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ELECTRICAL

SAFETY

CODE

Fourth Interim Collection

NESCC

1991-1993

INTERPRETATIONS



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**Fourth Interim Collection
1991–1993 NESC Interpretations**

National Electrical Safety Code Committee, ASC C2

**Fourth Interim Collection
of the
National Electrical Safety Code
Interpretations**

1991–1993

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, ASC C2.

Keywords: 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 structures

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Foreword

The IEEE C2 Secretariat regularly publishes Interpretation Requests received and Interpretations made by the National Electrical Safety Code (NESC) 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 first volume, INTERPRETATIONS 1961–1977, published in 1978, included the first interpretation request received for the 6th Edition of Part 2 (IR 92, May 1961) and ended with the last interpretation issued in 1977 (IR 212). The second volume, INTERPRETATIONS 1978–1980, continued with IR 213 issued in 1978 and ended with the last interpretation issued in 1980 (IR 283). It also includes all interpretations found in the archives and applying to the 5th and prior editions of the Code (IR 11 through IR 90). Where no copy of an interpretation request or an interpretation could be found in the archives, this fact is noted. The third volume, INTERPRETATIONS 1981–1984, continued with IR 284 issued in 1981 and ended with IR 361 issued in 1984. It also contains requests IR 362 to IR 366, but did not include their interpretations, as the Interpretations Subcommittee still had them under consideration at press time. INTERPRETATIONS 1984–1987 incorporated IR 362 to IR 366 with their interpretations, continued with IR 367, issued in 1984, and ended with IR 415, which was requested in 1987. The next volume, INTERPRETATIONS 1988–1990, incorporated interpretations for IR 407, IR 413, and IR 414, which were not included in the previous volume, and included interpretation requests to IR 443.

The First Interim Collection 1991–1993, provided interpretations for IR 442 and IR 443, which were still under consideration at press time of the previous volume, and incorporated interpretations for IR 444 through IR 447. The Second Interim Collection 1991–1993 provided interpretations for IR 448 through IR 453.

The Third Interim Collection 1991–1993, incorporated an interpretation for IR 454 and provided interpretations for IR 455 through IR 462. IR 463 through IR 467 were included, although the interpretations were under consideration.

This volume, the Fourth Interim Collection 1991–1993, provides interpretations for IR 463 through IR 467, and incorporates interpretations for IR 468 through IR 470. IR 471 through IR 474 are included although interpretations have not yet been provided for them.

The Secretariat hopes that the publication of all interpretations will prove helpful to those concerned with the NESC.

Procedure for Requesting an Interpretation

Requests for interpretation should be addressed to:

Secretary for Interpretations
National Electrical Safety Code Committee, ANSI C2
IEEE Standards Office
445 Hoes Lane
P.O. Box 1331
Piscataway, NJ 08855-1331

Requests for interpretations should include:

1. The rule number in question.
2. The applicable conditions for the case in question.

Line drawings should be black ink or excellent black pencil originals. Photos should be black-and-white glossy prints. These illustrations must be reproduced for committee circulation and eventually will be used to supplement the text of our next edition. Clear diagrams and pictures will make the work of interpretation easier and more valuable to C2 users.

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.

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Section 9.
Grounding Methods for Electric Supply
and Communications Facilities

Rule 97D**Separation of primary and secondary neutrals on a multiple-grounded system**

REQUEST (Sept. 23, 1992)

IR 466

In recent months some farmers have expressed concern that the separation of primary and secondary neutrals on a multiple-grounded system as outlined in Rule 97D2 is inadequate. These farmers assert that earth currents are accessing their dairy cattle via the primary multiple-grounded system and specifically the grounding conductor and electrode at the transformer.

I have been requested to obtain an interpretation from the National Electrical Safety Code Committee relative to installing a grounding conductor and electrode at the transformer locations only for the primary arrester and tank grounding. The primary neutral would then be grounded one span (approximately 300 ft) from the transformer. The primary and secondary neutrals would be separated by a spark gap or device with a breakdown voltage not exceeding 3 kV and the secondary neutral will have a separate grounding electrode as outlined in Rule 97D2.

1. Is the above arrangement allowable as outlined in Rule 97D2 and to reduce objectionable current flow in the grounding conductor as outlined in Rule 92D?
2. Does the above arrangement still meet the requirements of an effectively grounded neutral as indicated in the Definitions and a multiple-grounded system as in Rule 96A3 if the utilities continue to install a minimum of four grounds per mile?

97D

97D

3. Since the last span may be considered a single-grounded system, should the grounding connection on the secondary neutral be located at least 20 ft from the surge arrester grounding electrode as in Rule 97D1?

INTERPRETATION (Jan. 19, 1993)

This request for information is concerned with separation of primary and secondary neutrals to reduce earth current flow. However, the proposed system does not meet NESC requirements, primarily because the multiple-grounded neutral (termed primary neutral in the request for interpretation) is not grounded at the transformer pole as required by Rule 96A3.

Answers to specific questions are:

1. No. The primary neutral must be grounded at the transformer pole as required by Rule 96A3.
2. No, see answer to question 1. Also, Rule 215B1 requires that a common neutral be effectively grounded. This requirement is site specific; it may require more than four grounds per mile (see also definition of effectively grounded).
3. The last span of the proposed system is still part of a multi-grounded system; it may not be treated as a single-grounded system. Consequently, Rule 97D1 does not apply. Under Rule 97D2, the secondary neutral grounding conductor must be insulated for 600 V, and its electrode must not be less than 6 ft from the primary neutral and surge arrester grounding electrode.

NOTE: Rule references in this response are to the 1990 Edition, following the format in the request for information. The referenced requirements remain the same in the 1993 Edition.

Part 1.
Rules for the Installation and Maintenance
of Electric Supply Stations and Equipment

Rule 127L, Table 127-5

Hazardous area ratings for natural gas

REQUEST (Oct. 5, 1992)

IR 467

Review of Rule 127L of the NESC concerning hazardous area ratings for natural gas indicates that there are several industry practices that do not appear to be in strict compliance with the requirements of this rule. Your response to the following questions is requested.

1. Based on industry practice, the use of low-pressure natural gas for building heating (5 psig or less) does not seem to require the building to be rated as a hazardous area. Table 127-5 does not put any limitation on the gas pressure. According to this table, the building would have to be rated Class I, Division 2, Group D, because the gas piping contains screwed connections and valves. Can buildings using natural gas at 5 psig or less for heating, and containing natural gas heaters and piping with screwed or flanged connections, not be rated as hazardous (Class I, Division 2, Group D) solely because of the natural gas pipe and heating equipment?
2. A generation building of approximately 1 000 000 ft³ contains a natural gas pipeline operating at 550 psig or less. The natural gas pipeline passes through the building. The building has power roof ventilators, louvers, supply fans, and roll-up metal doors that are used for ventilation; however, the amount of ventilation provided will depend upon the outdoor ambient temperature and the amount of heat being generated within the building. The pipeline is all welded construction except for one ANSI Class 300 raised face flange. The flange is required at the point where the gas pipeline exits the ground in order to provide electrical separation between the below and above grade pipe for cathodic protection purposes. Does the presence of this one flange in this building require the entire building plus any connected

127L

127L

buildings that share a non-gas tight wall with this building, and 15 ft beyond any wall or roof ventilation louver on this building or the connected building, to be rated Class I, Division 2, Group D?

3. Question no. 3 is identical to question no. 2, except the flange on the pipeline is contained within a small enclosure that has weather boots at each pipe penetration into the enclosure and the enclosure has a 2-in vent pipe connected to the top of the enclosure and extended outside the building.
4. A generation building as described in question no. 2 contains a combustion turbine that burns natural gas. The combustion turbine is contained within a separate enclosure inside the building. Natural gas piping, valves, fitting, and connections to the combustors are contained within the combustion turbine enclosure. The combustion turbine enclosure has natural gas detectors that alarm and then shut off the gas turbine and the gas supply at levels below the ignitable level of natural gas. The combustion turbine has a positive pressure ventilation system. All penetrations into the enclosure are sealed sufficiently to hold in the CO₂ discharge in the event of a fire. The discharge of ventilation air is through a louver into the generation building. Is the combustion turbine enclosure a Class I, Division 2, Group D area, or a nonhazardous area? Is the entire larger generation building a Class I, Division 2, Group D area?
5. This question is identical to question no. 4, except the ventilation air discharged from the combustion turbine enclosure is ducted outside the larger generation building.

INTERPRETATION (January 19, 1993)

The answers to your specific questions are:

1. Rule 127L only identifies the areas where the requirements of ANSI/NFPA 70-1987 (NEC), Article 500, must be applied. It is the responsibility of the designer to determine what requirements, if any, are specified by Article 500 for low pressure gas used for building heating. The NESC Interpretations Subcommittee is not empowered to interpret NEC requirements.

2-5, inclusive:

Table 127-5 covers nonfired areas containing gas pipeline connections, valves or gauges for indoor locations with adequate ventilation. All of these questions appear to relate to different design methods used to obtain "adequate" ventilation. The Interpretations Subcommittee does not supply consulting information nor does it approve specific designs.

For information purposes only, note that NEC Article 500-2, FPN No. 3, indicates that "Through the exercise of ingenuity in the layout of electrical installations for hazardous (classified) locations, it is frequently possible to locate much of the equipment in less hazardous or in nonhazardous locations and thus to reduce the amount of special equipment required..."

Part 2.
**Safety Rules for the Installation and
Maintenance of Overhead Electric Supply and
Communication Lines**

Rule 232D4, Table 232-1, Footnote 8

**Exceptions to Vertical Clearance Limits for Cables Above
Ground**

REQUEST (Dec. 15, 1992) IR 470

Footnote 8 of Table 232-1 states, "Where the height of attachment to building *does not permit* service drops to meet these values, the clearances may be reduced to the following:..."

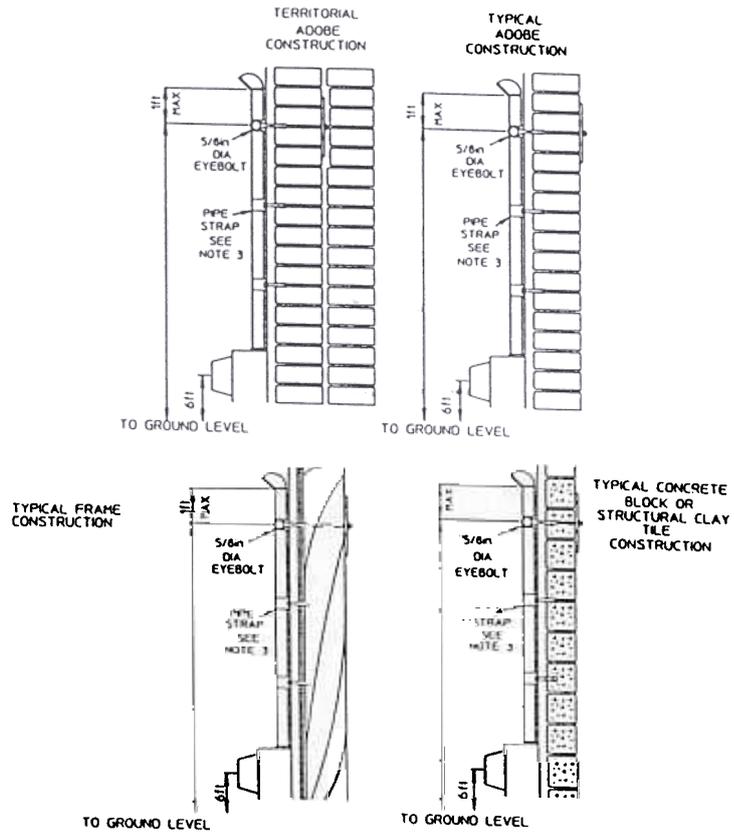
Our public service company uses an insulated triplex service cable for 120/240 volt service to homes. The cable meets the requirements of Rule 230C3. We allow for a 1 ft drip loop below the service point of attachment to a single family residence as shown in Figs IR 470-1 (a) through (d) and 470-2.

On new construction, we could require the point of attachment to be at elevation 13.0 ft so that the drip loop height is 12.0 ft in order to comply with the 12.0 ft in category 5 of Table 232-1. Alternatively, we could require that point of attachment at 11.5 ft so that the service drop and drip loop comply with Table 232-1, items a and c in Footnote 8.

Clarify the meaning of *does not permit*. This could mean anything from inconvenient to economically burdensome to almost impossible. Is it the intent of the NESC to routinely allow or condone a drip loop clearance of 10.5 ft, as is allowed by the 1993 National Electrical Code (NEC) in 230-24?

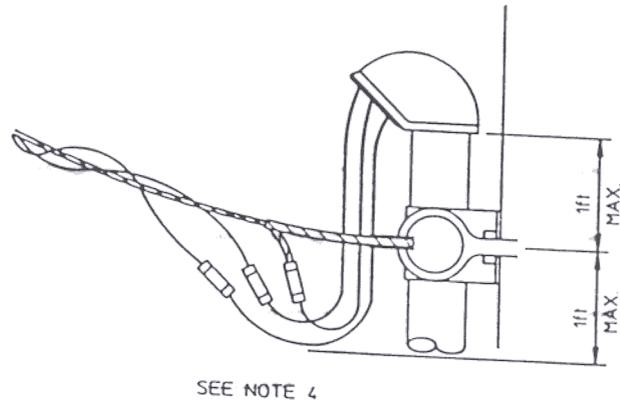
232D4

232D4



- NOTES: (1) Contact customer service representative for height of service attachment point if service crosses driveways.
(2) Service attachment to the building shall be designed to withstand 330 lbs tension applied at the point of attachment.
(3) Pipe strap shall be firmly attached to wall at intervals of 30 in minimum.
(4) Drip loop maximum 1 ft below point of attachment
(5) EMT may be used provided the point of attachment is not on the conduit. A raintight hub is required for use with EMT.

Fig IR 470-1 (a) - (d)



- NOTES: (1) Contact customer service representative for height of service attachment point if service crosses driveways.
 (2) Service attachment to the building shall be designed to withstand 330 lbs tension applied at the point of attachment.
 (3) Pipe strap shall be firmly attached to wall at intervals of 30 in minimum.
 (4) Drip loop maximum 1 ft below point of attachment
 (5) EMT may be used provided the point of attachment is not on the conduit. A raintight hub is required for use with EMT.

Fig IR 470-2
Detail of Attachment

232D4

232D4

INTERPRETATION (March 25, 1993)

The answer to your question is no, it is not the intent of the NESC to *routinely* allow or condone the reduced clearances stated in Footnote 8 of Table 232-1.

Application of Footnote 8 is limited to cases “where the height of attachment to a building. . . does not permit service drops to meet these values. . .” (as given in Table 232-1, Item 5). Table 232-1 clearances are required if the building being serviced is high enough so that the attachment may be made to the building without the need for a service mast (such as two-story or gable-roofed houses). Footnote 8 may be used *with discretion* on low buildings (such as flat or hip-roofed houses), either to avoid the use of a service mast or to limit the height of a mast where a mast is necessary.

235C2b

235C2b

Rule 235C2b

Conductors of different sags on same support

REQUEST (April 26, 1993)

IR 474

Our question involves vertical clearance between the phase wire and the neutral wire of a 12.47/7.2 kV distribution circuit. The voltage between conductors is nominally 7.2 kV. We understand the basic clearance requirement to be 16 in per Rule 235C1, Table 235-5.

Rule 235C2b(1)(a) applies to conductors of different sags on the same support. We are using conductors of the same size and sag when installed. However, when one conductor has ice and the other does not, the two conductors ~~no longer~~ have the same sag. Is it the intent to apply Rule 235C2b(1)(a) to this condition when the two conductors involved are of the identical size and type, and are installed at the same tension and sag?

In our situation, on a typical distribution vertical single-phase structure, the phase-to-neutral vertical spacing is about 4 ft. Application of Rule 235C2b(1)(a) to this type of structure severely limits its span capacity.

INTERPRETATION

(In process)

•Neither procedures which prohibit operation of equipment or switches without authorization from the designated person (Rule 442A) nor permanently installed tags satisfy the tagging requirements contained in Section 44. Individually installed tags, are required to identify switching/control points that must be kept in a specific position to provide worker protection (usually, but not always, in an abnormal position). Also, the tags should be removed when worker protection is no longer required (see Rule 444G). The procedures are clear for de-energizing equipment or lines for work; the same degree of protection is required in the situation under consideration in order to prevent (a) re-activation of reclosing controls, and (b) automatic, manual or remote closing of the associated switch if it trips out during the protected work operation.

It should be noted that the above statement is not intended to be critical of either (a) procedures that prohibit operation of equipment or switches without authorization from the designated person, or (b) use of permanently installed tags for instruction purposes. However, neither can be used to satisfy the tagging requirements of Section 44.

•Remote control systems, such as SCADA, may be used to implement switching and/or tagging operations, providing that the system operates in a fail-safe manner. To qualify, a SCADA system must be able to both verify that the intended operation has actually taken place and ensure that the intended operation will not change if the SCADA system loses power or otherwise becomes disabled. In this case, the SCADA system must be able to verify that the automatic reclosing control has been rendered inoperative and ensure that it will remain so, and/or verify that the SCADA tag is in place and ensure that it will remain so. This requirement would appear to disqualify electronic tags. Also, SCADA tags must meet all OSHA requirements.

442E

442E

Based on these principles, the answers to the specific questions are:

For IR 463

1. This option does not meet requirements.
2. This option appears satisfactory, providing that the stated operations are both verifiable and fail-safe. We understand the statement to mean that both reclosing and local breaker control will be rendered inoperative via SCADA during a hot line hold operation, such that local operation or restoration is impossible.
3. This option does not meet the full intent of Rule 442E2. Tags are required to prohibit reclosing after a trip until the designated person can determine that such reclosing will not be harmful to the protected party. While this option would eliminate automatic reclosing, tagging is still required for those instances where reclosing after a trip is prohibited for worker protection during specified work operations.
4. This option appears satisfactory, providing that the tagging operation is both fail-safe and verifiable. We understand the statement to mean that reclosing will also be deactivated, again in a verifiable and fail-safe manner.
5. This option is not satisfactory. Because a lamp can burn out, it is not a fail-safe operation — a lamp cannot be used as a substitute for a tag.

For IR 464

This operation, as described in “Point,” appears satisfactory (see IR 463, #2, including qualifications). Note that an electronic tag may not be substituted for a “normal” tag unless the electronic system is fail-safe; if it is not fail-safe and used, it should be treated as a supplementary warning.

The Interpretations Subcommittee has not analyzed the schematic included with the request for interpretation. Such action would constitute consulting advice beyond the scope of the Subcommittee.

442E

442E

Summary

The introduction of remote control systems does not change the basic requirements and procedures for worker safety. Such systems may be used only when they provide equivalent protection in a fail-safe manner.

239G

239G

Rule 239G

Electrical conductors in climbing space on joint-use utility poles

REQUEST (September 15, 1992)

IR 465

I have been requested to seek advice and interpretation of current NESC rules regarding electrical conductors in climbing space on joint-use utility poles. There has been much concern among telephone and CATV employees that the current practice of installing temporary electrical drops in climbing space presents excessive hazards to those climbing the poles. Therefore, I am requesting your assistance in providing a ruling on this issue.

The enclosed photographs (Figs IR 465-1-465-6) depict typical temporary power installations throughout the area concerned consisting of triplex conductors suspended freely from the transformer secondary splice to the weatherhead placed toward the bottom of the pole. As you can see, the conductors are somewhat loose in the climbing space and, according to some, create a considerable exposure hazard to those climbing with "hooks." One photo (Fig IR 465-3) exhibits an attempt by a communications worker to tie back the triplex so that it would not be adjacent to his working area on the pole.

The position of the local electric utility is that these installations are in accordance with the NESC rules in that the multiconductors are jacketed and require no extra protection as specified in Rule 239G2. The communication companies in the area believe that if in fact this service drop requires no extra protection, it still would require being fastened taut on the pole as specified in Rule 239G4b. It also appears that Rule 239E2c addresses the issue of attaching the secondary conductors to the surface of the pole. The local electric utility does not agree with this.

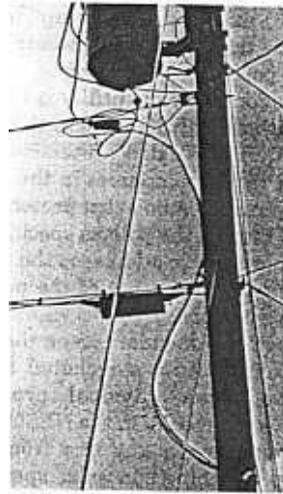
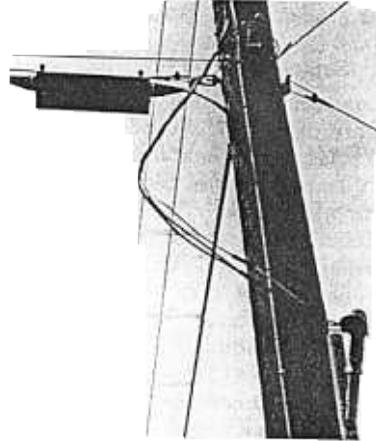
Please provide your recommendations on these issues:

1. Does Triplex constitute a jacketed multiconductor cable requiring no extra physical protection in vertical installations as referred to in the NESC Rule 239G2?
2. Is Triplex exempted in any way from being securely fastened through climbing spaces as specified in NESC Rules 239E and 239G?

239G

239G

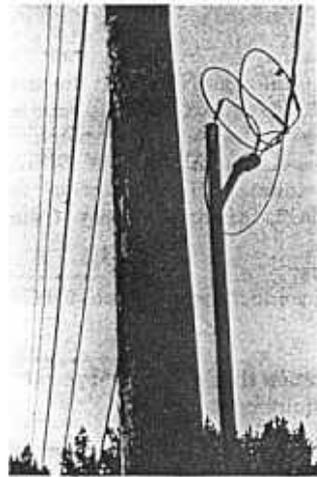
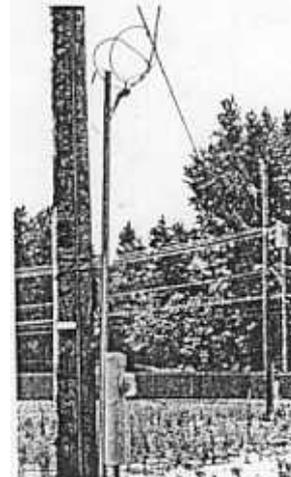
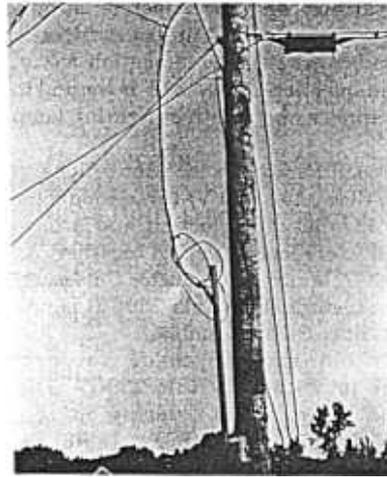
3. Are the construction methods depicted in Figs IR 465-1–465-6 in accordance with NESC rules and regulations?



Figs IR 465-1 and IR 465-2

239G

239C



Figs IR 465-3 IR 465-6

INTERPRETATION (Dec. 8, 1992)

This request for interpretation concerns electric supply conductors in the climbing space of jointly used utility structures. Rule 239G, covering supply conductors in communication space, appears to be the primary rule in question. Rule 239E is limited to supply space, and Rule 239G4b applies only to street lighting lamp leads.

Triplex, as used in this IR and as illustrated in the photographs, is a generic term for a low-voltage (less than 600 V) three-conductor supply cable consisting of two insulated conductors and a bare neutral, with the individual conductors loosely cabled together. As such, it is covered under Rule 239G7, Multiple-Conductor Cables. In contrast, a jacketed multiple-conductor cable (Rule 239G2) is one with a single jacket enclosing the entire cable assembly.

Vertical runs of *triplex* cable may be made through communication space under the provisions of Rule 239G7. The cable must be protected by a nonmetallic covering in the communication space (see also IR 439 — March 22, 1990). In addition, the triplex cable must be attached to the structure through the entire communication working space; it may not leave the structure as an aerial service with 40 in above or below communication attachments.

It should be noted that vertical runs may not obstruct either the climbing or the working space, nor may they interfere with the safe use of pole steps (Rules 237C and 239B). Also, vertical cable runs in the climbing space must be both securely attached to the structure and protected with nonmetallic covering (Rule 236H). While *jacketed* cables do not require nonmetallic protection in communication space under Rule 239G2, this applies only if the vertical run is not in the climbing space.

Answers to your specific questions are:

1. Triplex is not a jacketed multiconductor cable; Rule 239G2 does not apply.
 2. No.
 3. The photographs show construction that does not appear to be in accordance with NESC requirements.
-

280A1b

280A1b

Section 28 (NESC, 1984 ed.) Rule 280A1b

Climbing Requirements for Structures for Overhead Lines

REQUEST (April 8, 1993)

IR 472

This request involves Rule 280A1b in the 1984 NESC edition.

The structure in question is shown in Fig 472-1. This structure was constructed in 1894 to provide area lighting. Additionally, over the past thirty years, it has been utilized as a supporting structure for a three-phase 15 kV distribution line in a residential area. This was accomplished by bolting a spool insulator for the neutral conductor and a cross arm for the three primary conductors to two of the vertical members of the lattice structure.

In Fig 472-2, the lattice-type structure supported by a single tubular steel support is shown. The tubular support is approximately 24 1/4 in in diameter. The distances from ground level to the bottom of the support arms and additional distance to the first horizontal cross member are noted.

Please provide your response to the following questions:

1. Does this structure meet the definition of a "readily climbable" structure?
2. Is this structure a "closely latticed pole or tower"?
3. Does the proximity of the stop sign as shown in Fig 472-3 modify your interpretation if it is possible for the stop sign to be used to access the upper lattice area of the structure?

280A1b

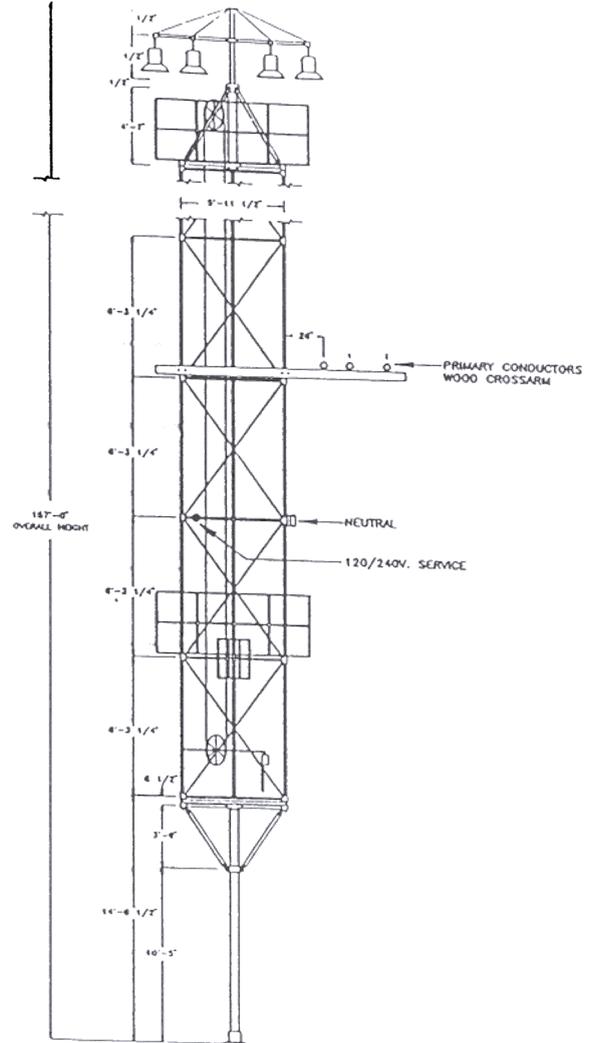


Fig 472-
Moonlight Tower

280A1b

280A1b

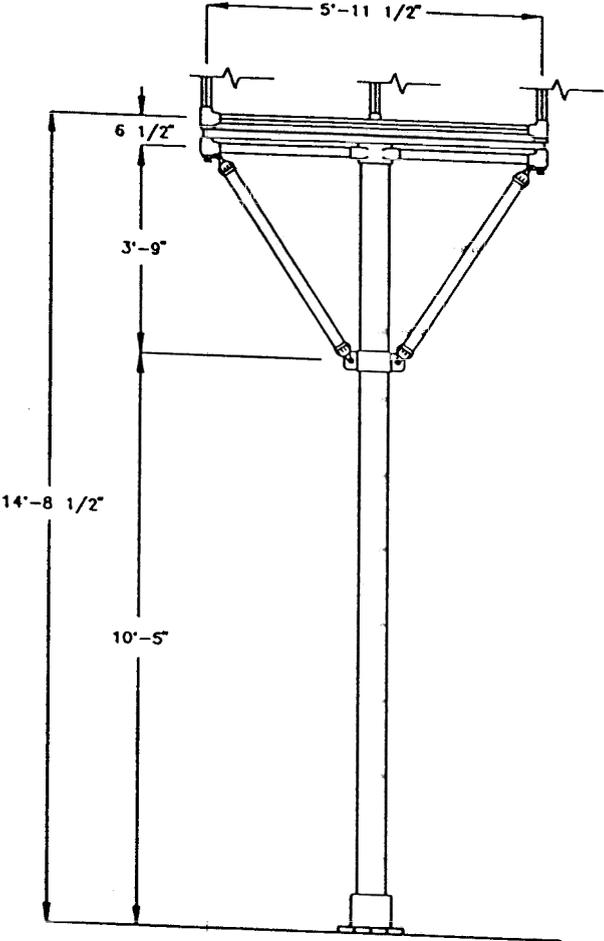
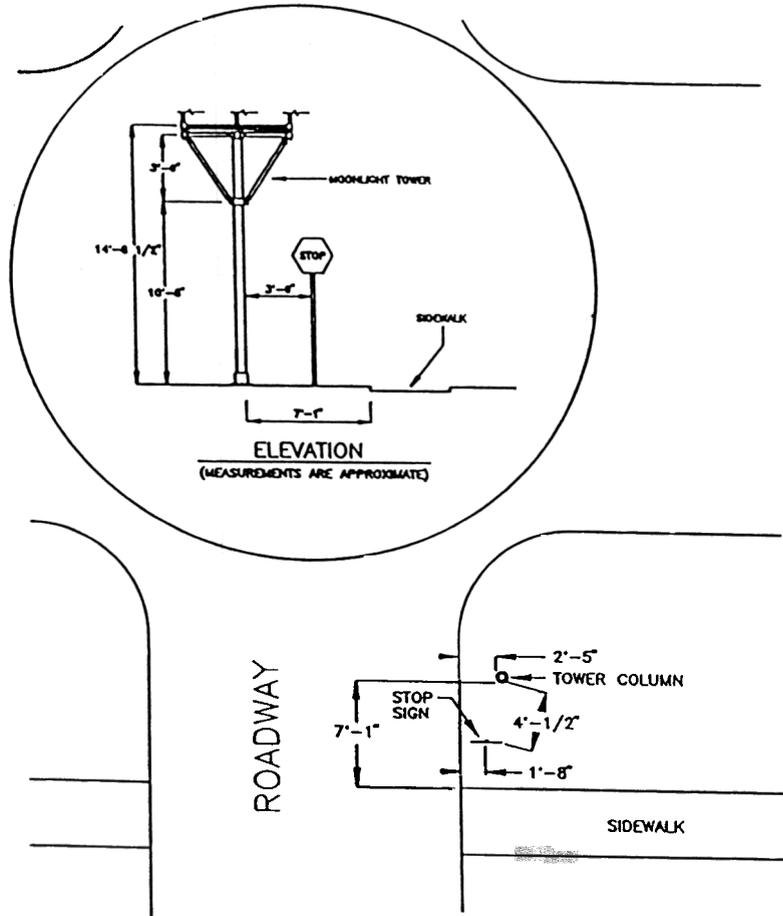


Fig 472-2
Column Base Elevation

280A1b

280A1b



ELEVATION
(MEASUREMENTS ARE APPROXIMATE)

ROADWAY

2'-5"
TOWER COLUMN
4'-1/2"
1'-8"
STOP SIGN
SIDEWALK

Fig 472-3
Plan View of Location

INTERPRETATION

(In process)

Part 3.
**Safety Rules for the Installation and
Maintenance of Underground Electric Supply
and Communication Lines**

Rule 350G**Markings on direct-buried cable**

REQUEST (Feb. 26, 1993) IR 471

Rule 350G states that "all direct-buried jacketed supply cable meeting Rule 350B and all direct-buried communication cables shall be legibly marked..."

Clarification is requested as to whether the marking defined in Rule 350G applies to communication service drops. The buried service drop is a wire typically 0.275 in to 0.350 in in diameter that connects a communication cable to users of services on that cable from a pedestal or terminal interface to that cable. Does Rule 350G apply to the communication service drops?

INTERPRETATION

(In process)

Rule 381G**Requirement for barriers securing live front transformers in excess of 600 V**

REQUEST (Nov. 25, 1992) IR 469

Rule 381G2, *Pad-Mounted Equipment* states, "Access to exposed live parts in excess of 600 V shall require two separate conscious acts. The first shall be the opening of a door or barrier that is locked or otherwise secured against unauthorized entry. The second act shall be either the opening of a door or the removal of a barrier."

381G

381G

My situation involves a locked fence surrounding both a water pumping station and a live front transformer in excess of 600 V. The transformer has a single door that when lifted, fully exposes the high-voltage and low-voltage compartments. Since the fence impounds both utilities, would the fence constitute the first barrier or door for the transformer under Rule 381G2?

INTERPRETATION (April 19, 1993)

This situation involves a single door, live front transformer located within a fenced area; the fence is locked (presumably to prohibit unauthorized entry).

Rule 381G covers access to pad-mounted equipment. Rule 381G1 states that all pad-mounted equipment *not fenced or otherwise protected* shall be either locked or otherwise secured (regardless of voltage). Rule 381G2 states that two separate acts are required to gain access to exposed live parts over 600 V. Both parts of the rule must be taken as a whole; they are not separable. Consequently, Rule 381G does *not* require two separate barriers on a live front transformer with exposed live parts in excess of 600 V *where the transformer is located within a locked fenced area*.

Rule 381G was added to the NESC in the 1973 Edition, as a single rule without subparts 1 and 2. The requirement for two separate procedures to gain access to exposed live parts in excess of 600 V was clearly limited to pad-mounted equipment that is not located within a fenced or otherwise protected area. However, the rule did not require that pad-mounted equipment with exposed live parts of 600 V or less be locked. Consequently, the rule was revised to its present form in the 1987 Edition. The intent was to require that all pad-mounted equipment not located within a fenced or otherwise protected area be either locked or secured against unauthorized entry; it was not the intent to require two separate procedures for equipment located within a fenced area.

It should be noted that this interpretation makes no determination as to the suitability of the fence in the subject case; *to do so* would constitute consulting advice that the Interpretations Subcommittee cannot provide.

381G

381G

My situation involves a locked fence surrounding both a water pumping station and a live front transformer in excess of 600 V. The transformer has a single door that when lifted, fully exposes the high-voltage and low-voltage compartments. Since the fence impounds both utilities, would the fence constitute the first barrier or door for the transformer under Rule 381G2?

INTERPRETATION (April 19, 1993)

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Rule 381G covers access to pad-mounted equipment. Rule 381G1 states that all pad-mounted equipment *not fenced or otherwise protected* shall be either locked or otherwise secured (regardless of voltage). Rule 381G2 states that two separate acts are required to gain access to exposed live parts over 600 V. Both parts of the rule must be taken as a whole; they are not separable. Consequently, Rule 381G does *not* require two separate barriers on a live front transformer with exposed live parts in excess of 600 V *where the transformer is located within a locked fenced area*.

Rule 381G was added to the NESC in the 1973 Edition, as a single rule without subparts 1 and 2. The requirement for two separate procedures to gain access to exposed live parts in excess of 600 V was clearly limited to pad-mounted equipment that is not located within a fenced or otherwise protected area. However, the rule did not require that pad-mounted equipment with exposed live parts of 600 V or less be locked. Consequently, the rule was revised to its present form in the 1987 Edition. The intent was to require that all pad-mounted equipment not located within a fenced or otherwise protected area be either locked or secured against unauthorized entry; it was not the intent to require two separate procedures for equipment located within a fenced area.

It should be noted that this interpretation makes no determination as to the suitability of the fence in the subject case; to do so would constitute consulting advice that the Interpretations Subcommittee cannot provide.

Part 4.
**Rules for the Operation of Electric Supply and
 Communications Lines and Equipment**

Section 44, Rule 440

Definition of supply employees

REQUEST (Nov. 30, 1992) IR 468

Define *supply employees*, specifically as applied to generating station electricians employed by an electric utility company.

INTERPRETATION (March 25, 1993)

Employees of an electric utility company are referred to as *supply employees* in the Part 4 Work Rules. This includes generating station electricians employed by an electric utility company. Section 44 rules apply to the extent that such employees are doing work covered by these rules.

Rule 441

Voltages of energized conductors or parts

REQUEST (April 8, 1993) IR 473

The voltage references in Table 441-1 are phase-to-phase voltages. The voltage references in the text, particularly in Rule 441A1, do not specify whether the voltage is phase-to-phase or phase-to-ground. By definition, voltage, unless indicated otherwise, is phase-to-ground; however, the text also refers to Table 441-1, which clearly contains phase-to-phase voltages.

I am requesting that an interpretation be rendered that would clarify the identification of voltage references in the text of Rule 441.

INTERPRETATION
 (In process)

442E

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Use of Supervisory Control and Data Acquisition Systems (SCADA) to tag electric supply circuits

REQUEST (July 1, 1992)

IR 463

Rule 442E of the 1993 edition has been changed in part to read:

“2. Controls that are to be deactivated during the course of work on energized or de-energized equipment or circuits shall also be tagged. Tagging of Supervisory Control and Data Acquisition Systems (SCADA) in itself shall not be considered sufficient. A physical tag is required to be located at every switch, breaker, or like device from which operation via SCADA of equipment is possible.”

Previously interpretation request numbers IR 433 and 434 were issued on this matter, which indicated that the intent was to require tagging on all controls, both local and remote, from which re-energization of a line or piece of equipment was possible. The intent of the revised rule seems confusing once again.

The condition in question is when qualified personnel are working on or near energized lines or equipment and the feature of automatic reclosing on fault-protecting breakers/reclosers is disabled; we term this a hot line hold: in the event of a tripout, the switching authority obtains a release from the crew prior to directing re-energization.

At one time we had relied on our operating rules that require all personnel to obtain authorization from the switching authority prior to operating any controls or switches; i.e., we were tagging only the SCADA controls, and this worked without incident for many years. A couple of years ago, we added permanently installed hot line hold tags on all SCADA-controlled breakers in an attempt to meet code by providing local warning not to operate without authorization. These permanent tags read: “Caution. Hot Line Hold Order may be in effect on this circuit. Do not place in local position unless requested by Operator.” Based on the previously referenced

interpretations, we were considering the modification of local breaker controls such that local closing capability was disabled during a hot line hold (at the same time automatic reclosing was disabled). As a result we felt that tagging during our hot line holds would be done on the only controls from which re-energization could occur, i.e., only on SCADA. This approach was to have been done using the same latching relay now used to disable automatic reclosing, such that loss of power or loss of SCADA communications would not change the status of local closing control or of automatic reclosing. Now we are unsure of the intent of the revised rule requiring local tagging. If SCADA controls are the only point of closing control remaining in effect, how do local tags provide for worker safety?

I agree that such local tagging is prudent and necessary for de-energized work, when not only breakers but also disconnect switches are open and motor operators are also uncoupled. It seems the revised language applies most when working on de-energized lines (as detailed fully in NESC Rule 444C) rather than to energized work; perhaps rules for work on energized and de-energized facilities should be kept separate and distinct from one another.

The requirement for local tagging during hot line holds may in fact result in some adverse safety effects. The NESC does not require that automatic reclosing be disabled when workers perform energized work, so rather than wait for the time necessary to place local tags, the fear is that some may choose to work with automatic reclosing enabled.

If our breakers had no automatic reclosing feature, then no controls would be deactivated during energized work, and no tagging (local or SCADA) would be required, and yet the local breaker controls could conceivably be operated to re-energize. This seems to be an inconsistent requirement.

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If as in our organization, the disabling of reclosing and the operation of breakers will be done predominantly via SCADA, the local tags during a hot line hold provide no warning to the control center operator; only the SCADA tag provides that. Our operating restriction requiring authorization prior to switching covers the local possibility of breaker closing.

In our effort to meet the intent of the revised code, we are considering several options:

1. Continue to count on permanently installed tags on each breaker's local control panel, warning to obtain authorization prior to operating any equipment, without adding any other tags each time a hot line hold is issued, i.e., tagging only SCADA controls since that is the control we normally use.
2. Change control wiring schemes, using the **latching relay** to deactivate all local breaker closing controls at the same time that the reclosing feature is disabled via SCADA and tag only the SCADA controls during hot line holds.
3. Remove all reclosing relays from service such that no tagging (either local or SCADA) is required during energized work since no controls will be deactivated.
4. Replace our local/remote control switches on breaker panels with a new type that includes a **tagging flag feature** to provide a warning locally when a hot line hold is implemented via SCADA.
5. Add a warning lamp to breaker panels that would serve as the local warning tag, i.e., turned on when the reclosing feature is deactivated via SCADA command.

I am unsure which of these options would meet the intent of the revised rule as presently written and would appreciate some clarification to help guide us in this matter.

INTERPRETATION

NOTE: A single response is given for IRs 463 and 464 because these requests for interpretations raise overlapping concerns. See the interpretation for both IRs 463 and 464 following IR 464.

Rule 442E**Use of Supervisory Control and Data Acquisition Systems (SCADA) to tag electric supply circuits**

REQUEST (July 10, 1992)

IR 464

This request for interpretation is in regard to the 1990 NESC Rule 442E, *Tagging Electric Supply Circuits* (paragraph 1, second sentence), "Controls that are to be deactivated during the course of work on energized or de-energized equipment or circuits shall also be tagged. The tags shall be placed to identify plainly the equipment or circuits on which work is being performed." Paragraph 2 follows with: "Tagging of Supervisory Control and Data Acquisition Systems (SCADA) in itself shall not be considered sufficient."

As a result of paragraph 2, a portion of the benefit realized from the installation of a SCADA system is diminished, namely, the time and cost factor of sending a switchman to the location to install tags on switches previously operated by the system. Case in point: when performing any energized work on transmission or distribution circuits, safety procedures require the reclosing devices to be turned off during this work. Prior to Rule 442E, our SCADA system was utilized for this purpose, including the tagging of the device in SCADA. Our switching and tagging procedures do not allow operation of switches or equipment without authorization from the appropriate operator; therefore, the practice worked very well.

In an effort to regain some of the cost incentive features, we would propose the following comments for consideration by the Committee.

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Point: If the circuit that normally provides the reclosing voltage to the closing circuit of breakers were rendered inoperative, a person could not close a breaker from any manually operated control switch located at the substation control room or the breaker itself without first turning control voltage onto the closing circuit for that breaker via SCADA. Would the device, rendered inoperative, and the electronic tag placed in SCADA become sufficiently safe as the present Rule 442E provision provides?

We understand that all companies must apply this rule to the operation of their electrical system, and the effect is relative to procedure and degree of automation in place. We believe this modification does produce a positive desirable result for the safety of electric utility workers, and will help to minimize the increases in operating costs.

We are committed to safety and system reliability in the electrical power industry and realize the tremendous impact that advanced technology has made. We are confident that an automated solution is possible, one in which total safety and economics are provided for.

In regards to our telephone conversation on July 23, 1992, concerning the 1990 edition of the NESC Rule 442E, please find the enclosed schematic drawing showing the installation of a remotely operated contact that provides interruption of the closing circuit's power supply. This feature does not allow any closing of the device from the panel or the breaker. However, the intent of the rule to provide a warning to anyone at the substation is not achieved even though an operation to close would have no effect. In addition to the power cutoff contact, new developments in electronic tags for remote operation are available.

We are actively pursuing this approach in order to maintain the full benefit of our SCADA equipment.

INTERPRETATION

Basically, both IRs 463 and 464 involve tagging procedures when SCADA systems are used to deactivate reclosing controls during the course of work on or near energized circuits or equipment (Rules 442E2 and 442E3, 1993 Edition). While this response refers to the 1993 Edition, it is also applicable to the 1990 Edition.

The following principles apply to tagging when reclosing controls are to be deactivated (termed "hot line hold" in IR 463):

- In order that employees may reliably depend on disabling of reclosing provisions, each location from which the reclosing provision can be reinstated must carry a physical tag (Rule 442E2).
- General tagging procedures and requirements are covered in Rule 444. While written specifically to cover de-energization of high-voltage equipment or lines for work (clear – tag – ground – work – remove tags and grounds – re-energize), the tagging portions of Rule 444 illustrate the steps required when tagging deactivated reclosing controls. In this context, the reclosing relay is equipment that is deactivated to prevent reclosing of a line after a trip.
- Reclosing controls should be deactivated, tagged and re-activated in a specific sequence (see Rule 444A1). When reclosing has been deactivated and the circuit opens automatically, the circuit shall be left open until reclosing has been authorized (Rule 442F1). This allows the designated person (Rule 442A) to ensure that (a) the circuit did not trip due to conditions at the work site, or (b) in the event that the circuit tripped due to conditions at the work site, all workers are clear and conditions are such that the circuit may be re-energized.

•Neither procedures which prohibit operation of equipment or switches without authorization from the designated person (Rule 442A) nor permanently installed tags satisfy the tagging requirements contained in Section 44. Individually installed tags, are required to identify switching/control points that must be kept in a specific position to provide worker protection (usually, but not always, in an abnormal position). Also, the tags should be removed when worker protection is no longer required (see Rule 444G). The procedures are clear for de-energizing equipment or lines for work; the same degree of protection is required in the situation under consideration in order to prevent (a) re-activation of reclosing controls, and (b) automatic, manual or remote closing of the associated switch if it trips out during the protected work operation.

It should be noted that the above statement is *not intended* to be critical of either (a) procedures that prohibit operation of equipment or switches without authorization from the designated person, or (b) use of permanently installed tags for instruction purposes. However, neither can be used to satisfy the tagging requirements of Section 44.

•Remote control systems, such as SCADA, may be used to implement switching and/or tagging operations, providing that the system operates in a fail-safe manner. To qualify, a SCADA system must be able to both verify that the intended operation has actually taken place and ensure that the intended operation will not change if the SCADA system loses power or otherwise becomes disabled. In this case, the SCADA system must be able to verify that the automatic reclosing control has been rendered inoperative and ensure that it will remain so, and/or verify that the SCADA tag is in place and ensure that it will remain so. This requirement would appear to disqualify electronic tags. Also, SCADA tags must meet all OSHA requirements.

Based on these principles, the answers to the specific questions are:

For IR 463

1. This option does not meet requirements.
2. This option appears satisfactory, providing that the stated operations are both verifiable and fail-safe. We understand the statement to mean that both reclosing and local breaker control will be rendered inoperative via SCADA during a hot line hold operation, such that local operation or restoration is impossible.
3. This option does not meet the full intent of Rule 442E2. Tags are required to prohibit reclosing after a trip until the designated person can determine that such reclosing will not be harmful to the protected party. While this option would eliminate automatic reclosing, tagging is still required for those instances where reclosing after a trip is prohibited for worker protection during specified work operations.
4. This option appears satisfactory, providing that the tagging operation is both fail-safe and verifiable. We understand the statement to mean that reclosing will also be deactivated, again in a verifiable and fail-safe manner.
5. This option is not satisfactory. Because a lamp can burn out, it is not a fail-safe operation — a lamp cannot be used as a substitute for a tag.

For IR 464

This operation, as described in “Point,” appears satisfactory (see IR 463, #2, including qualifications). Note that an electronic tag may not be substituted for a “normal” tag unless the electronic system is fail-safe; if it is not fail-safe and used, it should be treated as a supplementary warning.

The Interpretations Subcommittee has not analyzed the schematic included with the request for interpretation. Such action would constitute consulting advice beyond the scope of the Subcommittee.

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Summary

The introduction of remote control systems does not change the basic requirements and procedures for worker safety. Such systems may be used only when they provide equivalent protection in a fail-safe manner.