

DEVELOPMENT OF SOLID INSULATED SWITCHGEAR FOR MEDIUM VOLTAGE

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ABSTRACT

Because of SF₆ gases excellent electrical insulating characteristic, they are widely used on electrical equipments as insulating materials for medium voltage and high voltage class. However, these kinds of gases should be controlled to use on electrical equipments for reducing environment pollution. And eco friendly products like epoxy are proved to some extents can replace SF₆ gas and also show high level insulating abilities. Nowadays many companies make efforts to use epoxy on their electrical products such as VCB and switchgears. This paper introduces a kind of epoxy moulded Solid Insulated Switchgear (SIS) for medium voltage class on distribution system in Korea, for the purpose of replacing some parts of gas insulating switchgears (GIS) for Korean Electrical Power Corporation (KEPCO).

INTRODUCTION

SF₆ gases are widely used on electrical equipments on medium voltage and high voltage for distribution and transmission lines. Even though SF₆ gases have excellent electrical insulating characteristic, their shortages on environment pollution make them very difficult for further development. And eco friendly products are needed to instead of SF₆ gas equipments especially on medium voltage distribution lines. Epoxy are proved to some extents can replace SF₆ gas and also show high level insulating abilities.

Nowadays many companies make efforts to use epoxy on their electrical products such as VCB and switchgears. LS industrial system try to use epoxy to make switchgears of 25.8kV on distribution system in Korea, for the purpose of replacing some parts of gas insulating switchgears (GIS) for Korean Electrical Power Corporation (KEPCO). And we apply epoxy on all the part of switchgear even the connecting bus bar for two panels. At the same time, we try to make it functional and modular to realize a variety of combinations to meet different customers' requirements. Because of its high reliability and protection of environment, this Solid Insulated Switchgear (SIS) will be a new concept and further

developing trends for power equipments. In addition to its technical characteristics, SIS meets requirements concerning safety of life and property as well as ease of installation, operation and protecting the environment. [1~4]

STRUCTURE OF SIS

Specification

SIS is fully satisfied with IEC Standard 62271-100, 62271-200 and 60694. The specification of SIS is shown below in **Table 1**.

To satisfy with the strict requirement of KEPCO, our product is designed to fulfill high insulation level than other products. And this kind of switchgear is only half or one third size of air insulation switchgear for same voltage level.

Table 1. Specification of SIS

Item	Specification
Rated voltage	24/25.8 kV (60Hz)
Rated current	630A, 2000 A
Rated withstand voltage	150kV BIL, 70kV/1min
Rated short-time current	25 kA/3sec
Dimension (WxDxH)	600x2050x1850
Degrees of protection	IP4X

And we designed SIS as double bus-line type to meet KEPCO distribution system and single bus-line type to meet normal distribution system. It offers optimum and flexible switchboard configuration for every electrical scheme with the highest safety. It can be used in a wide range of application fields.

SIS switchboards are designed for indoor distribution system, and ever unit is made up of 4 compartments that are low-voltage control compartment, mechanism operation compartment, cable connection compartment and switch compartment. And all of them are separated by metal or insulating partitions. To enhance the safety of people, it is desirable to provide as high a degree of protection as possible by metal coating on the outside of epoxy mold for touching safety.

DS/ES Module of SIS

CB Module cuts off the fault current when fault occurrence in the power system. Disconnecting Switch Module (DS) opens the circuit with a safety distance for maintenance in no-load state. And the role of Earth Switch Module (ES) is that make the remaining charging current in bus to the earth after DS open. DS and ES switch represent a natural interlocking system that prevents incorrect operation. That means the earth switch can be closed only if disconnecting switch on open state. On the contrary disconnecting switch can only be closed when earth switch on open state.

DS and ES are applied one same platform by using same structure and mechanism, and the only different are bus line modules. It can be shown on **Figure 1**. Both of the switches are using sliding rod switching method. The shaft housing that can both insulate by electric and operate ON/OFF by mechanical rotating inside the epoxy. Moving-contact rotation is driven by a fast-acting mechanism through epoxy rotator, which can be seen on **Figure 2**.

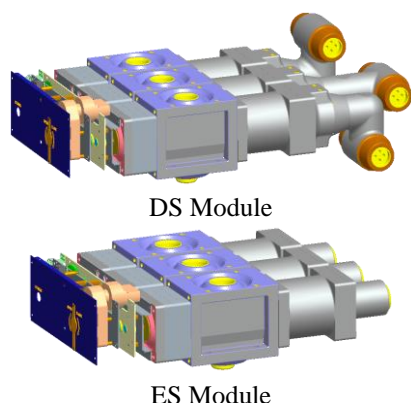


Figure 1. Structure of DS/ES

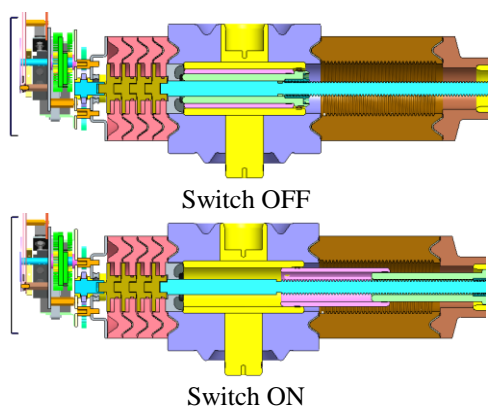


Figure 2. Positions of DS/ES

Connection of busline

SIS units can be easily connected together by using flexible solid bus bar and silicone cover. The connecting bus bar is developed for connecting two panels which is 2000A. And the end part of DS module is designed as connectable bus line for two panels. All of the bus lines of different SIS units are designed in the same horizontal plane, thus enabling later switchboard extensions and connection to existing equipment. And the three insulated bus bars are parallel-mounted.

Before inserting bus bar, it is need to install an extension conductor on the end of bus line module to fit the bus bar conductor. And the bus bar conductor and bus line conductor are fixed by rings ⑩ as shown on **Figure 3**. After fixing the bus bar, slide on the silicone cover from bus bar side for insulation. The end port of bus line which is temporarily not in use or later extension is also covered with silicone end cover. Outside the silicone cover, we use metal cover to fix it and also let it connect to the earth for safety.

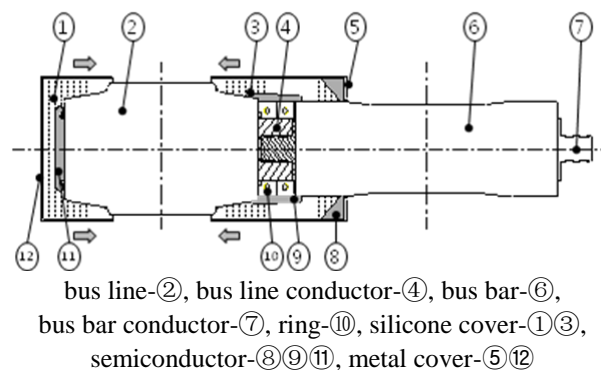


Figure 3. Connection method of bus bar

As shown on Figure 3, the interface of conductor and epoxy is normally high electrical field intensity, such as part ③. For reducing electric field concentration on the conductor part of bus bar, we use semiconductor combined with silicone to soften high electrical field intensity part. And it is worth to mention that the end part of silicone cover also combine with semiconductor. The metal cover ⑤ and the surface of bus bar are all connected to earth. In order to soften the electrical field intensity on the end part of silicone cover, we also add semiconductor to reduce the intensity of electrical field. And this kind of bus line is very easy for later extension. It only need to seal up the end of bus line by using end silicone cover ① for temporarily not in use. When other function blocks need to extend, just open the end silicone cover and connect the bus line conductor to finish extension.

CONCLUSIONS

SIS is high technology integrated product that it considered advanced reliability, economical efficiency, safety, maintenance free, reduction of installation area and the protection of environment.

And the most convenient point that worth to be mentioned is all SIS module components can be re-assembled to form different function block to fulfill customer's requirement. And all the component modules have stability through electrical analysis by switchgear of new concept. The composition of single line and double line are possible easily in one Panel and suit for any power system. And these module components had achieved product of high reliability through great many tests to satisfy with KEPCO's strict requirement.

From now on, we expect to contribute in industry activation of power equipment field and elevation of power stability through development of this eco-friendly & a higher value-added SIS.

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