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DISTRIBUTION ENGINEERING DEPARTMENT

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APPLICATION OF LIGHTNING ARRESTERS
ON
DISTRIBUTION SYSTEMS

FILE: APPLICATION AND DESIGN
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Field Manuals:

- No. 7 Overhead - B&Q - Sect 15
- No. 8 Overhead - Bx & West - Sect 15
- No. 9 Overhead - Superv. - Sect 15
- No. 10 Overhead - S.I. - Sect 15
- No. 17 Survey - Sect 4

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APPLICATION OF LIGHTNING ARRESTERS
ON
DISTRIBUTION SYSTEMS

1.0 PURPOSE

This Specification covers the application of lightning arresters on lines and equipment on the 4, 13, 27 and 33kV overhead distribution systems and on 13kV URD installations.

2.0 DISTRICTS APPLICABLE

All Customer Service Areas.

3.0 LIGHTNING ARRESTERS FOR THE 4 AND 13KV SYSTEMS

All lightning arresters employed are of the "DISTRIBUTION CLASS" and rated 3, 6 and 12kV RMS.

3.1 Overhead Systems

Two types of arresters are used on the 4 and 13 kV overhead systems, as follows:

3.1.1 NORMAL DUTY, Silicone - Carbide, valve type, with internal gaps.

3.1.2 HEAVY DUTY, gapped, Metal Oxide Varistor (M.O.V.).

3.2 URD Installations

URD installations operating at 13.8 kV are equipped with elbow type, gapped M.O.V. arresters at open points in the circuit.

4.0 LIGHTNING ARRESTERS FOR THE 27 AND 33KV SYSTEMS

"DISTRIBUTION CLASS, HEAVY DUTY, GAPPED M.O.V." arresters are used on the 27 and 33kV systems, as described in the following paragraph.

5.0 APPLICATION OF LIGHTNING ARRESTERS

Lightning arresters shall be used on all applications, as follows:

5.1 Overhead Distribution Circuits

Nominal System Voltage	Silicone-Carbide or Gapped M.O.V. Arrester Rating	Protected Equipment BIL And Type Of Application
(KV-RMS)	(KV-RMS)	(KV-Crest)
4	3 KV, Silicone-Carbide 3 KV, Gapped M.O.V.	60 KV, All 4 KV Applications
13	12 KV, Silicone-Carbide 12 KV, Gapped M.O.V.	95 KV, All 13 KV Applications
27	27 KV, Gapped M.O.V.	125, 150 And 200 KV, For All Equipment Supplied From Within A 27 KV Automatic Loop And For Sensing Transformers Of Automatic Loops.
	33 KV, Gapped M.O.V.	125, 150 And 200 KV, For Equipment Supplied From The 27 KV Feeder Main Run.
33	33 KV, Gapped M.O.V.	150 and 200 KV, All 33 KV Applications

5.1.1 "GAPLESS M.O.V." lightning arresters are not permitted on any of the Company's Overhead Distribution Systems or on U.R.D. Installations.

5.2 Series Street Lighting Circuits

R.O. Transformer Sizes	Silicone-Carbide or Gapped M.O.V. Arrester Rating
	(KV-RMS)
10 KW and 15 KW	3 KV
20 KW and 25 KW	6 KV

5.3 URD Installations

Nominal System Voltage	Gapped M.O.V. Elbow Arrester Rating	Protected Equipment BIL
(KV-RMS) 13	(KV-RMS) 12	(KV-Crest) 95

5.4 See Purchase and Test Specifications EO-5430 and EO-100,059 for details regarding arrester type, electrical characteristics and approved manufacturers.

6.0 LIGHTNING PROTECTION ON OPEN WIRE DISTRIBUTION AND 4KV SPACER TYPE AERIAL CABLE CIRCUITS

Lightning arresters shall be installed at the following locations on 4, 13, 27 and 33kV open wire circuits and on 4kV spacer type aerial cables:

6.1 Primary Risers

6.1.1 All risers connected to open wire or to 4kV spacer type aerial cable circuits and supplying underground cables and electrical apparatus, shall be equipped with a lightning arrester on each phase wire. The arresters shall be installed on the riser pole and connected to the overhead side of any disconnecting device.

6.1.2 Lightning arresters shall be installed on riser poles that supply URD developments for the protection of underground primary cables, URD transformers and related equipment. In addition, 13kV URD installations should be equipped with 12kV gapped M.O.V. elbow arresters at open points in the circuit. The elbow arresters are installed inside the primary compartment of padmounted transformers.

6.1.3 The proper kV arrester rating shall be provided for riser poles of URD developments built to 13kV standards but initially operating at 4kV. If all URD primary cables are rated at 13kV and all URD transformers are dual rated,

then 12kV arresters should be installed on the riser from the start and 12kV elbow arresters provided at the open points in the circuit. If during the initial phase, however, some primary URD cable sections are rated at 4kV and some URD transformers are not dual rated, 3kV arresters should initially be installed on the riser pole and changed to 12kV arresters prior to operating the circuit at 13kV. Elbow arresters will also have to be installed at open points on the URD circuit when converting to 13.8kV operation.

6.2 Overhead Transformers and Step Voltage Regulators

- 6.2.1** All overhead distribution transformers and step voltage regulators, supplied from open wire or spacer type aerial cable circuits, shall be equipped with a lightning arrester on each phase wire. The arresters shall be installed on the transformer or regulator pole and connected to the primary side of the equipment. Regulators should also have an arrester installed on each phase on the load side.
- 6.2.2** Completely self protected (CSP) transformers are equipped with lightning arresters at the factory. Lightning arresters for conventional type transformers shall be provided at the time of installation.

6.3 Overhead Automatic Reclosers

- 6.3.1** Lightning arresters shall be provided on both sides of all feeder and tie reclosers on 4kV automatic loops, as stipulated in Specification EO-5311.
- 6.3.2** Lightning arresters shall be installed on both sides of all feeder, mid-point and tie reclosers on 13 and 27kV automatic loops, as described in Specifications EO-5311 and EO-2112 respectively.

6.4 Overhead Automatic Sectionalizers

6.4.1 All automatic sectionalizers on 27kV open wire loops shall be equipped with lightning arresters on both sides of the sectionalizer, as per Drawing EO-16394-B.

6.5 Overhead Switches

6.5.1 All normally open tie switches on open wire lines and spacer type aerial cables shall be provided with lightning arresters on both sides of the switch. The arresters shall be installed on the switch pole, except for vertically mounted, manually operated, 3-phase gang switches where arresters are installed on the adjacent pole on both sides of the switch. If arresters already exist on the adjacent poles for the protection of other equipment, additional arresters are not required.

6.5.2 No arresters shall be provided for normally closed line sectionalizing switches on the 4, 13 and 27kV systems. Arresters are required on each phase conductor, on both sides of a closed line switch on 33kV overhead circuits.

6.6 Dead-End Poles

6.6.1 Lightning arresters shall be installed on all phase wires on dead-end poles. If arresters exist on all phase wires at the adjacent pole, they are not required on the dead-end pole.

6.7 Overhead Capacitors

6.7.1 All capacitor banks installed on open wire and spacer type aerial cable circuits require lightning protection. The arresters shall be installed on the capacitor pole.

6.7.2 Factory assembled capacitor banks are equipped with lightning arresters. Arresters for other banks shall be provided at the time of installation.

6.8 Series Street Lighting Circuits

- 6.8.1 All risers of high tension series street lighting circuits shall be equipped with lightning arresters on the riser pole as per Drawing EO-20503, Plates 1, 2 and 7.
- 6.8.2 Constant current (R.O.) transformers shall be protected with arresters mounted on the transformer pole in accordance with Drawings EO-2432-B, EO-9007-B and EO-9008-B.
- 6.8.3 No lightning arresters shall be installed on transformers which step-up a low voltage supply to a series street lighting transformer, or on the primary of the series street lighting transformer supplied in this manner.

6.9 Transition From Aerial Cables to Open Wire or to 4KV Spacer Type Cable Circuits

- 6.9.1 Lightning arresters are required on each phase wire whenever there is a transition from 4kV self supporting aerial cable to 4kV open wire or to 4kV spacer type cable circuits. The arresters shall be installed on the transition pole and connected to the open wire side or to the spacer type aerial cable side. The same lightning protection applies to transitions from 13, 27 and 33kV aerial cables to open wire circuits.

7.0 LIGHTNING PROTECTION FOR EQUIPMENT SUPPLIED FROM AERIAL CABLES

No lightning arresters shall be installed for any apparatus supplied from 4kV self supporting aerial cables whose messenger is wrapped around the aerial cable, or from 13, 27 and 33kV aerial cables which are supported by the messenger with cable rings. The only exceptions are those listed under paragraphs 6.5.1 and 6.9.1, as previously described.

8.0 UNPROTECTED 33KV OPEN WIRE CIRCUITS

Arresters should be installed every one-half mile of unprotected 33kV open-wire lines, by taking into account existing equipment arresters. An arrester should be provided for each phase conductor at the same supporting structure location.

9.0 GROUND RODS AT ARRESTER POLES

A ground rod should be driven at the base of every arrester pole that does not have a ground rod. The ground wire of the rod should be connected to the ground lead of the arrester and to the secondary neutral, when available. Ground rod requirements should comply to Specifications EO-2013 and EO-2025. The provisions of this paragraph apply to distribution circuits of all voltage classes.

10.0 LOCATIONS OF ADEQUATE GROUND FOR AERIAL CABLES

The messenger of 4kV spacer type and 4kV self supporting aerial cables, and the messenger and the metallic sheath of 13, 27 and 33kV aerial cables, shall be connected to an adequate ground with a #2 copper or equivalent conductor, every four normal pole spans of cable length. For description of adequate grounds refer to Specification EO-2013.

11.0 LIGHTNING ARRESTER GROUND LEADS

All lightning arrester ground leads shall be connected to an adequate ground by means of #6 copper conductor.

12.0 SPECIAL APPLICATIONS

Applications not covered by this Specification shall be referred to the Network Systems Section Manager of the Distribution Engineering Department for study and final determination.

13.0 REFERENCE SPECIFICATIONS

The following Specifications are referenced:

<u>Number</u>	<u>Title</u>	<u>Engineering Manual</u>
EO-2013	Adequate Ground Requirements and Grounding of Spacer Type and Metal Sheathed Aerial Cables	4
EO-2025	Requirements for Neutral Conductor on Primary Radial Distribution Circuits	4
EO-2112	Installation of Automatic Oil Reclosers - Wiring and Lightning Protection	4

EO-5311	Installation of Automatic Vacuum Reclosers - Wiring and Lightning Protection	4
EO-5430	Surge Arresters for the Distribution System	6
EO-100.059	Purchase Recommendations for Distribution Class Surge Arresters	6



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REVISION 12: Introduced gapped M.O.V. arresters on the 4 and 13 KV overhead systems and gapped M.O.V. elbow arresters on the 13 KV U.R.D. system. To be reviewed as required.	FILE: Application and Design Manual No. 4 Field Manuals: No. 7 Overhead - B&Q - Sect 15 No. 8 Overhead - Bx & West - Sect 15 No. 9 Overhead - Superv. - Sect 15 No. 10 Overhead - S.I. - Sect 15 No. 17 survey - Sect 4
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