strength considerably in excess of that provided line-to-ground. This appears proper when it is considered that there is generally a considerably greater exposure to phase-to-phase faults. Phase conductors in lines and substation buses are adjacent to one another over great distances but pass grounded structures only in the vicinity of insulator substations. It is recommended that the NEMA standards for phase spacing be followed wherever possible; however switch and bus spacing within outdoor substations may be reduced to solve special problems.

Tables 36-1 and 36-2 show recommended and minimum insulation spacings for outdoor switches and substations.

Authorized Engineering Information 1-17-1968.

Table 36-1
Phase-to-Phase Insulation in Outdoor Substations

		Insulator			Recommended Phase Spacing		
Nominal Voltage Rating, kV (1)	Impulse With-stand, kV (2)	Height, Inches (3)	Dry Arcing Dis-tance, Inches (4)	Minimum Phase Spacing for Horngap Switches and Expulsion Power Fuses, Inches (5)	Vertical Break Disconnecting Switches, Bus Supports and Power Fuses Other Than Expulsion Type, Inches (6)	Hori-zontal Break Dis-connecting Switches, Inches (7)	Minimum Metal-to-metal Distance, All Disconnecting Switches, Bus Supports, and Rigid Conductors, Inches (8)
7.2	95	7½	5¼	36	18	30	7
14.4	110	10	7¼	36	24	30	12
23	150	12	9½	48	30	36	15
34.5	200	15	14	60	36	48	18
46	250	18	17	72	48	60	21
69	350	29	28	84	60	72	31
115	550	47	44	120	84	108	53
138	650	52½	47	144	96	132	63
161	750	61½	58	168	108	156	72
230	900	76	74	192	132	192	89
230	1050	90½	88	216	156	216	105
345	1300	105	103	240	174	***	119

NOTES:

Column 1—Nominal voltage rating of air switch and bus support equipment. For selection of equipment on the basis of system voltage, see 8.2 of American National Standard C37.32.

Column 2—Impulse withstand rating associated with Column 1.

Column 3—Based upon cap and pin insulators covered in Table 6-1 (Part 31 Page 2). For 115 kV and above, the height shown includes 3½ inch base adapter. For characteristics of all cap and pin and post-type insulators, see SG6-31-2.

Column 4—Dry arcing distances of insulator in Column 3.

Column 5—Consistent with Table 5 of American National Standard C37.32.

Column 6—Consistent with Table 5 of American National Standard C37.32.

Column 7—Consistent with Table 5 of American National Standard C37.32.

Column 8—Same as AIEE Committee Report, paper 54-80 (no longer in print). These minimum clearances are for rigid energized parts. Allowances for conductor movement should be added to these minimum values. (AIEE is now IEEE.)

The phase spacings in Columns 6 and 7 are recommended values. It is recognized that at certain points of application these values may be reduced. Overall width of switch and bus support energized parts, angle of opening of side-break switches, etc, may allow a reduction in phase spacing. However, in no case should the resultant metal-to-metal distance between phase energized parts be less than that shown in Column 8.

Attention is called to the fact that the voltage ratings of systems having insulators and spacings covered by these standards must be derated when applications are made at altitudes in excess of 3300 feet (see 2.2 of American National Standard C37.30).

Table 36-2
Electrical Clearances in Outdoor Substations

Nominal Voltage Rating, kV (1)	Impulse Withstand, kV (2)	Insulator: Height, Inches (3)	Insulator: Dry Arcing Distance, Inches (4)	Clearance to Ground for Rigid Parts: Recommended, Inches (5)	Clearance to Ground for Rigid Parts: Minimum, Inches (6)	Recommended Minimum Clearance Between Overhead Conductors and Ground for Personal Safety, Feet (7)
7.2	95	7½	5¼	7½	6	8
14.4	110	10	7¼	10	7	9
23	150	12	9½	12	10	10
34.5	200	15	14	15	13	10
46	250	18	17	18	17	10
69	350	29	28	29	25	11
115	550	47	44	47	42	12
138	650	52½	47	52½	50	13
161	750	61½	58	61½	58	14
230	900	76	74	76	71	15
230	1050	90½	88	90½	83	16
345	1300	105	103	105	104	18

NOTES:

Column 1—Nominal voltage rating of air switch and bus support equipment. For selection of equipment on the basis of system voltage, see 8.2 of American National Standard C37.32.

Column 2—Impulse withstand rating associated with Column 1.

Column 3—Based upon cap and pin insulators covered in Table 6-1 (Part 31 Page 2). For 115 kV and above, the height shown includes 3½ inch base adapter. For characteristics of all cap and pin and post-type insulators, see SG 6-31.2.

Column 4—Dry arcing distance of insulator in Column 3.

Column 6 and 7—Same as AIEE Committee Report, paper 54-80 (no longer in print). These minimum clearances are for rigid parts and conductors. Any structural tolerances or allowances for conductor movement or possible reduction in clearances by foreign objects should be added to these minimum values. (AIEE is now IEEE.)

For minimum clearances phase to phase, see Table 36-1, Column 8.

The recommended clearance to ground, Column 5, is the same as the insulator height given in Column 3. It is recognized that at certain points of application it may be necessary to reduce this value. However, in no case should the clearance be less than the minimum shown in Column 6.

Attention is called to the fact that the voltage ratings of systems having insulators and spacings covered by these standards must be derated when applications are made at altitudes in excess of 3300 feet (see 2.2 of American National Standard C37.30).

INTERPRETATION (Dec 16, 75)

Part 2 of the Code deals with requirements for electric supply and communication lines (Rule 200A). Rules for electric supply stations are contained in Part 1 of the Code. Part 1 does not specify spacings between conductors of different phases, although Rule 124 does contain requirements for clearances of conductors from permanent supporting surfaces for workmen.

Compact transmission lines; status with respect to NESC 1973 Edition (C2.2-1960)

REQUEST (Oct 15, 74) IR 167

More efficient usage of transmission right-of-way is necessary for the required growth of electrical energy supply. Both environmental and economic arguments support this requirement.

Power Technologies, Inc, under contracts with the Electric Power Research Institute (EPRI) and the New York State Atomic and Space Development Authority (ASDA), has a continuing project for compaction of lines in the 115-345 kV range. Feasibility of significantly reducing phase spacing has been demonstrated with the current program directed toward parameter definition, and it is a question of when and to what extent utilities will desire to install such lines.

Because of reduced phase spacing, for example an experimental line has 36-inch phase spacing, we would appreciate interpretation of the recent NES Code relative to compaction design. For reference. . .see an IEEE paper by Barthold et al.,[1] and several photographs of the test line (Figs IR 167-1 through IR 167-5).

Relative to public safety, there is presently no anticipated change in ground clearance, and the electrostatic field effects on people and objects will be less than conventional design due to increased field cancellation by closer phase spacing. At 138 kV the electric field is in the order of only one-third that of a conventional line. Although the degree of reduction will be less at higher voltages, the decrease will be significant.

Methods of jacking the conductors apart will allow hot line maintenance by line crews. Such maintenance will be demonstrated shortly at the PTI Saratoga Research Center under energized conditions.

In summary, the methods of intermediate voltage transmission line compaction being derived and defined by the research program will enhance system environmental aspects, economics, and reduce field effects. This is very significant to the electric utilities, and the impact of the NES Code must be carefully considered and defined. Thus, an interpretation is requested.

---

[1] L. O. Barthold, I. S. Grant, and V. J. Longo, "Preliminary research studies on compact transmission lines," presented at the IEEE Power Engineering Society Summer Meeting and EHV/UHV Conf., Vancouver, B.C., Canada, July 15-20, 1973, Paper C73 429-8. Photocopies may be obtained from the United Engineering Center Library, 345 E. 47th St., New York, N.Y. 10017.

235A Table 6

Fig IR 167-1
Pole Instrument scaffold in place.

Fig IR 167-2
Pole top view.

Fig IR 167-3
Aerial view.

235A Table 6

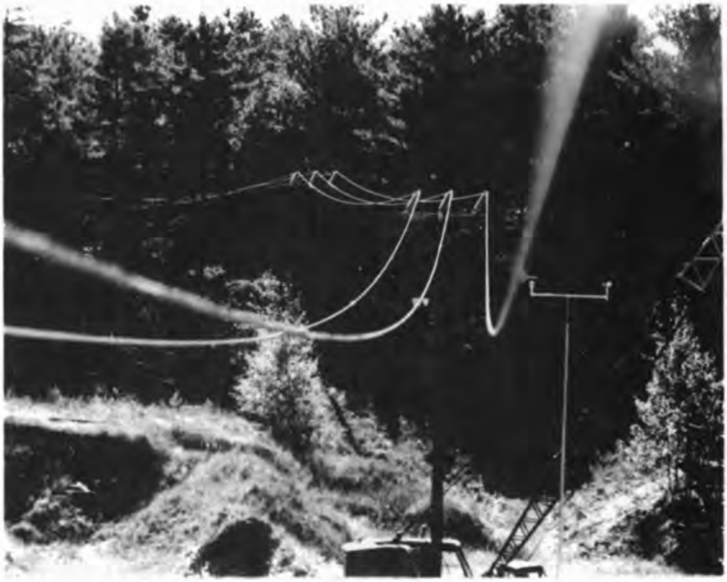


Fig IR 167-4
Conductor level view.

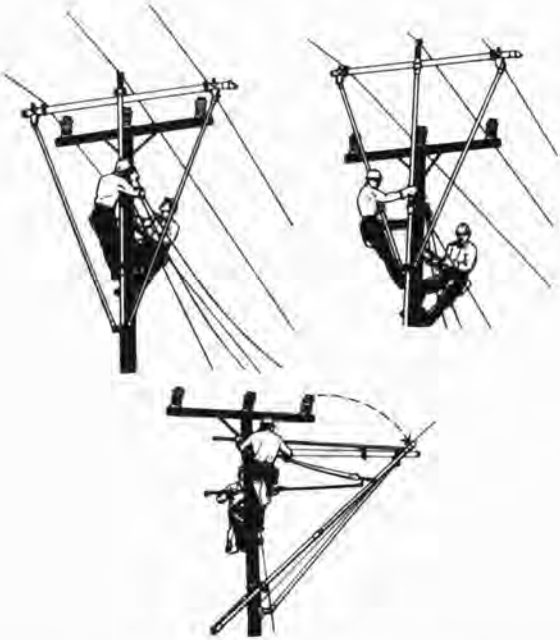


Fig IR 167-5
Maintenance by "jacking" conductors up or toward the side.

Extract from IEEE paper by Barthold et al.[1]:

It was decided to select a 36 inch (91.4 cm) phase spacing for the original line, providing a 60 Hz safety factor of 2.4 for the stationary position.

SUPPLEMENT TO PRECEDING

REQUEST (Nov 7, 74)

. . .Relative to the specific rules, it appears the only area is in phase-to-phase spacing. Applying Table 6, Rule 235A, the minimum separation is on the order of 5 feet. As indicated, the compact line is 3 feet.

Presently, the anticipated jacking of conductors for hot line maintenance will yield adequate clearances to meet NESC.

INTERPRETATION (Feb 11, 75)

Rule 235A2 prescribes phase-to-phase conductor clearances for normal operation with four exceptions. None of these exceptions apply to the experimental 138 kV line you describe. We see nothing in Rule 235A2 which permits a 3 foot spacing between phase conductors operating at 138 kV.

Working clearances are prescribed independently in Part 4. Jacking out the conductors to meet the requirements of Part 4 for maintenance does not affect the requirements for normal operation prescribed in Rule 235A2.

However, Rule 201A provides for waiver of the rules by the proper administrative authority. This is usually the state public utility commission. Among other things, this provides a means for authorization of lines of experimental design in order to establish parameters backed by satisfactory operating experience which then can serve as a firm basis for proposed changes in the Code.

235A, Table 9

Clearance between line conductors and span or guy wires.

REQUEST (Sept 13, 63) IR 101

The part in question is the clearance of span and guy wires attached to the same pole, to supply lines 0 to 8700 V. The table shows this clearance to be: General 6, when parallel to line 12 in. A footnote for the 12 in clearance states, "For guy wires, if practicable. For clearances between span wires and communication conductors, see Rule 238E3."

We have always considered a down guy as not being parallel to the line and, therefore, subject to the 6 in clearance. The footnote referring to the parallel line clearance specifically mentions guy wires (down guys) and leaves the implication that span guys are excluded. Should down guys in a plane parallel to the supply line have this 12 in clearance?

If span guys are included in this category, why is it necessary to have more clearance than for line conductors? Essentially with a bonded guy it is a conductor which should allow it to have the same clearance as line conductors.

INTERPRETATION (Feb 13, 64)

"A 'down' guy is considered to be a guy from a pole to an anchor in the earth, and its required clearance from line conductors of 8700 V or less is 6 in, regardless of whether the guy is transverse or longitudinal. A 'span' guy is considered to be a longitudinal guy, running from one pole to another, and its required clearance from conductors of 8700 V or less is 12 in, but this may be reduced by footnote 1."

With respect to your last question, the minimum clearance between supply line conductors of 8700 V or less on crossarms is 12 in. (See Table 6, page 73 of Handbook 81). This is consistent with the 12 in requirement of Table 9.

235A3 Table 9

Clearance between line conductors and guy of EHV guyed tower.

REQUEST (Oct 11 and 22, 63) IR 102

Rule 235A3 and Table 9 of the National Electrical Safety Code Handbook 81 specifies a clearance in any direction from line conductors to supports, to vertical or lateral conductors, span or guy wires, attached to the same support. The discussion of National Electrical Safety Code rules as covered in National Bureau of Standards Handbook H43 stipulates that where the conductors operate at voltages in excess of 8700, the separation is to be increased by an increment which is determined by the sparking distance in air. When computing the clearance of line conductors from guy wires attached to the same pole as outlined by Table 9, 12.3 ft at 345 kV and 17.7 ft at 500 kV will be required on guyed EHV metal towers.

This value of clearance appears to be very unreasonable when considering that the guying on metal EHV guyed towers is actually a structural member. It appears that the clearances to structures would more readily apply. Electrical tests at both 345 and 500 kV on full scale structures have verified that the point to point striking distance from conductor to guy is electrically greater than the point to plane effect existing from conductor to the structure. These are evident as shown in the attached copy of Fig IR-102.

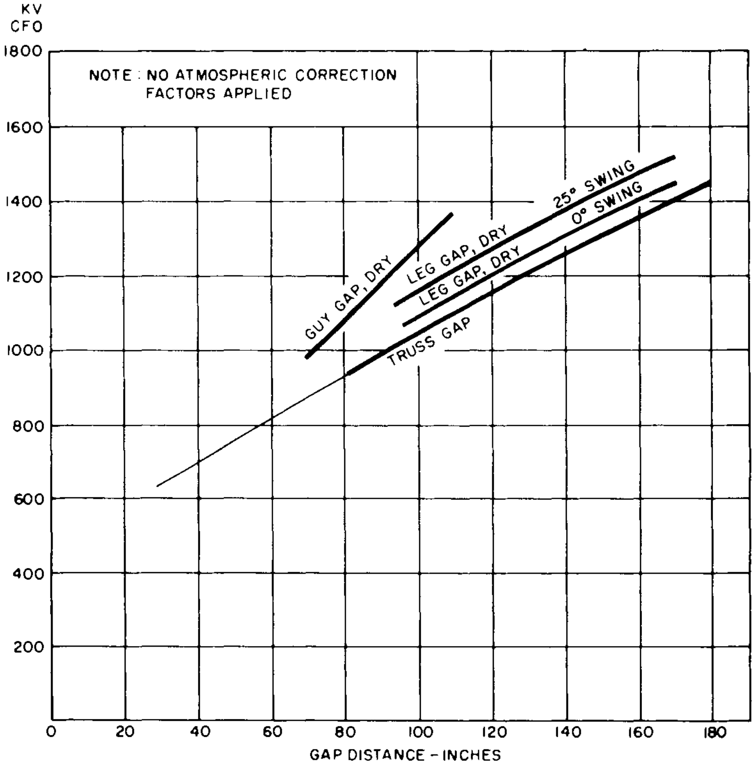
There have been many miles of 345 kV guyed metal towers placed in service in this country in the last two years. In addition, there are many miles of 500 kV guyed metal tower lines either currently being constructed or being planned for near future construction. In detail checking the clearances existing on existing EHB guyed tower lines and those that are planned for in the near future, it is evident that Rule 235A3, Table 9, are not used as part of the design criteria, the expalantion being that Section 235 is primarily dealing with pole lines, and Table 9 stipulates span and guy wires attached to the same pole. The code does refer to metal towers in other sections, and it is believed that Section 235 should not apply to an EHV guyed metal tower line.

We are currently providing the engineering and construction services on nearly 1200 miles of EHV transmission line that will be in service by May of 1967. It is evident that savings amounting to at least $5,000 per mi would be possible by the use of a guyed metal EHV tower. When considering the total number of miles involved and the possible savings, serious consideration is being given to the use of guyed EHV structures. It is also very desirable from a legal standpoint to be able to specify that all lines have been designed in accordance or exceed the requirements of the National Electrical

Safety Code. However, if Section 235A3, Table 9 is followed, more expensive self-supporting construction will be required in order to specify that all lines are in accordance with the strict letter of the code.

In view of the possible savings and the effect on the rate base, we are respectively requesting a clear interpretation of Rule 235A3, Table 9, in covering the conductor to guy clearances on guyed metal EHV structures. As representatives of eleven utility companies which are cooperating with the Tennessee Valley Authority in a 1500 mW diversity interchange, we have been authorized to prepare any exhibits or examples, provided it is necessary for your use in interpreting Rule 235 in connection with guyed EHV metal towers.

In view of the possible savings that can be realized with guyed EHV metal towers and the fact that utilities are presently installing such towers on both 345 and 500 kV lines, it would be desirable to the industry to obtain a clear interpretation of the intent concerning Rule 235 and its application on EHV metal towers. Various members of the C2 Sectional Committee have indicated that when the Sixth Edition of the code was being reviewed for revision, the subject of EHV was not considered for Rule 235. Rule 235 applies primarily on pole lines and Handbook H43 indicates that the separation required in increased by an increment which is determined by sparking distance in air. Actual service experience and many tests have shown that the same striking distance to guy, as allowed to the crossarm on a guyed EHV structure, is electrically of greater value because of the point to point effect as compared to the point to plane effect. Actually, the guy on a metal EHV guyed structure is a structural component, and clearances as outlined to surfaces of crossarms or surfaces of poles would be more applicable. In addition, considering voltages on the basis of single line to ground instead of conductor to conductor would be more reasonable.



COMPOSITE APPROXIMATION OF SWITCHING SURGE
C F O FOR AIR GAPS

Fig IR 102.

INTERPRETATION (Oct 13, 64)

At a meeting of the C2 Sectional Committee held on Sept 30, 1964, it was agreed that a letter ballot on several revisions to the National Electrical Safety Code would be taken. One of these revisions would change the requirements for clearances from conductors to guys of guyed EHV metal towers. The details of these revisions still need to be worked out. However, it was agreed that the required clearances to guys of guyed EHV metal towers should be approximately the same as the present clearance requirements from conductors to tower structures.

Because of the above proposed Code revision no action by the Interpretations Committee will be taken.

235C1, Table 235-5

Vertical clearance at supports.

REQUEST (Oct 31, 77) (1977 Edition) IR 209

Please clarify Note 5 relative to a three phase grounded wye distribution circuit. This Table appears to indicate that a 40-inch vertical clearance is not required between conductors of different phases for voltages 15 kV to 50 kV but is required for voltages 8.7 kV to 15 kV.

INTERPRETATION (Dec 9, 77)

Conductors of 8.7 to 15 kV above the conductors of the same voltage range take either a 40 inch clearance or a 16 inch clearance depending upon how they are worked and this applies to different phases of the same circuit. Conductors of 15 to 50 kV above conductors of 8.7 to 15 kV also take a 40 inch clearance. However, footnote 5 provides that conductors of the same circuit or circuits do not require 40 inch clearances if not worked when energized or if covered by shields, and so forth (per provisions of Table 235-5). In this particular situation, the clearance is left up to the line designer.

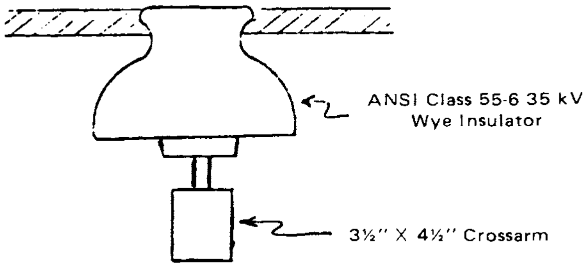
235E1, Table 235-6

Clearance from line conductors at supports.
(a) Meaning of minimum clearance
(b) Clarification of "voltages are between conductors"
(c) Reason for additional clearances on joint poles

REQUEST (Oct 31, 77) IR 210

a) Please clarify the meaning of minimum clearance, in particular as related to a pin type insulator of larger diameter than the cross-arm on which it is mounted. Is the minimum clearance the straight line ruler distance measured as though the insulator were not there or the total intervening surface length between conductors and support surface (flashover distance)?

Drawing of example:



b) Please clarify the annotation (all voltages are between conductors) relative to a ground wye distribution system.

If the line to line potential is 34.5 kV and the line to ground potential difference is 19.9 kV —

1. Which voltage is used to calculate the clearance of line conductors from the surface of support arms?

2. Which voltage is used to calculate the clearance of line conductors from the surface of structures?

c) What is the reason for additional clearances on jointly used poles when telephone or cable TV or both are at lower levels?

INTERPRETATION (Dec 9, 77)

(a) The minimum clearance is the straight line distance between the conductor and the surface of the supporting arm or structure measured as though the insulator was not there.

(b) The voltage to be used in determining the clearance from surfaces of structures is the phase to phase voltage, 34.5 kV in this case.

(c) This is a carryover from older editions of the code. The greater separation was specified to reduce the likelihood of contact between those guys and energized power conductors.

236

Climbing space

REQUEST (Dec 15, 75) IR 176

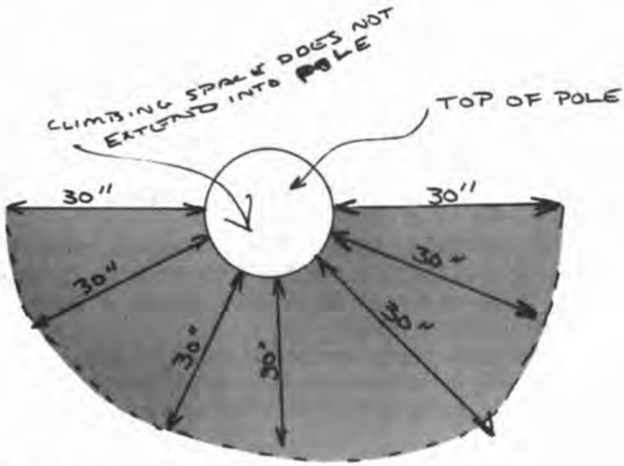
The Code specifies that in Rule 236E3 the climbing space has horizontal dimensions of 30 inches for supply conductors of 300 to 8700 volts to ground. My problem is this and details are attached (Figs IR 176-1 through IR 176-3).

The word "space," meaning volume, is measured past any conductor parts etc giving me a configuration for climbing space similar to Fig IR 176-1.

As I follow through the Code, Rule 236A2 specifies that the climbing space be on one side or corner, and I cannot determine what is meant by the corner of pole? How could a round pole be divided into corners?

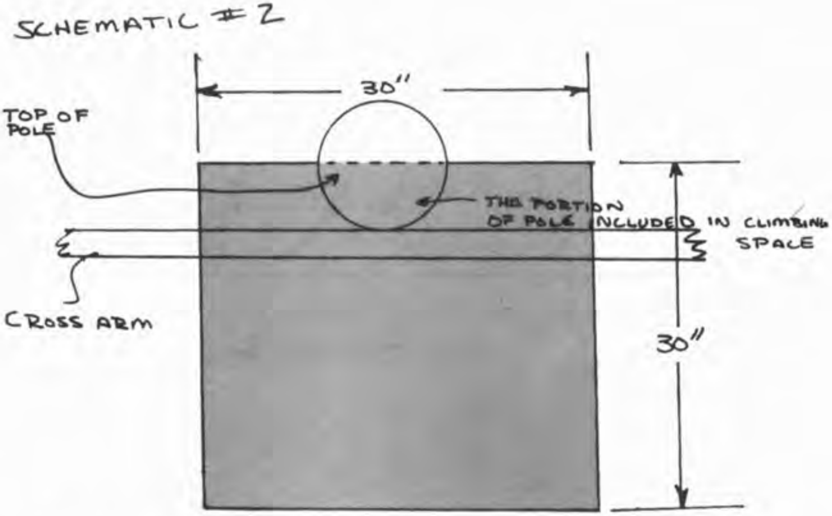
Further in this Code. . .Rule 236B. . .states that when the pole or structure is included in the climbing space it does not obstruct the climbing space and from my interpretation gives me a configuration described in Fig IR 176-2.

Fig IR 176-3 is the actual configuration in question, and I would like to know if the stinger wire from the bottom of the manual cutout would be considered in the climbing space as specified by the Code.



Shaded area denotes climbing space.

Fig IR 176-1



Shaded area denotes climbing space.

Fig IR 176-2

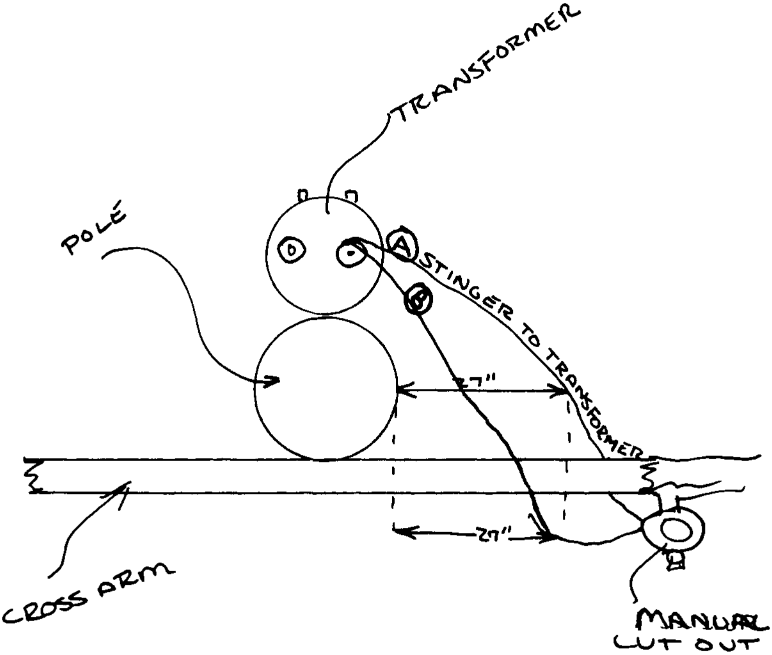


Fig IR 176-3. (1) Does climbing space extend into this stinger wire if mounted in the position of stinger *A*? (2) Does climbing space extend into this stinger wire if mounted in the position of stinger *B*?

INTERPRETATION (Feb 9, 76)

Climbing space may be considered as an imaginary box whose base is specified in Rule 236E3 (Table 10) and whose height is specified in Rule 236E1. In your example, the imaginary box has a base of 30 inches by 30 inches. This must be provided at least 40 inches above and below the limiting conductors. As the name implies, the purpose of climbing space is to permit a lineman to climb the structure without undue obstruction.

The term "corner of a pole" means any quadrant. Poles may be considered divided into quadrants by the direction of the line and crossarms (or support arms) at right angles to the line.

With respect to your implied question regarding Fig IR 176-2, please note that Rule 236 says, "Portions of the pole or structure, when included in *one side or corner* of the climbing space. . ." Fig IR 176-2 would be acceptable without the crossarm, but not as shown.

With respect to Fig IR 176-3, neither stinger wire *A* nor *B* extends into the climbing space if the space is provided on the left side away from the stinger wires. As Exception 1 to Rule 236E1 points out, these requirements for climbing space do not have to be met if the line is always de-energized before workmen climb the pole in question.

You may find the discussion of Rules 236 and 237 contained in National Bureau of Standards Handbook 39 (1944) or 43 (1949) (see below) to be of some assistance in understanding these rules. The language of both rules is essentially the same in the 1973 Edition as it was when these handbooks were written.

Discussion of the National Electrical Safety Code, Part 2, contained in NBS Handbooks H39 (1944) and H 43 (1949):

236. Climbing Space.

D. Location of Supply Apparatus Relative to Climbing Space.

See discussion of rule 286,B.

E. Climbing Space Through Conductors on Crossarms.

The same climbing space is to be maintained for communication conductors as is required for supply conductors immediately above them when both are attached to the same pole with a maximum of 30 inches. This requirement is made not so much for the hazard due to the communication conductors alone, but for the hazard that might exist if a fallen supply conductor at some distant point were in contact with one of the communication conductors. In this case a high potential might exist between the two pole conductors of the communication circuit which could cause a serious accident to a lineman required to crowd through conductors having a reduced climbing space. Other considerations are that supply linemen will not get their feet against communication wires, and that they will not injure them in climbing through.

Wherever a primary supply circuit is so installed on the same poles with communication conductors as to provide sufficient space for the installation of a secondary arm between the two, the intent of the rule is met if the communication conductors have a spacing at the poles corresponding to the secondary voltage. This is particularly true in urban territory. However, where the separation between the primary and communication arms is not sufficient for the insertion of a lower-voltage arm, the climbing space through the communication conductors should correspond to the primary voltage.

Communication linemen, in general, are not accustomed to working near supply conductors. It is therefore desirable to allow liberal free working space for these linemen when communication conductors are on the same structure as supply conductors and are above them. This will tend to avoid accidental contact with supply conductors when the lineman's attention is on his own wires.

G. Climbing Space for Longitudinal Runs.

It has become common practice in many localities to place the low-voltage conductors, which are generally used for supplying services, vertically on racks or brackets close to the poles, thus practically cutting the climbing space in half. While such construction provides comparatively easy and simple methods for the attachment of services, it requires readjustment of other construction to avoid obstructing the workmen climbing up and down the pole and, unless other arrangements in the locations of the adjacent conductors are made, constitutes a hazard. In order to comply with the provisions of the rules without variation, these racks are occasionally placed on extension pieces. In lieu of this, the nearest supply conductors on crossarms may be 4 feet from the rack, or the conductors on the adjacent arms may be so installed as to provide the full climbing space on one side of the rack. Where attachment of conductors close to the pole seems advisable, the racks should generally be on only one side of the pole for uniformity, and the climbing space should generally be carried vertically at the other side. The climbing space between any two wires is required, however, by the rule, to be carried vertically at least 40 inches above and below them, and any shifting of the climbing space from side to side must, therefore, be done in steps not less than 40 inches apart.

H. Climbing Space Past Vertical Conductors.

This rule shows that when the climbing space is changed from one side to a corner of the pole, as illustrated in Fig 7, the pole itself, or conductors enclosed in a conduit or protected by a molding when located in the corner of the climbing space, are not considered as an obstruction.

237. Working Space

Sufficient clear working space must be provided between the conductors supported on adjacent crossarms to permit linemen to work safely upon the conductors supported by a pole or structure. The vertical and horizontal clearances called for in the rules are generally between conductors rather than between pins or crossarms. (See Fig 8.) However, in cases where the crossarms fulfill the vertical-clearance requirements, but owing to the use of different types or sizes of insulators or different manners of attachment the clearances between the conductors themselves are slightly reduced, the requirements of the rule will be considered as having been met.

The requirements of this rule are to insure that the proper dimensions of the working space are maintained at all times. During reconstruction or when new apparatus, such as a transformer or switch, is being installed, unless the matter is given proper attention, there will be a tendency to place taps or leads in the working space. Such connections can generally be placed on the other side of the pole from the working side, or if this is impossible it will be necessary to install additional arms or other means to support the conductors in order to provide the proper clearances and separations.

D. Location of Buckarms Relative to Working Spaces.

The use of buckarms on poles carrying a considerable number of wires offers difficulties to the provision of normal climbing and working spaces and some concessions have been made in the rules in order to make their use practicable. Even though a pole were specially designed to provide the normal clearances, general levels would be disturbed where the buckarms were numerous, as at a junction pole.

The rules require the provision of climbing space, in accordance with Rule 236, under all circumstances. To accomplish this, exception is made by Rule 236,F, to the general requirement for horizontal separation of wires at supports, under certain conditions. For voltages not exceeding 8700, an exception has been included in this edition of the code to permit a 12-inch instead of an 18-inch working space in construction involving not more than two sets of line arms and buckarms when certain prescribed safety measures are practiced. Where crossarms have the usual 2-foot spacing and the 18-inch working space is provided, the buckarm is placed close to one of the line arms, as shown in Figure 9. This should be the line arm carrying the conductors which are connected to conductors on the buckarm. The vertical and lateral conductors will then not obstruct the free 18-inch space which constitutes a reduced working space. One set of conductors can be worked on from below and the other from above.

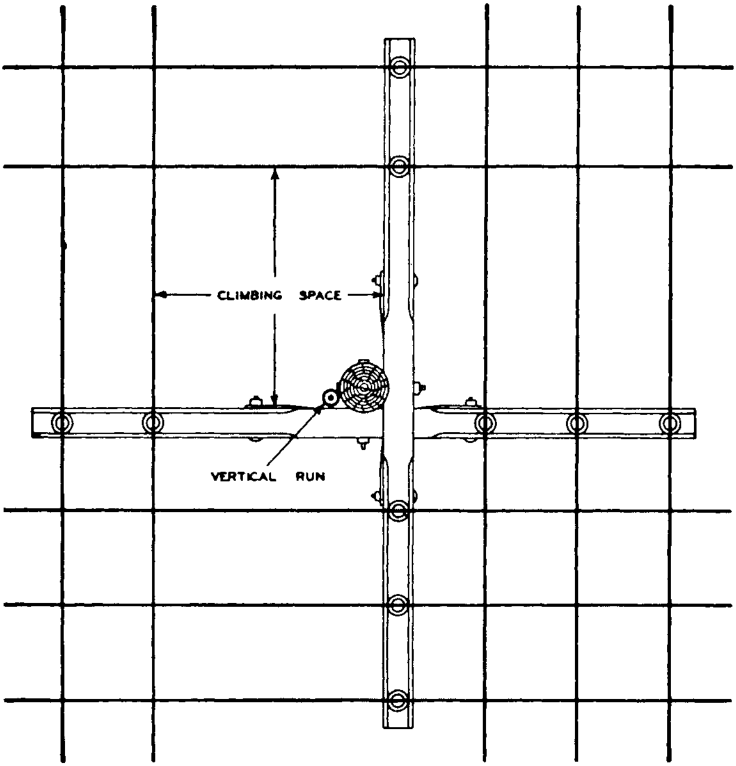


Fig 7
Example of unobstructed climbing space.

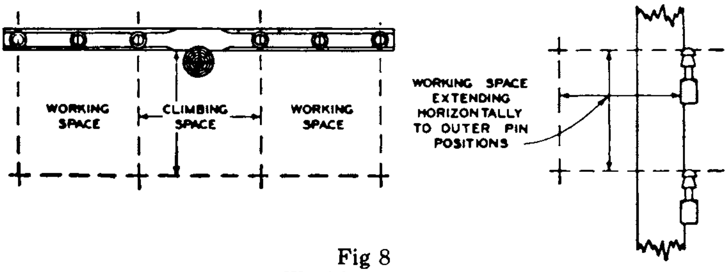


Fig 8
Working space.

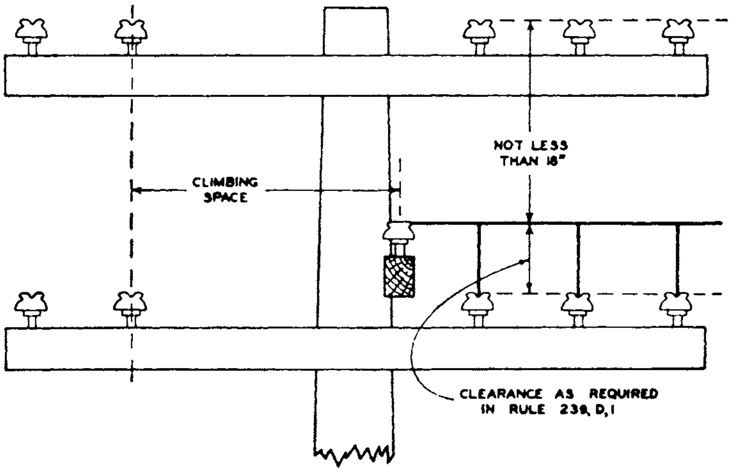


Fig 9
Obstruction of working space by buckarm.

238

Clearance between supply conductors, communication and CATV cables.

REQUEST (Feb 28, 68) IR 127

The National Electrical Safety Code, Article 238 outlines the requirements for vertical separation between line conductors, cables, and equipment located at different levels on the same pole or structure.

We are enclosing information on two locations where in order to attempt compliance with Rule 238, a CATV operator used a cross arm to support their cable. We would appreciate an interpretation on whether or not the requirements of Rule 238 are being met on these two examples.

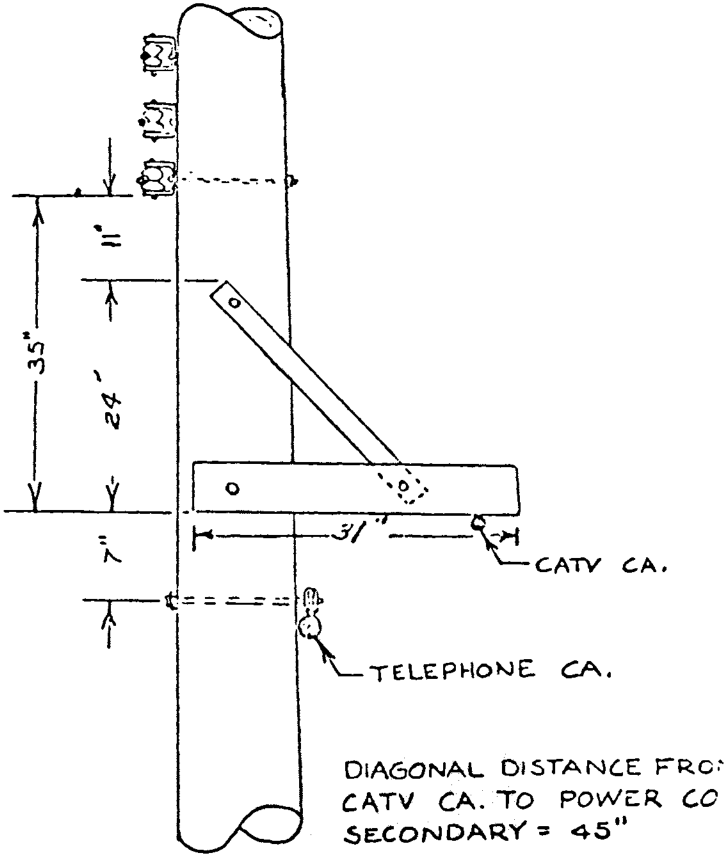
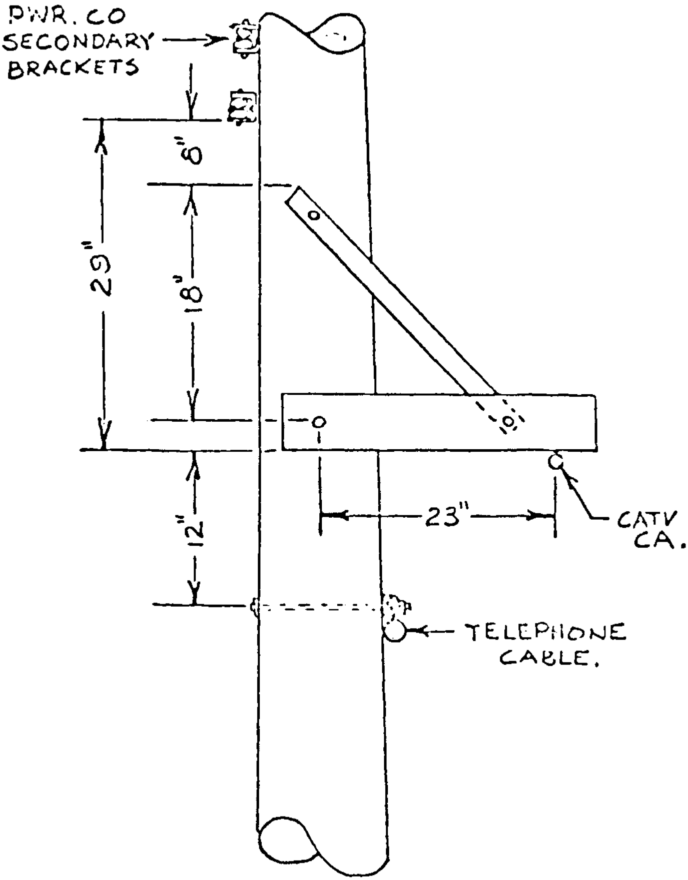

11"
35"
24"
7"
31"
CATV CA.
TELEPHONE CA.
DIAGONAL DISTANCE FRO
CATV CA. TO POWER CO
SECONDARY = 45"

Fig IR 127-1.



DIAGONAL DISTANCE FROM CATV CA. TO POWER COMPANY SECONDARY = 40"

Fig IR 127-2.

INTERPRETATION (Mar 20, 69)

The separations between electric supply and communication conductors specified in Rule 238, must be measured vertically. The required vertical separation between secondary electric conductors is 40 in. (See 238B and D). 238C entitled "Separation in Any Direction," does not apply to the separations required between electric supply and communication conductors.

238 Table 11

13.8 kV distribution clearance with horizontal post insulators without cross arms.

REQUEST (Aug 4, 65) IR 115

New Orleans Public Service Inc. overhead electric distribution is 13.8 kV with a common multi-grounded neutral. This neutral is also used as a shield wire being carried 4 ft above the primary crossarm and providing a shielding angle of 45° with 8 ft crossarms.

It is proposed, as a part of a program to improve the appearance of the electric distribution system, to change to the horizontal post insulator type of construction with 3 ft vertical separation between phases and have the "shield-neutral" 3 ft above the top phase.

We are questioning whether or not these proposed separations are in violation to Rule 238 (Table 11).

INTERPRETATION (Oct 7, 65)

The proposed 3 ft separations with the type of construction described is not in violation of Rule 282, Table 11. Rule 238D states that the vertical separation between conductors not carried on crossarms shall be the same as required in Rule 238B1 for conductors on crossarms. Rule 238B1 in turn refers to Table 11. Assuming that the 13 800 volt 3-phase circuit referred to is effectively grounded, the "voltage" of the circuit when referring to Table 11 would be less than 8700 volts and would fall in the 750 to 8700 volts class. This, in turn, calls for 2 ft vertical separation and Rules 238B1 and 238D then say that this can be reduced to 16 inches for line conductors not carried on crossarms. (Rule 238C also requires a minimum separation of 16 inches for the condition you outline). However, some committee members pointed out that the required climbing and working space specified by Rules 236 and 237 may not be provided if horizontal post insulators are to be staggered on alternate sides of the pole.

238A Table 11

Conductor vertical spacing with post insulators.

REQUEST (May 14, 64) IR 110

When post type insulators are used with bare conductors on a 12 480 Y 3-phase circuit, should the spacing between the vertical conductors be four feet as shown in Table 11 Rule 238A for vertical spacing between cross-arms carrying conductors? If this rule does not apply, what rule in the Safety Code does apply?

INTERPRETATION (Sept 21, 64)

For the type of construction described, Rule 238C and D apply. (The exceptions to Rule 238D do not apply).

Rule 238D states that the vertical separation between conductors not carried on crossarms shall be the same as required in Rule 238B1 for conductors on crossarms. Rule 238B1 in turn refers to Table 11. Assuming that the 12 480 Y 3-phase circuit referred to is effectively grounded, the "voltage" of the circuit when referring to Table 11 would be 7200 volts and would fall in the 750 to 8700 volts class. This, in turn, calls for 2 ft vertical separation and Rules 238B1 and 238D then say that this can be reduced to 16 inches for line conductors not carried on crossarms. (Rule 238C also requires a minimum separation of 16 inches for the condition you outline).

238D

Clearance between multi-grounded neutral and communication service drop.

REQUEST (Apr 13, 62) IR 93

Rule 238D, Exception 2, of the Sixth Edition of the National Electrical Safety Code states that communication service drops which "*cross under* supply conductors on a common crossing pole" may have a separation of 4 in from "an effectively grounded supply conductor." We should like to know whether this rule may be interpreted as permitting a 4-in separation between a multi-grounded neutral and telephone drop attached to and distributing from a joint use pole as indicated in the enclosed sketch. If it is permissible to run drop wires vertically up a joint use pole to within 4 in of the multi-grounded neutral, it would be of considerable value in obtaining ground clearance over rods, etc., without requiring additional pole height. We can see no difference from a safety standpoint in the construction shown in the sketch, as compared with the construction that seemed to have been contemplated by the wording of this exception.

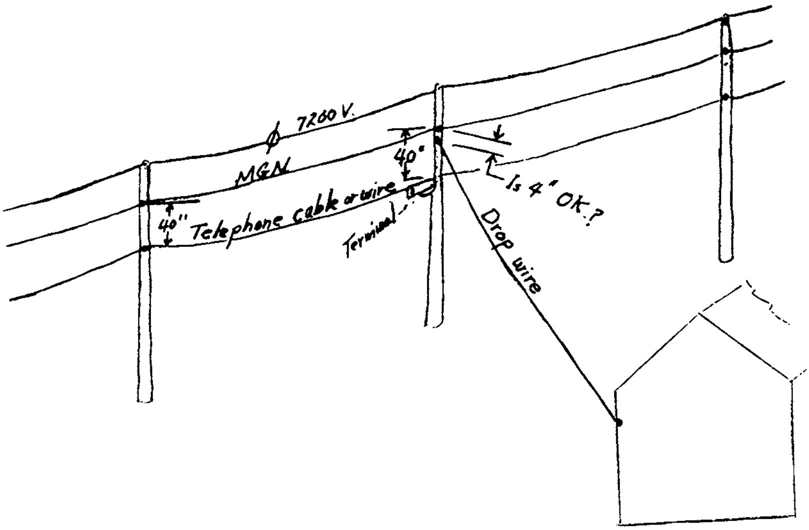

7200 V.
MGN
40"
40"
Telephone cable or wire
Terminal
Is 4" OK.?
Drop wire

Fig IR 93.

INTERPRETATION (Nov 8, 62)

The intention of Rule 238D, Exception 2 of the Sixth Edition of the National Electrical Safety Code was to differentiate between use of a "common crossing pole" and of a joint use pole. In the former case it is presumed that two sets of conductors for different services cross and are supported on the common crossing pole whereas in your illustration these different services make joint use of several or many poles in a single line as a common means of distribution of the two services. The exception was not intended to apply to this latter case.

It was recognized that, in many cases, pole lines designed for the sole use of power facilities would not have sufficient height to provide normal separation between power and communication and standard ground clearances at the same time. It was felt, however, that the greater safety of common pole crossing as compared to span crossing justified a reduced separation, at least between communication service drops and multigrounded neutrals. On the other hand, lines designed for joint use by power and communication facilities should provide sufficient height to meet the normal requirements of both services.

Furthermore, communications workmen are not ordinarily accustomed to working in the neutral space so close to power conductors and while multigrounded neutrals do not ordinarily represent an electrical hazard, it was considered important to minimize the operations a communications workman might have to perform in such circumstances.

238E4

Placement of communication cable above effectively grounded luminaires with drip loops.

REQUEST (June 15, 64) IR 105

Will you please advise if there is any type of construction which will permit communications cables to be placed *above* effectively grounded street light fixtures using drip loops without violating Rule 238E4?

INTERPRETATION (Oct 12, 64)

Rule 238E4 covers the case where the street light bracket is ungrounded and mounted 20 inches above the communications cable in accordance with the requirements of Rule 238E3. The drip loop in the supply cable serving this lamp is therefore above the communications space and according to Rule 238E4 can loop down to a point 12 inches above the communications cable (the cable itself must comply with the requirements of Rule 239D governing the type of supply cable permitted in the *supply space* on the surface of the pole above the communications cable). The drip loop provision for such a supply space cable outlined in Rule 238E4 does not apply to the case where the lamp bracket is mounted below the communications cable. For this particular case see the provisions of Rule 238E3, Table 12, for the separation between the lamp bracket and the communications cable (4 in below the cable for the effectively grounded bracket) and then see Rule 239F1, 239F1 Exception 3, and 239F4 for the method of bringing an effectively grounded metal-sheathed cable through and clear of the communications cable and its attachments to serve the lamp.

239C

Mechanical protection for interconnected (arrester-neutral) grounding lead

REQUEST (Sept 9, 65) IR 118(1)(3)(4)(7)

Metallic vs insulating

(1) If the lighting arrestor grounding conductor is interconnected with the secondary neutral in accordance with paragraph 97C1(b) or (c) do the provisions of paragraph 239C require that an insulating protective molding be required for the direct earth grounding connection (required by paragraph 97C1(b) or (c)) of the arrestor or can a conducting metal molding be applied?

(7) Are the ground connections (in addition to the direct earth grounding connection of the arrestor mentioned in paragraph 97C1(c) required to have insulating protective molding or can a conducting molding be employed and satisfy requirements of paragraph 239C.?

Permissable omission of mechanical protection

(3) Is Exception 1 under paragraph 239C intended to apply to grounding wires from lightning arresters?

(4) Is Exception 1 under paragraph 239C intended to apply to "the direct earth grounding connection of the arrester" mentioned in paragraph 97C1(b) and (c).

INTERPRETATION (Apr 66)

No final interpretation found in the records. The consensus of the committee responses appears to be:

(1) If wood (or insulating molding) is *not* required either wood or metal covering *may* be provided. Wood is not required in any case in rural districts (from 239C Exception 4). Wood is not required anywhere *if* the arrester-neutral interconnected downlead is one of several used to provide multiple grounds on the neutral.

(7) The ground connections (other than the lightning arrester ground) mentioned in Rule 97C1(c) are required to meet the mechanical protection provisions of Rule 239C. This does *not* require them to have an insulating protective covering but only "a covering which gives suitable mechanical protection" *unless* the installation can meet the requirements specified in one of the 5 exceptions noted. In such case, the covering may be omitted entirely. In specific answer to question 7, a conducting molding *may* be employed.

(3) Exception 1 of Rule 239C is not *intended* to apply to grounding wires from lightning arresters because it would be a most unusual case where such a grounding conductor would consist of "armored cables or cables installed in a grounded metal conduit".

If, however, the lightning arrester ground is made in this way, Exception 1 would apply and the covering may be omitted.

(4) This appears to be the same question as No. 3. See above.

Method of grounding mechanical protection over arrester grounding wire.

REQUEST (Sept 9, 65) IR 118(5)(6)

(5) If the answer to question number 3 is yes and the conduit consists of magnetic material, will electrically connecting the ends of the conduit to the grounding conductor as required by paragraph 93C1 constitute the "grounded" as required by paragraph 239C, Exception 1, or will separate ground conductor be required by 97A1 for the conduit?

(6) If the answer to question number 3 is yes and the conduit consists of nonmagnetic metal conduit, will electrically connecting the conduit at one point to the grounding conductor constitute the "grounded" as required by paragraph 239C, Exception 1?

INTERPRETATION (Apr 66)

No final interpretation found in the records. The consensus of the committee responses appears to be:

The answer to IR 118 question 3 is No.

(5) Although unlikely, if the direct earth grounding connection of the arrester *does* meet the requirements of Exception 1 of Rule 239C, the grounding of the metal conduit could be achieved by electrically connecting both ends of the conduit to the grounding conductor as specified in Rule 93C1. This does not appear to be in any conflict with Rule 97A1.

(6) Rule 93C-1 specifies guards of non-magnetic material *unless* the (magnetic metallic) guard is electrically connected to the grounding conductor at both ends. Hence a single connection may be used to ground non-magnetic conduit.

Note, however, that if the installation is in a rural district, it would not be necessary to make any connection between the conduit and the grounding conductor since, under Exception 4, no protection of any kind is required for the grounding conductor.

Use of nonmetallic conduit for riser protection

REQUEST (Dec 17, 73) IR 153

With reference to Rule 239C, is it permissible to use nonmetallic conduit for riser pipes provided they offer sufficient mechanical protection within 8 feet of the ground? These risers would contain supply cable of paper lead or polyethylene insulated concentric neutral cables operating up to 23 kV line to line.

INTERPRETATION (Nov 18, 74)

Rule 239C requires only "suitable mechanical protection" without specifying the type of material. The use of nonmetallic conduit to provide mechanical protection for the first 8 feet of riser cable is not prohibited by Rule 239C.

242

Joint use 7.2 kV/communications cable joint use poles; insulated strand, self-supporting communications cable.

REQUEST (Apr 24, 64) IR 109

The particular application involves joint use between open power conductors operated at 7200 V to ground, (wye connected) and self supporting communications cable. If the communications cable were conventional bare strand with the cable lashed to it, footnote 8 of Table 15 would permit Grade C construction with the standard protective measures normally employed in this situation.

We note that footnote 8 mentions de-energization in the event of contact with the communications plant. However, since self supporting cable features an insulated strand, a *physical* contact with a power wire does not necessarily mean an *electrical* contact, and without electrical contact, the power wire will not de-energize. On the other hand, there is no hazard (or damage) unless there is electrical contact. Hence we believe that the use of self supporting cable should not force Grade B construction as long as the provisions of footnote 8 are met in the event of *electrical* contact.

INTERPRETATION (June 29, 64)

The use of self supporting cable does not require Grade B construction as long as the provisions of footnote 8 of Table 15 are met in the event of *electrical* contact. ("Contact" does not necessarily mean "physical contact"). Presumably, in order to assure operation of the protection means specified in footnote 8, the supporting strand of the self supporting cable would need to be effectively grounded throughout its length even though insulated.

242 Table 15

Grade B crossing spans in a grade C supply line.

REQUEST (May 26, 64) IR 111

A railroad or a communications line is crossed over by a supply circuit of 7200 V to ground. The supply line is constructed grade C throughout except for the crossing span, which shall be grade B, since no means have been taken to de-energize the supply circuit in case of a contact with the communications line.

Refer to Table 15, footnote 8(1) as shown on page 105 of National Bureau of Standards, Handbook 81 dated November 1, 1961.

Conductor tension limitations are 4210 pounds. (4/0 ACSR @ 50% ultimate).

[We believe] based on Rules 261D3(b) and (d), 261E2(b) and (d) and 252C1(2):

(1) Normal double crossarms with double steel pins and ties without head guys are inadequate for the ends of the grade B crossing in the grade C line.

(2) Crossarms adequate to meet rule 262D3(b), conductor terminations (deadends) to meet rule 261E2(b) with a head guy away from the crossing adequate to meet rule 252C1(2) would appear to meet the requirements of the rules applying.

INTERPRETATION (Sept 2, 64)

Your interpretation for the condition you outlined is correct. The committee assumes that in the first line after "Our Interpretation," "261E2(e)" should be "261E2(b)". Several Committee members remarked that the condition you outline, that is, "no means have been taken to de-energize the supply circuit in case of a contact with the communication line" is a quite uncommon situation.

Definition of "promptly de-energized"

REQUEST (Feb 17, 66) IR 122(a)

(a) Note 3: Which are the criteria for characterizing a supply circuit *promptly de-energized*?

Our primary distribution feeders which are protected by oil circuit reclosers of the following operating sequence: 0 (0.15 sec) + 0.45 sec + C + TD + 0 + 5 sec + C + TD + 0 (where: 0 = tripping, C = closing, TD — time delay — 0,5 to 6,0 sec depending on the fault current) can be considered as promptly de-energized?

INTERPRETATION (May 66)

No final interpretation found in the records. The consensus of the committee responses appears to be:

The NESC does not define the de-energization time required to classify a circuit as "promptly de-energizing." However, . . .the recloser sequence detailed in Mr. Nitsolas' letter does not differ greatly from those used in this country. We agree. . .the circuit would be considered as promptly de-energizing.

Definition of constant potential

REQUEST (May 17, 74) IR 162

Please define "constant potential" as used with supply conductors in the headings for Table 15, Rule 242 of the National Electrical Safety Code.

INTERPRETATION (Oct 2, 74)

"Constant potential" refers to the normal class of electric distribution and transmission circuits where the voltage is held, within limits (for example, ANSI C84.1[1] values), to some predetermined nominal level. There may be transient variations of short duration which depart from these values without violating the principle of constant potential.

"Constant current" circuits (also mentioned in Table 15, Rule 242) are arranged so as to intentionally vary the voltage to maintain the system current at the regulated level.

---

[1] ANSI C84.1-1977, Voltage Ratings for Electric Power Systems and Equipment (60 Hz).

243B

Clearance between highway lighting standards and transmission lines.

REQUEST (Dec 3, 65) IR 120

With the requirement that certain portions of the Interstate Highway System be lighted, we are constantly being faced with the problem of determining both vertical and horizontal clearances required between highway lighting standards and transmission lines crossing or running parallel to the Interstate Highway System.

We would appreciate being informed as to whether or not a formula or table exists, or if any criteria have been adopted or recommended, establishing vertical and horizontal clearances between highway lighting standards and transmission lines.

INTERPRETATION (Mar 28, 66)

This committee has determined that for purposes of applying rules of the National Electrical Safety Code "highway lighting standards" should be considered as supporting structures for an electric line. Therefore, clearances between "highway lighting standards" and wires of electric supply or communication lines on other supporting structures should be in accordance with Rule 234B on page 67 of NBS Handbook 81. Rule 234B applies whether the highway lighting facilities are "fed" by underground or overhead lines.

250C

Application of extreme wind loading.

REQUEST (July 8, 77) (1977 Edition) IR 200

Please examine our interpretation of Rule 250C "Extreme Wind Loading" in the following examples and advise if we are correct:

Examples 1 and 2

Conditions — Heavy Loading District
½ in Ice, 4 lb Wind plus k factor
— Extreme wind pressure, as per Figure 250-2 is 16 lb per square foot
— Use an 80 ft Class 1 pole
— Grade B Construction
— $1^3/_8$ HSS Static Conductor and 3 — 556 ACSR conductors with single pole type construction

EXAMPLE 1

80 ft, Class 1 pole set 10 feet deep	
Ultimate Resisting Moment at Ground Line	300 847 ft·lb
Allowable Resisting Moment at Ground Line — Grade B — 25%	75 211 ft·lb
Moment at ground line due to transverse load of 4 lb wind on pole	9 408 ft·lb
Therefore, allowable moment at ground line due to transverse load of 4 lb wind with ½ in ice on conductors	65 804 ft·lb
Assuming 480 ft adjacent spans and computing the moment at the ground line due to the 4 lb wind with ½ inch ice on conductors	65 804 ft·lb

Therefore the maximum allowable horizontal span for an 80 ft, class 1 pole is 480 ft. Example 1 *does not* take into consideration Rule 250C.

EXAMPLE 2

80 ft, Class 1 pole set 10 feet deep	
Ultimate Resisting Moment at Ground Line	300 847 ft·lb
Allowable Resisting Moment at Ground Line — Grade B — 25%	75 211 ft·lb
Moment at Ground Line due to transverse load of 16 lb wind on pole	37 632 ft·lb
Therefore, allowable moment at ground line due to transverse load of 16 lb wind on bare conductors	37 579 ft·lb
Assuming 158 feet adjacent spans and computing the	

moment at the ground line due to the 16 lb wind on bare conductor 37 579 ft·lb

Therefore the maximum allowable horizontal span for an 80 ft, class 1 pole is 158 ft. Example 2 *does* take into consideration Rule 250C.

If our interpretaton of Rule 250C is correct, this rule reduces the maximum allowable horizontal span from 480 feet to 158 feet which, in essence, means we can no longer use poles with a height greater than 60 feet above ground level.

INTERPRETATION (Sept 29, 77)

Rule 250C only specifies the wind loading on tall structures (that is, over 60 feet). Overload capacity factors are contained in section 26. Please note that Rule 260C allows an overload capacity factor of 1 when the extreme wind loading of Rule 250C is used.

251

Constant to be added to storm loading for messenger supported cable.

REQUEST (Nov 12, 63) IR 103

Request clarification of Conductor Loading of National Electrical Safety Code Rule 251, page 111 in Handbook 81, with regard to the constants to be added to the resultant storm loading for aerial telephone cables supported by galvanized steel strand when the galvanized strand is a part of the cable, as in the modern Figure 8 type cable, or when the cable is attached to the supporting messenger strand by lashing.

Rule 251 was written when telephone cable was suspended by rings a few inches below the supporting messenger strand. See Figure 1 on the attached sketch. In this case, the supporting strand can be completely surrounded by ice and also the messenger strand can be completely surrounded by ice.

In making the transition from 8 lb per square foot wind pressure of the Fourth Edition of National Electrical Safety Code to 4 lb of wind for the Fifth, and now the Sixth Edition of National Electrical Safety Code, it was correct to use a constant for the messenger and an additional constant for the cable as is specified in Rule 251 where it states "Where cables are concerned, the specified loadings shall be applied to both cable and messenger".

However, at present, telephone cable is either lashed to the messenger as shown by Figure 2 of the attached sketch or the supporting strand is an integral part of the Figure 8 type cable as shown by Figure 3 of the attached sketch. In both these cases, since the cable is held so close to the messenger strand, there is only one circumferential covering of ice, whereas, with the old method of cable supported by rings there were two circumferential coverings of ice, one for messenger strand and one for the cable.

For this reason, it is our opinion that for both lashed cable and Figure 8 cable only one constant (that for weatherproof, etc.) should be added to the resultant loading as specified in Rule 251.

In several cases, engineers, when making sag and tension calculations, have in the case of Figure 8 cable (Fig 3) used only one constant on the premise that the supporting strand was an integral part of the cable. If this is correct for Figure 8 type cable, it should also be correct for lashed cable (Fig 2) and only one constant should be used.

In addition to the attached sketch, we are also attaching another sheet with a comparison of the calculated ice and wind loads per ft plus constants added to the resultant loadings for the three cases all using the same size of supporting messenger strand (¼ in extra high strength galvanized steel strand) and same cable size (1.10 in diameter weighing 0.60 lb per ft).

It is recommended that for both lashed cable and Figure 8 type cable that only one constant, that for weatherproof, etc., be used for the combination of messenger and cable.

Calculation of Ice and Winding Loading as Per Rule 251.

One-quarter in (7 × .080 in) Galvanized Steel Strand supporting telephone cable weighing 0.60 lb per ft with diameter 1.10 in, by rings, by lashing, and as Figure 8 Type Cables. One-quarter in Galvanized Steel Strand was selected since this is commonly used as the support of Figure 8 Type Cable.

A comparison of ice and wind loads, 8 lb per ft wind load and 4 lb per sq ft wind load with one or two constants, on these three methods of support are shown in the following table. Also refer to accompanying sketch. The ice load is calculated as a hollow cylinder on the strand where cable is supported by rings or a band of ice ½ in thick encircling the lashed messenger and cable or the Figure 8 cable.

	Cable Supported by Rings (Figure 1)	Cable Lashed to Messenger (Figure 2)	Figure 8 Type Cable (Figure 3)
Diameter of Messenger Strand	0.240 in	0.240 in	0.240 in
Diameter of Cable	1.10 in	1.10 in	1.10 in
lb per foot of Messenger Strand	0.121	0.121	0.121
lb per foot of Cable	0.60	0.60	0.60
lb per foot of means of support, rings or lashing wire or polyethylene web and covering of Figure 8	0.035	0.006	0.039
lb per foot of cable, messenger, etc.	0.756	0.727	0.760
lb of ice per foot on messenger and cable	1.455	1.049	1.091
Total ice-covered messenger and cable, lb per ft	2.211	1.776	1.851

Heavy Loading	Cable Supported by Rings (Figure 1)	Cable Lashed to Messenger (Figure 2)	Figure 8 Type Cable (Figure 3)
Wind load			
8 lb per sq ft	2.227	1.560	1.640
Resultant (Fourth Edition)	3.138	2.364	2.473
Wind load			
4 lb per sq ft	1.113	.780	.820
Resultant	2.475	1.940	2.025
Add National Electrical Safety Code			
Constant for bare	0.29	—	—
Constant for Weatherproof	0.31	0.31	0.31
Resultant + constant	3.075	2.250	2.335
Constant for bare	—	.29	.29
Resultant + two constants	3.075	2.540	2.625

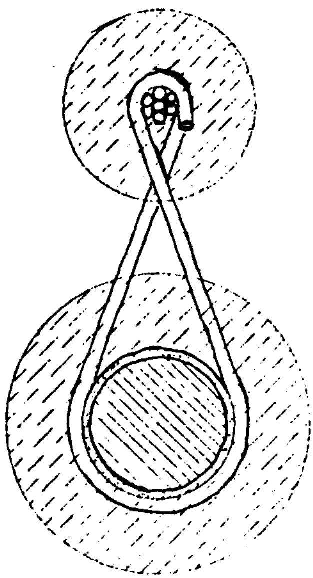


Fig IR 103-1.

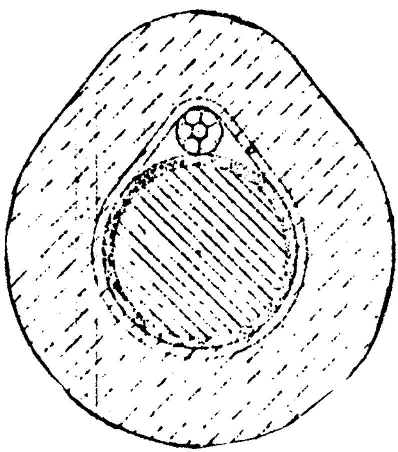


Fig IR 103-2.

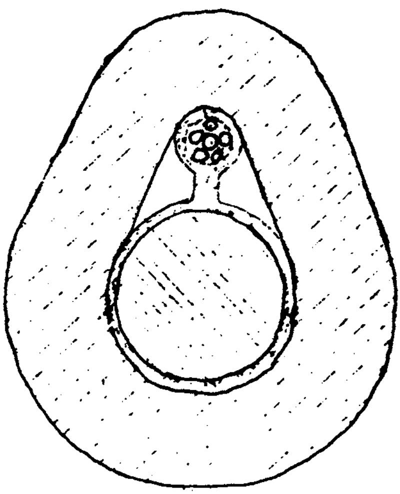


Fig IR 103-3.

It will be noted that for cable suspended by rings, the difference in the resultant loading for 8 lb of wind (Fourth Edition) and the resultant loading for 4 lb of wind plus *two* constants is 3.138 − 3.075 = 0.063 lb/ft. For the lashed cable with only *one* constant, the difference is 2.364 − 2.250 = 0.114 lb/ft and for Figure 8 cable with only *one* constant, the difference is only 2.473 − 2.335 = 0.138 lb/ft. Also, it is common practice to spiral both lashed cable and Figure 8 cable when erected in place to reduce the tendency of cable dancing. This spiraling will reduce the projected area exposed to wind pressure since the area of the messenger strand will only add to area exposed to wind pressure for one half of the length. Therefore, the difference between the resultant with 8 lb wind and the resultant with 4 lb wind plus one constant for lashed cable and Figure 8 type will be further decreased.

Comparison of the resultant loading for lashed cable and Figure 8 type cable with the 8 lb wind loading and the 4 lb wind loading plus *two* constants show the latter to be excessive.

For these reasons, it is recommended that for lashed cable and Figure 8 type cable that only one constant be added for the combined messenger and cable to the resultant with 4 lb of wind pressure per sq ft.

INTERPRETATION (Apr 13, 64)

The Committee's interpretation of the application of Rule 251 (NBS Handbook 81) to lashed cable or figure 8 cable is that loading should be calculated in accordance with the method outlined in the Fourth Edition of the National Electrical Safety Code.

In considering this question, it should be noted that neither type of facility existed at the time the present requirements were formulated; aerial cable was ring supported.

The general intent of the rule change which was made between the Fourth and Fifth Editions was to retain essentially the same conductor loading but reduce the transverse loading. As Mr. Holmes calculations indicate, Fourth Edition loading on ring supported cable is very nearly the same as Fifth (or Sixth) Edition loading. Literal application of the Fifth Edition loading rule to lashed and figure 8 cable results in loading which is heavier than Fourth Edition loading. Using Fifth Edition values of wind and ice with a single constant produces loading which is less than Fourth Edition values. This is perhaps to be expected since we are using a formula for something its authors had not visualized.

251; 252

Application of *K* factors

REQUEST (Mar 8, 76) IR 181

It has been our experience that there is some diversity of opinion among utilities as to the application of NESC loading conditions (heavy, medium, and light) as outlined in Rules 251 and 252 of the Sixth Edition of the Code.

Our interpretation of Rules 251 and 252 is that the constant factor (*K*), which is added to the resultant of transverse and vertical loads, is applicable only to analysis of conductor load capability. Consequently, only the loadings described in Rule 252 (without addition of a *K* factor) are applicable to determining the necessary capabilities of the structural support system.

We have found that some utilities are interpreting the rules such that the *K* factors are also applied to the structure loadings. We do not feel that this is the intent of the Code and would appreciate a clarification from the committee as to this point.

INTERPRETATION (Apr 26, 76)

Rule 251 sets forth loading on conductors in terms of ice, wind, temperature, and constants which are added to the resultant. All of these factors influence conductor tensions. Rule 252 sets forth loading on supporting structures but does not include constants. However, conductor tensions do contribute to structure loading in situations such as corners and dead ends. In these situations, the constants, or *K* factors, do affect structure loading. In the case of tangent structures where conductor tensions do not affect structure loading, the constant or *K* factors of Rule 251 need not be considered in calculation of structure loading.

252C1 **See IR for Rule 242 Table 15, IR 111**

260C

Meaning of "other supported facilities".

REQUEST (Nov 4, 77) IR 211b

. . .will you please provide us with a definition and/or examples of "other supported facilities" as stated in 260C.

INTERPRETATION (Dec 6, 77)

. . .the phrase "other supported facilities" would include connectors, transformers, capacitor racks, etc. The 1.25 overload capacity factor would not apply to cross arms and their braces or to guys since they are part of the structure.

261A1

Allowable pole loading

REQUEST (June 10, 76) IR 184

Table 21, Rule 261A, permits vertical and transverse loading of Grade C wood poles (at replacement) up to 75 percent of their ultimate stress. (I think he means strength.) This means that the required strength of such poles must be at least 133 percent of the loading.

Rule 261A(1) permits a weak pole to remain in the line provided: (1) the average strength of three poles (the weak pole and stronger poles on each side of it) meets the required strength requirements, which means the average strength of the three poles must be at least 133 percent of the loading, and (2) the strength of the weak pole is at least 75 percent of the required strength, which means the loading is not more than 75 percent of the required strength (75 percent of 133 percent or 100 percent).

In my words, a weak pole in a Grade C line can remain in place until its strength is reduced to 100 percent of the assumed load if it is flanked by stronger poles so that the average strength of the three poles is at least 133 percent of the assumed loading.

...I will very much appreciate official confirmation of the above....

One further question is the matter of using steel reinforcement for such wood poles. The Code is not clear on this, but I am assuming that if the reinforcement had sufficient strength to bring the pole — the same weak pole referred to above — to 100 percent of the assumed loading, it would meet the requirement of the NESC. I will very much appreciate your comments or approval of this opinion.

INTERPRETATION (Aug 5, 76)

In general, a weak pole in a Grade C line can remain in place until its strength is reduced to 100 percent of the specified loading if it is flanked by stronger poles so that the average strength of the three poles is at least 133 percent of the assumed loading. This does not apply to crossings over railroads or communications lines. (Exception to Rule 261A1.) Rule 261A1 also applies to situations where the required pole strength is developed by installation of steel reinforcing.

261A2b,c

Omission of fiber stress calculation point formerly stated in 6th Edition, 261A4a, b.

REQUEST (Nov 4, 77) (1977 Edition) IR 211a

Please refer to Rule 261A2b & c (Page 204) of the 1977 Edition of the National Electrical Safety Code Part 2. In these rules, the words "at the ground line for unguyed poles, or at the point of guy attachment for guyed poles" which appear in the equivalent rules of the 6th Edition have been omitted. By this omission, it would appear that the overload capacity factors given in Table 261-3 would have to be applied at any point on the pole. Due to the taper of the pole, the allowable moment reduces faster than the actual moment as the calculation is moved up the pole from the ground line. The calculation of the allowable load on a given pole, such that the designated fiber stress at any point on that pole is not exceeded is an awesome task if performed by hand. Even with the use of a computer, the calculation is not uncomplicated.

The omission of the above quote from these rules will require a substantially higher strength pole for the same loading. Was this the intent of this change? In a comment by the committee on Page 65 of the April 1976 revision of the Unapproved Draft, they indicated that no change in pole strengths required were intended.

INTERPRETATION (Dec 6, 77)

The words "at the ground line for unguyed poles, or at the point of guy attachment for guyed poles" were deliberately removed in recognition of the fact that these locations are not necessarily the points of maximum stress. It should be recognized however, that the point of maximum stress may shift as decay progresses. Your interpretation of this rule is correct.

261A3(b)

Longitudinal strength of towers — Grade B construction.

REQUEST (Apr 2, 64) IR 108

Some papers have been published stating that Grade B construction requires *no* longitudinal strength...for a suspension...type steel tower. IEEE transaction paper 64-57, published by Bonneville Power Administration Personnel, states that they have reclassified as Grade N, their light steel towers designed only for nominal non-concurrent longitudinal forces. These towers are designed under Grade B requirements for lateral and vertical forces.

Being concerned with construction of transmission lines, I am interested in the Committee's conclusions as to the interpretation that might be placed on the words expressed in the Sixth Edition of the Code regarding grade requirements more in a legal sense and by lawyers in the eventuality of any damage suits.

Some railroads require the submission of a form for approval of crossings containing a question; "are towers Grade B construction?" Reading the Code as printed and the implications thereof leaves me a little in doubt as to whether Grade B construction requires some longitudinal strength. Reference to Item 261A3(b) indicates that Grade B construction requires some longitudinal load for suspension towers in general. If none was required it would have been simple to use the same statement that was used to describe longitudinal strength requirement for Grade C; "no longitudinal strength requirements except dead ends". The reference, in the requirements for Grade B longitudinal strength, to Table 17 and Paragraph 252C indicates that in 252C there is a loading requirement for longitudinal strength that should be multiplied by 1.00 and included in the strength investigation for a Grade B tower. Since these tensions are referred to in 252C with regard to "change" in grade of construction" it has apparently caused some confusion. Item 252C3 refers to 252C1 as "broken wire conditions". If there is no requirement for longitudinal strength in Grade B construction when crossing railroad tracks there would be no "change in grade of construction" concerned to imply any longitudinal strength requirement under Item 252C. However, 261A3b does not imply condition of loading, only amount of loading. Some longitudinal strength for broken wire is apparently required, particularly since it would have been very simple to say so if none is required.

I would appreciate the opinion of the Interpretation Committee as to what is required for Grade B construction with regard to longitudinal strength in suspension towers and at railroad crossings. Is the intention under the Code to leave this to any designer's choice, or is there some minimum requirement that should be met?

INTERPRETATION (May 13, 64)

This interpretation concerns the question of whether or not there are any requirements for longitudinal strength for towers built to Grade B standards. If the line is Grade B throughout, there are no specific longitudinal requirements except at deadends. If there are occasional Grade B towers (as at crossings) in a Grade C or N line, the Grade B towers should be designed for the longitudinal loading requirements of Rule 252C1. Deadend towers would have to meet the longitudinal requirements of Rule 252C2. (Rule 261A3b is not applicable unless there is some longitudinal loading required by Rule 252C).

261A4

Construction grade of line, effect of additional loading

REQUEST (Feb 3, 76) IR 180

A transmission line is installed using Grade B construction; poles loaded to 25 percent of ultimate stress. Five years later it is desired to reconductor the above line to a larger conductor, resulting in a pole loading of 30 percent of ultimate stress. Assuming poles have been checked for integrity, is the reconductored line considered Grade B construction? Note that the reconductored line is still loaded less than the "at replacement" stress of 37.5 percent.

INTERPRETATION (Mar 24, 76)

The Interpretations Subcommittee. . .has been unable to reach a consensus on this question.

At present the majority view is that the safety factor for new wood poles can be reduced only by pole deterioration. The minority view holds that the particular mechanism of reducing the safety factor for new poles is immaterial (that is, the safety factor may be reduced either by deteriorated strength or by increased load).

It will take some time to resolve this problem which may have to be presented to the subcommittee concerned with strength and loading.

261A4(g)

Spliced and stub pole definitions; extension at top of pole.

REQUEST (Nov 14, 62) IR 95

I would like to have a clarification of the intention of Rule 261G concerning "Spliced and Stub Reinforced Poles". There seems to be a difference of opinion on what is meant by a spliced pole. Would you answer the following questions for me:

(1) What is the definition of a spliced pole?

(2) Is a 2 ft to 7 ft extension at the top of a pole considered a spliced pole?

(3) What is the definition of a stubbed pole?

In paragraph 1 of Rule 261G it may be noted that spliced poles have a restricted use in that they are not permitted on joint use Grade B or C construction. I would assume that #2 above is not considered a splice because utilities all over the country have used bayonets for adding a shield wire or a new circuit to an existing lead on joint use poles. Am I correct in this assumption?

INTERPRETATION (Dec 7, 62)

Clarification of the intention of Rule 261A4(g) has been requested in the matter of distinction of the meanings of the words stub-reinforced, spliced, and extension as applied to wood poles.

(1) Stub-reinforced or stub pole.

Figure 12 on page 60 of the Code Discussion Handbook 39 (July 15, 1944), now out of print, gives a clear picture of a stub reinforcement for a pole. In this illustration a section of a short good pole is placed alongside the original pole that has deteriorated just above or below ground. The "stub" is fastened securely to the original pole so as to restore the strength of the combination to essentially the required grade of the original pole. (This assumes that the upper part of the pole has not deteriorated appreciably and warrants a repair less expensive than replacement cost.)

(2) Spliced pole.

There is no corresponding illustration in the Discussion (H39) of a spliced pole, however, the consensus is that splicing might be resorted to in the case of a pole broken or deteriorated above ground in order to restore service promptly, generally not as a permanent repair as it may be difficult by splicing to restore a broken pole to its original grade, but rather as a useful expedient with rather early and more convenient replacement of the repaired pole in mind. Instead of having the replacing or added section alongside, as in stub-reinforcing, the two pole-sections are joined in line so that their center lines are substantially continuous, the two mating ends being dressed for joining or "splicing" together with a slip-over collar, by banding, bolting, or other necessary permanent clamping means.

(3) Extension.

A metal or wood extension for a pole, no matter whether it is attached by bolting-, clamping-, or splicing- of the part added on top of the pole to provide some small additional mounting height, by its very nature should not be confused with either a stub-reinforced- or spliced-pole as described above. It is important that the bayonet or extension will not add enough loading or groundline moment to the existing structure to exceed the safety factors specified for Grade B or C for the service required of the complete assembly, or "composite" pole thereby created.

261A6b

Deflection, unbalanced pull; should dissimilar ice loading be considered?

REQUEST (Feb 17, 66) IR 122(b)

For the deflection determination, with the exception of the unbalanced pull defined in 252C, should we also consider the case of dissimilar ice-covered loading on the conductors of the successive spans?

If so, the most unfavorable case for the supports of a span would be with the span fully ice-loaded while the spans on both sides of it are unloaded?

This subject concerns especially the 15 kV urban lines supported on wooden poles, in heavy loading districts, where, the conductors of one or more spans are released from the ice while it remains on others.

INTERPRETATION (May 66)

No final interpretation found in the records. The consensus of the committee responses appears to be:

. . .With regard to the deflection determination relating to rule 261A6(b), . . .the answer is "No" since this rule deals with longitudinal strength requirements and rule 252C1 defines longitudinal loading in terms of conductor pull but says nothing about storm loading on the crossing span or the adjacent spans. Generally, application of Rule 252C will require the use of headguys, which would prevent movement of the poles toward the crossing. Use of a common crossing pole (recommended in Rule 233) would usually result in safer construction since it would result in fixed, as opposed to variable clearances.

261B

Foundation strength for steel pole structure.

REQUEST (Mar 23, 77) (1977 Edition) IR 191

This letter requests clarification of the intent of Rule 261B as it relates to the requirements for a foundation for a steel pole structure at an angle in a Grade B line.

Rule 261A1b states that the steel pole is required to withstand the transverse combined wind and ice loading, defined in Rules 250B and 252B2, at an overload factor of 2.50 (from Table 261-2 "transverse strength"), and is required to withstand the transverse component of cable tension, defined in Rule 252B3, at an overload factor of 1.65 (from Table 261-2 "longitudinal strength at dead-ends").

Rule 261B states that the foundation is required to withstand both the transverse combined wind and ice load and the transverse component of cable tension at an overload factor of 2.50.

If the above interpretation of the Rules is correct, the foundation loading due to the transverse component of cable tension is 2.50/1.65 times the steel pole loading from the same cable tensions. For structures at large angles, where this loading is dominant, this implies that the foundation is required to be about 1.5 times as strong as the pole.

Please advise us if the above interpretation is correct, or if it is not, of the correct interpretation.

INTERPRETATION (May 23, 77)

Rule 261A1b requires the supporting structure to have strength to withstand the transverse loading specified in Rule 252. One part of this loading is wind pressure on the structure and its conductors. The second part of the load arises from the change in direction of the conductors. For this purpose, conductor tension is taken as the storm loaded tension (which of course, includes the component of tension caused by wind and ice). For grade B, an overload capacity of 2.5 is required for transverse loading (the first part of the load) and an overload capacity factor of 1.65 (longitudinal loading at dead ends) is required for the second part.

Rule 261B requires that the earth reactions resulting from the loading of Rule 252 *without the overload capacity factors* be multiplied by the overload capacity factors of Table 261-5. Foundations are then designed to withstand these reactions. The overload factors for the structure and the foundation are the same.

261D

Requirements for crossarms, specifically with respect to structurally integrated conductor support assemblies

REQUEST (Nov 15, 73) IR 151

We wish to submit our low profile structurally integrated "conductor support assembly" to your committee for interpretation of proper classification within the existing National Electrical Safety Code. Please find attached photographs and drawings of our conductor support assembly along with copies of load test data as performed upon said assembly (Figs IR 151-1 through IR 151-3). This unit has been given conditional approval under item "eq," "Narrow Profile Brackets and Special Arm Assemblies," in the *List of Materials Acceptable for Use on Systems of REA*[1] *Electrification Borrowers.* The question has now been raised as to whether this assembly is a crossarm as per Rule 261D in the National Electrical Safety Code. We understand it is within the realm of your committee to make this interpretation.

In the opinion of Aluma-Form, Inc, this assembly is an integrated structural member as opposed to a crossarm. Our company manufactures a wide variety of mounting brackets for sale to electrical utilities for the purpose of mounting transformers, regulators, lightning arresters, switches, cable terminators, etc. Primarily these devices employ aluminum extrusions as the main support means; however, a number of the brackets employ a wood member. These "wood brackets" are offered by Aluma-Form to compete with fiberglass or similar insulated brackets used by a large number of utilities in this country. A photograph and catalog sheet of one such assembly for mounting three cutouts and three arresters are enclosed (Figs IR 151-4 and IR 151-5). These brackets have never been considered crossarms. Likewise, we have never been questioned on any aluminum bracket, nor are the fiberglass brackets considered crossarms.... Another interesting "wood assembly" manufactured by Aluma-Form is our W12MG-31 wood cluster mount designed for use in California where the "G0-95 State Safety Law" requires transformers to be insulated from the pole. For your interest. . .a catalog sheet of this item is enclosed (Fig IR 151-6). All of the above mentioned wood brackets including the conductor support assembly in question are completely assembled at the factory and are shipped to the customer ready to install on the utility pole. As such, we maintain they are integrated structural members. In our opinion, if Aluma-Form had chosen fiberglass, steel, or aluminum as the horizontal support member in the conductor support assem-

[1] Rural Electrification Administration, US Department of Agriculture, Washington, DC.

bly, the question of its being a crossarm would not have arisen. We hope the decision of your committee regarding this interpretation will support our position.

In the event your committee determines that our conductor support assembly is in fact a crossarm, we would fail to qualify under existing specifications for wood section and wood type under Rule 261D4, "Dimensions of Crossarms of Selected Yellow Pine or Fir." Our assembly, however, is superior to a crossarm in its ability to perform its intended function. As such, it embodies the essential structural requirements which are most important from the standpoint of safety to the utility employees and the public.

The large horizontal member in our assembly is an Asian material Dipterocarpus species (Apitong) which has a modulus of rupture of 16 200 psi in static bending with a maximum crushing strength of 8540 psi in compression parallel to the grain. Said member has uniform square sectional dimensions of 2¹¹⁄₁₆ inches by 2¹¹⁄₁₆ inches which calculations indicate to have a section modulus of 3.2 about both horizontal and vertical axis. The said member in this assembly is supported at the point of conductor attachment by bracing, which comes back under the horizontal member attaching to the pole with thru-bolts. Upon complete installation of the assembly we have an integral rigid frame structure of a cross section at the point of attachment to the pole of 2¹¹⁄₁₆ inches by 13½ inches therefore, giving us a very large section modulus about the horizontal axis which affects the vertical loading. Please find attached a sheet that lists mechanical values of slash leaf pine, long leaf pine, douglas fir, and apitong along with listings of sources of that information (Fig 151-7).

The National Electrical Safety Code, Part 2, Rule 26114). . .lists the minimum cross section dimensions of crossarms and restricts material in said crossarms to selected yellow pine or fir; therefore, not allowing or recognizing any newly developed materials when they may become available. This writer believes that Rule 261D4 was written in an age and time when the minimum length crossarm used by a utility was 8 feet. It is also believed at that time the maximum allowable stress ratings of pine and fir were much lower than they are presently rated. It is also believed by the writer that at that time the pin diameters allowed for in a crossarm section were for locust pins having a diameter of 1½ inch as opposed to the pins employed in our conductor support assembly having a diameter of ⅝ inch. The crossarm had to have larger holes bored into it, in general, having a weaker structure.

Until most recently, the method of bracing an 8 foot crossarm was at a point approximately midway between the attachment of the arm to the pole, and the point of attachment of the outer conductor; therefore, that creates a great vertical cantilever stress level within the crossarm at the point of attachment of bracing; whereas, our support does not carry any substantial vertical cantilever stresses within the main horizontal member as the said member is primarily supported at point of conductor attachment.

Calculations indicate a section modulus of 4.7 about the vertical axis of an 8 foot-two pin crossarm having minimum dimensions of 2¾ inches by 3¾ inches; thus, this is the critical figure for rating any unbalanced longitudinal load to which that member might be exposed. Rule 261D3(a) states the longitudinal strength of a crossarm shall be no less than 700 lb load at the outer pin. Assuming that the outer pin location is 44 inches from the pole and assuming that the attachment to the pole is rigid, the stress that might be created within that crossarm would be slightly in excess of 6500 psi; whereas, in the design of our assembly, taking into consideration the section modulus of the main horizontal member about the vertical axis with the point of attachment of the outer pin being 19 inches from the center of the pole, and again assuming that this is a rigid attachment with a 700 lb load applied, the longitudinal cantilever stress level within the material would be less than 4200 psi. Our assembly, therefore, has more than a 35 percent reduction in the longitudinal stresses within the horizontal support member.

Having reviewed the proposed unapproved draft of August 15, 1973, of the National Electrical Safety Code, we are aware that there is a proposed paragraph, Rule 260B, which allows for approval of newly developed materials when they may become available. It is further recognized that while these materials are in the process of development, they are subject to evaluation and trial installations as may be approved by proper administrative authorities. We would like to suggest the addition of another paragraph which might read, "It is recognized that newly developed methods of fabrication and assembling materials and component members may reduce deformation, deflection, and/or displacement of parts of the structure or assembly and change the effect of the load assumed. It is further recognized that while these methods of fabricating and assembling are in the process of development, they are subject to test evaluation and trial installation and may be approved by proper administrative authorities."

. . .We sincerely hope that the committee will interpret our conductor support assembly as an integrated structural support member as is our contention. Failing this, we hope the above discussion is sufficient to convince the committee that the assembly is superior in its ability to perform the intended function outlined in the Code as it relates to crossarms. . . .

Strength Properties of
Certain Imported Tropical Woods and Selected Species of the US
(Results based on small, clear specimens at a moisture content of 12 percent)

Botanical Name	Specific Gravity[1]	Static Bending: Modulus of Rupture psi	Static Bending: Modulus of Elasticity 1000 psi	Compression Parallel to Grain: Maximum Crushing Strength psi	Shear Parallel to Grain: Minimum Strength psi
[2]Pinus palustris (Longleaf Pine)	0.54	14 700	1990	8440	1500
[2]Pinus elliotti (Slashleaf Pine)	0.56	15 900	2060	9100	1730
[2]Dipterocarpus species (Apitong)	0.59	16 210	2350	8540	1690
[3]Pseugopuga menziessii (Douglas Fir)	0.48	12 200	1950	7430	1160

[1]Specific gravity based on volume when green and weight when oven dry.

[2]USDA Forest Product Laboratory Wood Handbook 125.

[3]USDA Forest Product Laboratory Wood Handbook 72.

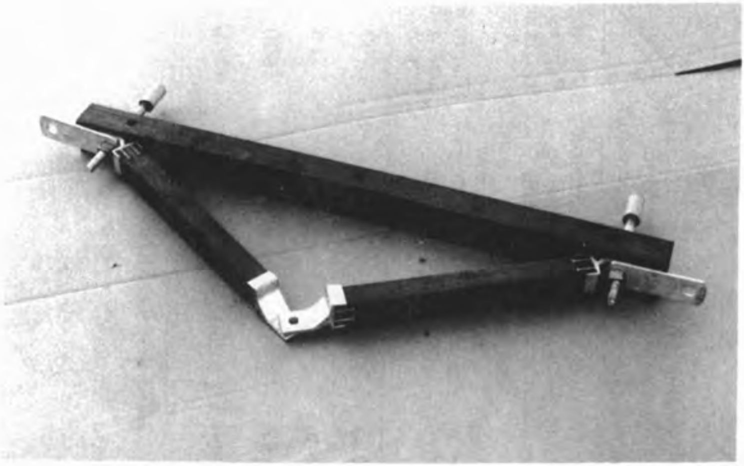


Fig IR 151-1

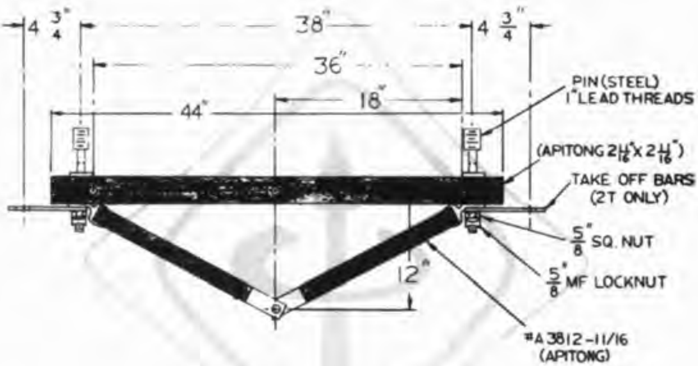


Fig IR 151-2
Aluma-Form conductor support assembly.

Date: 1-2-73.

Product Tested: XA-38-12 conductor support assembly.

Test Method: Steadily increasing unbalanced static load applied through a 0-6000 lb capacity Dillion Dynamometer with load applied 19 inches from center of pole (38 inch conductor spacing) and deflection readings taken at point of load application.

Miscellaneous Information: Conductor support assembly attached to a 10 inch diameter steel pole with 5/8 inch hardware. Load applied with a single hydraulic cylinder as illustrated by Fig 151-3(c).

Test Results:

Load (lbs)	*Average Deflection*
0	0.00
500	0.19
1000	0.38
1500	0.47
2000	0.58
2500	0.66
3000	0.75

Ultimate failures at 4500 lbs and 5500 lbs.

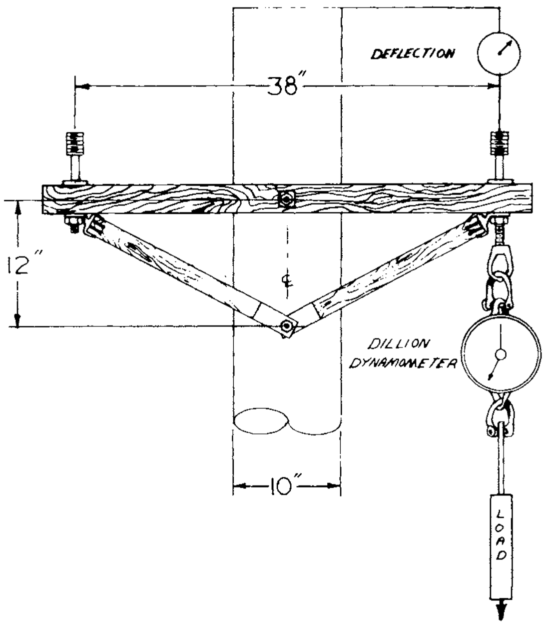


Fig IR 151-3(a)

Date: 3-3-73.

Product Tested: Experimental Apitong double dead-end conductor support assembly.

Test Method: Steadily increasing static load applied through two 0—10 000 lb capacity Dillion Dynamometers with loads applied at dead-end points 18 inches from the center of the pole (36 inch conductor spacing).

Miscellanous Information: Double dead-end conductor support assembly was attached to a 10 inch diameter section of Southern Yellow Pine pole with loads applied by a single hydraulic cylinder, through a pulling frame, to the above-mentioned dynanometers as illustrated by Fig 151-3(c). Conductor support assembly failed with a total load of 9900 lbs (4950 lbs per conductor).

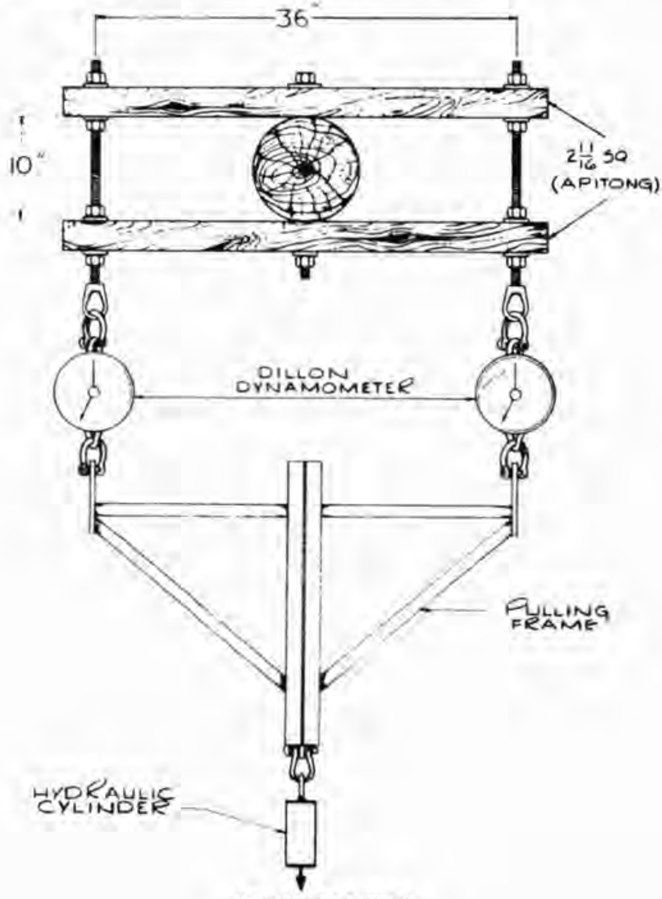


Fig IR 151-3(b)

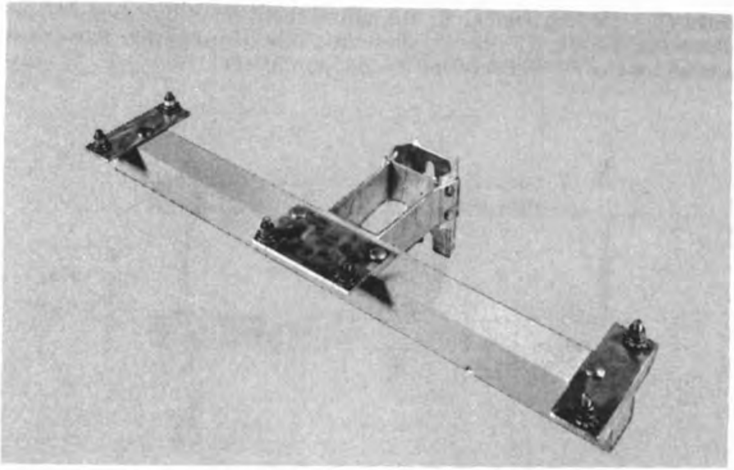
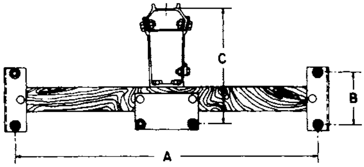
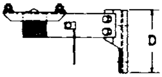


Fig IR 151-4

NEW ALUMA-FORM DOUGLAS FIR EQUIPMENT MOUNT. FOR MOUNTING CUTOUTS, ARRESTERS, OR POTHEADS. GREY COLOR DOUGLAS FIR PROVIDES ACCEPTED INDUSTRY INSULATION VALUE.





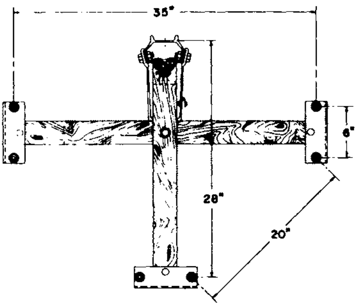
SIDE VIEW

CATALOG NO.	A	B	C	D
W3CA-36	36"	6"	13"	7 1/4"
W3CA-48	48"	10"	13"	7 1/4"

MODEL	PRODUCT	WEIGHT	DESCRIPTION
W3CA-36	51082	14.0#	3 POSITION FOR MOUNTING 6 PIECES OF EQUIPMENT
W3CA-48	51083	19.0#	3 POSITION FOR MOUNTING 6 PIECES OF EQUIPMENT

Fig IR 151-5(a)

NEW ALUMA-FORM DOUGLAS FIR GREY COLOR EQUIPMENT MOUNT FOR GREATER PHASE TO PHASE SPACING AND INSULATION. FOR MOUNTING CUTOUTS, ARRESTERS, OR POTHEADS.

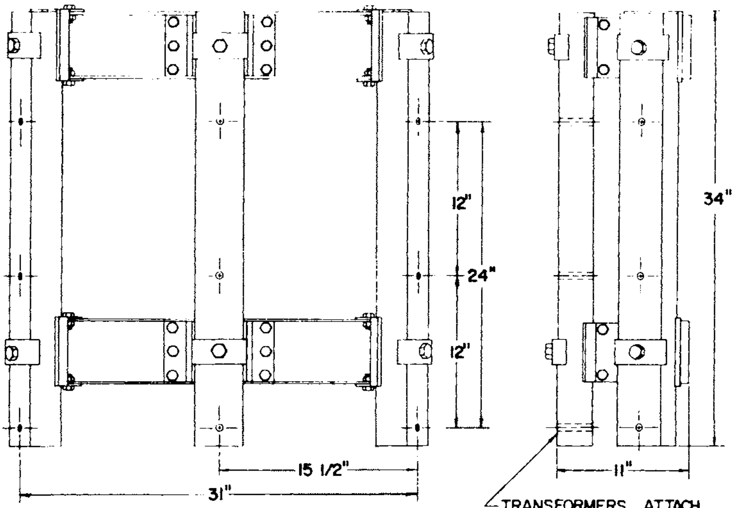


SIDE VIEW

MODEL	PRODUCT	WEIGHT	DESCRIPTION
WT3CA	51081	20.0#	3 POSITION FOR MOUNTING 6 PIECES OF EQUIPMENT

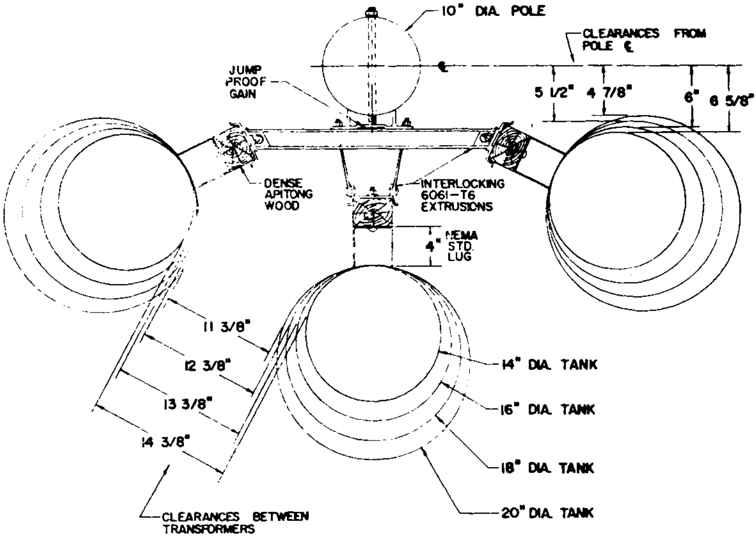
Fig IR 151-5(b)

NEW ALUMA-FORM W12MG-31 WOOD CLUSTER MOUNTS THREE 3 KVA THRU 100 KVA TRANSFORMERS HAVING ANY COMBINATION OF 12" OR 24" EEI-NEMA TYPE "A" OR "B" LUGS. CLUSTER IS LOAD RATED AT 2,000 LBS. PER POSITION, HAVING A SAFETY FACTOR OF TWO. AVERAGE DEFLECTION IS ONLY 3/16" AT 2,000 LB. LOAD. CLUSTER ATTACHES TO POLE WITH TWO 3/4" THRU BOLTS ON 24" CENTERS. JUMP PROOF ELEMENT CAPTURES UPPER THRU BOLT.



MODEL	PRODUCT
W12MG-31	54029

Fig IR 151-6(a)



TOP VIEW—W12MG-31

SHOWING TRANSFORMER CLEARANCES

ALUMA-FORM W12MG-31 WOOD CLUSTERS ARE DESIGNED TO PROVIDE GOOD APPEARANCE AND STRENGTH WHILE MAINTAINING PROPER CLEARANCES. LABOR SAVINGS MAY BE REALIZED BY PRE-WIRING TRANSFORMER BANKS ON GROUND AND HOISTING CLUSTER INTO PLACE, WHERE CONDITIONS ALLOW. UNITS CONSTRUCTED OF STRONG 6061-T6 INTERLOCKING ALUMINUM EXTRUSIONS AND DENSE APITONG WOOD. AVAILABLE IN PAINTED GREY (ASA* 70) OR NATURAL COLOR WOOD. TRANSFORMER MOUNTING HARDWARE AVAILABLE AT EXTRA COST.

Fig IR 151-6(b)

INTERPRETATION (Nov 5, 74)

(1) The assembly described in the Aluma-Form letter of November 15, 1973, should be designated as a crossarm.

(2) Rule 261D does not require crossarms to be made of yellow pine or fir, but if they are, they must meet the dimensional requirements of Rule 261D4.

(3) The installed crossarm (including braces) must meet the strength requirements (Rules 261D1,2,3).

From the discussions in the committee it appears that the main question is whether or not the Aluma-Form assembly does or does not meet the requirements of Rules 261D1,2,3.

261D3(b)(d) See IR for Rule 242 Table 15, IR 111

261D5

Crossing of power and communication lines.

REQUEST (Feb 17, 66) IR 122(c)

(c) Are there any additional requirements to that defined in Rule 261D5 for the crossing of an urban, grade B, 15 kV, pin-type construction line with communication wires carried on different supports? In accordance with our explanation the Rule 252C does not concern this case.

In the corresponding case, but in lines of a lower grade than B, there are, because of the Rules 252C1 and 261A6 stricter requirements.

INTERPRETATION (May 66)

No final interpretation found in the records. The consensus of committee responses appears to be:

In answer to Mr. Nitsolas' third question, if Rule 261D5 applies, then, of course, rule 261E5 also applies. If the line is Grade B throughout, the statement that "Rule 252 does not concern this case" is correct. Also, the clearance requirements of Rule 233A and B would apply, regardless of whether the line is Grade B merely at the crossing or is Grade B throughout. I assume Mr. Nitsolas is referring to the normal type of crossing where the power facilities are in the upper position.

261E3 See IR for Rule 242 Table 15, IR 111

261F4 See IR for Rule 232A, IR 121; Rule 234A1, IR 112

272

Insulator electrical strength.

REQUEST (Sept 2, 65) IR 119

Rule 272, Electrical Strength of Insulators in Strain Position, states "Where insulators are used in a strain position they shall have not less electrical strength than the insulators generally used on the line when under the normal mechanical stresses imposed by the loadings specified in section 25."

Does the intent of this rule prohibit the use of insulators at dead ends, corners, and large angles which have a lower wet and dry flash-over than the insulators used in the straight run portion of an electric supply line? All insulators will exceed the test voltages specified in Rule 274.

Can the phrase "electrical strength" be construed to be synonymous with dry and wet flashover values for an insulator?

INTERPRETATION (Mar 10, 66)

The phrase "electrical strength" refers to the wet and dry flashover rating as well as other electrical characteristics of the insulator or insulators.

It should be noted that rule 272 means the assembly or group of insulators, not the individual elements.

COMMITTEE COMMENT:

The following information, which should *not* be considered as a part of the interpretation or as part of any official recommendation of the National Electrical Safety Code Committee, is being passed on to you.

The critical points in a line are the corners, etc., where, with large angles, lightning voltages of twice the tangent line values may be expected due to wave reflections. The usual practice in distribution construction is to double the insulation at these points since, by adding one extra insulator where one would be sufficient to meet Rule 272, these critical points can be reinforced at the point where a broken insulator can drop the line. This insurance is cheap in view of the protection afforded. A shattered pin insulator may be held together by the tie wire and the conductor kept in the air, while a damaged suspension unit may drop the conductor or also shatter the pole top and drop the conductor to the ground since there is unbalanced tension at the pole top which normally is assumed by the guy and the upper section of the pole.

280A1b

Meaning of "readily climbable".

REQUEST (July 14, 77) (1977 Edition) IR 199

Your interpretation is requested on the meaning of the phrase "readily climbable" as used in the above referenced rule.

Enclosed are two prints showing our standard construction practices. Are these or similar structures considered "readily climbable" by unauthorized persons?

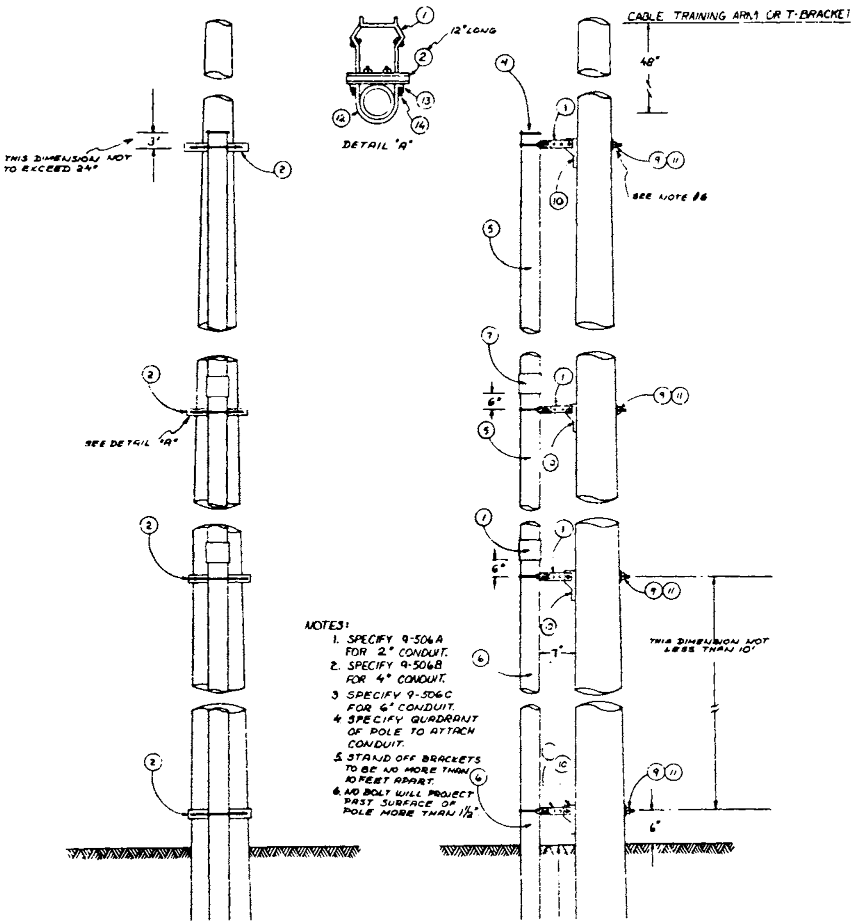

12" LONG
DETAIL 'A'
THIS DIMENSION NOT TO EXCEED 24"
3'
SEE DETAIL 'A'
CABLE TRAINING ARM OR T-BRACKET
48"
SEE NOTE #6
6"
THIS DIMENSION NOT LESS THAN 10'
NOTES:
1. SPECIFY 9-506A FOR 2" CONDUIT.
2. SPECIFY 9-506B FOR 4" CONDUIT.
3 SPECIFY 9-506C FOR 6" CONDUIT.
4 SPECIFY QUADRANT OF POLE TO ATTACH CONDUIT.
5 STAND OFF BRACKETS TO BE NO MORE THAN 10 FEET APART.
6. NO BOLT WILL PROJECT PAST SURFACE OF POLE MORE THAN 1½".

Fig IR 199-1.

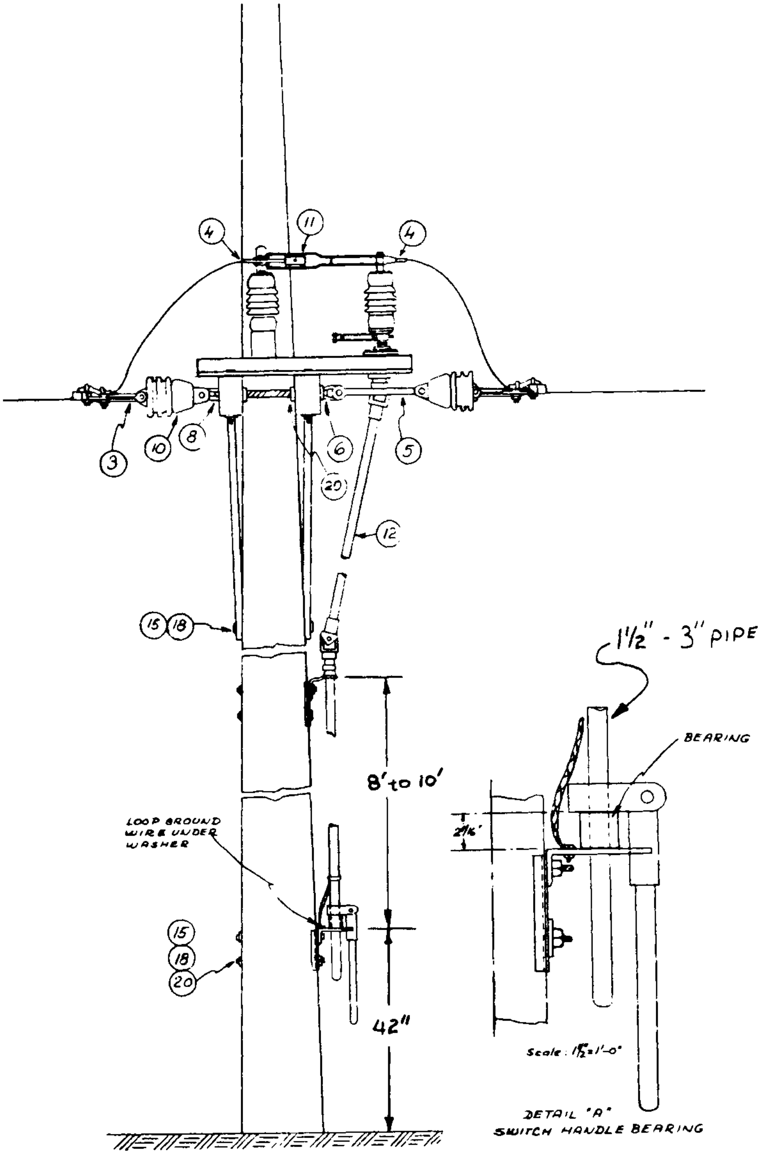

4
11
4
3
10
8
6
20
5
12
15 18
1½" - 3" PIPE
BEARING
8' to 10'
LOOP GROUND WIRE UNDER WASHER
15
18
20
42"
Scale: 1½"=1'-0"
DETAIL "A"
SWITCH HANDLE BEARING

Fig IR 199-2.

INTERPRETATION (Sept 29, 77)

We believe that a 'readily climable' structure must have sufficient handholds and footholds to permit an average person to climb easily without using a ladder or special equipment. We do not believe that the structures shown in the sketch are 'readily climbable' within the meaning of Rule 280A1b.

280A2(b)

Meaning of "closely latticed poles or towers".

REQUEST (Apr 15, 68) IR 128

We would like to know what the definition of "closely latticed poles or towers" is within the context of the rule.

We would appreciate it if you would advise us as to how we may determine what this term was intended to mean at the time that the Standard was adopted.

INTERPRETATION (Dec 19, 69)

Members of the National Electrical Safety Code concerned with interpretations agreed that the determination of whether or not a particular structure was considered "closely latticed" was subject to judgment. However, they noted that Rule 280A5(a) states "steps closer than 6½ ft from the ground or readily accessible place shall not be placed on poles." Since the lowest cross member of the structure illustrated in your sketch was more than 6½ ft (it was shown as 8 ft) the committee determined that the subject rule concerning "closely latticed poles or towers" does not apply.

282B; 282D

Fiberglass rod; acceptability in lieu of steel

REQUEST (May 17, 76) IR 183

At the present time our company. . .installs guying on our wood pole line construction utilizing steel strand in combination with either porcelain or fiberglass strain insulators.

Currently we have completed extensive laboratory and field testing of guys consisting for their entire length of fiberglass rod, attached at each end with factory formed grips similar to type used on steel strand but designed for use on fiberglass rod. The 3/8 inch fiberglass rod utilized was tested for ultimate tensile strength to compare with that of 5/16 inch EHS guy wire (ultimate 11 200 lbs) and was found to be in excess of 12 000 pounds. In addition tests were made to determine weathering characteristics, flame resistance, as well as minimum allowable coiling diameter for packaging. The manufacturers supplied electrical test data on the rod submitted. In all cases the testing and field trials performed gave satisfactory results.

In view of the fact that fiberglass strain type insulators are in general use by the industry in combination with steel guy strand we would appreciate an opinion as to whether a guy whose entire length consists of fiberglass rod would comply with the intent as well as the requirements of the National Electrical Safety Code.

INTERPRETATION (Aug 20, 76)

Rule 282D states that guy material should be stranded. The proposed material is a solid rod. Rule 210 requires lines and equipment to be of suitable design and construction for the service and conditions under which they are to be operated. Experience in the power industry indicates that long fiberglass insulators have failed in service. These failures were attributed to vibration. Thus there is doubt as to whether fiberglass rod guys would be suitable for the service and conditions under which they would operate.

We do not believe that fiberglass rod guys meet the requirements of the Code. However, Rule 201A provides for a modification or waiver of the rules by the proper administrative authority. Usually, this means the public utility commission. You may wish to arrange a trial installation of fiberglass rod guys with the concurrence of the appropriate commission.

282E

Plastic guy guards

REQUEST (A) Mar 27, 62)

I call particular attention to page 161, [NBS Handbook 81, Safety Rules for the Installation and Maintenance of Electric Supply and Communication Lines, Nov 1, 1961] section 282E Guy Guards which says, "The ground end of all guys attached to ground anchors exposed to traffic shall be provided with a substantial and conspicuous wood or metal guard not less than 8 ft long." We as manufacturers of electrical fittings for electric power utilities are in basic support of this section, but we do not understand the reason for limiting the guy guard material to wood or metal.

In recent years great advances have been made in the field of plastics and we believe that certain plastics will provide all of the applicable characteristics of wood or metal. Plastics are generally lighter in weight, lower in cost as a finished product, corrosion resistant, and can be provided in bright, contrasting color combinations such as yellow and black for greater visibility.

I respectfully suggest that this section be written to include the phrase "or other suitable material".

REQUEST (B) Mar 5, 62) IR 94

As suppliers of equipment for the electric and communications utility industry, it has come to our attention that the present National Electrical Safety Code is phrased to restrict the materials for guy guards to wood or metal.

Our company has expended a considerable amount of time and effort in developing a suitable plastic guy guard. Since the basis of our choice of a plastic material for this product was primarily that of safety, we are taking this opportunity to respectfully request a revision of supplemental statement to the effect that "plastic or other suitable material may be used."

Over the past year-or-so we have had a gratifying response to this product from many customers. The safety features incorporated in it have been praised as a substantial contribution to the concept of safety which is so important to the electric utilities, and, no doubt, is the basic spirit of the National Electrical Safety Code.

REQUEST (C) (Aug 6, 62)

In the past few years, a number of manufacturers, including ourselves, have developed guy guards made from plastic. At the present time, these guards are being used in at least eight states, and in several of them, have been employed for several years. They have proven to be at least as durable and shock-resistant as metal and wooden guards, besides offering the added safety features of inflammability and a conspicuous color.

However, the use of guy guards made from plastic is not included in the National Electrical Safety Code recommendation to the utilities (National Bureau of Standards Handbook, H30) regarding this type of product — cf. section 282, p. 217, subsection E, Guy Guards: "The ground end of all guys attached to ground anchors exposed to traffic shall be provided with a substantial and conspicuous wood or metal guard not less than 8 ft long."

As concerns this code, I am writing at this time to ask how our company may go about requesting National Electrical Safety Code sanction of plastic guy guards — whether or not an up-dating of the code to include plastic guy guards is already planned, I do not know.

REQUEST (D) (Aug 8, 62)

We understand that requests have been made to modify Section 282E of the National Electrical Safety Code to include materials other than steel or wood.

We believe plastic materials are suitable for use in guy guards and support a change in the Code to make them acceptable.

INTERPRETATION (Dec 5, 62)

Requests have been received relative to (1) the possible revision of and (2) the interpretation of, Rule 282E of the National Electrical Safety Code Part 2 (NBS Handbook 81, November 1961) Safety Rules for the Installation and Maintenance of Electric Supply and Communication Lines.

Rule 282 E. "The ground end of all guys attached to ground anchors exposed to traffic shall be provided with a substantial and conspicuous wood or metal guard not less than 8 ft long.

Recommendation: It is recommended that in exposed or poorly lighted locations such guards be painted white or some other conspicuous color."

(A) Because of the complexities and many interests involved, the National Electrical Safety Code (Handbook 81) is revised only at long intervals and there is no provision for interim revision of individual rules. Thus any action to revise Rule 282E will be deferred for several years.

(B) A literal interpretation of Rule 282E obviously excludes any other material than substantial metal (usually galvanized iron) or wood and recommends conspicuous coloring.

(C) Plastic guards, if fabricated to be as strong and durable as the usual iron or wood guy guards and as safe or safer by virtue of good visibility through incorporated pigment, may well be accepted by State Utility Commissions in lieu of "substantial wood or metal" guards. They would certainly be of value where guys are exposed to lesser hazards such as abrasion from livestock and where unguarded guys might constitute a serious hazard to playing children. In line with Rule 201A, it would be up to the State Utility Commission having jurisdiction to decide on acceptability of a particular type and composition.

Rule 201A. "The rules shall apply to all installations except as modified or waived by the proper administrative authority. They are intended to be so modified or waived whenever they involve expense not justified by the protection secured or for any other reasons are impracticable; or whenever equivalent or safer construction can be more readily provided in other ways."

(D) The intent of Rule 282E as to the purpose of a guy guard is quite clear. A guy guard is required only in those cases where the lower end of the guy is exposed to traffic. It must be substantial and conspicuous, made of metal or wood, and eight feet long. There is no definite provision for substitution of "Equivalent Materials" in this rule as in other cases, for example, Rule 271, 283. A recommendation is made that these guards be painted in poorly lighted areas to make them even more conspicuous.

Guy guards — on guys to ground anchors — in areas where stock runs.

REQUEST (Aug 31, 65) IR 116

(a) Are guy guards required in areas where it is reasonably foreseen that stock might be running?

(b) The National Electrical Safety Code reads as follows:

"The ground end of all guys attached to ground anchors exposed to traffic shall be provided with a substantial and conspicuous wood or metal guard not less than 8 ft long".

What interpretation has been given the word "traffic" and more specifically if this would cover areas where it is reasonably foreseen that stock might be running.

INTERPRETATION (Oct 6, 65)

(a) It is not the intent of this rule to require guy guards in areas where it is reasonably foreseen that live stock might be running.

(b) The term traffic in Rule 282E is intended to apply to vehicular or pedestrian traffic only.

Guy guards, meaning of "traffic"

REQUEST (Feb 5, 76) IR 179

...A man...was killed when he drove his tractor against a guy wire, and broke the pole to which the guy was attached, causing the pole and a transformer to fall on him. An engineer. . .has alleged that we are in violation of Section 280A2 of the National Electrical Safety Code which states that poles and towers exposed to abrasion by traffic or to other damage which would materially affect their strength must be protected by guards. It is also alleged that we are in violation of Section 282E which requires that guys exposed to traffic shall be provided with a substantial and conspicuous guard not less than 8 feet long.

It will be noted that each of these two rules of the National Electrical Safety Code refers to exposure to "traffic." The Code does not define the word "traffic." The particular location where this accident occurred was in a sparsely populated rural area and on land located to the rear of an outbuilding, where there was no roadway, trail, or any other way for the accommodation of pedestrians or of vehicles. In fact, it was grown up in weeds and brush higher than a man's head. The tractor and bushhog were engaged in cutting the weeds and brush. The tractor struck the guy wire so that it became wrapped around the axle of the tractor and pulled the pole over, breaking it near the ground. It is apparently the interpretation of the engineer abovementioned that anything on wheels is traffic, irrespective of where it is or whether it has ever been there before or not. Of course we cannot say that this area was never bushhogged before. It may have been. But it obviously had not been for a very long time, and was not being used for any purpose whatever.

Our question which we would very much like to have answered by an official group is, "What was the intention of the Committee which approved the adoption of these sections with regard to what constitutes traffic?" Our reference to ordinary dictionaries indicates that traffic is that which travels over a roadway or other established way. Is this the definition intended? Or did the Committee intend to require guards on every guy where any vehicle then in existence or thereafter invented might be capable of going?

These are the facts related to this particular case. We really would like the interpretation to apply generally to any situation so as to define traffic as intended in these two rules.

INTERPRETATION (Mar 24, 76)

The meaning of the word "traffic" as used in Rules 280A and 282E is essentially the dictionary meaning. The traffic referred to in Rule 280A is vehicular; the traffic referred to in Rule 282E is pedestrian. The presence of vegetation as high as a man's head in the vicinity of a pole and anchor indicates an absence of both vehicular and pedestrian traffic.

Guy guards; placement on guy in field

REQUEST (June 1, 76) IR 182

Briefly, the accident occurred when a tractor, pulling a fertilizer spreader, struck a power pole guy line near the edge of a farm field causing the pole to collapse. Subsequent activity on the part of the farm workers resulted in one of the participants receiving severe electrical burns. The power line and guy wire was located on private property with permission granted through a normal easement.

The plaintiff in this case is alleging that the power company was negligent by virtue of a violation of Rule 282E of the National Electrical Safety Code which requires guy line covers or guards. The rule itself refers to the placement of guy guards or covers where the area is exposed to "traffic." I have talked to several engineers in our area and it was their feeling that this provision was adopted merely because of recreation vehicles such as snowmobiles, trail bikes, etc. The question we have is, does Rule 282E apply to a guy line extending out into a field, which is located on private property, require a guy guard where the only anticipated traffic would be a farm tractor traveling at 3 to 5 miles per hour? We would like some clarification as to the intent of Rule 282E and whether such application would refer to slow-moving farm machinery.

INTERPRETATION (Aug 5, 76)

It is the opinion of the Interpretations Committee that it was not the intent of Rule 282E to require the installation of guards on guys extending into a field where only anticipated traffic would be a slow-moving farm tractor.

Guy guards in relation to definition of "guarded".

REQUEST (June 24, 77) IR 188

. . .Power & Light Company installed its standard guy wire 2½ ft from. . .driveway when it initially installed its power pole over twenty years ago. That pole is at the end of a distribution line. The guy wire, located 22 ft north of the pole, was designed to add support to the entire line. . . .

The first question presented to the committee is whether the word "guarded" as defined in the 1973 National Electrical Safety Code was intended to define the type of guard required on the guy wire located on. . .premises. The second question submitted is whether the Code requires that a guy wire of the type located on. . .premises be enclosed by a guard which prevents people from contacting that wire, or whether it is sufficient merely to have a substantial and conspicuous marker on that wire to alert people to its existence.

In summary,

(1) Was either Definition Section A-20 of Part I or Definition Section A-33 of Part II of the word "guarded" intended to define or describe the type of guy guard required in Part II, Section 28, Paragraph 282E?

(2) Was the type of guy guard to which Part II, Section 28, Paragraph 282E refers intended to be an object which would keep people from contacting the guy wire or was it intended to alert people of the existence and location of the guy wire?

INTERPRETATION (Jun 24, 77)

The use of the phrase "guy guard" in Rule 282E was perhaps unfortunate since the essential purpose of the device has always been to make the installation more visible. There was no intention to apply definition 33 to guy guards. Rule 282 requires only that the guy guard be substantial, conspicuous and at least eight feet long. There is no requirement that it must prevent persons from physically contacting the guy.

282H

Guy grounding; upper end effectively grounded vs. anchor end ground.

REQUEST (Feb 14, 63) IR 97

Section 28, Rule 282H of Handbook 81, National Electrical Safety Code, Part 2 reads as follows: "The anchored end of guys attached to wood poles carrying circuits of more than 15 000 volts shall be effectively grounded wherever this part of the guy has a clearance of less than 8 feet to ground."

We presently bond all distribution (12 470 volts and under) guys to the system neutral. In our opinion this has been an effective ground for the guy. When a distribution circuit has been installed as an underbuild on transmission poles this same method of grounding has been utilized. In rereading Rule 282H we note specific mention is made that the anchored end shall be effectively grounded.

We would like an interpretation on whether a connection at the pole end of a guy to a system neutral and a pole ground is an effective ground for the anchored end of guys.

INTERIM COMMENT BY
INTERPRETATIONS COMMITTEE (Mar 14, 63)

...[One] explanation of the seeming inconsistency of providing for either a well-grounded guy at the anchor end or guy insulators for "insulating in line" the anchor section of the guy from the upper end is as follows: The intention of the Code is to rely on other good grounding, (neutral or pole ground), but not to trust the anchor as the ground connection to earth. A guy anchor, although buried, may not in general of itself have a reliably low resistance to ground so that a sizeable fault current through the guy and anchor to ground could prove hazardous for anyone in contact. Thus, where an "Effectively Grounded" neutral or pole ground is not available, Rule 283B provides for the introduction of adequate guy insulators out of reach at eight feet to block fault current that otherwise might take this path and produce high earth gradients adjacent to the anchor.

INTERPRETATION (Mar 14, 63)

The grounding of the guy to the system neutral (multigrounded neutral) meets the multiple connection requirement in the "Effectively Grounded" Definition No. 31 referred to in 282H.

Rule 282H does not specify how the grounding is to be done. Because guys are short and of sufficient conductivity to make their impedances low, a non-insulated guy effectively grounded at the upper end would normally provide good effective grounding of the anchor end, so as to meet the requirements of Rule 282H.

Grounding of guys

REQUEST (May 21, 74) IR 163

Does this part of the Code make it necessary to have a ground connection to the guy tail at the anchor rod, in addition to making a ground connection of the upper guy tail to an effectively grounded neutral conductor. Also, is the anchored end "at the pole or at the earth"?

INTERPRETATION (Oct 2, 74)

Rule 282H does not specify how the grounding is to be done. Because guys are short and of sufficient conductivity, a noninsulated guy which is effectively grounded at the upper end would normally be considered as being effectively grounded at the anchored end.

With respect to your question regarding the anchored end, please note that Rule 282H contains the words "wherever this part of the guy has a clearance of less than 8 feet to ground." This can be the lower end of a pole-to-pole guy or the end of an anchor guy which is attached to the anchor.

283B2

Insulators in guys.

REQUEST (Apr 22, 63) IR 100

The first sentence of Rule 283B2 states: "Where a guy attached to any pole carrying communication or supply conductors or both, is carried over or under any overhead supply conductor of more than 300 V to ground *and where hazard would otherwise exist*, two or more guy insulators shall be placed so as to include the exposed section of the guy between them as far as possible."

Must the underlined phrase be considered only when one of the foregoing conditions exists or does it cover any hazardous condition?

In a particular case which prompts this question supply conductors only are involved. However, the guy does not pass over or under the supply conductors but angles past them in a vertical plane. Only one insulator was used at a point above the supply conductors. Although the clearance between the guy and the supply conductors meets the appropriate clearance requirements a death resulted when the guy was deflected momentarily by an impulse to the guy. A second insulator might have been applied under the rule above if the underline phrase applies. (This of course is hindsight).

INTERPRETATION (May 29, 63)

Rule 283B2 is aimed at the specific situations mentioned and requires two insulators where guys must pass over or under supply conductors of more than 300 V to ground if a hazardous condition would be created by omitting the insulators, but is not intended to cover miscellaneous conditions where guys are in the vicinity of conductors.

It has been pointed out that a change of the word "*and*" in the phrase. . .and where hazard would otherwise exist. . ." to *or*, could be interpreted as a basis for requiring two insulators in the more general case of guys in the vicinity of conductors. Even so this would not provide for a clear cut interpretation in line with the intent of the Code to outline good practices and hopefully leave little room for misinterpretation.

Safety Rules for the Installation and Maintenance of Underground Electric-Supply and Communication Lines

Part 3

(Sections 30-39).

314B See IR for 350B, IR 196

330D

Immediate vicinity of fault as applied to damage withstanding capability of underground cable

REQUEST (May 29, 74) IR 164

The subject rule states that "The conductor, insulation, and shielding shall be designed to withstand the effects of the expected magnitude and duration of fault current, except in the immediate vicinity of the fault."

It is the desire here to obtain an interpretation of what is meant by "immediate vicinity" in the exception "in the immediate vicinity of the fault."

If Rule 330D is applied to a phase-to-grounded-shield fault at the midpoint of a 500 foot long direct buried cable run between splices, which of the following statements (if any) would best describe the limits intended by the term "in the immediate vicinity of the fault"?

(1) A few inches in either direction from the fault.

(2) A few feet in either direction from the fault.

(3) The entire section of the cable run between the adjacent splices.

(4) That part of the cable adjacent to the fault that is exposed to the direct effects of the fault (arcing, fire, explosion gases, etc).

INTERPRETATION (Sept 27, 74)

The phrase "in the immediate vicinity of the fault" is best described by your item (4): "That part of the cable adjacent to the fault that is exposed to the direct effects of the fault (arcing, fire, explosion gases, etc)."

350B

Neutral grounding for buried concentric neutral cable with semiconducting sheath.

REQUEST (July 14, 77) (1977 Edition) IR 196

. . .has need of a jacketed cable primary service on his system. The system is 4.16/7.4 kV grounded wye with a common primary and secondary neutral.

The service consists of a 3-15 kV 4/0 AL UD cable with concentric neutral wires and a semi-conducting jacket over the concentric neutral.

Section 97C requires four ground connections per mile on a common neutral.

Section 314B requires cable sheaths and shields to be effectively grounded.

Is a directly buried cable as described above considered effectively grounded or would we have to install direct connections to the concentric wires and to ground in order to be effectively grounded?

INTERPRETATION (Sept 29, 77)

We do not believe a jacketed concentric neutral type cable can be considered effectively grounded without direct connections to grounding electrodes. Please note that four grounds per mile does not necessarily insure that the installation will meet the requirements for effective grounding. (See definition for effectively grounded.) Four grounds per mile meets the requirement for interconnection of neutrals but may not provide effective grounding in some soils.

351C1

Direct buried cable near swimming pool

REQUEST (Feb 25, 75) IR 170

. . .Rule 351C1. . .states: "Supply cable should not be installed within 5 feet of a swimming pool or its auxiliary equipment."

In our specific case we have direct buried cable approximately 15 feet from the swimming pool. Additionally our equipment is in a clubhouse some 50 feet from the swimming pool, the equipment and the pool are connected by two each, 2 inch PVC pipes. The purpose of these pipes is solely for recirculation.

Our direct buried cable goes under the PVC pipe at approximately the midpoint between the swimming pool and the equipment, therefore being in the vicinity of 25 feet from each. Additionally, our cable is encased in conduit.

The question therefore is if your interpretation would be that this installation does or does not comply with the aforementioned regulation.

INTERPRETATION (May 6, 75)

Rule 351C1 deals with the installation of direct buried supply cable. Your note indicates that the cable in question is in conduit. The Code has no rules specifying separation between auxiliary equipment of swimming pools and conduit installations.

353D

Cable burial depth

REQUEST (Feb 5, 74) IR 155

At the time Part 3 (Sections 30-39) were being revised, suggestions were made with respect to Rule 353D2 which suggested minimum burial depths for cable which were 6 inches less for all classifications than those appearing in the June 8, 1973, Edition. These recommendations were based on safe operating experiences by our company as well as others. We believe that a 6 inch lesser burial depth is permitted in the current edition of Section 3.

Our confusion is centered in the language of Rule 353D, paragraphs 1, 2a, and 2c. We believe that we comply with paragraph 1 in that the history of cable performance on the Vepco system has resulted in no cable injury or damage imposed by surface usage when 6 inch lesser burial depths are used. For this reason, we believe that we have complied with the mandatory wording of "shall" in paragraph 1. However, paragraph 2 uses a much less restrictive phrase in describing burial depths. The burial depths of paragraph 2a are characterized by the terminology "generally considered adequate." However, paragraph 2c confuses the issue further by stating that "lesser depths than indicated above may be used where supplemental protection is provided."

We provide supplemental protection at road crossings in compliance with Rule 353D1 and D2c; however, we believe the wording of Rule 353D permits the lesser burial depths I have outlined which are used for direct burial distribution facilities.

There is no way to protect an underground cable system from dig-ins and apparently this section of the Code does not address itself to subsurface usage occasioned by dig-ins. I would appreciate having an opinion from you whether our present practice of using burial depths 6 inches less than the recommendation in Rule 353D2 are in compliance with the intent of the NESC. . . .

INTERPRETATION (Oct 3, 74)

The burial depths stated in Rule 353D are a minimum unless supplemental protection is provided. Rule 302 does, however, provide for possible waiver of any rule by the authority enforcing the Code. Usually that authority is the state public service commission.

Communication cable burial depth

REQUEST (Mar 19, 75) IR 171

We request an interpretation of the intent of the NESC with respect to depths of burial of communication cables. Is it the intent of the Code, Rule 353D, that the depth of burial for communication cables should be 24 inches? The communication cables have less than 400 volts to ground ringing potential and have a transmitted power of 150 watts or less.

Rule 353D1 of the Code states that the depth of burial selected for cables "shall be sufficient to protect the cable from injury or damage." Section 353D2 recommends certain depths for supply cables that "are generally considered adequate." Since all cables at a given depth are subject to the same probability of damage from dig-ins (unless provided with supplemental protection) it seems the recommended depths are also intended to apply to these communication cables.

We would appreciate an opinion as to the intent of the Code in this matter.

INTERPRETATION (May 6, 75)

The National Electrical Safety Code does not specify burial depth for communication cables. Depth of burial for such cables was considered to be principally related to service reliability and other factors rather than safety. Since the Code is not intended to be a design specification, the depth of burial for communication cables was not specified.

381G

Unfenced, pad-mounted equipment; meaning of two procedures

REQUEST (June 29, 76) IR 185

What procedures, equipment, etc, is intended to meet the requirements of this rule? Does a lock and pentahead bolt on the door meet the requirements? Or, does the rule intend to require either two metal doors, or one door and a removable metal or insulating barrier.

At present this Code is voluntary, and not required of pad-mounted equipment produced by manufacturers.

INTERPRETATION (Aug 20, 76)

Rule 381G requires two separate procedures for gaining access to live parts energized at more than 600 volts. The rule requires the first procedure to be the opening of a locked or otherwise secured door. The rule also requires the second procedure to be dependent upon completion of the first procedure. Thus, unlocking and opening the door might expose the lock of a second door or a barrier secured by perhaps a recessed pentaheaded bolt. This rule applies to pad-mounted unfenced equipment.