
	APPLICATION OF SURGE ARRESTERS ON OVERHEAD DISTRIBUTION LINES		031822
	Asset Type: Electric Distribution	Function: Construction, Maintenance, and Operation	
Issued by: Sam Chang (SKC5) 	Date: 07-01-16		
Rev. #17: This document replaces PG&E Document 031822, Rev. #16. For a description of the changes, see Page 11.			

Purpose and Scope

This document provides information for ordering and applying surge arresters on overhead distribution circuits.

General Information

1. The normal operation of an arrester is to shunt a voltage surge (lightning or a system voltage transient) and recover for continued use. An arrester is a non-destructive type of device.
2. The criteria outlined in this document applies only to new installations. Arresters may be installed on existing installations where field experience and judgment indicate that surge protection is justified.
3. Table 1 on Page 4 shows the ratings and types of applications for various types of California Department of Forestry and Fire Protection (CAL FIRE) Non-Exempt Surge Arresters approved for use at PG&E. Distribution-class arresters are used on all overhead equipment and riser-pole-class arresters are used on underground riser applications.
4. The maps on Pages 8 through 10 show the various surge districts within the system. District 1 areas are the most severe and average more than 5 thunderstorm days per year. District 2 areas average 3 to 5 thunderstorm days per year, and District 3 areas average less than 3.
5. To some extent, the application of surge arresters must be based on local conditions, experience, and judgment. However, at a minimum, surge arresters shall be installed as follows:
 - A. On primary cable risers and self-protected transformers in District 1 and 2 areas.
 - B. On conventional transformers in the portions of District 1 areas that are subjected to severe surges such as along mountain ridges, etc. In the other portions of District 1 and 2 areas, arresters shall be installed only on the last transformer of each phase of tap lines and on the last transformer of each phase before an open point on a circuit (see Figure 7 on Page 7 for an example). Studies indicate that many transformers are not damaged by the initial surge, but by the higher surge reflected from an open point in the circuit, such as the end of a tap line or a normally open switch. The voltage of the reflected surge can be as high as twice the voltage of the initial surge.
 - C. On reclosers, regulators, and auto-boosters in District 1 and 2 areas.
 - D. On 1,200 kvar and 1,800 kvar capacitor banks in all District areas.
 - E. For arrester installations, treat the primary neutral (not common neutral) as a phase wire; i.e., a single-phase transformer installation with a phase wire and a primary neutral will require two arresters.
6. For crossarm-mounting arresters, order crossarm-mounting bracket, Code 180081 (see Figure 5 on Page 6). For mounting on distribution transformers, order "ELL" bracket, Code 180166 (see Figure 6 on Page 6).
7. Arresters need to be mounted close to the equipment they are to protect, with the leads as short as practical.
8. It is imperative to keep the arrester leads as short as practical. Lead voltage during a lightning discharge is approximately 5 kV per foot. This lead voltage adds to the arrester discharge voltage and can significantly increase the voltage impressed across the equipment.
9. In general, connect arresters on the source side of fuses. This is to prevent the fuse from blowing due to the lightning discharge current going through the fuse. Exception for transformers: Universal fuse links above 15T and power fuses above 20E. These larger fuse sizes will not blow during lightning discharge.

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10. Do not over tighten the mounting bolt on non-porcelain arresters because the non-metal mounting tab may crack. The correct torque requirement is 20 foot-pounds.
11. All CAL FIRE Non-Exempt arresters are supplied with a ground lead disconnecter (GLD) assembled at the ground terminal. The GLD helps prevent circuit lockout by automatically disconnecting an internally damaged arrester. The GLD also serves as a visual indication that arrester replacement is necessary. For a quick visual indication of the type of arrester, PG&E has standardized, color-coded GLD: yellow in color for riser-pole-class arresters and black in color for distribution-class arresters. **Note:** Keep the ground lead as short as possible to avoid shorts should the arrester fail and the GLD blow off.
12. All arresters are supplied with an animal guard insulating cap. Use #4 XLP insulated lead wire from [Document 059626](#) on the table titled "Jumper and Lead Wires for Raptor Protection."
13. The U.S. Department of Transportation (DOT) has regulations on surge arresters shipped by common carrier. A ground lead disconnect (GLD) shipping restraint is required on some arresters. The Joslyn arresters are shipped to PG&E with a removeable, temporary wire restraint. The Ohio Brass arresters are exempt from these DOT requirements.

Before installing an arrester that has a temporary wire restraint on the GLD, remove and discard this wire.
14. PG&E has recently approved the use of Siemens Type 3EK4 Surge Arresters. These arresters are CAL FIRE exempt equipment, having secured a 24-month temporary exemption status on September 10, 2014. Siemens is currently working on obtaining a permanent exemption status on these arresters. Table 3 on Page 5 shows the ratings and types of applications for CAL FIRE exempt arresters. The Siemens arresters must be used in the SRA (State Responsibility Areas for Fire Protection), the FRA (Federal Responsibility Areas for Fire Protection), or the UWF (Urban Wildland Fire) areas. Refer to [Document 072148](#) for more information on the various fire-area designations. **Note:** Even though the new Siemens arresters are exempt, if other non-exempt equipment is installed on the pole (such as cutouts, switches, or transformers), then the pole clearing is still required. In the non-fire areas, both the Siemens exempt arresters and other non-exempt arresters can be used. Refer to the *Power Line Fire Prevention Field Guide* for the list of exempt and non-exempt equipment. Note that the current version of the document is dated November 2008 and does not contain all exempt equipment such as the Siemens arresters. The Siemens arresters are constructed similarly to all other existing non-exempted arresters. The external connection wirings can be installed in the exact same way, or the currently coded mounting brackets can be used.
15. Unlike all the CAL FIRE non-exempt arresters listed in Table 1 on Page 4, the Siemens arrester does not have a GLD, which is used to provide visual indication of a blown arrester by dropping open, thus signaling a replacement is needed. Instead, the Siemens arrester uses a visible fault indicator to provide a visual indication of a blown arrester. Figure 8 and Figure 9 on Page 7 were taken at the June 4, 2014 testing conducted at ATS to satisfy the CAL FIRE exemption requirements. These are included to assist field personnel in determining what to look for in a blown Siemens arrester. The ATS testing demonstrated the electrical separation of the arrester from ground whenever a fault indicator targets (by physically drops down approximately 2"). In addition, the Siemens arrester utilizes a unique and patented feature calls the Arc Protection System (APS) that extinguishes any arc that may develop from a blown arrester. This was demonstrated during the testing to the satisfaction of the CAL FIRE officials. The CAL FIRE exempt arrester must be equipped with both the APS and the visible fault indicator.

Material Requirements

16. Arresters shall be supplied for bracket mounting.
17. Arresters shall be equipped with connectors for attaching line and ground leads.
18. All arresters shall be furnished completely assembled.
19. All arresters shall be equipped with an automatic ground lead disconnect device.

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References	Location	Document
Cable Risers in Vertical Primary Construction		
Wood Pole Distribution Lines	FRO: Risers	015193B
Installation of Cable Risers on Wood Poles	OH: Risers/UG-1 Terminations	027742
Overhead Transformer Installation	OH: Transformers	056425
Conductors for Overhead Lines	OH: Conductors	059626
Installing Automatic Circuit Reclosers on		
Distribution Lines	OH: Switches	066199
Fire Responsibility and Urban Wildland Fire Areas	OH: General	072148
Estimating Equipment Installations for Fire Area Districts		TD-9100P-09
Non-Exempt Equipment Replacement Program		TD-2999B-027
Power Line Fire Prevention Field Guide		

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Table 1 CAL FIRE Non-Exempt Arresters ^{1,2} – Approved for Purchase

Circuit Voltage	Arrester		Application	Manufacturer and Catalog Number			Code	Figure Number
	Rating kV	Type Class		Joslyn	Ohio Brass	Tyco ³		
4 kV to and Including 12 kV	15	Distribution	Overhead Equipment	ZHP015-0000300	213713-5166	DAH-15C-E0D0B0-1	330053	Figure 1 on Page 6
		Riser-Pole	Riser	ZRP015-Y000300	221613-5165	DAR-15C-E0D0B0-1-081	330056	Figure 2 on Page 6
17 kV to and Including 21 kV	24	Distribution	Overhead Equipment	ZHP024-0000300	213720-5166	DAH-24F-E0D0B0-1	330054	Figure 3 on Page 6
		Riser-Pole	Riser	ZRP024-Y000300	221620-5165	DAR-24F-E0D0B0-1-081	330001	Figure 4 on Page 6

¹ All surge arresters will automatically disconnect the ground lead in the event of an internal failure (see Note 11).

² All surge arresters are non-porcelain type.

³ Tyco no longer supplies any distribution arrester equipment.

Table 2 “ELL” Brackets – Approved for Purchase

Manufacturer	Catalog Number	Code
Kortick	K-8384	180166
Joslyn	J-26256	180166
Chance	T2060439	180166

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Table 3 CAL FIRE Exempt Arresters ¹ – Approved for Purchase

Circuit Voltage	Arrester		Application	Manufacturer and Catalog Number	Code	Figure Number
	Rating kV	Type Class		Siemens		
4 kV to and Including 12 kV	15	Distribution	Overhead Equipment or Riser	3EK4 150-1AF4-ZQ99N11	330300	Figure 8 on Page 7
17 kV to and Including 21 kV	24	Distribution	Overhead Equipment or Riser	3EK4 240-1AK4-ZQ99N11	330301	Figure 9 on Page 7

¹ The exempt arresters will automatically disconnect from ground in the event of an internal failure using a different mechanism than the traditional GLD. See Note 15.

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Surge Arresters and Brackets



Ground Lead Disconnecter (black in color)

Figure 1
15 kV Distribution-Class Arrester
Non-Porcelain, MOV Type
(Joslyn)



Ground Lead Disconnecter (yellow in color)

Figure 2
15 kV Riser-Pole Arrester
Non-Porcelain, MOV Type
(Joslyn)



Ground Lead Disconnecter (black in color)

Figure 3
24 kV Distribution-Class Arrester
Non-Porcelain, MOV Type
(Ohio Brass)



Ground Lead Disconnecter (yellow in color)

Figure 4
24 kV Riser-Pole Arrester
Non-Porcelain, MOV Type
(Ohio Brass)

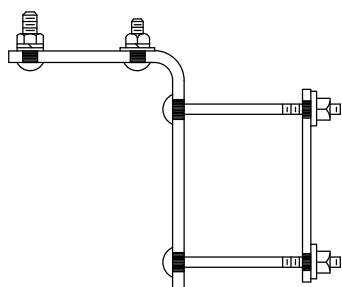


Figure 5

Crossarm Bracket

Type B, EEI Spec. TDJ-19 (Code 180081)

See [Document 015190](#) for Detail and Dimensions

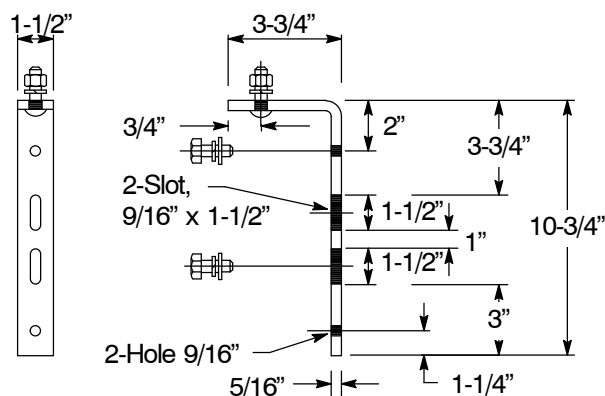


Figure 6

"ELL" Bracket (Code 180166)

Note

- "ELL" bracket (Figure 6) includes one 1/2" x 1-1/2" captive carriage bolt, lockwasher, and nut; two 1/2" - 13 x 1" length stainless steel cap screws; two 1/2" flat washers and two 1/2" lockwashers. Hardware, except capscrews, shall be galvanized in accordance with [ASTM A153](#).

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Arrester Locations

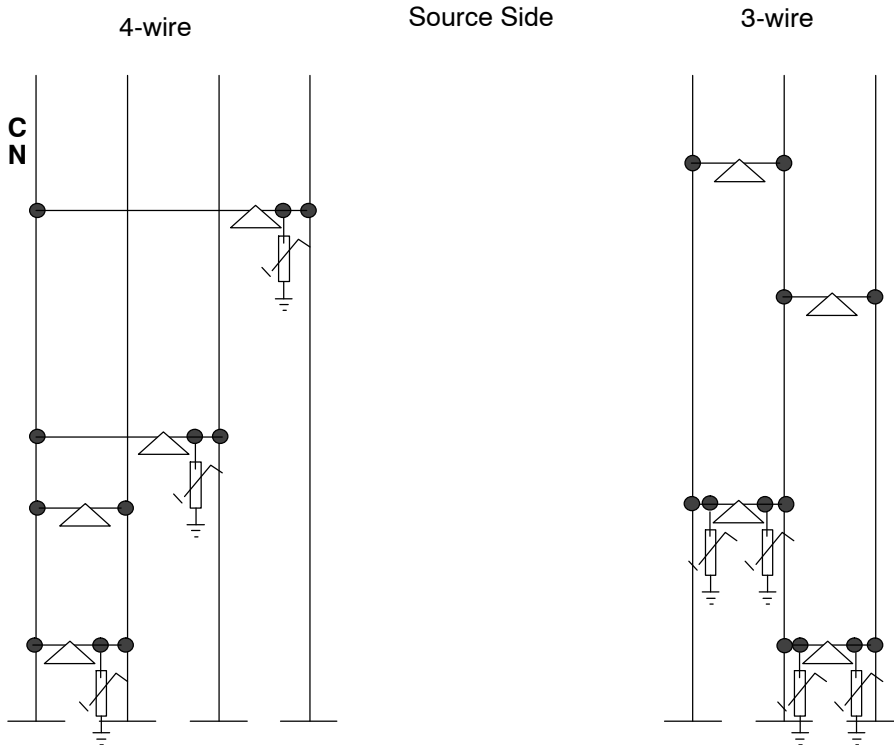


Figure 7
Example of Arrester Locations at End of Line or Open Points
(see Note 5B on Page 1)



Figure 8
Testing of Siemens 15 kV Arrester



Figure 9
Testing of Siemens 24 kV Arrester

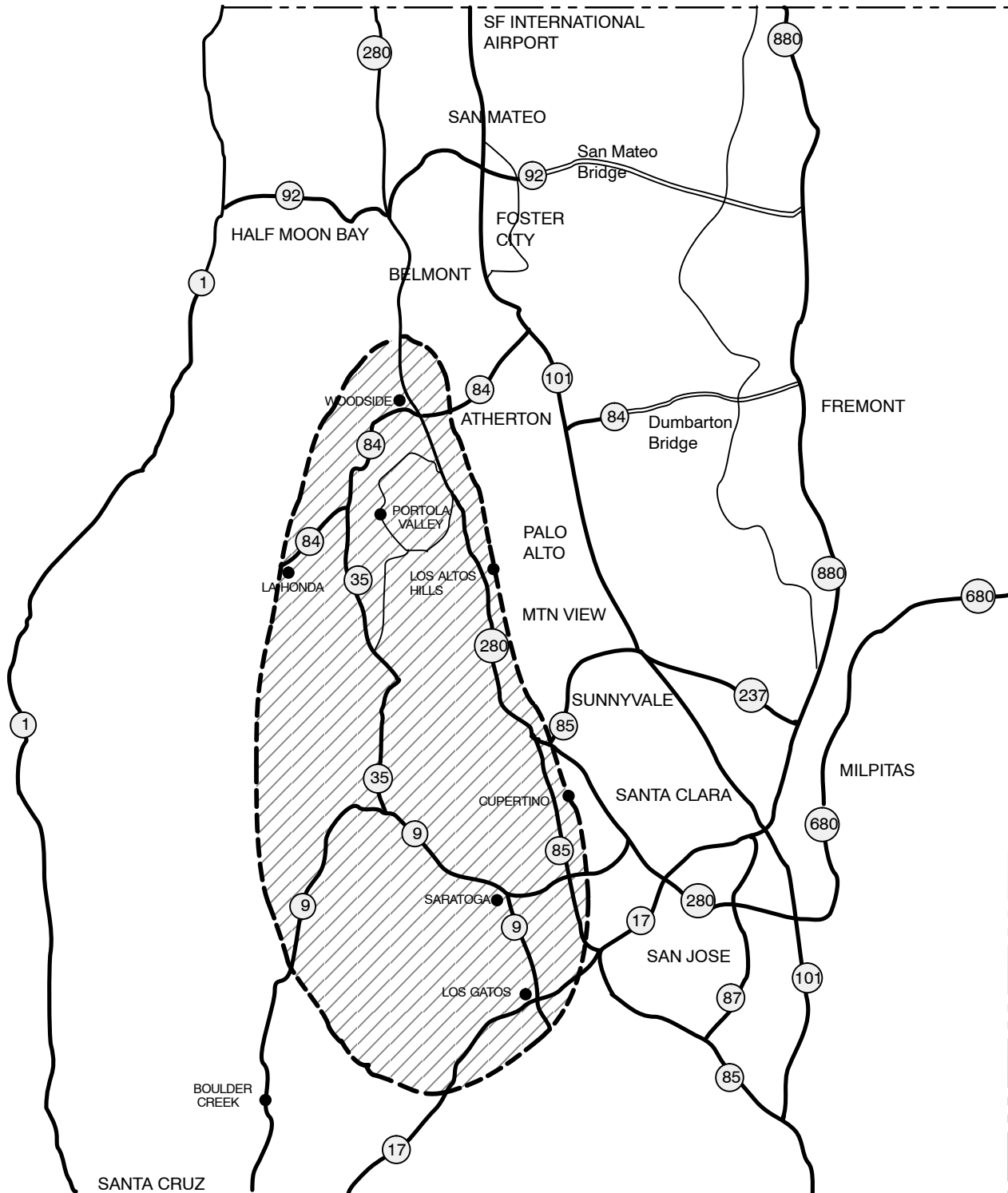
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Surge Protection Districts (continued)



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Surge Protection Districts (continued)



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Revision Notes

Revision 17 has the following changes:

1. Revised Note 3 on Page 1, and Notes 13, 14 and 15 on Page 2.
2. Revised Table 1 on Page 4.
3. Added Table 3 on Page 5.
4. Revised Figure 1 through Figure 4 on Page 6.
5. Added Figure 8 and Figure 9 on Page 7.