LEAKAGE CURRENTS AND POWER LOSSES ON OUTDOOR INSULATORS UNDER ARTIFICIAL RAINS

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Abstract: *The paper is about the theory of creation of leakage currents on insulator suspensions at the lead of the transmission network system. In practice insulators are exposed to weather impacts that are during the year various and they influence conductive conditions at the surface of the insulators. The result is a flow of leakage currents on the surface of the insulator suspensions to the construction of the towers against the ground. On the base of entrance data from the control system CEPS in Ostrava and measurement values form the lab VVN in Prague-Bechovice, in system there are introduced calculations and results. They show the influence of temperature and dampness on a flow and a value of leakage currents.*

Key words: *Leakage current, temperature, dampness, lead of the transmission network system, insulator suspension, tower.*

PROBLEMATIKA MĚŘENÍ SVODOVÝCH PROUDŮ U VYBRANÝCH IZOLÁTOROVÝCH ZÁVĚSŮ S OHLEDEM NA JEJICH ZNEČIŠTĚNÍ

Abstrakt: *Příspěvek se zabývá problematikou měření a výpočtu svodových proudů u vybraných izolátorových závěsů v laboratorních podmínkách. K tomuto účelu jsou pro měření použity vybrané izolátory, které se v praxi vyskytují. Měření proběhla v EGÚ-Laboratoři velmi vysokého napětí, a.s. v Praze 9- Běchovicích. Pro podmínky měření byly simulovány různé stavy vodivosti povrchu izolátorů. Jedná se o stav za sucha, silného a slabého deště s různou vodivostí a intenzitou stříkající vody. Výsledky jsou zpracovány ve formě tabulek a oscilogramů.*

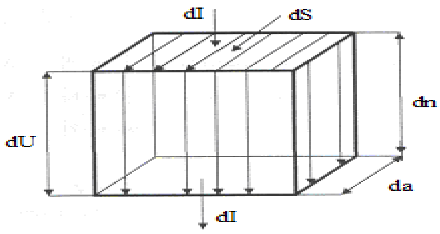
Klíčová slova*: Svodový proud, teplota, vlhkost, přenosová soustava, izolátorový závěs, pollution.*

I. Introduction

The paper is about the issue of measurement and calculation of leakage currents at chosen insulator suspensions in lab conditions. For this purpose there are used chosen insulators for measurement that occur in practice. Measurements were done in Energetic Department of the Laboratory of Extra High Voltage (EGU – Laboratory EHV) Inc., in Prague 9 – Bechovice. For measurement conditions there were simulated various situations of conductivity of the insulator surfaces. It is dryness, heavy downpour and light rain with various conductivity and intensity of splashing water. Results are processed in tables and oscillograms.

II. Theory for calculation of leakage currents

Leakage currents on line of high and extra high voltage cause a part of technical losses. These losses are caused by an imperfect isolation that arises as a coat on a surface of insulator sheds from the air. By this there is made a conducting way that is created by a slim pollution layer on single insulator suspension sheds. Pollution on insulators is made by reason of industrial work in the locality where the line goes through. It causes a flow of leakage currents and an increase of electrical losses. Atmospheric influences and purity of the air that is influenced by industrial work in the locality have big influence on the pollution layer. For the calculation of leakage currents, there is necessary to well guess the pollution zone which is signed in the standard CSN 33 0405 (Design of outdoor electric isolation after the grade of pollution). After the pollution zone, we can – from the standard – set the specific surface conductivity that is important for calculations. Another possibility is calculation of the specific surface conductivity on the base of measurement in a laboratory. Measurement of leakage currents is done in Laboratory EHV. Disadvantage is that the values don't express leakage currents on the whole line. For this reason the part of the paper targets the calculations of leakage currents and derivations of relations and formulas. The derivation is interpreted by the elementary cuboid (pic.1) that represents an elementary sample of pollution on the insulator. In the paper there is outlined the derivation of the relation for definition a leakage distance of the smooth cuboid (pic 2) and the rotary symmetrical body (pic.3). The leakage distance represents the way for the flow of leakage current on the surface of the insulator. For calculations of leakage currents, there is necessary to define a form factor of the particular insulator. A general derivation of the form factor is presented in following chapters. By the calculation of the form factor of the insulator, I want to mention the influence of the form and proportion of the insulator. In case we have results of laboratory leakage currents measurements on insulators during various situations of conductivity (i.e. simulated rain) and we know specific surface conductivity that polluted the insulator, we must count also with the value of pollution at the result of the form factor.



Pic. 1: *Elementary Cuboid representing a particle of pollution on the insulator*

Where

dU ,,, electric voltage along cuboid of pollution,
dS ,,, a normal area vertical to the direction of flowing leakage current,
dn ,,, elementary height of cuboid of pollution,
da ,,, elementary width of cuboid of pollution,
dI ,,, elementary leakage current.

In isotropic background there is a direction of electric field intensity and current density identical, so there is:

$$\bar{E} = \frac{1}{\gamma} \cdot \bar{J} = \rho \cdot \bar{J} \quad (1)$$

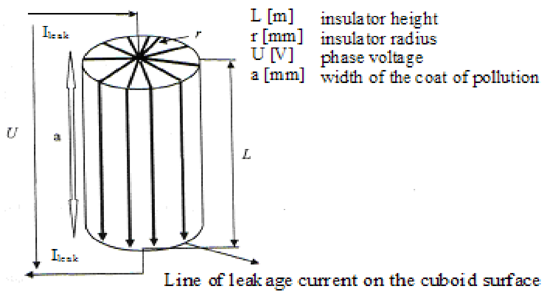
where

ρ ,,, [$\Omega.mm^2.m^{-1}$] specific resistance of the pollution layer
γ ,,, [$S.m.mm^{-2}$] specific conductivity of the pollution layer

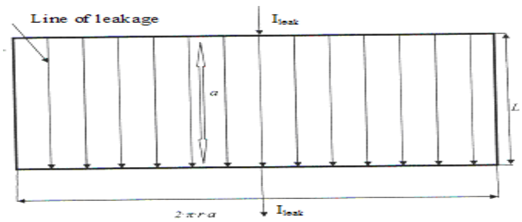
Relation (1) expresses the Ohm's Law in elementary form

Resistance (conductivity) of the insulator pollution layer:

Insulator of the shape of the smooth cuboid.



Pic. 2: *Direction of the flow of leakage current on the insulator cuboid surface*



Pic. 3: *An extended insulator cuboid surface*

Resistance of the cuboid area of the smooth cuboid (R_{cf}):

$$R_{cf} = \rho \cdot \frac{L}{S} = \rho \cdot \frac{L}{2 \cdot \pi \cdot r \cdot a} \quad (2)$$

P ,,, [$\Omega.mm^2.m^{-1}$] specific resistance of the Pollution layer
L ,,, [m] cuboid area height
S ,,, [mm^2] pollution layer section
R ,,, [mm] insulator cuboid radius
a ,,, [mm] width of the pollution layer

Note:

Width of the pollution layer is unknown value that can involve the result with known value of specific resistance „ρ"very much.
For example if $a \to 0$ than $R_{cf} \to \infty$ for any size "ρ" and an influence of the insulator surface shape can't be described to the size of the cuboid flat resistance R_{cf}.

That's why we suppose that we know specific resistance "ρ" or specific conductivity "γ" of the pollution layer even with the size of the pollution layer.

Than $\rho \to \rho'$, $\rho' = \frac{\rho}{a}$

$$\gamma \to \gamma' \qquad \gamma' = \frac{1}{\rho'} = \frac{a}{\rho}$$

From the hypothesis we can write:

Resistance of the cuboid area (R_{cf}) of the smooth cuboid:

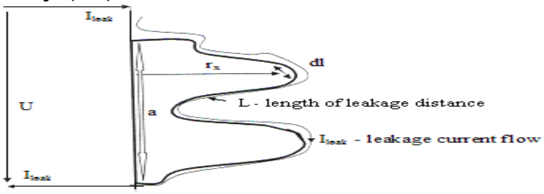
$$R_{cf} = \rho' \cdot \frac{L}{2 \cdot \pi \cdot r} = \rho \cdot \frac{L}{2 \cdot \pi \cdot r \cdot a} \quad (3)$$

R_{cf} ,,, resistance of the cuboid area
Admittance of the cuboid area (Y_{cf}):

$$Y_{cf} = \gamma' \cdot \frac{2 \cdot \pi \cdot r}{L} = \gamma \cdot \frac{2 \cdot \pi \cdot r \cdot a}{L} \quad (4)$$

Y_{cf} ,,, admittance of the cuboid area

Surface of the insulator rotary symmetrical body (R_{si}):



Pic.4: *Part of the rotary symmetrical general insulator*

Resistance of the symmetrical insulator surface (R_{si}):

$$R_{si} = \rho' \cdot \int_0^L \frac{dl}{2 \cdot \pi \cdot r_x} \quad (5)$$

where $f = \int_0^L \frac{dl}{2 \cdot \pi \cdot r_x}$

Where "f" is *derived form factor* of the insulator. Admittance of the symmetrical insulator surface (Y_{si}):

$$Y_{SI} = \frac{1}{R_{SI}} = \gamma' \cdot \int_0^L \frac{1}{\frac{dl}{2 \cdot \pi \cdot r_x}} \quad (6)$$

Leakage current on the insulator surface (I_{leak}):

$$I_{leak} = \frac{U_f}{R_{SI}} = \frac{U_f}{\rho' \cdot \int_0^L \frac{dl}{2 \cdot \pi \cdot r_x}} \quad (7)$$

or

$$I_{leak} = U_f \cdot Y_{SI} = U_f \cdot \gamma' \cdot \int_0^L \frac{1}{\frac{dl}{2 \cdot \pi \cdot r_x}} \quad (8)$$

From derived formulas results that a form factor "f" of the insulator surface direct involves a value of leakage current. When the leakage distance is longer then leakage current on the insulator surface is smaller. This stadium is farther involved by a structure of insulator suspensions (serial parallel connection of insulators). During a calculation, first it is necessary to specify (from CSN 330405) specific surface conductibilities for various areas of pollution ρ or γ or, for this purpose, to use measured values. I use these values for obtaining of the surface conductivity. Process is written in the literature [2].

Value of the specific conductivity of the pollution layer γ or the specific resistance ρ involves the pollution layer "a". In case I know measured value of leakage current through an insulator used at the concrete line (i.e. from field measurement or from measurement on insulators in a laboratory EHV) then I can use this knowledge for the calculation of the specific conductivity of the pollution layer γ or the specific resistance ρ, where this value is already involved. Then I can consider the value ρ or γ are known. Further I use this knowledge for calculations of the form factor where the pollution layer is involved. In my case I used values of leakage currents measured in EGÚ – Laboratory EHV in Prague – Bechovice. Value of leakage currents, measured in such way, are objective and exact because there are simulated various atmospheric influences in shorter time parts than outside where atmospheric conditions can be changeable in longer time part. Measured values are recapitulated in tables 1, 2 and 3.

In tables 1-3 there are stated measured values of leakage currents at three types of insulator suspensions. In the view of size of the paper there is not stated methodology and process of measurement. In tables there are stated resultant data. It is the state of insulator, if the measurement was done in dry weather, heavy downpour or light rain. This state was characterised by a substitutional conductivity which is stated in tables too. At oscillograms of voltage and current there is seen that leakage current has a capacitive character in dry weather. Current overtakes voltage – see the Pic.12. During a measurement in dry weather there were achieved similar results even at the other stated insulator suspensions.

Table 1: *Values of leakage currents for long rod insulator 400 kV DN 2x3 LS 75/21*

proof	**dryness**	**light rain**	**heavy downpour**	**light rain**	**heavy downpour**
conductivity [$S \cdot m^{-1}$]		0,0097	0,0097	0,049	0,0498
I_{leak} [mA] average	0,004	0,278	0,812	1,914	2,568

Table 2: *Values of leakage currents for glass insulator 400 kV DN 2x24 U120*

proof	**dryness**	**heavy downpour**	**heavy downpour**
conductivity [S·m^{-1}]		0,0097	0,0498
I_{leak} [mA] average	0,0034	0,0088	0,0114

Table 3: *Values of leakage currents for composite insulator 400 kV JN 1xFURUKAWA*

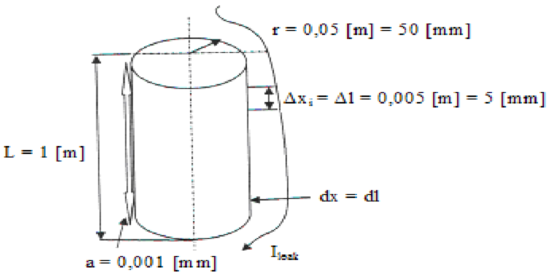
proof	**dryness**	**heavy downpour**
conductivity [S·m^{-1}]		0,0498
I_{leak} [mA] average	0,00084	0,00204

Note:

Value of leakage currents, stated in tabs 1 to 3 were measured in EGU Laboratory EHV in Prague Bechovice. Stated values are average. It is for the reason of impartiality for calculations of leakage currents and leakage losses in order we wouldn't count only maximal or minimal values a = 0,001 [mm].

Example of calculation of the form *f* factor of the smooth insulator cuboid:

Calculation of the form "f" factor of the smooth insulator cuboid with integral including the pollution layer



Pic. 5: *Model of general insulator of the form of the smooth insulator cuboid*

Chosen pollution layer a = 0,001[mm] is for visual example of calculation. Value "a" is chosen as an illustration of calculation of the form factor.

$$f = \int_0^L \frac{dl}{2\cdot\pi\cdot r\cdot a} = \frac{1}{2\cdot\pi\cdot r\cdot a}\cdot[x]_0^1 = \frac{1}{2\cdot\pi\cdot 50\cdot 0{,}001}\cdot 1 = \frac{1}{0{,}1\cdot\pi} = \frac{10}{\pi} = \underline{\underline{3{,}18 m\cdot mm^{-2}}}$$

(9)

Calculation of the "f" factor of the smooth insulator cuboid with differential including the pollution layer:

$$n = \frac{L}{\Delta l} = \frac{1000}{5} = 200 \quad (10)$$

$$f = \frac{1}{2\cdot\pi\cdot r\cdot a}\cdot\sum_{i=1}^{n}\Delta x_i = \frac{1}{2\cdot\pi\cdot 50\cdot 0{,}001}\cdot\sum_{i=1}^{200} 0{,}005 \quad (11)$$

$$= \frac{1}{2\cdot\pi\cdot 0{,}05}\cdot 200\cdot(0{,}005) = \underline{\underline{3{,}18 m\cdot mm^{-2}}}$$

III. PROGRESS OF MEASUREMENT OF LEAKAGE CURRENTS

In this chapter there is described a way of measurement of leakage currents on three types of insulator suspensions.

Measurement was done in Laboratory EHV in Prague Bechovice. Testing voltage was 242 kV. Measurement on insulators suspension was done after connection at the Pic. 14.

<u>Measurement of leakage current was done in five modes:</u>

- Dryness
- Light rain with conductivity of 97 [μS.cm^{-1}], intensity of downfalls less than 0,5 [mm.min^{-1}]
- Heavy downpour with conductivity of 97 [μS.cm^{-1}]., intensity of downfalls more than 0,5 [mm.min^{-1}]
- Light rain with conductivity of 498 [μS.cm^{-1}], intensity of downfalls less than 0,5 [mm.min^{-1}]
- Heavy downpour with conductivity of 498 [μS.cm^{-1}], intensity of downfalls more than 0,5 [mm.min^{-1}]

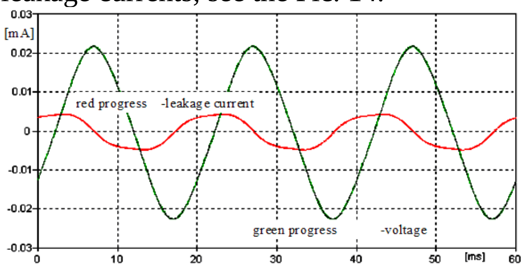
Measurement of leakage currents on insulator suspensions leads to finding what insulator ability has used insulator suspension in practice. In natural conditions, various influences of weather and pollution cause at these insulators. That leads to the situation that on surface of insulator sheds there flow leakage currents and then there are leakage losses. In order we could create the influences in artificial conditions we use laboratories EHV for this purpose where is possible to create partly leakage currents and then to measure them with necessary technique and instruments. The scheme of such connection is stated at the Pic. 5. Values of used bypasses R_b for measurement of leakage currents on individual insulator suspensions are stated in the Tab. 4.

Table 4: *Values of used bypasses for measurement of leakage currents at individual suspensions 400 kV*

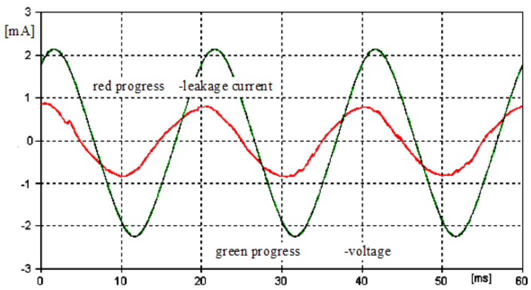
Test	**dryness**	**rain 0,0097 [S·m^{-1}]**	**rain 0,0498 [S·m^{-1}]**
Suspension 400 kV	size of bypasses R_b in [kΩ]		
DN 2 x 3 LS 75/21	10,15	10,15	1,031
DN 2 x 24 U120	99,5	99,5	99,5
JN 1 x FURUKAWA	99,5	99,5	99,5

IV. MEASURED RESULTS OF LEAKAGE CURRENTS

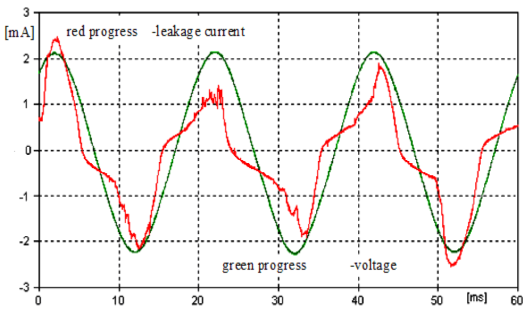
From results of individual measurement the values of leakage currents were put down in oscillograms. The scale corresponded to the value of leakage current in milliamperes. These oscillograms are stated at the Pic. 6 to 13. Results of leakage currents for individual insulators in various stages of conductivity are later stated in Tabs 1 to 3. In the Tab. 4 there is stated value of bypass for measurement of leakage currents, see the Pic. 14.



Pic. 6 Oscillogram of the value of leakage current at the insulator suspension 400 kV DN 2x3 LS 75/21 **test in dryness**

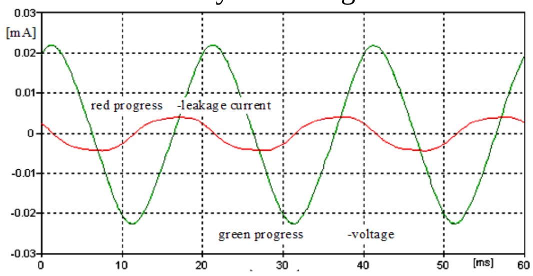


Pic. 7 Oscillogram of the value of leakage current at the insulator suspension 400 kV DN 2x3 LS 75/21 **test in heavy downpour 0,0097 [S·m^{-1}]**



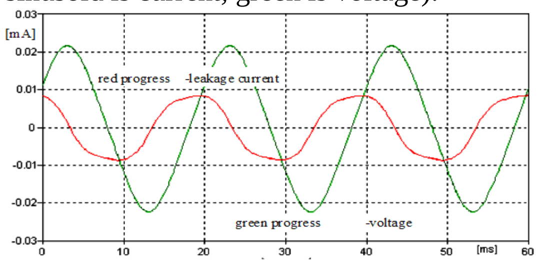
Pic. 8 Oscillogram of the value of leakage current at the insulator suspension 400 kV DN 2x3 LS 75/21 **test in heavy downpour 0,0498 [S·m^{-1}]**

After the pictures 6 to 8, in oscillograms there are stated progresses of leakage currents on measured insulator 2x3 LS75/21. They show us that measured leakage currents are very changeable according to creation of connectional ways during interflow of water on sheds. Interflowing water makes a connectional way for leakage current.

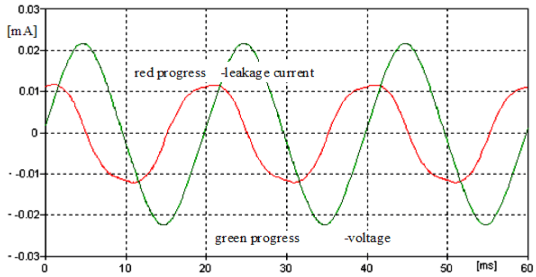


Pic. 9 Oscillogram of the value of leakage current at the insulator suspension 400 kV DN 2x24 U120 **test in dryness**

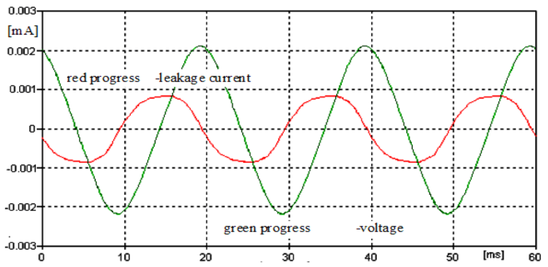
At the Pic. 9, during the test in dryness, we can see what value has a capacity current during passing of voltage through zero (red sinusoid is current, green is voltage).



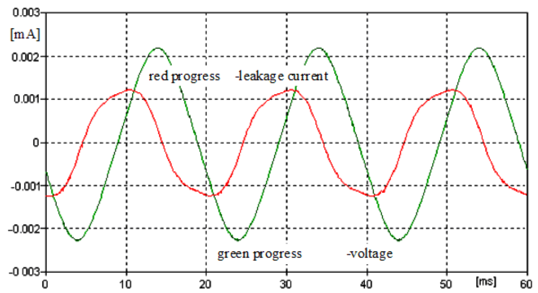
Pic. 10 Oscillogram of the value of leakage current at the insulator suspension 400 kV DN 2x24 U120 **test in heavy downpour 0,0097 [S·m^{-1}]**



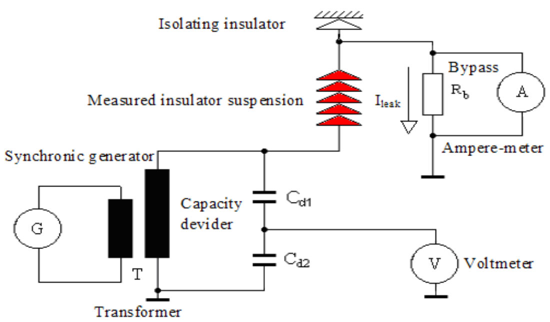
Pic. 11 Oscillogram of the value of leakage current at the insulator suspension 400 kV DN 2x24 U120 **test in heavy downpour 0,0498 [S·m^{-1}]**



Pic. 12 Oscillogram of the value of leakage current at the insulator suspension 400 kV JN 1xFURUKAWA **test in dryness**



Pic. 13 Oscillogram of the value of leakage current at the insulator suspension 400 kV JN 1xFURUKAWA **test in heavy downpour 0,0498 [S·m⁻¹]**



***Pic. 14:** The scheme of connection for measurement of leakage currents on chosen insulator suspensions*

During the test in rain it is active current (during passing of voltage through the top value).

Line voltage: U=242 [kV], when measurement of leakage currents was done.

$$P_{susp} = \frac{U}{\sqrt{2}} \cdot I_{leak\ max} \quad [\text{kW, kV, mA}] \quad (12)$$

In case we think of 12 insulator suspensions at 1 km we can write the formula for a calculation of leakage losses at 1 km.

$$P_{1km} = \frac{P_{susp}}{1000} \cdot 12 \quad [\text{kW·km}^{-1}\text{; kW, km}] \quad (13)$$

V. LOSSES AT INSULATOR SUSPENSIONS

Losses made by leakage make one part of technical losses at line EHV. These losses are involved by a structure and a type of insulator suspensions. An important item is pollution on the surface of the insulator. In practice on switched-on lines there is very difficult to do measurement in various weather. First there is a problem to feel atmospheric influences and a pollution of the insulator. That's why in laboratories EHV there are made model situations – in the Czech Republic in Prague-Bechovice, in Slovakia in Bratislava-Trnavka, possibly in another countries. Adjusted results are rather exact and it is possible to use them during suggestion of methodologies for calculation of leakage losses. With methodologies for calculation of leakage losses at individual line EHV and also at all lines of the transmission network system it is possible to calculate these losses. In my dissertation thesis I deduced a methodology of the theory for calculation of leakage losses and it is in that work [2]. It was preceded by a paper at colloquium in Podebrady 2003, the title of the paper is stated in literature [3]. In Tabs 5 to 7 there are stated values of leakage losses at individual types of insulator suspensions in various model situations. The demonstration of calculation of one value of leakage losses is stated in this sub-chapter.

***Table 5:** Results of leakage losses at the long rod insulator suspension 400 kV DN 2x3 LS 75/21*

The insulator suspension of the type of 2x3 LS 75/21			
The state of insulator	**conductivity of rain**	**losses on 1 suspension**	**losses at 1km of line N_{is}**
	$\mu S \cdot cm^{-1}$	**W**	**$kW \cdot km^{-1}$**
Dryness		$0{,}69^{*)}$	$0{,}008^{*)}$
Light rain	97	47,57	0,71
Heavy downpour	97	139	1,67
Light rain	498	328	3,93
Heavy downpour	498	440	5,27

Table 6: *Results of leakage losses at the glass insulator suspension 400 kV DN 2x24 U120*

The insulator suspension of the type of 2 x 24 U 120			
The state of insulator	**conductivity of rain**	**losses on 1 suspension**	**losses at 1km of line N_{is}**
	μS·cm^{-1}	**W**	**kW·km^{-1}**
Dryness		0,59$^{*)}$	0,007$^{*)}$
Light rain	97	1,77	0,021
Heavy downpour	97	1,50	0,018
Heavy downpour	498	1,82	0,022

Table 7: *Results of leakage losses at the composite insulator suspension 400 kV JN 1x FUKURAWA*

The insulator suspension of the type of JN 1 x FURUKAWA			
The state of insulator	**conductivity of rain**	**losses on 1 suspension**	**losses at 1km of line N_{is}**
	μS·cm^{-1}	**W**	**kW·km^{-1}**
Dryness		0,14$^{*)}$	0,0017$^{*)}$
Heavy downpour	498	0,35	0,0042

*capacity current and reactive losses

The demonstration of calculation of leakage losses after the formula (12) at one insulator suspension LS 75/21 where, for comparison, this value is stated in tab. 5 and leakage current in tab. 1.

$$P_{susp} = \frac{U}{\sqrt{2}} \cdot I_{leak\,max} = \frac{242}{\sqrt{2}} \cdot 0{,}278 = \underline{\underline{47{,}57W}}$$

VI. General Solution Of Leakage Currents and leakage Losses at the line EHV

Leakage currents cause (especially EHV) losses of electric energy at the line. In this chapter I would like to use the base of knowledge of measured values of leakage currents from the Laboratory EHV and the configuration of used insulators in a concrete demonstrative line for derivation of relations for calculations of leakage currents. From these bases I would like to outline an original way of solution of leakage currents and leakage losses at the EHV line.

Entrance Parameters to General Solution of Leakage Currents

For general solution of leakage currents, it is necessary to think what circumstances and influences cause flow of leakage currents. First there are insulators on line and their configuration in setting of the structure of the insulator suspension. The point is how many insulators of one phase are connected in a branch in a set and how many of these branches are connected parallelly. For example the name of the insulator 2//4L100BH550 means that insulator suspension has two branches connected parallelly and in each branch there are 4 insulators in a set and a type of one insulator is L100BH550. Farther it is necessary to define groups of towers with identical insulator suspensions. On the base of knowledge of used insulators it must be counted so-called form factor that presents a surface line of relevant insulator (line of flow of leakage current). The procedure of the calculation is stated in literature [2]. Another important quantity for calculation is a specific surface conductivity which gives pollution of an insulator. It involves pollution in the area. It is possible to find this quantity for the pollution zone in the standard CSN 330405 or it is possible to calculate it on the base of measurement of leakage currents through given insulator. Recount of the specific surface conductivity is stated in literature [2]. Measured values of leakage currents from EGU Laboratory EHV in Prague Bechovice in various conditions (test in dryness, light rain, heavy downpour) are stated in tables 5, 6 and 7. Calculation of the specific surface conductivity on the base of measured leakage currents is more exact than values from the standard.

Measured leakage currents demonstrate more exact values because measurement of these currents on the surface runs in a simulated way and the insulator is really exposed to various atmospheric conditions. And last but not least it is necessary to know line or phase value of voltage. For determination of leakage currents and losses it is necessary to design general formulas for calculations that would be valid for a definition of entrance data.

Explanation of the composite insulator suspension in examples:

2||2LS75/21 The insulator suspension has two branches with the insulator type of LS75/21. In each branch there are two insulators in a set, branches are connected parallelly (total 4 insulators in one phase).

2||4L100BH550 The insulator suspension has two branches with the insulator type of L100BH550. In each branch there are four insulators in a set, branches are connected parallelly (total 8 insulators in one phase).

Entrance parameters for calculation of leakage currents and losses on general line after the Pic. 15:

U_c ,,, line voltage of the general line
I_{leak} ,,, total leakage current of the general line,
ΔP_{leak} ,,, total leakage losses on the general line,
L ,,, total length of the general line [km].

On the base of defined data and quantities it is possible to derive, after the theoretic analysis in literature [2] these general formulas (14), (15), (16) and (17) for calculations of leakage currents and losses on general EHV line. Explanation is evident at the Pic. 15 (defined quantities).

General formula for calculation of leakage current on general line:

$$I_{leak} = \sqrt{3} \cdot U_s \cdot \sum_{n=1}^{l} \left(k_n \cdot i_n \cdot \frac{\gamma_n}{j_n \cdot f_n} \right) = \sqrt{3} \cdot U_s \cdot c$$

(14)

Where **“c”** coefficient respecting the pollution layer on insulators, type, structure and numbers of insulator suspensions on line EHV [unit is in Siemens - S].

General formula for calculation of leakage losses on general line:

$$\Delta P_{leak} = U_s^{\,2} \cdot \left(\sum_{n=1}^{l} k_n \cdot i_n \cdot \frac{\gamma_n}{j_n \cdot f_n} \right) = U_s^{\,2} \cdot c$$

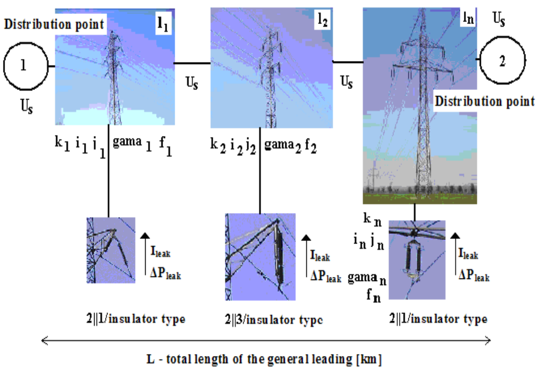
(15)

[W, V, - , - , S·mm^2·m^{-1}, - , m·mm^{-2}, V, S]

$$\Delta P_{leak/km} = \frac{U_s^{\,2} \cdot c}{L} \qquad (16)$$

[W·km^{-1}, V, S, km]

General model of line, what connect derived formulas 14 – 16 on, is stated at the Pic. 15.



Pic. 15: *General model of the line with various types of towers and insulator suspensions*

VII. CONCLUSION

On the base of comparison of results, how were the values of leakage currents measured at various models of pollution of insulator suspensions, there are the biggest losses during the rain at long rod insulators of the type of LS75/21. However at present these suspensions are used very often we have to take leakage losses into account. On the contrary at glass and composite insulator suspensions there are small leakage losses. From measured values of leakage losses we can say that at long rod insulators there are higher leakage losses and at calculation of total technical losses we have to take them into account. In the end it is possible to say that in the future a change of insulators at line EHV into glass or composite can reduce leakage losses. By this, costs for transmission of electric energy would be lower. In the end of this paper it is possible to say that the problem of leakage currents and losses on line EHV is a very current area. Generally line represents a complex of elements where each one must carry out its function. The tower makes supporting construction for line and an insulator suspension makes an insulating component that insulates line from the tower. Just structure and using of this component was the topic of discussion of his paper. Strictly speaking, it is clear that an insulator suspension makes jaggy line in form of sheds and these ones have to prevent the flow of leakage current through this surface. Atmospheric influences (light rain, heavy downpour, conductivity of the air, industrial work) involve a tidiness of the surface very much. As in practice it is very difficult, from the view of safety on line EHV, to measure leakage currents, we have two given possibilities to their determination. One possibility is to measure, in given conditions, leakage currents in a laboratory of EHV and to use their values for calculation. In the paper there is outlined a procedure from the theoretic analysis to concrete derivation of general formulas (14-16) for calculations of leakage currents and losses. I have solved some problems in my dissertation thesis [2] where are stated concrete results and procedures. As the theme of leakage currents is still current I’ve decided to go farther and to use another data from practical measurements and to improve and specify procedures for calculations with relation in practice in CEPS (Czech Energetic Transmission System).

ACKNOWLEDGMENT

Thank the Department of Electroenergetics in VSB-TU Ostrava and CEPS Inc. in Ostrava for facilitation and cooperation during creation of this paper.

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