Magnetic Field Strength with distance from equipment at NPPs

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1. Introduction

Magnetic fields may adversely affect power plant equipment. There are insufficient measurement data to determine the level of magnetic field strength at power plants. Equipment is not intended to be installed in areas including strong sources of magnetic fields such as transformers, motors, electric fans and power suppliers carrying high currents. There are needs to measure the data on the strength of radiated magnetic fields in power plants. In this study, we measured some of the high strength low-frequency magnetic fields radiated by sources that can be used in NPPs at various distances, and the difference between theoretical and measured values is presented.

2. Methods and Results

This section evaluates the effect of the magnetic field on the equipment and devices by measuring the magnetic field strength over distance.

2.1 Test measurements

The low-frequency radiated magnetic field strengths of each source were measured over distance as shown in Fig. 1. Some of the typical low-frequency magnetic field sources in NPPs include LCD monitors, power supplies (AC Slidac), cable reels, mobile phones, electrical fans, electric drivers, and others.

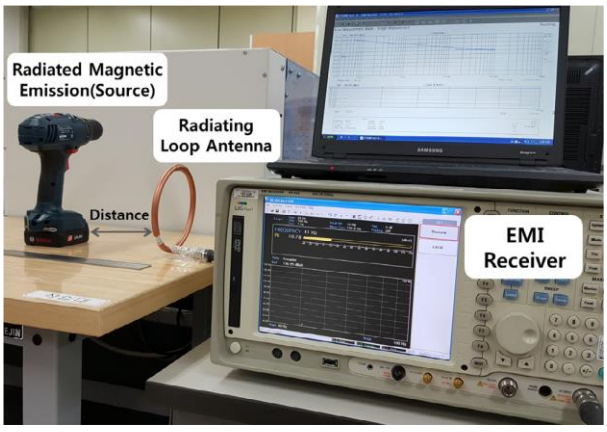

Fig. 1. Measurement of low-frequency radiated magnetic field emissions

2.2 Magnetic field strength over distance

The test results of the measured magnetic field strengths are shown in Fig. 2. All of the measured low-frequency radiated magnetic field strengths were less than the RS101 envelope in RG 1.180 revision 1. The largest field strength measured was 11.9 A/m (143 dBpT) at 0 cm. The source of this largest measured magnetic field was AC Slidac; Thus, to maximize the strength of the low-frequency field for the test, a large current was intentionally applied to the AC Slidac. Most of the measured field strengths were less than 6.31 A/m (138 dBpT) [1].

Through distance-specific measurements, it was learned that the strength of the low-frequency radiated magnetic fields dramatically decreased as the distance from the source increased. When the equipment was installed more than 30 cm away, the strength of the radiated magnetic fields was even less than the RS101 lowest envelop (0.5 A/m, 116 dBpT) at 100 kHz frequency.

Therefore, if magnetic field sources such as electrical fans, LCD Monitors and power supplies is away by more than 40 cm from the safety-related Equipment in NPPs, there will not be affect by the magnetic field.

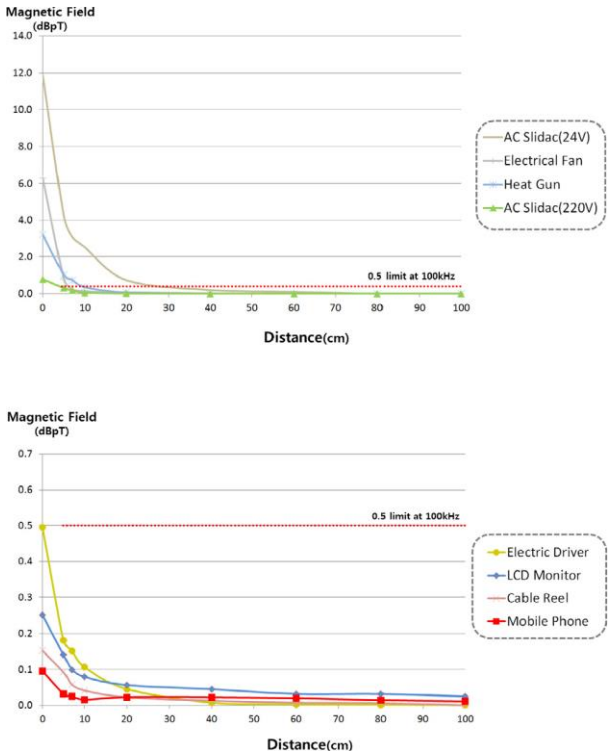

Fig. 2. Low-frequency radiated magnetic field strength over distance

2.3 Comparisons between Theoretical and Actual Value

In C.2 of RG 1.180 Revision 2 describes the magnetic field strength over distance. A schematic diagram of the description is shown in Fig. 3. This diagram is theoretical[2,3,4].

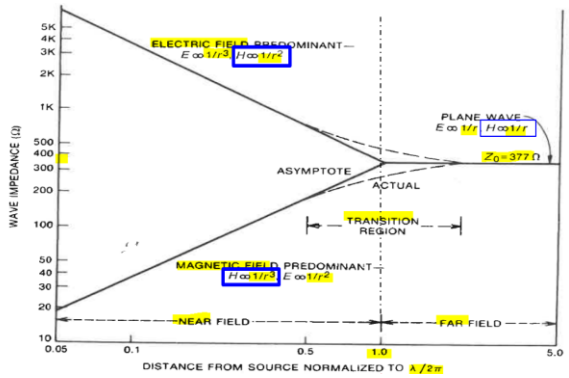

Fig. 3. Theoretical Diagram of the magnetic field strength over distance in C.2 of RG 1.180 Revision 2

Based on the data through measurement, the actual schematic is shown in Fig. 4. As a result of the measurement at Slidac AC 220V equipment, the actual decrease in magnetic field strength with distance is inversely proportional to the square of the distance and the cube.

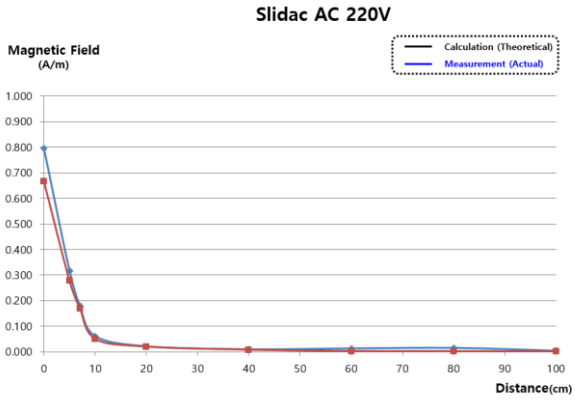

Fig. 4. Actual Diagram of the magnetic field strength over distance at Slide AC equipment

It was confirmed that there was little difference between the theoretical and the actual measured value at interval more than 7 cm from Slidac AC 220 equipment.

3. Conclusions

The radiated magnetic fields generated by sources in power plants can inference the reliable operation of digital systems. Since magnetic field sources are often installed near safety related equipment in an EER(Electrical Equipment Room) and MCR(Main Control Room), the radiated magnetic fields needs to be reasonably identified over distances. Some of the sources of high radiated magnetic fields in NPPs include LCD monitors, power supplies, cable reels, mobile phones, electrical fans, and others. In this study, all of the measured strengths of radiated magnetic fields were bounded by the envelope of RS101 in RG 1.180 revision 1. It was learned that the radiated magnetic fields can be considered as long as the safety-related I&C system is separated by 40 cm from the magnetic field sources.

This study verified by experiment that actual decrease in magnetic field strength with distance is inversely proportional to the square of the distance and the cube. Experiments on several equipment confirmed that there was little difference between the theoretical and the actual measured value.

REFERENCES

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