Evaluation of a Spring-Viscous Damper Vibration Isolation System by Measuring the Vibration of the Emergency Diesel Generator

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1. Introduction

The Emergency Diesel Generator (EDG) is a very important piece of equipment for the safety of a Nuclear Power Plant (NPP). In this study, the operating vibration of two kinds of EDG system was measured. The target EDG systems are Yonggwang 5,6 unit and Ulchin 3,4 unit. Each EDG system is the same type but the foundation systems are different. One is an anchor bolt type and the other is a spring and viscous-damper type. The purpose of this measurement is for a verification of the vibration isolation effect of a spring-viscous damper system. As a result, it can be said that the spring and viscous damper system of the EDG performed well for the vibration isolation.

2. Measurement Overview

2.1 Emergency Diesel Generator

The Emergency Diesel Generators of this test are of the same type. A figure of the EDG is shown in Figure 1. The model is 16PC2-5V400 manufactured by the SEMT Pielstick corporation. This EDG generates seven thousand million kilowatts of electricity and the velocity is 541 RPM. The EDG operates for 1 hour every one month.

Fig. 1 Emergency Diesel Generator

2.2 Foundation System

The foundation systems are shown in Fig. 2. As shown in the Figure 2(a), the foundation of Yonggwang 5,6 unit is an anchor bolt type. On the other hand, the coil spring and viscous damper system is used in the EDG of Ulchin 3,4 unit. This spring-viscous damper system was installed for reducing the operation vibration.

(a) Yonggwang 5,6 (b) Ulchin 3,4

Fig. 2 The Foundation of EDG

2.3 Vibration Measurement

For the measurement of the vibration of the operating EDG, a measurement system was installed as shown in the Figure 3. As shown in Figure 4, there are eight accelerometers used in this measurement. Six accelerometers are installed on the foundation, one is on the body of the EDG and the other is on the outside of the foundation. A signal conditioner & power unit, tape recorder and signal analyzer were used also. For comparing the foundation systems, a vibration was measured for four cases; before operation, start to the full power operation, normal operation and shut down operation. Time and frequency domain responses are measured.

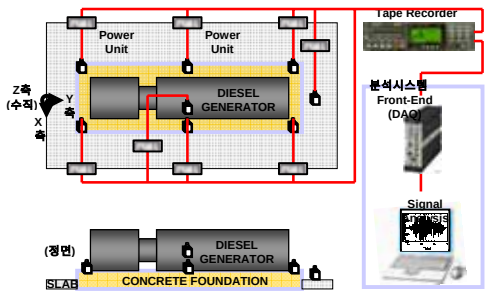


Fig. 3. Schematic Diagram of Measurement System

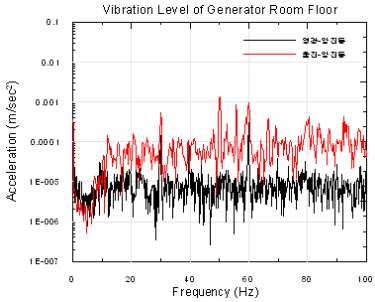
3. Measurement Result

3.1 Acceleration Response

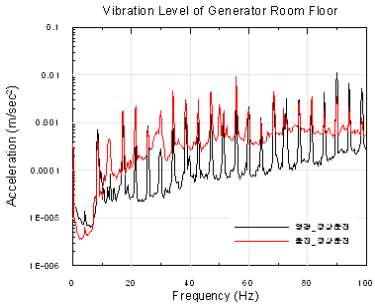
One of the measurement results is shown in Table 1. The results of the frequency ranges are 1-100Hz. The foundation means the concrete foundation of the EDG, the body point means the EDG itself and the floor means a separate ground position of the foundation of the EDG. Therefore, it can be said that the differences in the vibration of the foundation and the floor point responses are the isolation effect. One of the frequency responses is shown in Figure 4.

Table 1. Vibration Measurement of EDG

Status	Measuring Location	Yonggwang 5		Ulchin 3(Spring)	
		Peak [m/s2]	Peak [dB]	Peak [m/s2]	Peak [dB]
Before Operation	Foundation	0.004	52.5	0.023	67.3
	Body	0.183	85.2	0.036	71.1
	Floor	0.003	48.0	0.038	71.6
Normal Operation	Foundation	0.187	85.4	3.202	110.1
	Body	1.056	100.5	1.997	106.0
	Floor	0.071	77.1	0.048	73.7



(a) Yonggwang 5 unit EDG



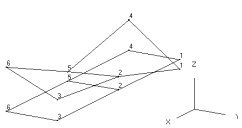
(b) Yonggwang 5 unit EDG

Figure 4. Frequency Response of EDG at the Floor[1]

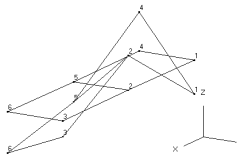
As shown in Table 1 and Figure 4, the shut down vibration of the Ulchin unit is much higher than that of the Yonggwang. The Diesel Generator room of the Ulchin unit has a lot of noise and vibration because of anther reason like the fans. But the vibration of the Ulchin unit does not increase much during the operation time. The peak response of the Yonggwang 5 unit EDG floor measured 0.003m/s^2 at the before operation and 0.071m/s^2 at a normal operation. In the case of the Ulchin 3 unit EDG, 0.038m/s^2 was measured at the before operation and 0.048m/s^2 measured during the operation. As a result, the increment of the Yonggwang 5 unit as the operation progress is almost 24 times, but in the case of the Ulchin unit only 1.5 times. It means that the spring and viscous damper system works well for vibration isolation.

3.2 Operating Deformation Shape

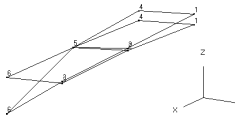
The operating deformation shape presents the real structural behavior of the special frequencies. The operation deformations of two kinds of frequencies are shown in the Figure 5. As shown in Figure 5, the operation deformations are fairly different in spite of the same EDF type and frequencies. This shows the differences of the foundation systems. But it is very difficult to compare the responses of the two EDG systems directly. Although the two EDG systems are the same model the surrounding of each EDG system is not same. Therefore, it requires more numerical analysis for more meaningful results.



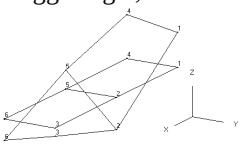
(a) Yonggwang 5, 4.25Hz



(b) Yonggwang 5, 8.5Hz



(c) Ulchin 3, 4.25Hz



(d) Ulchin 3, 8.5Hz

Fig. 5 Operating Deformation Shape of EDG[1]

4. Conclusion

In this study, the operating vibration of two kinds of EDG systems was measured. The purpose of this measurement is a verification of the vibration isolation effect of the spring-viscous damper system. As a result, it can be said that the spring and viscous damper system of the EDG performed well for a vibration isolation.

ACKNOWLEDGEMENT

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REFERENCES

[1] VE Tech Corporation, 2005, Vibration Measurement Report of Emergency Diesel Generator in the Nuclear Power Plant.