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COUNTRY :	Japan	PREF. SUBJECT :PS 3
REGISTRATION NUMBER : 7312		QUESTION N° : PS 3.1

Q PS3.1 : Which measures are necessary to increase the acceptance of intelligent IoT-based power equipment in substations ?

Environmental consideration on IoT -based power equipment in HV/EHV outdoor substation

1. Introduction

In increasing the acceptance of intelligent IoT-based power equipment in substations, it is necessary to determine equipment specifications and develop with full consideration on an environmental aspect (i.e., temperature, humidity, and switching surge etc.) which is expected in actual HV/EHV substations. In Japan, actual measurements of switching surges in 500kV substations have been conducted by domestic research groups. Based on these experiences, we have developed an IoT based intelligent equipment called equipent monitoring unit (EMU) that can be implemented close to HV/EHV switchgear, especially in outdoor. EMU specifications are based on consideration of environmental resistance to high/low temperatures, high humidity, high switching surges, and differences in indoor/outdoor installation environments, and are in accordance with current standards and provide equal or better performance. By fully considering these environmental resistance features, it is expected to increase the acceptance of intelligent IoT-based power equipment in substations.

2. Measured switching surge in 500kV substation in Japan

In Japan, actual surge measurements of GIS installed outdoors at EHV substations have been occurred. As an example, a measurement for 550kV GIS is presented here(Figure 1). The switching surge observed during the open-operation of disconnectors was actually measured. As shown in Figure 2, surge voltages of close to 5 kV were observed at measurement points C1 and C2. This result is referenced in the latest IEC (IEC 61869-13 Annex13B [1]).

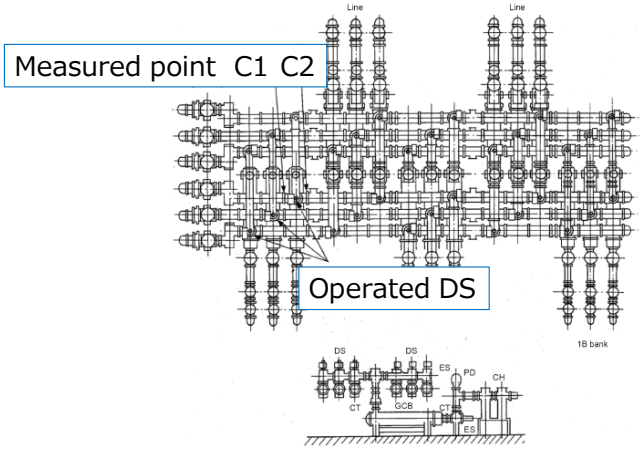

Figure-1 Measured 550kV GIS construction

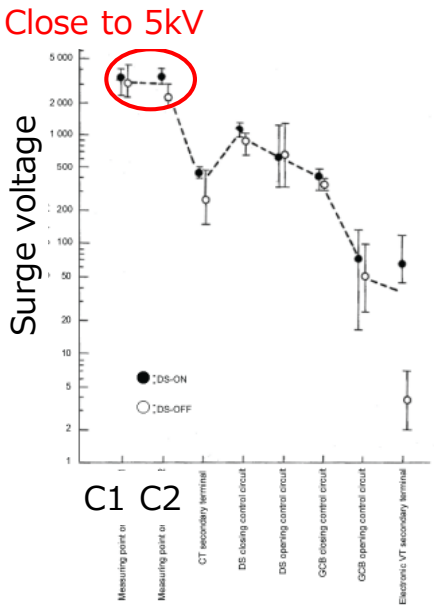

Figure-2 Measurement results

3. Measured temperature and humidity in local control panel of outdoor GIS

Next, we introduce a field test being conducted on the outdoor GIS of a substation. A control panel and equipment operation box, which may house electronic equipment, were prepared and field tested under the conditions shown in Figure 3.The field tests were conducted for 16 months between July, 1999 and November, 2000. The results are shown in Table 1. [2] The results show that when the outside temperature is close to 40°C, the inside temperature is close to 60°C.

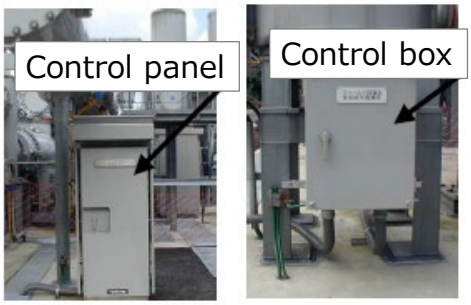

Figure-3 The view of field test

	Test results
Temperature	• 12K temperature rise inside the panel/box due to solar radiation. • Shielded plate reduced temperature rise to 6K due to solar radiation.
Humidity	• The relative humidity reduction was about 20-30% with the use of space-heaters and about 50% with the use of dehumidifiers.

Table-1 Test results

4. Developed equipment monitoring unit

Based on these experiences, we have developed an IoT based intelligent equipment called equipent monitoring unit (EMU) that can be implemented close to HV/EHV switchgear, especially in outdoor (Figure 4). In order to increase the acceptance of intelligent IoT-based power equipment in substations, it is necessary to install EMUs near the equipment (e.g., GIS) to collect data for the equipment. But at the time of development, there were no standards specifying for such cases. Therefore, based on the aforementioned experience, the development specifications shown in Table 2 were determined and developed. Currently, the IEC (IEC 61869-13 of SUMU) is published, which also specifies voltage resistance, etc., assuming installation near equipment.

Figure-4 The view of EMU

	Development Specification	IEC 61869-13
Impulse-voltage withstand capability	7kV	6kV
Rated ambient temperature	-20℃～+60℃ (No condensation)	-5℃～+55℃

Table-2 Specification of EMU

5. Conclusion

Intelligent IoT-based power equipment installed near the equipment (edge) must have performance commensurate with the surge voltage and temperature and humidity conditions generated by the HV/EHV substation.We believe that the latest SUMU IEC standard, which reflects the results of surge voltage measurements in Japan, should be adopted for equipment monitoring systems.This ensures long-term reliability. In addition, new needs on security may be considered and reflected in the future.

[1] IEC 61869-13 Annex13B
[2] Emi Kurosaki, Koji Kawakita et al., “Research and Test of Outside Cubicle's Environmental Condition in Substation”, IEEJ (2001) 6-308