

PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

RESOLUTION NO. E-1401
UTILITIES DIVISION
Branch/Section: Electric
Date July 16, 1974

SUBJECT: Changes and Additions to Rules of General Orders Nos. 95 and 128
Concerning Grounding of Secondaries on 3-Phase Transformer Banks

WHEREAS: The State Division of Industrial Safety has requested that the Commission's General Orders Nos. 95 and 128 be revised to require that where the secondary system of a transformer bank is grounded at any point that the grounded conductor be run to the service, and

WHEREAS: The grounded conductor between the transformer secondary and the service provides a good path for fault current and insures prompt operation of customers' protective devices in the event of an accidental short circuit, and

WHEREAS: The proposed revisions were submitted to all privately owned and municipal electric utilities in California and none opposed them, and

WHEREAS: The safety of workmen and the general public would be enhanced, and

WHEREAS: Additional expense in the running of a fourth conductor can be avoided by permitting the optional grounding of one-phase conductor, and

WHEREAS: It appears that these changes and additions to the orders are necessary and desirable and good cause appearing,

IT IS HEREBY ORDERED that the changes and additions to Rule No. 58.3 of General Order No. 95 and 36.5 of General Order No. 128 be made as set forth in the attached appendix. The Secretary is directed to cause appropriate notice of the issuance of this order to be given to all operators of overhead electric supply lines coming within the jurisdiction of this Commission.

I hereby certify that the foregoing Resolution was duly introduced, passed and adopted at a regular session of the Public Utilities Commission of the State of California, held on the 16th day of July 1974, the following Commissioners voting favorably thereon:

Vernon L. Sturgeon, President
William Symons, JR,
J.P. Vukasin, JR,
Thomas Moran,
D.W. Holmes, Commissioners

State of California

File No. G.O 95/1550

MEMORANDUM

Date July 16, 1974 Conference

To: Commission

Subject: Revision of the
Commissions General Order Nos. 95
and 128 Relating to Grounding of
Three Phase Transformer Banks,
Requiring Resolution

From: Public Utilities Commission- - San Francisco – W. J. Cavagnaro
Chief Electrical Engineer

ISSUE: It is proposed to revise Rules 58.3-C of General Order NO. 95 and 36.5-A of General Order No. 128 to permit optional grounding of one of the phases on the secondary of three-phase transformer banks and to require that where the secondary system is grounded at any point, the grounded conductor be run to each service.

FACTS: Article E 250-23b of the state's basic electrical regulations (Title 24, Part 3, California Administrative Code) states in part:

"Where the secondary system is grounded at any point, the grounded conductor shall be run to each service."

The Commission's General Orders Nos. 95 and 128 do not contain a similar requirement. The state Division of Industrial Safety has requested that this requirement be added. Municipal and privately owned electric utilities concur with the proposed revisions.

DISCUSSION: Installing the grounded conductor between the secondary of a transformer bank and a customer's service provides a good path for fault current in case of an accidental ground on the customer's equipment and insures prompt operation of the customer's protective devices.

General Orders 95 and 128 presently require that, where available, the midpoint of one winding be grounded. At a meeting between the Commission staff and utility representatives it was suggested that in order to avoid the expense of running a fourth conductor on three-phase power only services, grounding of one of the phases be made optional. Grounding one phase is presently allowed only when the midpoints of the secondary windings are not accessible.

CONCLUSIONS AND RECOMMENDATIONS: Since requiring that the grounded conductor of secondaries on three-phase circuits be run to the customer's service

would improve safety of the general public, and provision for optional grounding of one-phase conductor would eliminate additional expense, it is recommended that the General Orders be revised. The necessary resolution has been prepared for adoption if approved by the Commission.

JFA:EL
Attachments

APPENDIX

General Order No. 95 shall be revised as follows:

RULE 58.3-B7

C. GROUNDINIG

- (1) Grounding of Windings: Transformer windings not exceeding 250 volts (except those used exclusively for energizing street lighting circuits and those used exclusively for energizing signal and track circuits) shall be effectively grounded as follows:
 - (c) Three-Phase Systems: In three-wire delta (nominal 120 or 240 volt) systems the midpoint of one transformer winding or shall be grounded, or if the midpoint is not available on any of the transformer windings, a point common to two windings (one phase wire) shall be grounded; in three-wire star (nominal 120 208 or 240 volt) systems, the point common to all windings or shall be grounded, or if the midpoint is not available on any of the transformer windings, one of the phase wires shall be grounded; in four-wire star (nominal 120/208 volt) and ~~three-wire T or Scott (nominal 240 volts)~~ systems, the common point shall be grounded (see App. G, Fig. 59).
 - (d) Where the Secondary system is grounded at any point, the grounded conductor shall be run to each service.

General Order No. 128 shall be revised as follows:

36.5 Grounding and Bonding of Conductors and Equipment

A. GENERAL.. .

(1) Transformer Windings: Transformer windings not exceeding 250 volts (except those used exclusively for energizing street lighting circuits and those used exclusively for energizing signal and track circuits) shall be effectively grounded at the points specified in the following:

(c) Three-Phase Systems:

3-wire Delta 120 or 240 volt:	midpoint of one winding or, if not available ; a point common to two windings.
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3-wire and 4-wire Star 120, 208,240, or 120/208 volt, and 3-wire T or Scott 240 volt:	point common to all windings or, if not available one conductor.
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(d) Where the Secondary system is grounded at any point, the grounded conductor shall be run to each service.

Strikeout and Underline Section added on July 26, 2002 by Raymond G Fugere.

Original Version
Rule 58.3-C1(GO 95)

- 58.3-C1 Grounding of Windings: Transformer windings not exceeding 250 volts (except those exclusively for energizing street lighting circuits and those used exclusively for energizing signal and track circuit) shall be effectively grounded as follows:
- a) Single phase systems: In two wire (nominal 120-volt system one wire shall be grounded; in two wire (nominal 240-volt) systems where the mid-point or some intermediate point of the windings is not available, one wire shall be grounded; in two-wire (nominal 240 volt) systems where the mid-point or some intermediate point of the winding is available, that point shall be grounded; in three-wire (nominal 120/240-volt) systems, the mid-point of the winding shall be grounded. (See App. G, Fig 57.)

 - b) Two phase systems: In three-wire (nominal 240 volt) systems, the point common to both windings shall be grounded; in four-wire (nominal 120/240-volt) systems, the mid-point of the winding on one phase shall be grounded; in four wire (nominal 240-volt), and five wire (nominal 120/240-votls) systems, the mid-points of both windings shall be connected and grounded. (See App. G, Fig. 58.)

 - c) Three phase Systems: In three-wire delta (nominal 120 or 240 volt) systems the mid-point of one transformer winding shall be grounded, or if the midpoint is not available on any of the transformer windings, a point common to any two windings (one phase wire) shall be grounded; in three-wire star (nominal 120, 208, or 240 volt) systems, the point common to all windings shall be grounded or, if the common point is not available on a three-phase star-connected transformer of such a system, one of the phase wires shall be grounded; in four-wire star (nominal 120/208 volt) and three-wire T or Scott (nominal 240 volt) systems, the common point shall be grounded. (See App. G, Fig 59.)

Strikeout and Underline Version

Rule 58.3-C1(GO 95)

- 58.3-C1 Grounding of Windings: Transformer windings not exceeding 250 volts (except those exclusively for energizing street lighting circuits and those used exclusively for energizing signal and track circuit) shall be effectively grounded as follows:
- a) Single phase systems: In two wire (nominal 120-volt system one wire shall be grounded; in two wire (nominal 240-volt) systems where the mid-point or some intermediate point of the windings is not available, one wire shall be grounded; in two-wire (nominal 240 volt) systems where the mid-point or some intermediate point of the winding is available, that point shall be grounded; in three-wire (nominal 120/240-volt) systems, the mid-point of the winding shall be grounded. (See App. G, Fig 57.)
 - b) Two phase systems: In three-wire (nominal 240 volt) systems, the point common to both windings shall be grounded; in four-wire (nominal 120/240-volt) systems, the mid-point of the winding on one phase shall be grounded; in four wire (nominal 240-volt), and five wire (nominal 120/240-volts) systems, the mid-points of both windings shall be connected and grounded. (See App. G, Fig. 58.)
 - c) Three-Phase Systems: In three-wire delta (nominal 120 or 240 volt) systems the midpoint of one transformer winding or shall be grounded, or if the midpoint is not available on any of the transformer windings, a point common to two windings (one phase wire) shall be grounded; in three-wire star (nominal 120 208or 240 volt) systems, the point common to all windings or shall be grounded, or if the midpoint is not available on any of the transformer windings, one of the phase wires shall be grounded; in four-wire star (nominal 120/208 volt) and three-wire T or Scott (nominal ~~240 volts~~) systems, the common point shall be grounded (see App. G, Fig. 59).
 - d) Where the Secondary system is grounded at any point, the grounded conductor shall be run to each service.

Final Version
Rule 58.3-C1 (GO 95)

- 58.3-C1 Grounding of Windings: Transformer windings not exceeding 250 volts (except those exclusively for energizing street lighting circuits and those used exclusively for energizing signal and track circuit) shall be effectively grounded as follows:
- a) Single phase systems: In two wire (nominal 120-volt system one wire shall be grounded; in two wire (nominal 240-volt) systems where the mid-point or some intermediate point of the windings is not available, one wire shall be grounded; in two-wire (nominal 240 volt) systems where the mid-point or some intermediate point of the winding is available, that point shall be grounded; in three-wire (nominal 120/240-volt) systems, the mid-point of the winding shall be grounded. (See App. G, Fig 57.)

 - b) Two phase systems: In three-wire (nominal 240 volt) systems, the point common to both windings shall be grounded; in four-wire (nominal 120/240-volt) systems, the mid-point of the winding on one phase shall be grounded; in four wire (nominal 240-volt), and five wire (nominal 120/240-votls) systems, the mid-points of both windings shall be connected and grounded. (See App. G, Fig. 58.)

 - (c) Three-Phase Systems: In three-wire delta (nominal 120 or 240 volt) systems the midpoint of one transformer winding or, a point common to two windings (one phase wire) shall be grounded; in three-wire star (nominal 120 208or 240 volt) systems, the point common to all windings or, one of the phase wires shall be grounded; in four-wire star (nominal 120/208 volt) systems, the common point shall be grounded (see App. G, Fig. 59).

 - (d) Where the Secondary system is grounded at any point, the grounded conductor shall be run to each service.

Original Version
Rule 36.5 (GO 128)

36.5-A(1) Transformer Windings: Transformer windings not exceeding 250 volts (except those used exclusively for energizing street lighting circuits and those used exclusively for energizing signal and track circuits) shall be effectively grounded at the points specified in the following:

(a) Single Phase Systems:

2-wire 120 volt: one conductor.
2-wire 240 volt: intermediate point or, if not available, one conductor.
3-wire 120/240 volt: mid point.

(b) Two Phase Systems:

3-wire 240 volt: point common to both windings.
4-wire 120/240 volt: mid point on one phase.
4-wire 240 volt: mid points of both windings connected together.
5-wire 120/240 volt: mid points of both windings connected together.

(c) Three Phase Systems:

3-wire Delta 120 or 240 volt: mid point of one winding or, if not available, a point common to two windings.

3-wire and 4-wire Star 120, 208, 240, or 120/208 volt, and 3-wire T or Scott 240 volt: point common to all windings or, if not available, one conductor.

Strikeout and Underline Version

Rule 36.5 (GO 128)

36.5-A(1) Transformer Windings: Transformer windings not exceeding 250 volts (except those used exclusively for energizing street lighting circuits and those used exclusively for energizing signal and track circuits) shall be effectively grounded at the points specified in the following:

(a) Single Phase Systems:

2-wire 120 volt: one conductor.

2-wire 240 volt: intermediate point or, if not available, one conductor.

3-wire 120/240 volt: mid point.

(b) Two Phase Systems:

3-wire 240 volt: point common to both windings.

4-wire 120/240 volt: mid point on one phase.

4-wire 240 volt: mid points of both windings connected together.

5-wire 120/240 volt: mid points of both windings connected together.

(c) Three Phase Systems:

3-wire Delta 120 or 240 volt: mid point of one winding or, ~~if not available~~, a point common to two windings.

3-wire and 4-wire Star 120, 208, 240, or 120/208 volt, and 3-wire T or Scott 240 volt: point common to all windings or, ~~if not available~~ one conductor.

(d) Where the Secondary system is grounded at any point, the grounded conductor shall be run to each service.

Final Version
Rule 36.5 (GO 128)

36.5-A(1) Transformer Windings: Transformer windings not exceeding 250 volts (except those used exclusively for energizing street lighting circuits and those used exclusively for energizing signal and track circuits) shall be effectively grounded at the points specified in the following:

(a) Single Phase Systems:

2-wire 120 volt: one conductor.
2-wire 240 volt: intermediate point or, if not available, one conductor.
3-wire 120/240 volt: mid point.

(b) Two Phase Systems:

3-wire 240 volt: point common to both windings.
4-wire 120/240 volt: mid point on one phase.
4-wire 240 volt: mid points of both windings connected together.
5-wire 120/240 volt: mid points of both windings connected together.

(c) Three Phase Systems:

3-wire Delta 120 or 240 volt: mid point of one winding or, a point common to two windings.
3-wire and 4-wire Star 120,208,240, or 120/208 volt, and 3-wire T or Scott 240 volt: point common to all windings or one conductor.

(d) Where the Secondary system is grounded at any point, the grounded conductor shall be run to each service.