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Simulation and Partial Discharge Measurement in 400kv Typical GIS Substation

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Abstract**:** *In this paper, we will analyze Partial Discharge (PD) in a typical Gas-insulated substation and the voltage signals are simulated in bus bars and different elements such as transformers in presence of PD and normal state. Then, the corresponding carves compare with together. For this means, we simulate sheikh bahayi substation in Tehran as a 400kv GIS substation in EMTP software. First, very fast transients(VFT) model is used for the GIS substation modeling. Then, voltage signal of different points of GIS substation in presence of PD are measured by use of the PD model in gas insulator and VFT model, until the PD effects on system voltage is determined.*
Keyword: *GIS Substation, Partial Discharge, VFT Method, Digital Simulation.*

I. Introduction

Recently, the GIS substation because of simple construction, small size and high reliability are introduced as an important device in UHV power systems. In spite of, there arepossible hidden faults such as trivial discharge occurrence into theself insulator[1].Investigations have been shown which the partial discharge (PD) is sign of insulation problem in GIS substations[2]. With regard to the GIS devices are installed in metallic boxes therefore, devicecontrol and observation in this substation is not possible or it is limited. If analyzing internal elements are considered,separation of equipments will be necessary. To achieve this means, the fault recognition approaches during occurrence and fault location indicator without opening the boxes are considered.Often, existence methods for the fault recognition have been related to insulation property and GIS devices isolation consists of (PD)Partial Discharge measurement. Partial Discharge can be known as an effective phenomenon on aging of electrical insulator. It is possible that,Partial Discharge can be very obnoxious and in Gas-insulated substation should be recognize and clear on time. Electrical tensions or stresses are the most important factor in Partial Discharge which, it can be cause to the insulationbreakdown. Voltages and current with high frequency, abnormal sounds, light, heat, abnormal electromagnetic waves can be maintain as signs of Partial Discharge (PD) occurrence [3].It is necessary exact demonstration of each part of system for exact and reliable simulation. VFT case is one of exact method of substation simulation which, belong to highest transient frequency range in power system [4]. In this paper, our main goal is modeling the element of substation in VFT case and then Partial Discharge is modeled in this substation.

II. Models

According reference [5], the PD calculations perform in VFT case. Thus, for simulation of PD we need models for GIS component in VFT case.

A short explanation about the representation of the mostimportant GIS components follows.

a) Bus ducts- For a range of frequencies lower than 100 MHz, a bus duct can be represented as a lossless transmission line.

b) Surge arresters- The model of Surge arresters considers two sections, lossless transmission lines, and a capacitance paralleled by a resistance between sections.

c) Circuit breakers- A circuit breaker has a different transient response depending upon which terminal is connected to the surge source.

A closed breaker can be represented as a lossless transmission Line.The representation of a closed circuit breaker is more complicated because the electrical length is increased and the speed of progression is decreased due to the effects of the higher dielectric constant of the grading capacitors [7]. If the intermediate voltages are needed, the breaker is divided into as many sections as there are interrupters, all connected by the grading capacitors.

d) Gas to air bushings- A detailed model of the bushingmust consider the coupling between the conductor and shielding electrodes, and include the representation of the grounding system connected to the bushing. A simplified model consists of several transmission lines in series with a lumped resistor representing losses. The surge impedance of each line section increases as the location goes up the bushing. If the bushing is distant from the point of interest, the resistor can be neglected and a single line section can be used.

e) Current transformers-The parameters needed to represent these models can be determined either from manufacturer's data or by calculation based on the physical sizes of the equipment. If neither of these is possible, the capacitance values can be estimated from those shown in Table 1, while surge impedances can be estimated around 50-80 ohms.

A summary of the models is shown in Table 1.

III. Simulation Assumptions

In this paper, we will analyzePartialDischarge(PD) in a typical Gas-insulated substation and the voltage signals are simulated in bus bars and different elements such as transformers in presence of PD and normal state. Then, the corresponding carves compare with together. For this means, we simulate sheikh bahayi substation in Tehran as a 400kv GIS substation in EMTP software. Under study substation is a 400kv system with 1400m heightabove the seaside and its latitude and longitude are $51^{\circ}23'32.78''E$and$35^{\circ}44'59.08''N$, respectively.Elements model are considered in VFT case because the PD calculations perform in VFT case. For GIS element modeling should be use compact form of element such as capacitor, inductor and other parameters of transmission line with regard to carrier characteristic of VFT.Skin losses have been neglected becausethe geometry shapes of the GIS box.It is assumed that in this simulation the GIS box has been earthed, perfectly.

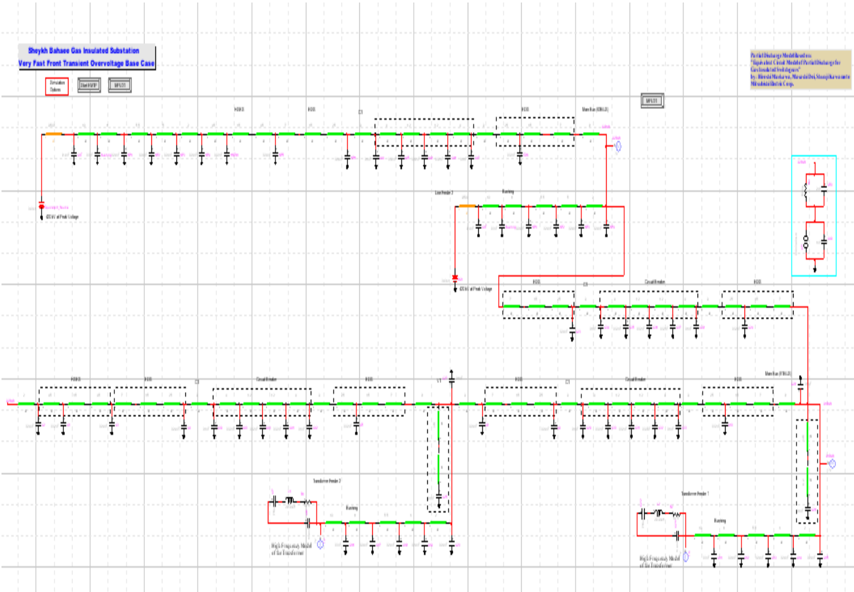

Fig.1: Substation diagram in VFT case

COMPONENT	EQUIVALENT CIRCUIT	NOTES
Bus duct		Loss-free distributed parameter transmission line
Spacer	C	(C ≈ 20 to 30 pF)
Elbow		
Spherical shield	C	(C ≈ few pF)
Surge arrester		
Closed switch		
Open switch		(n = number of breaking chambers)
Closed disconnector		
Open disconnector		
Disconnector during sparking	r R	r = r(t) ; R = a few Ω C = a few tens pF
Bushing (capacitive type)		n = number of equivalent shields (5 to 8) simulated
Bushing (gas filled)	GIS Z_s AIR C	C = a few tens pF Z_s ≈ 250 Ω
Power transformer (termination)		parameters evaluated from the frequency response of the transformer
Current transformer		sometimes negligible
Capacitive voltage transformer	C	
Earth connection		
Aerial line or long cable (termination)	r	r = surge impedance

Table1: A summary of the models

IV. Modeling and Results

The typical substation simulate in EMTP software by use of above assumptions and substation elements model in VFT case [5]. Substation diagram in VFT case is shown in fig. (1). Sinusoidal wave with 50HZ frequency acts as a DC signal Because of Simulation time is considered 1µs, therefore all of resources are considered in form of DC. Worst case about PD is in maximum amount of voltage signal, which DC signal amplitude is equal to maximum amount of AC voltage (for example 343kv). PD model in Gas insulator according to reference [6] has been shown in fig. (2), which this model in software are applied to different points of substation (for example 91th and 92th bus bars).

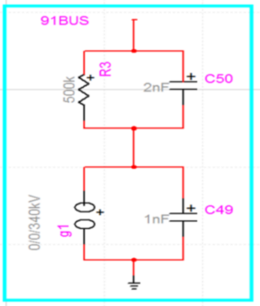

Fig.2: PD model in Gas insulation

We measure four points voltage of substation consist of V_{T1}, V_{T2}, V_{BUS91}, V_{BUS92} in presence and absence of PD based on simulation model of substation.Four points voltage of substation in absence of PDhave been shown in the fig. (3).

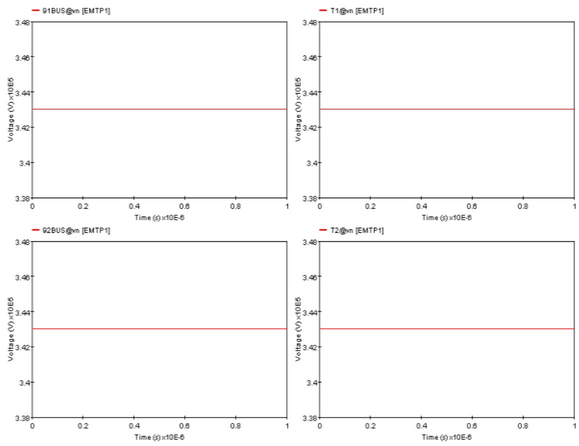

Fig.3: Four points voltage of substation in absence of PD

Now, we apply the PD model which has been shown in fig. (2) to bas bar 91th. Aforementioned four pointsvoltage in presence of PD in bas bar 91th have been shown in fig. (4).Now, PD location replaces to bus bar 92th from the bus bar 91th and then the voltages are measured, again. For example, transformer voltage T1 is shown as one curve in fig. (5) with the presence and absence of PD in bus bar 91th and bus bar 92th. From fig. (5) can be conclude that PD location change cause to change in voltage waveform at other points of substation.

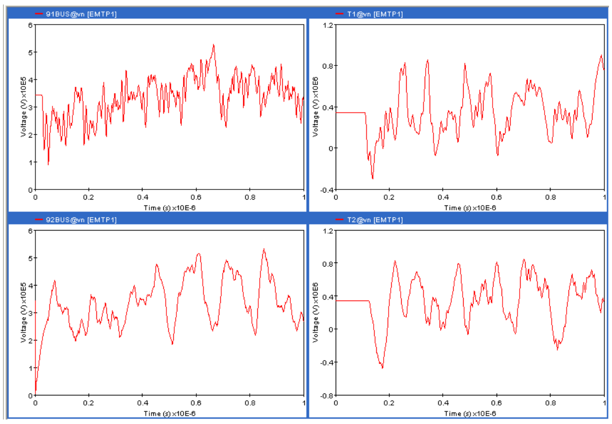

Fig.4: Four points voltage in presence of PD in bus bar 91th

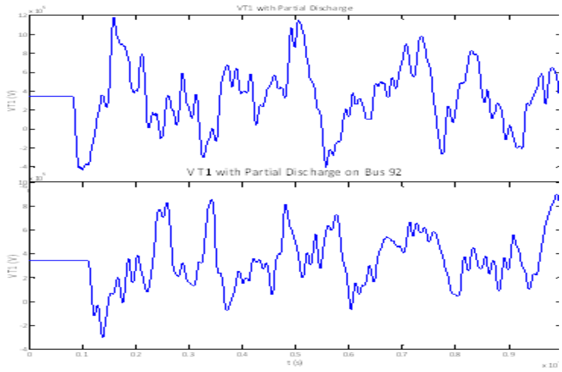

Fig.5: Transformer voltage T1 with the presence and absence of PD in bus bar 91th and bus bar 92th

V. Conclusion

In this paper for PD effect recognition on the voltage of different substation points, the VFT method are used to simulation the typical GIS substation.By analyzing the curves, this result can be concluded that PD occurrence in one point of substation cause to very disturbance into the voltage waveforms and increase in voltage until 50% nominal voltage.On other side, the PD location change in substation cause to change in waveforms which, in addition to this property by available substation voltage information can be used to PD recognition and locating in one substation.

References

[1] Y.Cheng, X. Xie, Y. Chen, X.Hu and Z. Zhu “Study of factalcharactristics of ultra-wideband partial Discharg in gas-insulated system with typical defects”, proceeding of the CSEE, Vol. 20, pp. 99-102, 2004

[2] Y.Qiu, “Online monitoring of insulation for GIS with the UHF method” ,High Voltage Apparatuse, Vol. 33,pp. 36-40, 1997.

[3] Achatz, N., Gorablenkow, J., Schichler, U., etc.: Features and benefits of UHF partial discharge monitoring system for GIS, ISEIM, 2005,3: 722-725.

[4] CIGRE Working Group 33.02, Guidelines for representation of networks elements when calculating transients, 1990

[5] J.A. Martinez (Chairman), P. Chowdhuri, R. Iravani, A. Keri, D. Povh, “Modelingguidelinesforveryfasttransientsin gasinsulatedsubstations”, IEEE Working Group,2010.

[6] Hiroshi Maekawa, Masashi Doi, Shunji Kawamoto, “Equivalent Circuit Model of Partial Discharge for Needle on Spacer in Gas insulated Switchgears”

[7] D.L. Nickel, “Very fast transients in Gas-insulatedsubstations”, EPRI Report, 1991.