

# High Voltage Surge Arresters

## Buyer's Guide — Section Transmission Line Arrester PEXLINK

# Transmission line arresters PEXLINK

## The concept

Both large and small public/private utility owners of transmission systems face a sharpened competitive situation which demands increased availability and reliability of the systems. Consumers have become more demanding as their processes are dependent on constant and reliable energy supply of good quality.



In many countries, it has also been increasingly difficult to obtain permission to build new lines of normal dimensions. Hence, new lines under construction may mostly be "compact-insulation" lines. This, in turn, requires optimal control of overvoltages caused by lightning or switching events. Surge arresters installed along the line or at a few selected critical towers, in this case, may be an attractive solution or a complement to other means.

Improvement in the reliability and availability of a transmission system can be obtained in one or more of the following ways:

### 1. Duplication of the system (more than one line)

This is a very expensive method and often impractical.

### 2. Increased insulation withstand.

It can both be expensive and create other problems such as the need for increased insulation of station equipment.

### 3. Improved footing impedance

Often difficult and expensive, specially in hilly terrain.

### 4. Shield wires

If the provision was not in the original tower design, it can be expensive to retrofit such shielding. It helps eliminate a large number of interruptions but it is not enough to obtain the now-demanded degree of reliability.

### 5. Protection of line insulation by surge arresters

Surge arresters connected in parallel with them at selected towers. In this application usually the term line arresters is used. Protection using polymer-housed arresters (ABB type PEXLIM) along with additional accessories for fixing the arresters across the insulators and providing automatic disconnection of the arresters in the event of their being overstressed is called the PEXLINK concept. This method is simple, cost-effective and, in many cases, an attractive alternative to the methods mentioned above.

### More information on internet

Visit [www.abb.com/arrestersonline](http://www.abb.com/arrestersonline) for viewing the PEXLINK video.

# PEXLINK

## ABB's protection philosophy

ABB's philosophy is to provide protection for line insulation at selected locations by using standard available components. The main item is the gapless silicone polymer-housed arrester, PEXLIM, with metal-oxide (MO) active elements. Such arresters have been used for many years for protection of equipment in substations and hence their protective performance is well-known.



Transmission line arresters, including line discharge class 3 PEXLIM Q arresters and disconnecting devices on earth leads, erected on ESKOM 300 kV system in South Africa.

The low weight permits installation on existing structures and the polymer housing gives increased safety of the line equipment as well as people and animals which may be in the vicinity of the lines during overstress conditions.

With regard to lightning energy, line arresters are exposed to more severe conditions than arresters placed in substations. The latter are benefited by the reduction of surge steepness due to line corona effect and reduction in surge amplitude as the lightning current finds parallel paths through shielding wires, flashover and parallel lines. Thus, it is necessary to ensure that the MO blocks of the TLA are not under-dimensioned from energy and current point-of-view. A computer program is used to determine the optimum number of locations (generally where the footing impedance is high) and to calculate the arrester stresses at each of the chosen locations.

The design permits installation using standard transmission-line hardware normally available locally. The design also permits mounting at different angles based on tower geometry and conductor spacing.

If very high availability is desired, a very large number of locations may have to be protected, mainly due to the unpredictable nature of lightning. In such a case it may not be economically justified to select arresters with "sufficient energy capability" and instead a higher failure rate may be acceptable.

To ensure quick, safe, automatic and controlled disconnection of a failed arrester, ABB uses a special disconnecting device with a suitable link, often in the earthing circuit of the arresters.

The earth lead is designed to withstand the short-circuit currents and the disconnecting device is tested to ensure no false operations. Thus, at a failure, the tripped line does not have to be locked-out and attended to immediately.

By moulding the silicone polymer housing on the active MO elements directly, internal atmosphere is eliminated and with it the risk of ingress of moisture which in the past has been established as the major cause of arrester failures in service.

# PEXLINK

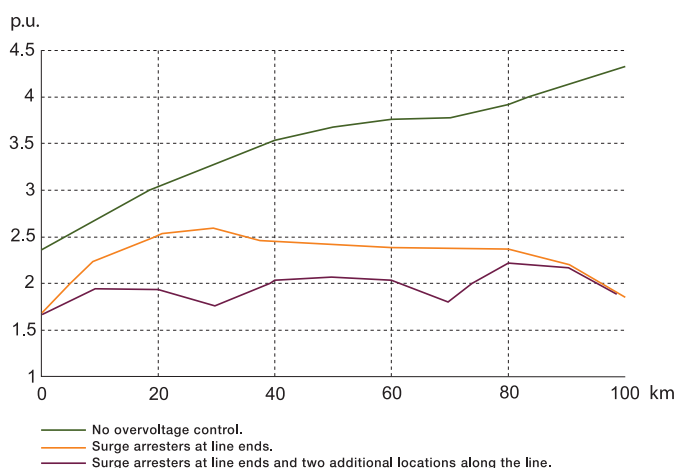
## Application

### Increased line availability

By locating the PEXLINK on sections of lines with high footing impedance towers and one additional low footing-impedance tower at each end of the section, PEXLINK protects existing shielded and non-shielded lines from abnormal lightning surges (frequent or high amplitudes) and reduces the outages.

The reduced outages are beneficial also indirectly in that sensitive equipment is not damaged and the circuit breakers overhaul interval can be increased. Thus, total maintenance costs are also reduced.

This protection may be used for all system voltages where the stated abnormal conditions exist. Arresters with moderate energy capability are often sufficient. However, the high-current capability must be large and distribution-type arresters may not be suitable.



The diagram shows overvoltages phase-ground generated by three-phase reclosing of 550 kV, 200 km transmission line with a previous ground fault. For long EHV lines pre-insertion resistors traditionally are used to limit switching overvoltages. Surge arresters, as a robust and efficient alternative, could be located at line ends and along the line at selected points.

### Switching overvoltage control

For long EHV lines, surge arresters usually are located at line-ends. In addition, by locating arresters at one or more points along the line e.g. at midpoint or 1/3 and 2/3 line length switching surge overvoltages and thus line insulation requirements could be limited without using preinsertion resistors. Arresters used for this type of application should be designed for high energy capability. Usually a class 2 or 3 arrester will be sufficient out on the line but higher arrester classes may be necessary at the receiving end of the line.

### Compact-insulation lines

Arresters placed in parallel with line insulators permit a large degree of compacting of a transmission line with lower right-of-way costs as a result.

### Line upgrading

The existing insulation level of a line, when suitably protected by arresters, may be upgraded for service at a higher system voltage leading to greater power transfer without much additional capital cost.

### Extended station protection

By locating arresters on towers near a substation, the risk of backflashovers near the station is eliminated. This results in reduction of steepness and amplitude of incoming travelling waves, thus improving the protection performance of station arresters and eliminating the need for additional expensive metal-enclosed arresters even for large GIS.

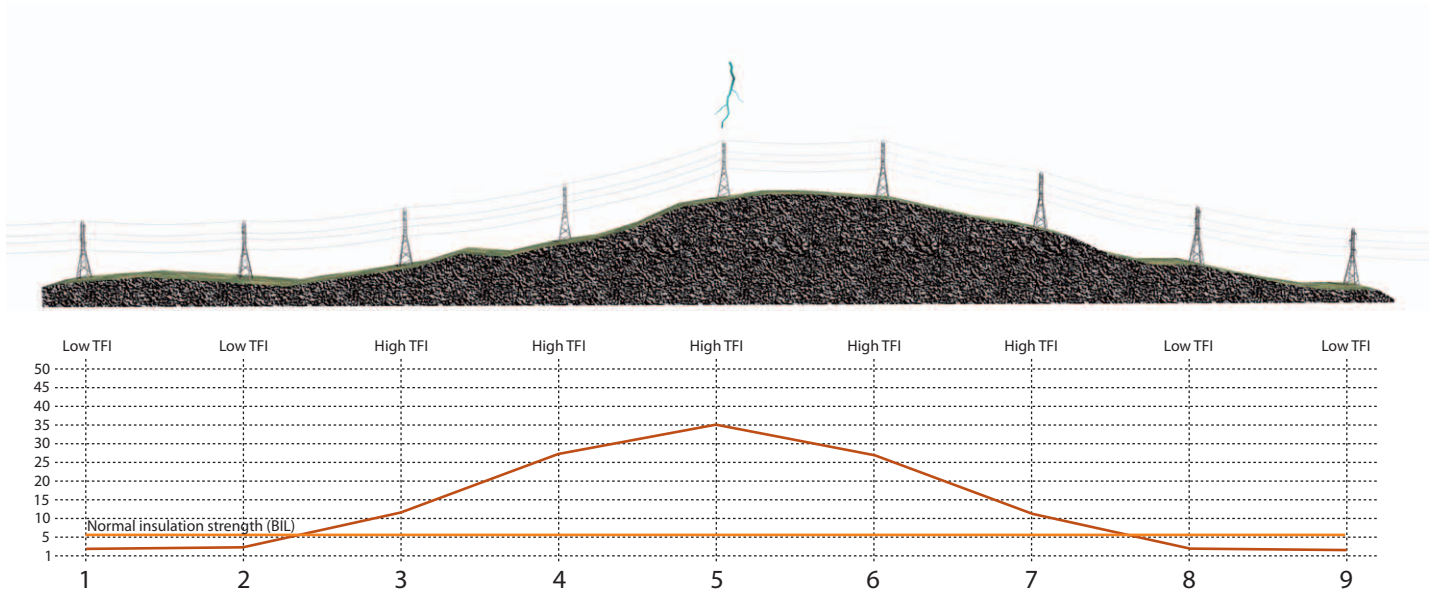
### Substitute for shield wires

In cases where provision of shield wires is not practical physically or is very expensive, e.g. very long spans, very high towers etc, arresters are a good and economical substitute.

Arresters located in all phases on each tower eliminate the need for both shield wires and good footing impedance and may be economically justified in cases where the cost of reduction in footing impedance and the cost of overhead shield wire are very high.

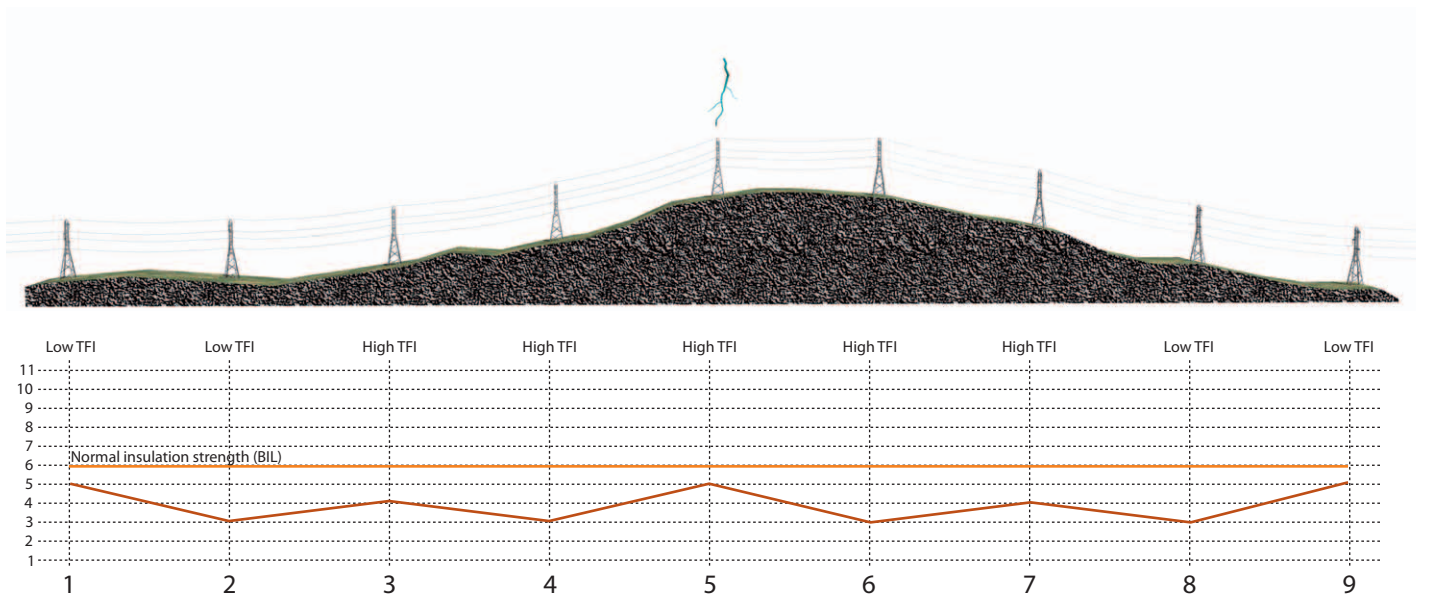
# PEXLINK

## Application



**No arresters at all. Lightning stroke to tower number 5**

Very high risk for flashover due to high TFI (Tower Footing Impedance) with an earth fault followed by a circuit breaker operation as a consequence.



**Arresters in all 9 towers. Lightning stroke to tower number 5**

The overvoltage profile is well below the BIL of the system all along the section. An ideal protection is obtained.

# PEXLINK

## Features

### Standard components

The suspension of the arresters is simplified and standard clamps and similar hardware normally available may be used for this purpose. This leads to overall economy for the user.

Arrester type	Lightning discharge capability as per IEC 60099-4 Annex N	
	Energy	Charge
PEXLIM R	2.5 kJ/kV ( $U_r$ )*	1.0 As **
PEXLIM Q	4.0 kJ/kV ( $U_r$ )*	1.8 As **
PEXLIM P	7.0 kJ/kV ( $U_r$ )*	2.8 As **

\*  $U_r$  = Rated voltage  
 \*\* As = Ampere second

A few examples can be seen in the figures for "Some erection alternatives" on next page.

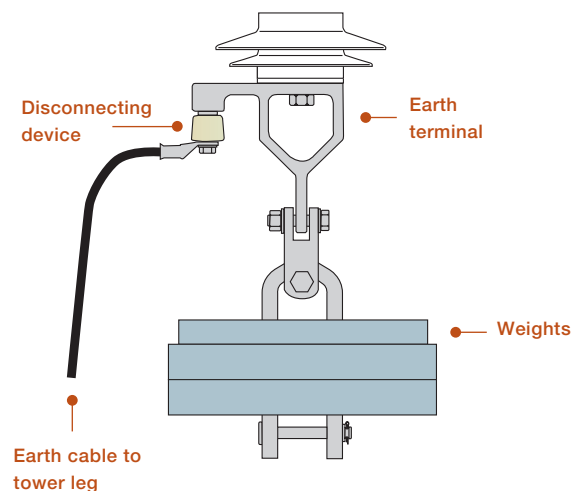
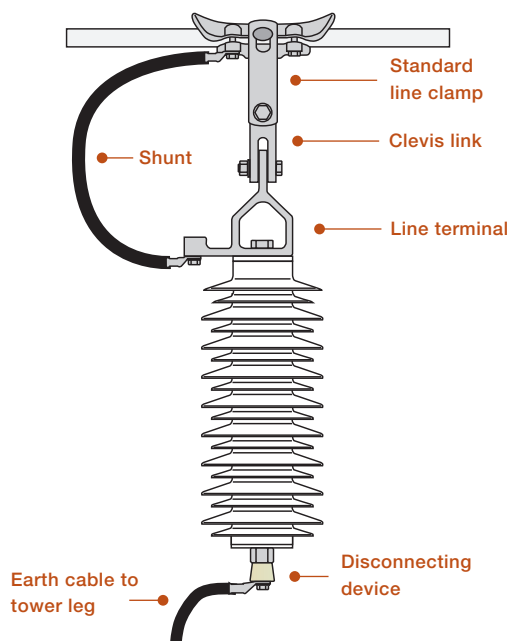
The disconnecting device is carefully chosen to perform its function only at the failure of the arrester.

The separation of the disconnecter is quick and effective and the method of connection advised by ABB in each particular case ensures that neither the disconnected wire nor the damaged arrester lead to any interference with other live parts. Thus, after a failure, the line can be re-charged without attending to it immediately.

The disconnection is easily visible from the ground and thus locating it is simple for the maintenance crew.

### Easy to install

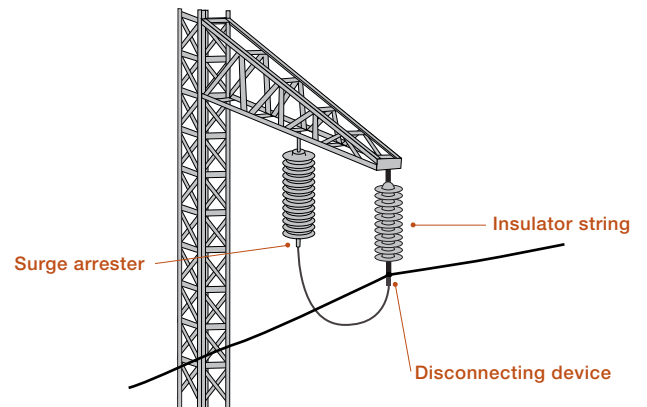
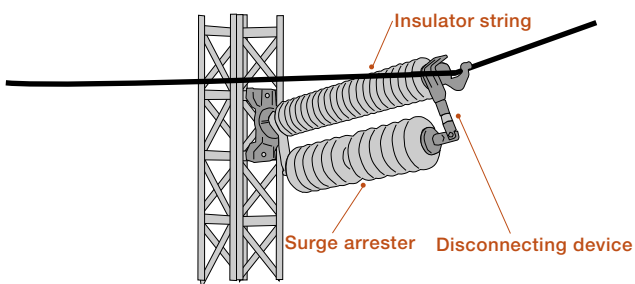
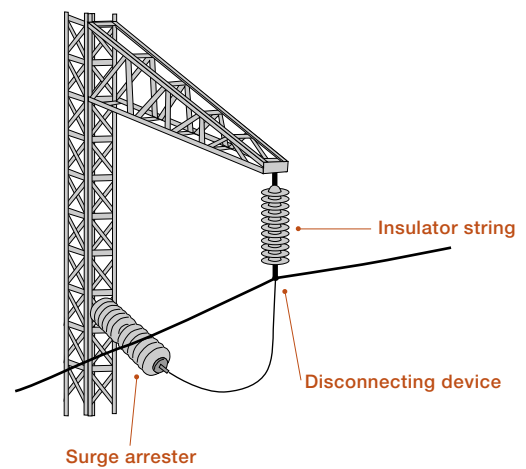
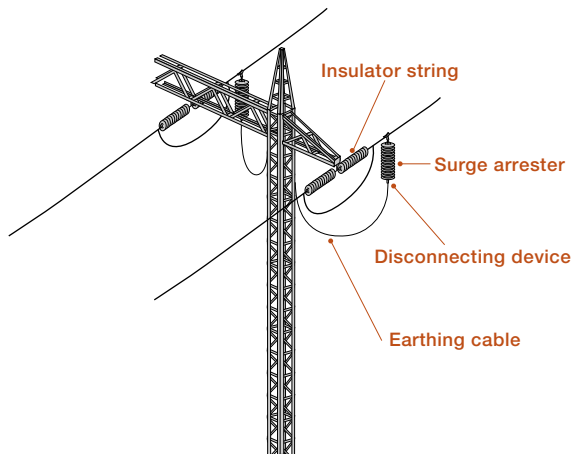
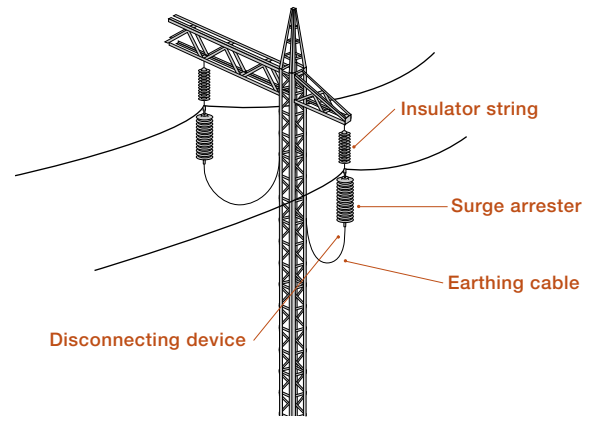
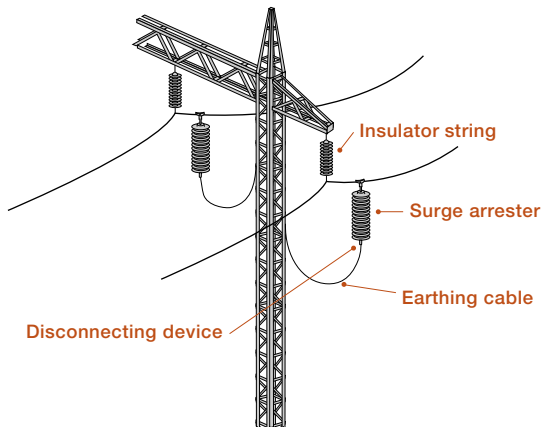
The PEXLIM arresters are built-up of optimum-length modules and hence can be easily designed for use on various voltages. They are light and hence easily transported up the towers.



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## Some erection alternatives

Different arrangements showing how easy it is to install the PEXLINK concept in towers of different design.



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