ICEST 2010 23 - 26 June 2010, Ohrid, Macedonia

Overvoltage Protection of a Cable Part in an Electrical Grid 20 kV

Margreta P. Vasileva[1]

***Abstract* – The problem solved in this paper is determination of the cable length when the Chopped Wave Withstand Level is not exceed in the unprotected cable end.**

A model scheme of the electrical grid is created for variant researches. Numerical and graphic results are given. The variant research depends on the using surge protective devices type and the way of laying of the cables.

***Keywords* – Overvoltage protection, cable line 20 kV.**

I. Introduction

The question connected whit the right choice of the surge protective devices\` type and their installing place has a direct attitude whit the devices insulation coordination.

The insulation levels characterize the specific requirements for insulation systems of devices according to theirs function and voltage class.

The Metal Oxide Surge Arresters (MOSA) reduce the overvoltage sooner as the spark-gap arresters. The last ones are able to conduct after the overvoltage was increased to U_p. That is why their protection distance is shorter in many cases. This means that the overvoltage to the electrical equipment is higher when a spark-gap arrester instead of a MOSA is installed as both types of arresters are at the same distance from equipment to be protected [3].

II. Research Variants and Results

The task of this study is to determine the length of power cables (Fig. 1) when the Chopped Wave Withstand Level (CWWL) is not exceed in the unprotected edge of the cable line (CL), depending on the type of used MOSA and of the type laying of the CL. The insulation level will not be exceeded if the selected MOSA between the CL and power line (PL) to provide the necessary protection in the unprotected edge or wave surge has abated sufficiently and it is not dangerous at the end of the power cable (PC).

Figure 1 shows one scheme decision for limiting of overvoltages in the electrical grid 20 kV according to [1].

Model scheme of electrical grid 20 kV is presented in [2].

The results for the length of power cables dependent on MOSA - type MWK 19 and the single-phase power cables whit cross- section 95, 120, 150, 185 mm are summarized in Table 1. The power cables are whit polymeric insulation.

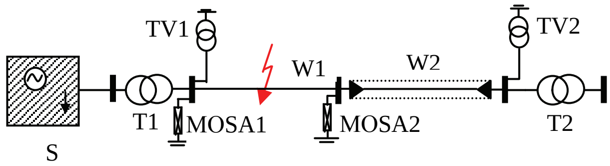

Fig. 1. One-line diagram of power grid 20 kV whit cable connection to the transformer

W1-PL; W2-CL; TV1,TV2 – voltage measure transformers, S – power system 110 kV; T1 – power transformer 110/20 kV; T2 – power transformer 20/0,4 kV.

Table I

Length of power cable (L_{KEP}), m, when the Chopped Wave Withstand Level (CWWL) is exceed in the unprotected edge of the cable line

Cable type	CAXEкT 95		CAXEкT 120		CAXEкT 150		CAXEкT 185	
MOSA	△	○○○	△	○○○	△	○○○	△	○○○
MWK 19	105÷ 478	70÷ 524	104÷ 475	67÷ 522	102÷ 472	65÷ 521	100÷ 470	63÷ 420

Table 1 shows the values for L_{KEP} depending on the cross-section of the power cables and their way of laying. The results show that L_{KEP} depends largely on the way of laying the power cables and not depend substantially on their cross-section.

Fig. 2 shows the voltages at the cable end depending of its length for MOSA - type MWK 18 and different ways of laying the PC.

Results on L_{KEP}, depending on the type of MOSA and way of laying of PC are summarized in Table 2.

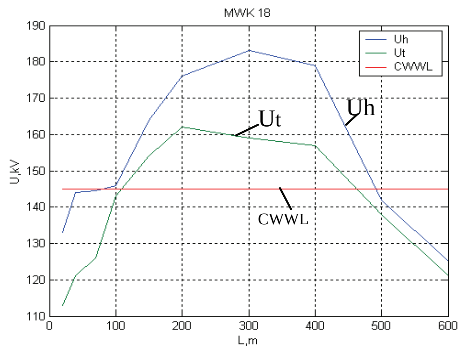

Fig. 2. Voltages at the cable end whit MOSA type MWK 18
Uh - in horizontal installation; Ut - in triangular installation; CWWL - Chopped Wave Withstand Level

[1]Margreta P.Vasileva, Technical University of Varna, Department of Electric Power Engineering, Studentska 1, Varna, 9010, Bulgaria, m.vasileva@tu-varna.acad.bg

TABLE II

LENGTH OF POWER CABLE (L_{KEP}), m, WHEN **THE CHOPPED WAVE WITHSTAND LEVEL IS EXCEED** IN THE UNPROTECTED EDGE OF THE CABLE LINE DEPENDING ON THE WAY OF LAYING THE PC AND THE TYPE OF MOSA.

	MWK 19	MWK 20	MWK 23	MWK 24	MVK 19	MVK 20	MVK 22	PVI 19,5	POLIM DN-20	POLIM DN-22
△	104÷475	125÷450	63÷473	19÷505	130÷445	120÷465	50÷450	120÷454	122÷468	52÷453
○○○	67÷522	57÷505	42÷512	19÷568	53÷493	52÷500	33÷550	57÷500	53÷502	35÷552

Research is done and the scheme from Figure 3.

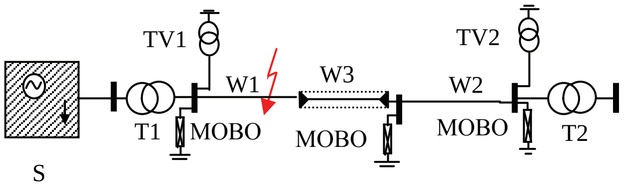

Fig. 3. One-line diagram of power grid 20 kV whit cable line between two power lines (W1, W2 - PL; W3 - CL)

To determine the maximum length of cable line with unilateral protection seen case where surge wave enters from the PL associated with unprotected edge of the cable.

The results for different lengths of the cables have the same character over time as those of fig. 2 and are not shown in the statement. The results for the various options are summarized in Table III.

III. CONCLUSION

When the lengths of PC are within the range specified in Table I and Table II is required MOSA protection at both ends of the PC.

Bilateral protection whit MOSA is recommended when the CL lengths exceed the values in Table 3.

TABLE III

MAXIMUM LENGTH OF THE CABLE LINE (L_{KLMAX}), M, OF WHICH **NOT TO EXCEED CWWL** IN THE UNPROTECTED EDGE OF THE CABLE LINE DEPENDING ON THE WAY OF LAYING THE PC AND THE TYPE OF MOSA

	MWK19	MWK20	MWK23	MWK24	MVK19	MVK20	MVK22	PVI 19,5	POLIM DN-20	POLIM DN-22
△	18	15	11	10	17	12	11	19	11	10
○○○	15	14	10	9	15	10	10	16	10	10

REFERENCES

[1] Ordinance № 3 regarding the structure of electrical devices and power lines, Sofia, 2004.

[2] Vasileva M., “Limitation of overvoltages in electric networks - 20 kV”, Disertation, Varna, 2004.

[3] Dimensioning, testing and application of metal oxide surge arresters in medium voltage networks, ABB Hige Voltave Tehnologies, July, 1999.