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Selection of Sheath Voltage Limiter for Mixed Overhead-Underground Cable in 220 kV Transmission Lines

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Abstract

This paper presents the most common methods of sheath bonding of transmission cables and the calculation of parameters, including rated voltage and energy absorption, of sheath voltage limiters for a mixed overhead-underground 220 kV transmission lines. The dependence of sheath voltage limiters parameters on the sheath types, system parameters such as the short-circuit capacity, the cable length, lightning current amplitudes, grounding resistance and cable installation are calculated in details. In this research, several methods in selecting sheath bonding types as well as sheath voltage limiters for a given set of conditions in mixed overhead-cable 220 kV transmission lines are proposed. The cross bonding permits to choose SVLs with the lowest rating voltage. However, the grounding resistance value of the tower at the junction between overhead lines and cables must be maintained at or below 3 Ω. The surrounding environment of cables changes, the required parameters of SVL to be selected must be recalculated to take the cable installation into account.

Keywords: Sheath Voltage Limiter, sheath voltage, sheath interruption voltage, energy absorption, lightning overvoltage, mixed line, EMTP-ATP.

1. Introduction

The power transmission lines with a mixed configuration of overhead lines and underground cables has become increasingly present in modern power systems thanks to the urbanization and the load pocket development. Insulation failure of the cable due to lightning stroke in a mixed configuration is more likely to happen than in the fully underground configuration because the overhead line portion of the mixed configuration exposes to lightning events [1,2]. In addition to installing line arresters (LA) to protect the main insulation sheath voltage limiters (SVL) have to be used to limit the voltage of cable sheaths during transient voltage conditions. The selection of SVLs in transmission lines with a mixed configuration is fundamentally different from that of fully underground cables because one must take into account lightning parameters and the grounding resistance of the tower.

To protect against overvoltage of cable insulation, two types of equipment should be distinguished:

- The first one is the normal surge arrester (SA) for the main insulation of the cable, which is connected between the phase conductor and the ground at the junction between the overhead line and the underground cable. SAs used for this purpose must satisfy temporary overvoltage (TOV) and dissipation energy requirements corresponding to the cables [3]. The insulation withstand level of the cable is typically 20% or greater of the SA operating voltage [4]. The SA characteristics of this type depend on the tower footing resistance [4], the cable capacitance, the resonance phenomena [3]... The characteristics of this SA lie between the SA used for substations and that of overhead line.
- The second type SA that protects the sheath insulation, also known as the Sheath Voltage Limiters (SVLs). SVLs are used to protect the cable sheath insulation from overvoltage induced by the current flowing in the cable core [5]. Therefore, their duties are much smaller than that of the first type and they are usually pre-built inside link boxes.

The following criteria must be addressed when selecting an SVL:

- The maximum continuous operating voltage (MCOV) of the SVL depends on the method of shield bonding, i.e., single-point bonding, cross bonding or a combination of both. The values of grounding resistance grounding [6] and the installation environment of the cable [5] also dictate how SVLs should be selected.
- The SVL is sized to protect shield insulators and cable jackets from flashover caused by transient overvoltage (lightning, switching and faults) [7]. However, the energy capability of SVL may not be enough to handle the voltages during power

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fault [8]. Since the maximum induced voltage on the shield during faults depends on the method of bonding, which corresponds to the phase-to-ground fault (1LG) for the single-point bonding and three phase to ground fault (3LG) for the cross bonding, the required absorption energy of SVL needs to be calculated accordingly for each type of bonding.

- Since SVLs are also designed to protect the sectionalizing insulation between minor sections (sheath interruption) as shown in Fig. 1, they can be star or delta connected. In the star connected configuration, the common point can be isolated from the ground if the grounding resistance is greater than 0.2 Ω [8].

Because of the complexity in calculating the voltage on the cable sheath, criteria for choosing right SVLs are still unclear for transmission cables, including fully underground cables. IEC 60099-5 [9], IEEE 575-2014 [7] and CIGRE 07-SC 21 [8] only suggest selecting SVLs rated at voltages which are greater than the maximum transient voltage appearing on the cable sheath during power faults. SVLs in transmission cables always use the distribution arresters which means that the rated voltages of SVLs can vary in a relatively wide range. IEEE 575-2014 [7] and CIGRE 283 [10] also suggest that reducing the rated voltage of the SVL results in increasing absorption energy of SVLs. Incorrect sizing SVLs would lead to serious consequences for the reliability of transmission lines [11]. Thus, appropriate SVLs are a compromise between the maximum voltage that the cable sheath insulation can tolerate and the maximum dissipation energy that SVLs can absorb without being destroyed.

In this paper, overvoltages on cable sheaths due to lightning and power faults in a mixed cable-overhead line are calculated with different methods of sheath bonding, the effect of SVL connection configuration and short-circuit power of the system in which the cable under study is connected to the sizing process of SVLs are also studied.

2. Cable Sheath Grounding Methods

Depending on the operating conditions and the cable construction, the sheath can be bonded by one or a combination of the following methods.

2.1. Solid Bonding

The cable sheath is connected directly to earth at both ends of each cable segment as shown in Fig. 2. In this bonding technique, the voltage across the sheath is maintained at the ground potential but lossess associated with the permanent induced current flowing can significantly decease the cable ampacity [12]. Therefore, this bonding arrangement is only used for short length transmission cables or distribution cables [6].

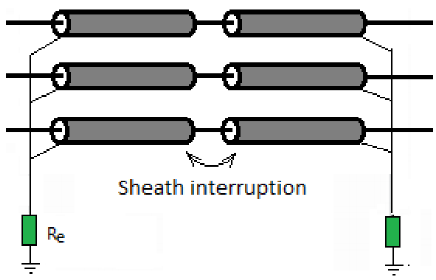


Fig. 1. Single point bonding

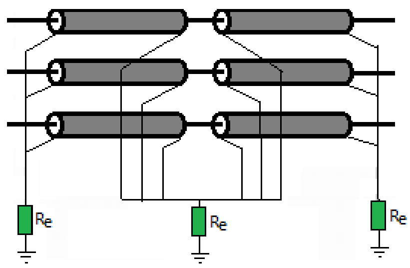


Fig. 2. Solid bonding

2.2. Single-Point Bonding

In this method the sheath is grounded at only one common point as shown in Fig 3 and Fig 4. In this type of bonding, the induced current in the sheath is eliminated and there is no loss in the sheath regardless of the loading current [12]. However, the standing voltage on the sheath of each phase is proportional to the distance from the grounding point and the loading current as follows [7]:

$$E_a = j\omega.I_a.2.10^{-7}(-\frac{1}{2}\ln\frac{2}{d}\frac{S_{ab}^2}{S_{ac}} + j\frac{\sqrt{3}}{2}\ln\frac{2S_{ac}}{d}) \quad (1)$$

$$E_b = j\omega.I_b.2.10^{-7}(\frac{1}{2}\ln\frac{4S_{ab}^2.S_{bc}}{d^2} + j\frac{\sqrt{3}}{2}\ln\frac{S_{bc}}{S_{ab}}) \quad (2)$$

$$E_c = j\omega.I_c.2.10^{-7}(-\frac{1}{2}\ln\frac{2}{d}\frac{S_{bc}^2}{S_{ac}} + j\frac{\sqrt{3}}{2}\ln\frac{2S_{ac}}{d}) \quad (3)$$

where d is the geometric mean shield/sheath diameter; S_{ab},S_{bc},S_{ac} is the axial spacing of phase; I_a, I_b, I_c are are the conductor current in each phase

For this bonding method, the voltage at the open end of the sheath can reach a very large value if any abnormal currents associated with transient phenomena in the cable core, including lightning, switching and short circuit events. Therefore, the open end of the cable sheath must be protected by SVL (Fig. 3 and Fig. 4). Furthermore, the sheath interruption insulation also needs to be protected by SVLs as shown in Fig. 3. This type of bonding is usually utilized in short length cables where the cross bonding is not possible, such as river crossing cables or the remaining section of crossbonded cables.

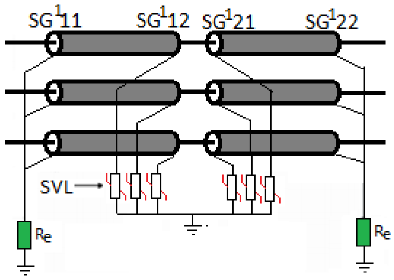


Fig. 3. Single-point bonding (2 sections) with SVL at the mid-cable (Type 1)

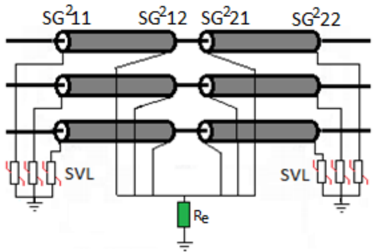


Fig.4. Single-point bonding (2 sections) with SVL at both ends (Type 2)

2.3. Cross Bonding

By cross-bonding or connecting the sheath of phase A to phase B, phase B to phase C and phase C to phase A at each minor section as in Fig. 5, the standing voltage in the sheath is the sum of all three standing voltages in (1),(2) and (3):

$$U_{standing}=E_a+E_b+E_c \tag{4}$$

For a trefoil formation, $S_{ab}=S_{bc}=S_{ca}$ or $U_{standing}=0$.

In practice the cables are laid not only in trefoil formation but vertical or horizontal formations which results in $U_{standing}$ not completely zero. However, E_a, E_b and E_c still cancel out each other to bring $U_{standing}$ in (4) to a negligible value. The circulating current and its associate losses are therefore almost zero in cross bonded cables.

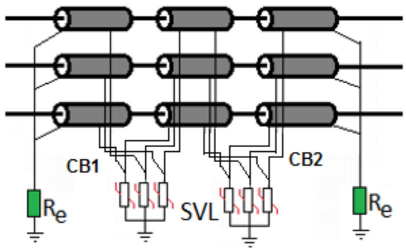


Fig. 5. Cross bonding (3 minor sections) with SVL in star connected

This method combines the advantages of both sheath join methods described in sections 2.1 and 2.2. In this case, the induced sheath voltage is almost eliminated in balanced load operations (Fig. 5). The voltage across each sheath is the sum of the induced voltages from the three cable cores with a phase difference of 120° in balanced loads. On the other hand, the sheath of all 3 phases is completely isolated from the ground, which results in zero induced current flowing on the sheath. However, overvoltage due to lightning or switching at the sheath interruption can be very high and SVLs are still needed to protect the sheath interruption insulation. SVLs can be triangle or star connected as shown in Fig. 5. In this bonding, the number of minor sections of the circuit must be divisible by three. For a lengthy circuit, remaining minor sections which are not included in the crossed bonding can be either single bonded or solidly bonded as described in section 2.1 and 2.2.

3. Simulation Models

A 220 kV double-circuit with a mixed configuration of 15 km was used for the simulation (Fig. 6). The cables and overhead lines are typically used in 220 kV transmission line in the Vietnam [5]. Generally, the footing resistance of the tower (R_f) is maintained at 10 Ω or lower. The grounding resistance of the tower at the junction between the overhead line and the cables is connected to the cable sheath (R_e) with the values ranging from 1 Ω to 10 Ω.

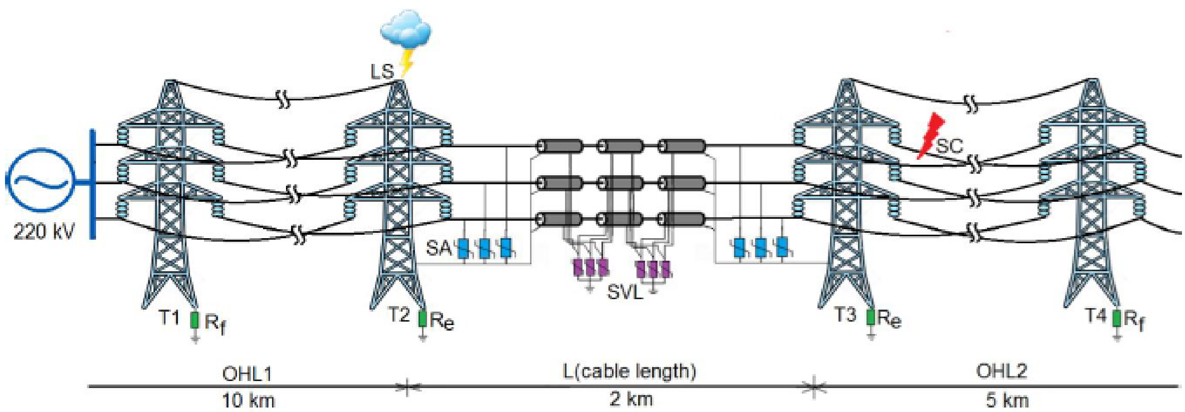


Fig. 6. Mixed overhead-underground 220 kV transmision line to be studied

The underground cable segment consists of 6 single cables (3 single cables per circuit), is arranged in a flat formation as shown in Fig. 7. The interphase distance between phase is 2 m. The main insulation of the cable is protected by a 220 kV SA as shown in Fig. 6. Since the phase conductors of 220 kV overhead lines in Vietnam are mainly of type ACSR 330, 450 or 500 rated 945 A, maximum, of the normal operation current of 1000 A was used to calculate the value of the standing voltage on the sheath for single-point bonding.

By using (2) with $S = 2$ m and the loading current $I = 1000$ A, each minor section must not exceed 1.1 km for the single-point cables to limit the standing voltage at 250 V. A 2 km cable segment can be divided into 2 minor sections for single-point bonding as illustrated in Fig. 3 and Fig. 4, or 3 minor sections for cross bonding (Fig. 5).

The short-circuit current in the cable core depends on the short-circuit capacity of the system and the fault position. For the sake of simplicity, we assume that the short-circuit current does not exceed the rated current of the 220 kV circuit breaker (CB). The 220 kV transmission lines in Vietnam mainly use SF6 circuit breakers rated from 10 kA to 50 kA, which are the short circuit currents used in this paper.

4. Simulation Results

4.1. Criteria for Selecting SVL Rated Voltage

4.1.1. Short circuit capacity

As described in section 1, the rated voltage of the SVL must be greater than the temporary overvoltage (TOV) on the cable sheath during a power fault [8-10] to prevent the SVL from dissipating energy associated with TOV. To determine the temporary overvoltage on the cable sheath, we calculate the voltage on the sheath for different short-circuit capacities. The source (on the left side of Fig. 6) has a short-circuit capacity varying from 4000 MVA to 20000 MVA, which are equivalent to the rated breaking current from 10 kA to 50 kA of 220 kV circuit breakers. For the flat formation, the single-point bonding cable has the maximum induced sheath voltage during a phase to ground (1LG) fault. In the cross-bonding scheme, the induced sheath voltage is the highest for a 3-phase to ground fault (3LG) for cable circuits in flat formation circuit [7]. Therefore, the selection of SVLs against power fault was made by comparing the highest induced sheath voltage resulted from 1 LG fault and 3LG fault single-point bonding. The fault is assumed to occur at the point SC of the overhead line, a distance of 0.2 km from the tower T3. In order to achieve the maximum fault current, the fault is assumed to occur when the phase voltage reaches its peak and last for 5 cycles, which is equivalent to the tripping time of the circuit breaker.

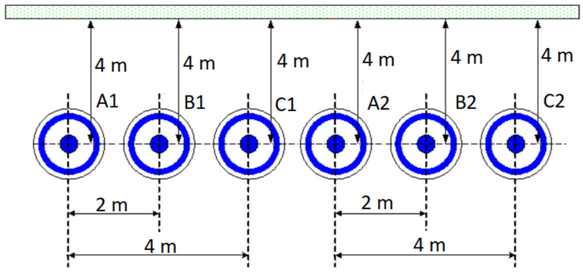
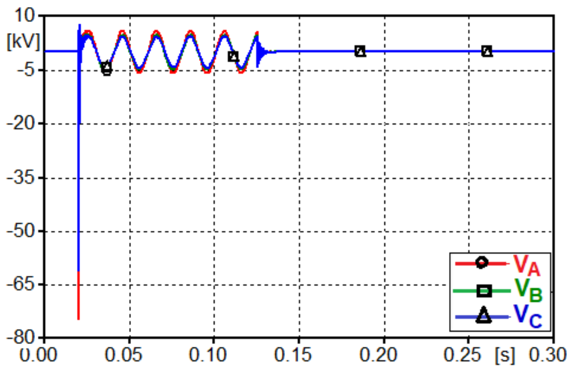
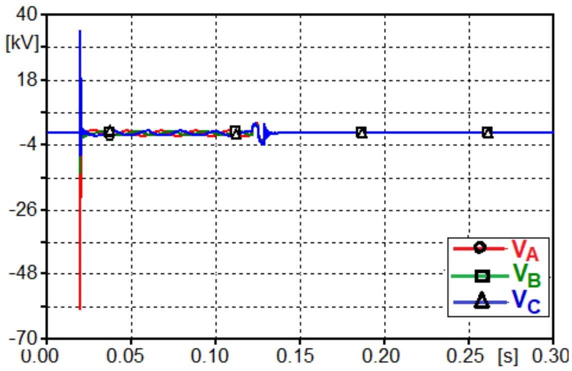


Fig. 7. Underground cable with flat formation



(a)



(b)

Fig. 8. Sheath induced voltage for a short circuit capacity 4000 MVA. (a) Sheath voltage at the location $SG^1 12$ with single-point bonding, $R_e = 4\ \Omega$, (b) Sheath voltage at the location $SG^1 12$ with cross bonding, $R_e = 4\ \Omega$

Fig. 8 shows the sheath induced voltage calculated with the short circuit current of 10 kA (4000 MVA of short circuit capacity) and the grounding resistance R_e of 4 Ω. The potential rise in the sheath due to the fault current is assumed to be negligible, the sheath voltage at the position $SG^1 12$ (for the single-point bonding scheme) for 1LG fault single-point bonding is shown in Fig. 8a. In this calculation, a transient voltage peaked at 74.6 kV gradually decreases to the standing voltage of 6 kV on the sheath, which is resulted from the fault current of 10 kA in the core. After 5 cycles, the breaker tripped and the sheath induced voltage was brought to zero. Obviously, the SVLs rated at 6 kV would operate with fault currents equal or greater than 10 kA in the cable core. Since SVLs are not designed to dissipate the energy associated with power faults, SVLs with rating voltage higher than 6 kV should be selected for the fault current of 10 kA. When the cross bonding is used, the "standing" dramatically decreases to 1 kV with the same short circuit current (10 kA) as shown in Fig. 8b. Therefore, the SVLs rated at voltage of 3 kV are safely used for the crossbonding scheme.

Changing the system short-circuit capacity from 4000 MVA to 20000 MVA, the resulting "standing" voltages increase almost linearly as shown in Fig. 9. Consequently, the rating voltage of SVLs to be selected must be increased accordingly. For the single-point bonding (Fig. 9), the cable connected to a source with short-circuit capacity of 4000 MVA requires SVLs with a minimum rated voltage of 7.5 kV type. The cross bonded cables, however, only need SVLs rated at 6kV for the short-circuit capacity up to 20000 MVA.

4.1.2. Minor section length

For the short circuit capacity of 4000 MVA, the "standing" voltage dependence on the minor section length is shown in Fig. 10. For cables with single-point bonding, it is clear that SVLs rated at 3 kV and 7.5 kV are good enough for the cable length less than 300 m and 1 km, respectively single-point bonding. Changing to cross bonding substantially decreases the required rating voltage of SVLs to be selected compared to single point bonding at the same cable lengths, i.e., only 1.5 kV for 300 m and 3 kV for 1 km.

4.2. Lightning Overvoltage

Fig. 11 shows the sheath voltage for single-point bonding-type 2 (position $SG^2 12$) with a grounding resistance of 4 Ω, 7.5 kV SVL and a lightning current amplitude of 100 kA, form 1.2 /50 µs hitting the top of the tower (T2). In this case, flashover occurs on all three phases of the overhead line and results in a lightning current of 14.5 kA entering each cable. Since the sheath induced voltage is maximum on the phase A cable due to the cable flat formation, the sheath voltage in this section implies the induced voltage on the phase A. It is found that the sheath voltage is 43 kV, exceeding 40 kV, the basic lightning impulse insulation level (BIL) of 220 kV cable sheath [7].

Fig. 12 shows a voltage difference of 86.3 kV across the sheath interruption of phase A, which exceeds 80 kV limit of the sheath insulation BIL at 220 kV [8].

The energy dissipated by 7.5 kV SVL (Fig. 13) is approximately 1.2 kJ, which is much smaller than the typical absorption energy of distribution SAs [13] (~ 3.6 kJ/kV or 23 kJ for 7.5 kV SVL).

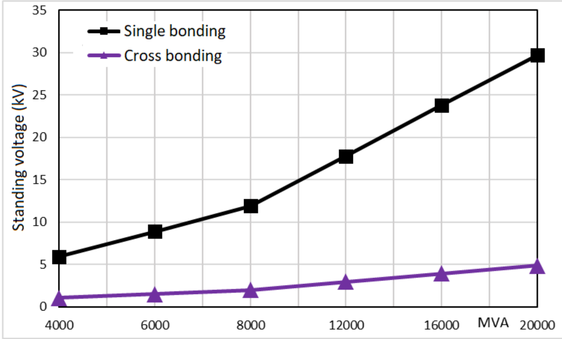


Fig. 9. Maximum "standing" sheath voltage as a function of the system short-circuit capacity

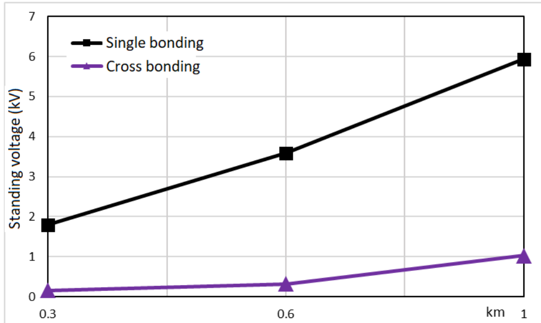


Fig. 10. "Standing" sheath voltage as a function of the minor section length with a short circuit capacity is 4000 MVA, R_e= 4 Ω

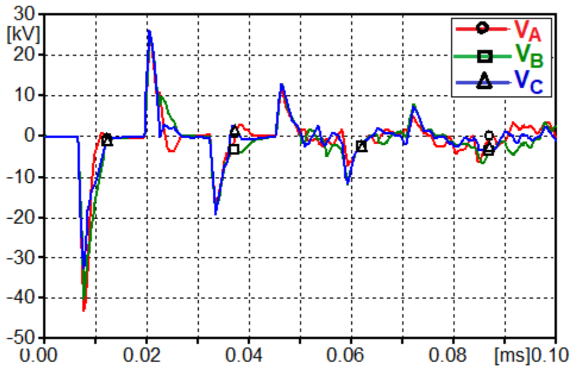


Fig. 11. Sheath voltage at the location $SG^2 12$ single-point bonding-type 2 with R_e= 4 Ω, using SVL 7.5 kV

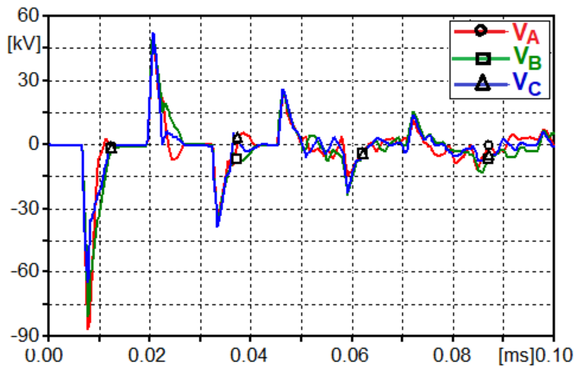


Fig. 12. Maximum interruption voltage at the location $SG^2 12$ and $SG^2 21$ single-point bonding-type 2 with R_e= 4 Ω, using SVL 7.5 kV

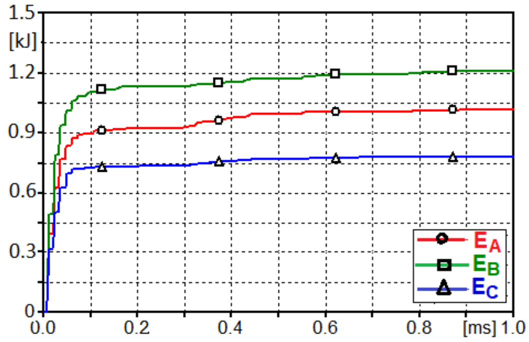


Fig. 13. Dissipation energy of 7.5 kV SVLs for single-point bonding-type 2 with R_e= 4 Ω

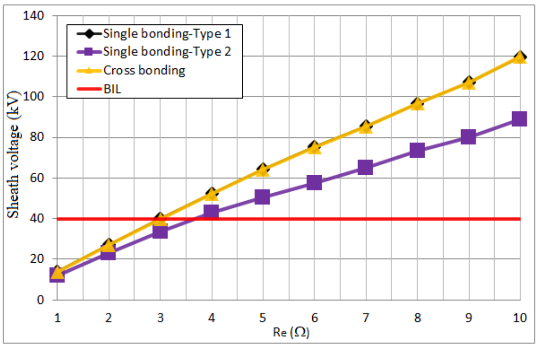


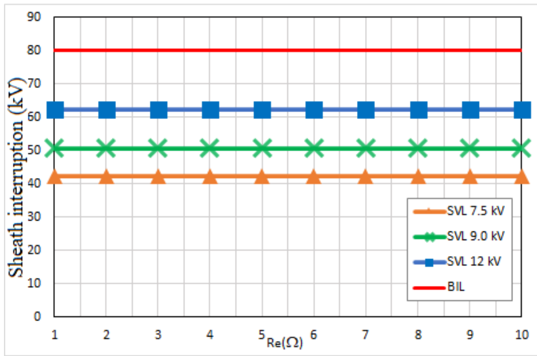
Fig. 14. Maximum sheath voltage as a function of the grounding resistance

4.2.1. Grounding resistance

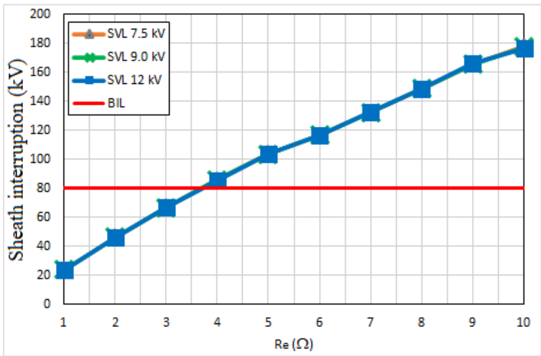
Fig. 14 shows the maximum voltage value on the sheath at the junction between the overhead line and the cable for all three types of bonding when using 7.5 kV SVLs with different grounding resistance values. It is found that the 7.5 kV SVL is not enough to protect the sheath insulation for grounding resistances of 3 Ω or more. This is straightforward because the lightning current flowing into the cable conductor via flashover increases with the grounding resistance values, which results in an increase of the sheath induced voltage. The simulation results show that the lightning current in the cable core of phase A increases from 11.2 kA to 16.8 kA when the grounding resistance of tower T2 is increased from 1 Ω to 10 Ω.

Fig. 15 shows the sheath interruption voltage with respect to different types of SVL. For single-point bonding- type 1, the sheath interruption voltage does not depend on the grounding resistance value but the rating voltage of SVLs. The sheath interruption voltage increased from 43 kV to 63 kV as the rated voltage of the SVL increased from 7.5 kV to 12 kV (Fig. 15a). An opposite trend was observed for single-point bonding- type 2 in which the sheath interruption voltage depends more on the grounding resistance than the SVL rated. The sheath interruption voltage exceeds 80 kV BIL limit when the grounding resistance is greater than 3 Ω (Fig. 15b). The cross bonding scheme combines the characteristics of both single-point bonding type 1 and type 2 in term of the dependence of the sheath interruption voltage on SVL rating voltage and grounding resistance (Fig. 15c). However, the absolute value sheath voltage and sheath interruption voltage in cross bonding are much less than the voltage limit in any given value of grounding resistance and SVL rating voltage.

The dissipation energy SVLs is always less than the typical absorption energy of distribution surge arresters for all types of bonding and the given range of grounding resistance (Fig. 16) In particular, the dissipation energy of SVLs cross bonding is nearly 6 times smaller than that of the single-point bonding counterpart for the same lightning current at any given grounding resistance.



(a)



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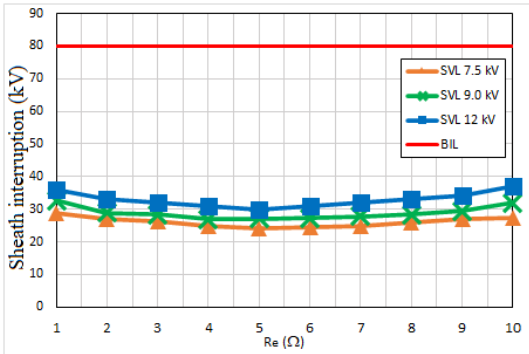
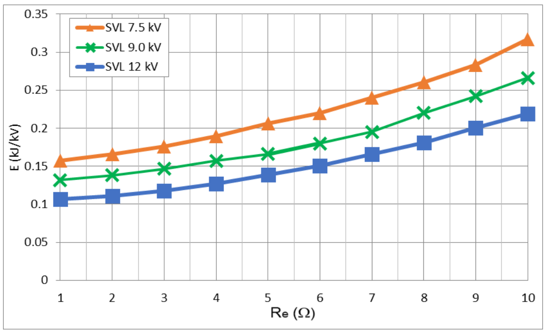
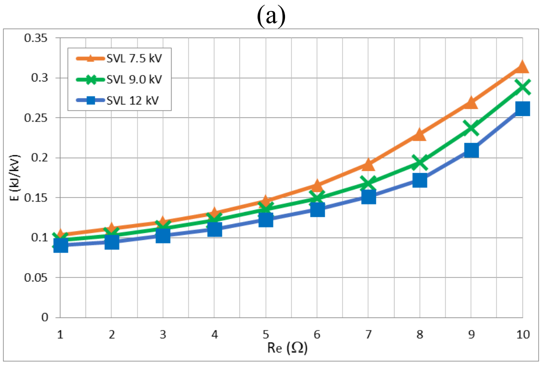


(c)

Fig. 15. Sheath interruption voltage as a function of the grounding resistance. (a) Single-point bonding-type 1, (b) Single-point bonding-type 2, (c) Cross bonding



(a)



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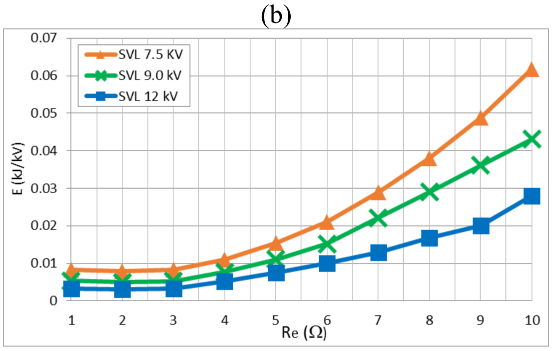


(c)

Fig. 16. Energy absorption of SVL according to the grounding resistance at different rated voltages. (a) Single-point bonding-type 1, (b) Single-point bonding-type 2, (c) Cross bonding

4.2.2. Amplitude of lightning current

As recommended by CIGRE SC 21 [14], the lightning current from 80 kA to 120 kA was used for calculating the sheath voltage with respect to the change of lightning current for a grounding resistance of 3 Ω (Fig. 17). For lightning currents above 100 kA, the 7.5 kV SVLs are not enough to protect the sheath insulation for in single-point bonding- type 1 or cross bonding for the grounding resistance of 3 Ω. The threshold lightning current from which 7.5 kV SVL no longer can protect the sheath is 113 kA for single-point bonding-type 2.

All SVLs are suitable for protecting the sheath interruption in single-point bonding-type 1 and cross bonding in the lightning current range (Fig. 18a and Fig. 18c). In single-point bonding-type 2, the voltage across the sheath interruption is greater than its withstand voltage for the lightning current exceeding 113 kA (Fig. 18b).

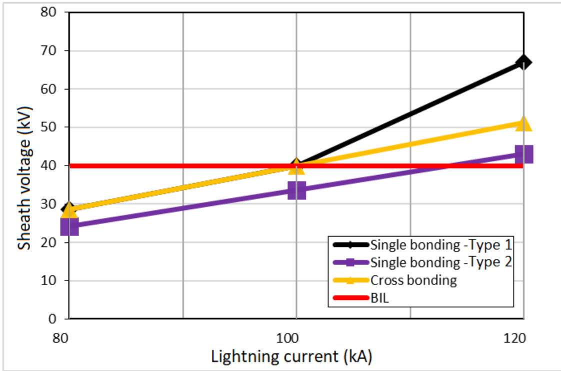
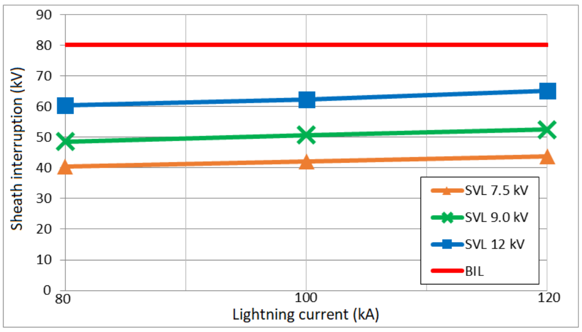
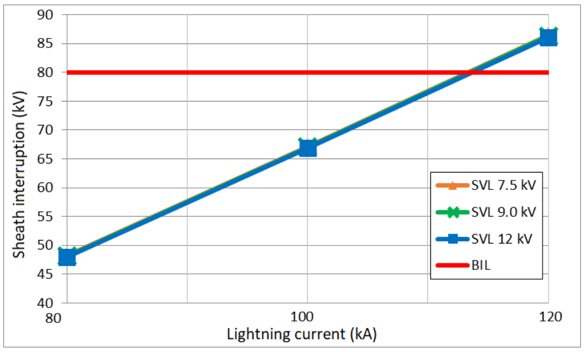


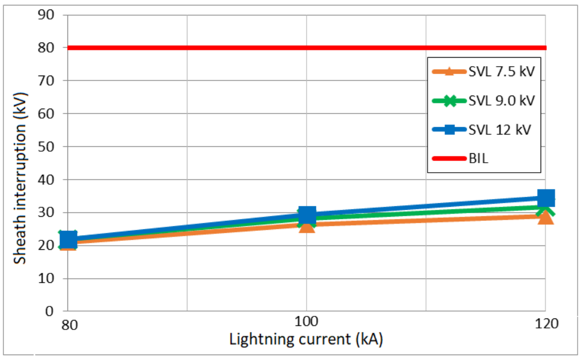
Fig. 17. Maximum induced sheath voltage with R_e= 3 Ω and 7.5 kV SVL



a. Single-point bonding-type 1

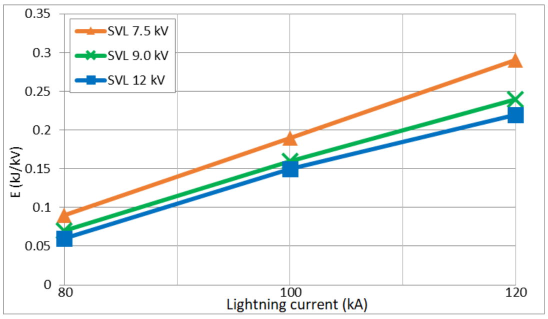


b. Single-point bonding-type 2

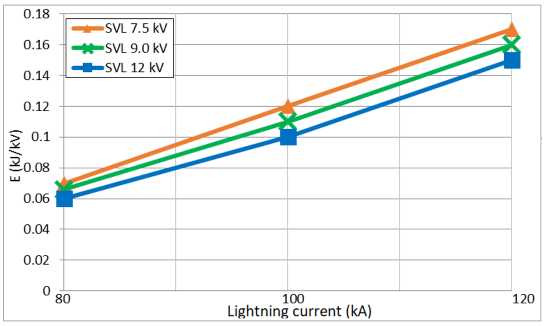


c. Cross bonding

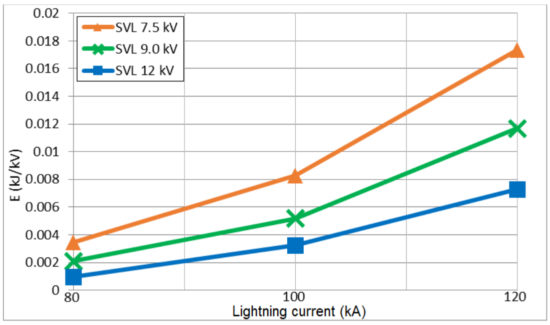
Fig. 18. Sheath interruption voltage versus lightning currents with R_e=3 Ω



(a)



(b)



(c)

Fig. 19. Dissipation energy absorption of SVLs versus lightning currents with R_e = 3 Ω. (a) Single-point bonding- type 1, (b) Single-point bonding- type 2, (c) Cross bonding

The dissipation energy in Fig. 19 shows that all SVL can safely handle lightning currents up to 120 kA. In this case, SVLs associated with single-point bonding- type 1 has the largest dissipation energy and the smallest dissipation energy is observed in SVLs with cross bonding.

4.3. Cable Installation

Cables can be installed in different environments depending on their actual right-of-way, such as underground, submarine, under bridge or in air (overhead cables). The results have shown [5] that overhead cables result in a higher sheath induced voltage than that in underground cables. In this section, the cable sheath is calculated for overhead cables (10.5 m above the ground) with the same formation as described in Fig. 7 [5]. A lightning current of 100 kA to the tower top of the overhead line section (Location LS in Fig. 6) with a grounding resistance of 3 Ω was used for the simulation.

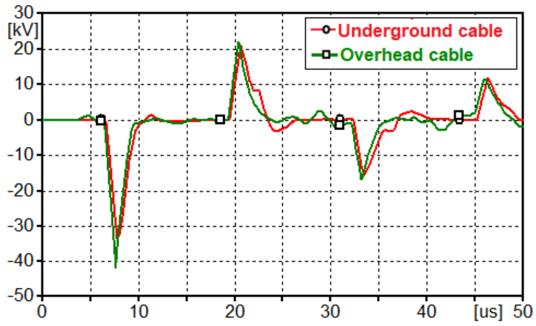


Fig. 20. Cable sheath voltage at the location $SG^2$12 single-point bonding-type 2 with R_e=3Ω and 7.5 kV SVL

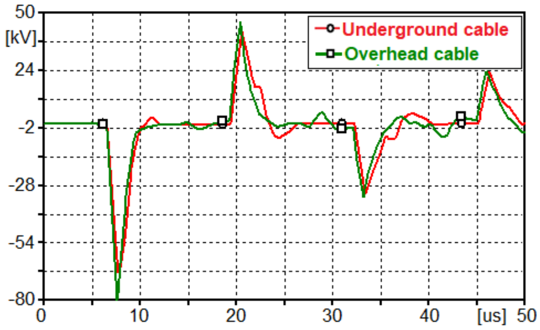


Fig. 21. Sheath interruption voltage at the location $SG^2$12 and $SG^2$21 single-point bonding-type 2 with R_e=3Ω, using 7.5 kV SVL

Fig. 20 compares the cable sheath voltage at the location $SG^2$12 in single-point bonding-type 2 using 7.5 kV SVLs 7.5 kV between underground and overhead installations. The maximum sheath voltage appears on the A of overhead cables (42 kV), which is slightly above their sheath BIL and about 1.3 times greater than the underground cable sheath (33 kV). The sheath interruption voltage in the single-point bonding-type 2 (Fig. 21) of overhead cables is approximately 79 kV, which is less their BIL limit (80 kV) and greater than the corresponding values in underground cables (67 kV).

The maximum values of sheath voltage and sheath interruption voltage with all three types of bonding are compared in Fig. 22 and Fig. 23 for different types of cable installation. We notice that the sheath voltages increase from 33.5 kV to 41.9 kV, from 39.9 kV to 43.2 kV for three types of bonding, respectively, when cables move from underground to overhead installation. Similar amounts of increase in voltage are also observed in the sheath interruption when the cable installation changes from underground to overhead. It is clear that the same SVLs (7.5 kV) used for underground cables no longer can protect the sheath insulation if the cable installation changes to overhead. Therefore, SVL selection needs to be recalculated when cable installation changes.

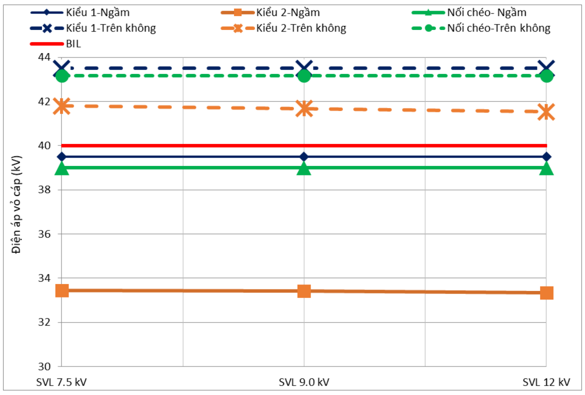


Fig. 22. Maximum sheath voltage at the location SG[1]12 with single-point bonding and cross bonding

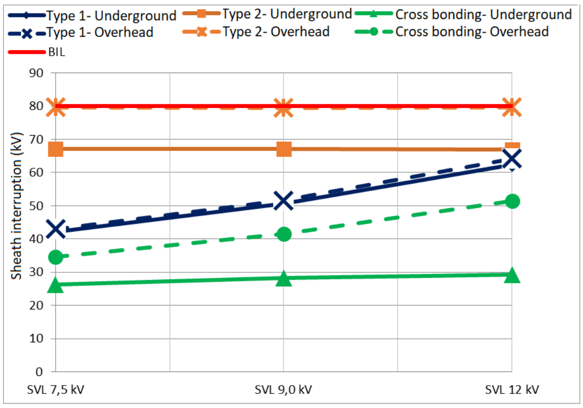


Fig. 23. Sheath interruption voltage versus cable installations.

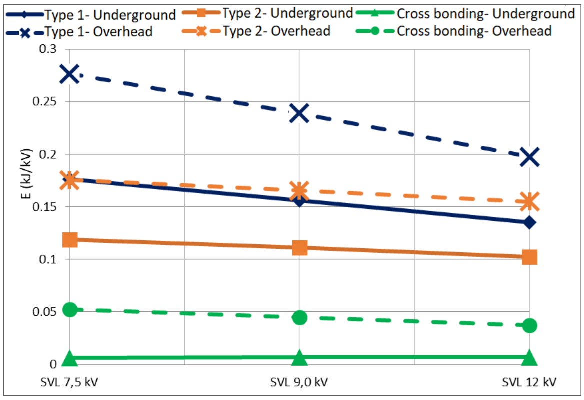


Fig. 24. Dissipation energy of the SVLs versus cable installations.

There is no substantial change in dissipation energy of SVLs with the cable installation (Fig. 24), which remains well below the typical values of absorption energy used in distribution arresters. However, this observation needs to proceed with caution since higher rating voltage SVLs (higher than 7.5 kV) need to use for overhead cables as discussed in the previous paragraph.

5. Conclusion

The selection of bonding schemes in transmission cables depends on the regulated safety voltage and the complexity of the sheath connection. Cross bonding method has outstanding advantages over single-point bonding but its limits lie on the fact that the cable sheath has to be divided into minor sections, which leads to a more expensive installation and complicated maintenance. The parameters of the SVL must be calculated in accordance with the sheath connection method to ensure the reliability during operation.

The results in this paper show that the cross bonding permits to choose SVLs with the lowest rating voltage. However, the grounding resistance value of the tower at the junction between overhead lines and cables must be maintained at or below 3 Ω.

In the case that cross bonding is not a viable solution due to actual conditions of installation such as the cable is too short to be divided into 3 segments, the cable are installed in an environment where the realization of minor sections is not possible (river crossing cables, cables crossing a bridge, etc.), then single-point bonding-type 1 is more advantageous. However, the parameters of SVLs (rating voltage and absorbed energy) must be calculated specifically for a given short-circuit capacity of the system, the minor section length, the tower footing resistance as well as the maximum lightning current. Those parameters are subject to be recalculated whenever one of the above system parameters changes. In addition, the cable installation is also an important factor to consider when selecting SVLs. The results also made clear that the footing resistance of the tower at the junction between overhead lines and cables must be maintained at 3Ω or less so that the distribution arresters can be used as SVLs.

The simulation results also show that SVLs used for underground cables is no longer suitable for protecting the same cables when they run in overhead. Therefore, when the surrounding environment of cables changes, the required parameters of SVL to be selected must be recalculated to take the cable installation into account.

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