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Analyses of the Insulators' Radiation Noises for Error Detections

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1. Introduction

The porcelain insulators are important devices on the high-voltage power transmission systems. They are used to isolate electrically and hold mechanically in the systems[1-2]. The errors of the insulators occure very serious problems for supporting the power system. There are several test methods for detection, inspection, and diagonsis of the insulators – the technique by the voltage and isolation resistance, the technique by the electric field, the technique by the infra-red image, technique by the ultrasound, and etc[1, 3]. Each methods have their merits and demerits, so it is needed to use combined methods.

In this paper, we introduce the technique for the error detection of the insulators by the acoustic radiation sound from them. We measured radiation sounds from the normal state insulators and the error state insulators. We suggest the technique for error detection from their frequency spectrums.

2. Measurements and Analyses of the sounds from the insulators

For the measurement of the radiation noises from the insulators, we used the system shown as **Fig. 1**. The insulator was connected to AC high voltage tester provided AC 0-60,000V. The used microphone was B&K 1/2 inch condensor microphone Type 4130, its frequency ranges were 5Hz-12.5kHz, so it was chosen the sampling frequency as 40kHz/s. the pre-amplifier was B&K Type 2642, the power supply was B&K Type 2810 and the data acqusition device was NI USB-9233 were conneted to the notebook pc.

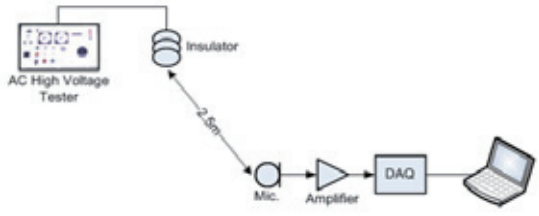
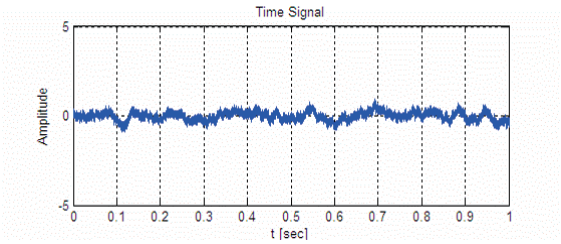


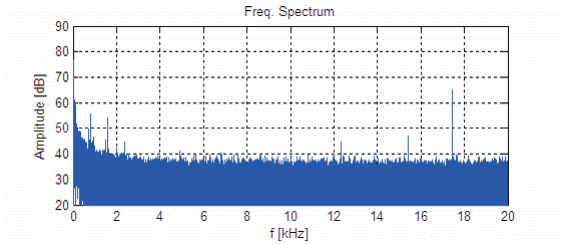
Fig. 1 Diagram for measurement of radiation noise from the insulator

To analysis of the error state insulator's radiation noises, the frequency spectrums were calculated by the FFT. The used insulator were two-plate suspension insulator, three-plate suspension insulator and a line poster.

At first, the characteristics of the ambient noise were shown in **Fig. 2**. From Fig. 2, (a) is the time signal, (b) is the frequency spectrum from 0Hz to 20kHz. In the time signal, there was no apparent characteristics. In the frequency spectrums, the peak components about 800Hz, 1.6kHz, 12kHz, 15kHz and 17kHz were appeared, these were not the characteristics from the insulators and appeared the others' results. So we would skip to ment these components regard as real ambient noises. Except above the peak components, there were not apparent components and were just exponentially decaded frequency spectrum. The average level was about 31dB.



(a)



(b)

Fig. 2 The characteristics of the ambient noises

Second, the characteristics of two-plate suspension insulator were shown in **Fig. 3**. In the time signal, we could find many spike signals and a periodic signal. In the frequency spectrums, the entire spectrum was increased about 10dB than the noise's spectrum and the peak components were appeared at 120Hz, 240Hz, 480Hz, 600Hz and so on. It means the harmonic components of 120Hz component. The average level was about 43.7dB.

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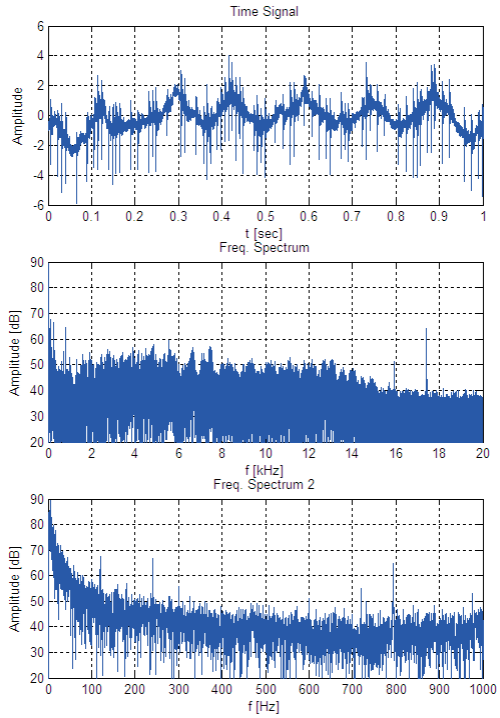

Fig. 3 The characteristics of the two-plate suspension insulator

The next, the characteristics of the three-plate suspension insulator were shown in **Fig. 4**. Both the characteristics of the time signal and frequency spectrum were similar to the two-plate suspension insulator. The average level was about 40.7dB.

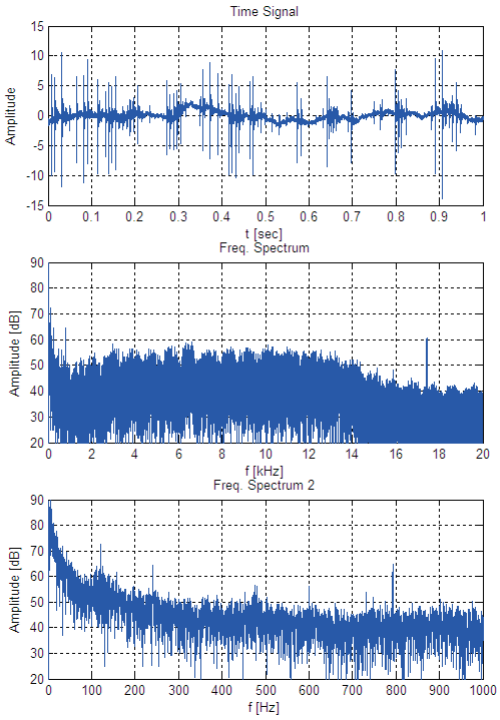

Fig. 4 The characteristics of the three-plate suspension insulator

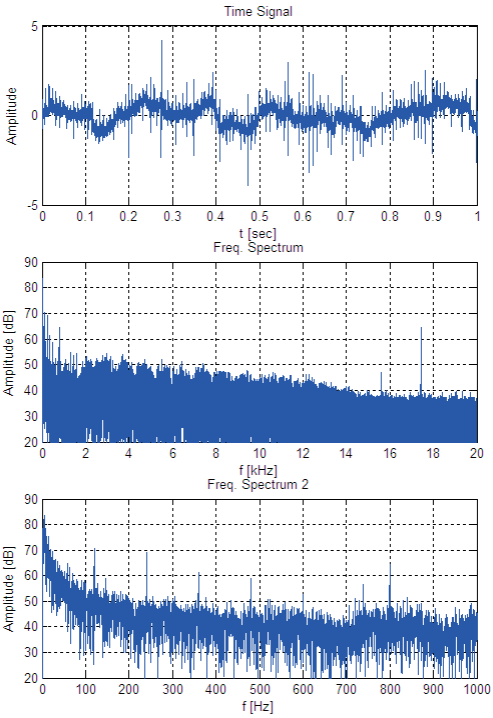

Fig. 5 The characteristics of the line poster

At last, the characteristics of the line poster were shown in **Fig. 5**. Both the characteristics of the time signal and frequency spectrum were similar to the suspension insulators. The spikes in the frequency spectrum are clearer than the suspension insulators. The high frequency components were more deep decreased than the others. As the results, the average level was about 37.6dB.

3. Conclusions

We measured the noises from the three error state insulators and presented their frequency spectrums by the FFT. From the frequency spectrums, we found the difference frequency components from the normal state insulators. First one is that the entire spectrum is increased about 10dB than the normal states. The rest one is that there are the components of the harmonics of 120Hz. These two apparent results would be used to detect the error state insulators and diagnose of them.

References

1. JongMin Kim: Risk Management *in Korean*, fall (2007)
2. Wilbur R Vincent *et al.*: *Power-Line Noise Mitigation Handbook for Naval and Other Receiving Sites* (Naval Postgraduate School, 2007)
3. Hao Lu: Proc. of the Electronics Eng. of Korea, **30**, (2007) 291.