'88 추계학술대회
'88 — E — 2

SF_6 개스중 미소방전을 가진 봉대평판 간극의 교류절연파괴특성

A.C. Breakdown Characteristics of a Rod-to-Plane Gap with a Small Discharge Current in SF_6 Gas.

Kwang-Sik Lee*[1], Yoshihisa Sekiya[2], Tatsuzo Hosokawa[3] and Dong-In Lee[1],
1)University of Yeungnam, 2)Daido Institute of Technology in Japan, 3)Nagoya Institute of Technology in Japan.

1. Introduction

A discharge, which is caused by an alternating voltage applied between the defective contactors in SF_6 gas insulated equipment such as SF_6 gas insulated switchgear (GIS), sometimes causes a accident breakdown between the conductor and the inner wall of GIS. This accident breakdown is big problems for power system and various electronic equipments, Considering this, the three-electrode gap in this paper consists of two rods facing each other together with a plane electrode. The rod-rod electrode simulates a defective contactor in GIS.

The breakdown(BD) between the rod-rod gap and plane electrode simulates an accident breakdown between the conductor and the inner wall of GIS.

We observed that the reduction of the breakdown voltage(V_{BD}) between a rod-rod gap and the plane electrode in presence of a small discharge (discharge of rod-rod gap, SD) depends on magnitude of a small discharge current (I), gas pressure (p) and rod-plane distance(d).

2. Experimental apparatus and techniques.

Figure 1 is experimental circuit and gap configuration. We installed the model gap in a cylindrical stainless steel chamber 0.25[m] in diameter and 0.65[m] long in length, and performed various experiments while varying the rod-plane distance d (6×10^{-3}~ 2×10^{-2}[m]), the gas pressure p(0.5,1[atm]) and magnitude of the I(Is=0.3A, I_1=1A peek).

The CCD camera, the video tape recorder(SL-HF3000 ,Sony Co.) and colour video printer(GZ-p11 sharp, Co.) are used the observation of the BD channels. The main breakdown characteristics were investigated with d,p,I and discharge channels under the condition that ℓ/D is 0.03 [rod-rod distance (ℓ):3×10^{-4}m, rod diameter (D):10^{-2}m].

The values of V_{BD} were determined by arithmetical meanvalue from the values of breakdown voltages for ten times measurements.

3. Results and discussion

As shown in Fig.2 and Fig.3, all characteristics of V_{BD}-d increase with increasing d. These characteristics are similar to general characteristics for the SF_6[1,2,3]. It is observed that V_{BD} shows the highest value among the three characteristics when the SD does not occur.

For this investigation, we observed BD channels by CCD camera technique when the SD is in existence and not. As the result, the typical configurations are shown in Fig.4. In this observation, the BD occurred between near edge of the plane electrode and stem position of the rod electrode when the SD is not in existence(Fig.4. a). On the other hand, the BD occurred between center of the plane electrode and the tip of the rod electrode or SD channel when the SD occurred

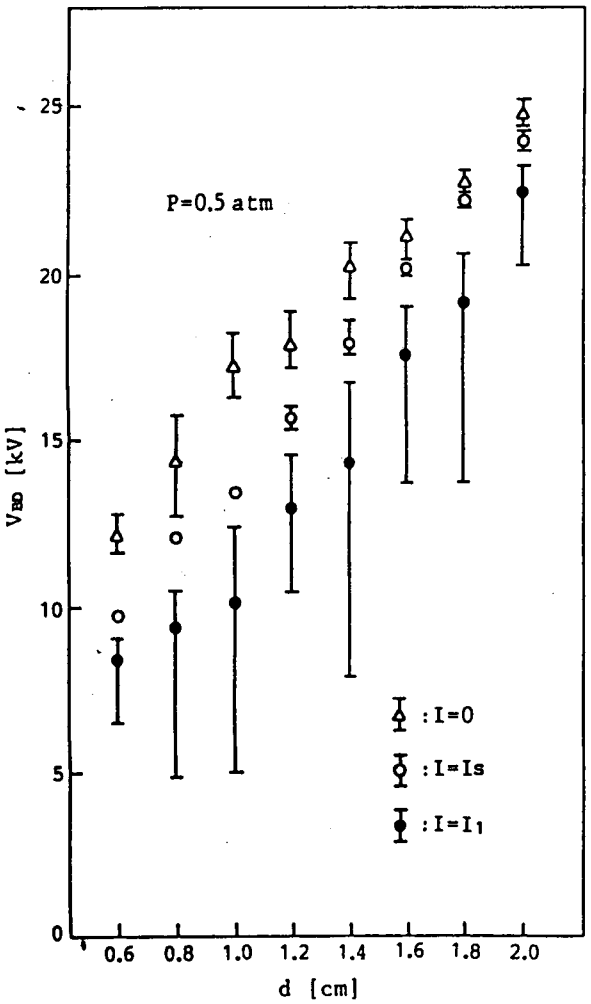

Fig.2,Characteristics of V_{BD}-d(P=0.5atm).

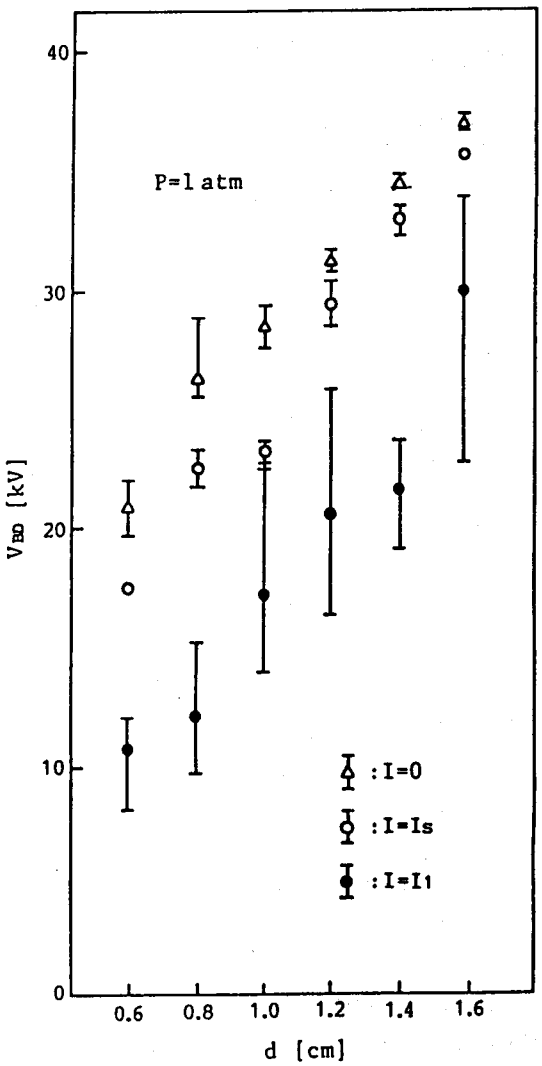

Fig.3, Characteristics of V_{BD}-d(P=1atm).

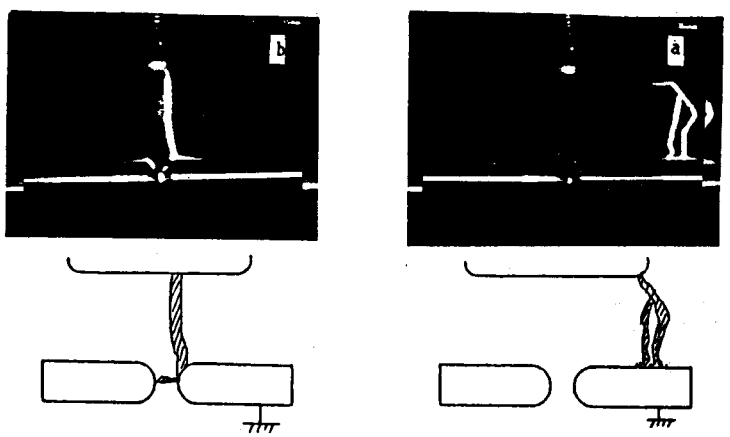

Fig.4, Photographs and configurations for the BD channel with P=0.5atm and d=1.2-?m.(a:small discharge current I=0, b:small discharge current I=I_s).

as shown in Fig.4.b.

Based on the results of these phenomenological observations and previous papers [4,5], possible mechanisms by which the SD could initiate the BD may be explained as follows.

The gas density decreases with increasing the tempercture of the circumference of the BD gap as the result of the SD.Therefore,the V_{BD} decreases with decreasing the gas density of the circumference of the BD gap.

Another version has it that the possible mechanism by which the SD initiates the BD would seem to be associated with the high local electric field around the SD channel enhanced by streamers protruding from its surface.

The V_{BD} when the SD current is I_1 lower than that of I_2 (Fig.2,3).The reasons are as follows. The first reason is that ocurrence of heat when the SD current is I_1 more than that of I_2. The second reason is that relative gap length when the SD current is I_1 shorter than that of I_2. Because, the diameter of discharge channel increases with increasing the discharge current [6].

4.Conclusions

The important results obtained from this investigation are as follows.

The reduction of the V_{BD} to plane electrode due to the small discharge (SD) depends on magnitude of the SD current, the gas pressure P and on the rod-plane distance d.

The possible mechanism by which the SD lowers the V_{BD} was discussed in terms of the results and discussion.

References

[1] K.R.Spriggs,IEEE.Trans.E.I,vol.EI-14,No.3, P.142,1979.

[2] Akira Watanabe, Tatsuzo Hosokawa and Yasunori Miyoshi,Electrical Engineering in Japan,Vol.106,P.37,1986.

[3] Dong-in Lee,IEEE Trans. E.I.vol.EI-21,No.2, P157,1986.

[4] S.Nishiwaki, Y.Kanno, S.Sato, E.Haginomori, S.Yamashita and S.Yanahu,IEEE.PES, 82 WM 187-3,1982.

[5] H.Fujinami, T.Takuma and Y.Aoshima,IEEE.E.I. vol.EI-18,No.4,P.429,1983.

[6] I.Miyaji, Y.Kito, and I.Miyachi,JIEE,vol.92-A,No.10,P.457,1972.

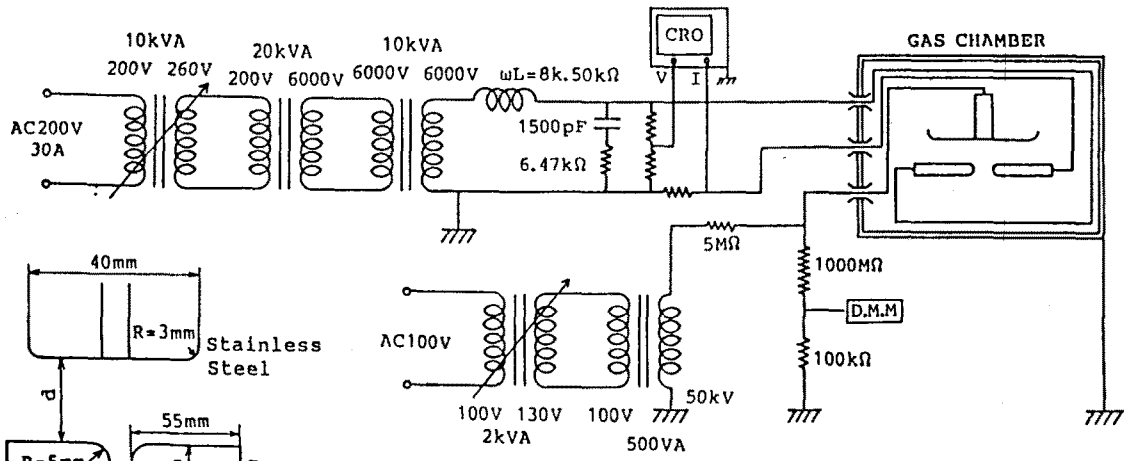

Fig.1 Experimental circuit and gap configuration.