

# SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

## RELATED TO THE USE OF MILES LASER SYSTEMS

### DURING FORCE ON FORCE EXERCISES AT NUCLEAR POWER PLANTS

#### 1.0 INTRODUCTION

By memorandum dated February 7, 2003, the Office of Nuclear Security and Incident Response (NSIR) asked the Office of Nuclear Reactor Regulation (NRR) to determine whether the use of the Multiple Integrated Laser Engagement System (MILES) within nuclear power plants could adversely affect the proper operation of plant instrumentation and control (I&C) systems. In addition, NSIR asked NRR to evaluate the potential hazard of the laser light on personnel, and the effect of smoke produced by the blank cartridges used in the MILES weapons on plant equipment.

#### 2.0 REGULATORY EVALUATION

In order to ensure the electromagnetic compatibility of electronic equipment installed in nuclear power plants, Regulatory Guide (RG) 1.180, "Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems " was issued in January 2000. This RG confirmed Electric Power Research Institute (EPRI) topical report TR-102323, "Guidelines for Electromagnetic Interference Testing in Power Plants," as a method of addressing issues of EMC for safety-related digital I&C systems in nuclear power plants. EPRI submitted Topical Report TR-102323 for staff review in 1994, and by letter dated April 17, 1996, the NRC staff issued a safety evaluation concluding that the recommendations and guidelines in TR-102323 provide an adequate method for qualifying digital I&C equipment for a plant's electromagnetic environment.

The MILES equipment is different from the type of equipment which TR-102323 was written to qualify, in that the MILES equipment is hand-held, not wired into the plant. Therefore, no determination of conducted electromagnetic interference (EMI) is necessary. In addition, since the MILES equipment is not a safety-related system and is only used for guard force exercises, there is no requirement that the MILES equipment have immunity from EMI emissions of other plant equipment. The susceptibility of the MILES equipment will therefore not be addressed. The only requirement is that the EMI emissions from the MILES system not interfere with the operation of plant systems, and for this reason, only the EMI from radiated emissions will be considered.

The light from a laser source has the potential for being a hazard to humans; however, there is no NRC regulation concerning the use of laser light within a nuclear power plant. The safety aspects of laser light are regulated by 21 CFR 1040, and those aspects were reviewed.

The smoke produced by the blank cartridges used in the MILES weapons has the potential for interfering with smoke detectors within the power plant. Again, there are no specific NRC regulations concerning the smoke emissions from gunfire, however there have been several Nuclear Regulatory Guidance Reports (NUREG's) concerning the effects of smoke on electronic equipment.

### 3.0 TECHNICAL EVALUATION

#### 3.1 Electronic Emissions

The MILES equipment has been tested for conformance with the requirements of MIL-STD-461E using the Army ground criteria, Radiated Emissions, Electric Field, RE102. The radiated emissions allowed by this test is 24 dB $\mu$ V/m for 2 MHz to 100 MHz, and then ramping up to 44 dB $\mu$ V/m at 1 GHz. Therefore, anywhere within the 2 MHz to 1 GHz range, the equipment is allowed to radiate no more than 44 dB $\mu$ V/m. The test results on the MILES 2000 equipment was supplied to the staff by Cubic Defense Applications, 9333 Balboa Avenue, San Diego, California. The test was performed by TÜV Product Services, 10040 Mesa Rim Road, San Diego, California, in October and November 2000. The test results showed that the MILES 2000 equipment passed the electric field radiated emissions test RE102 with one exception. The Helmet and Torso detector assembly, at 49.27 MHz, radiated an E-field of 24.4 dB $\mu$ V/m, which is 0.4 dB $\mu$ V/m higher than allowed by RE102.

The equivalent test listed in EPRI TR-102323 for Electric Field Radiated Emissions has a somewhat higher limit for radiated emissions. The limit is a slope from 80 dB $\mu$ V/m at 1 KHz to 60 dB $\mu$ V/m at 1 GHz. Therefore, anywhere within the 1 KHz to 1 GHz range, the equipment is allowed to radiate no more than 60 dB $\mu$ V/m. This is 16 dB higher than the military requirement. While the two tests are not exactly the same, they are similar enough to allow comparison. The test methodology in both cases is the same, as EPRI TR-102323 specifies the Mil-Std-461 RE102 methodology.

Since the MILES equipment met Mil-Std-461 RE102 requirements with the exception of one 0.4 dB $\mu$ V/m spike above the required maximum of 24 dB $\mu$ V/m, it will meet the requirements of EPRI TR-102323. The 0.4 dB $\mu$ V/m spike is significantly lower than the 16dB margin between the military and EPRI requirement. Since the MILES equipment meets the requirements of EPRI TR-102323, this equipment will not affect the safety related instrumentation in nuclear power plants.

The only equipment test results presented to the staff for review were of the MILES 2000 equipment, and therefore only the MILES 2000 equipment has been shown to pass the requirements of EPRI TR-102323. Honeywell Federal Manufacturing & Technologies, the manufacturer of the MILES and MILES 2000 equipment had determined that the emissions testing performed on the MILES 2000 equipment is applicable to the older MILES equipment. Since the older MILES equipment does not have the inductive loop communications link between the headband detector assembly and the vest, the actual emissions from the older MILES equipment is expected to be less than that from the MILES 2000. The staff concurs that based on the testing performed and considerations discussed above, that there is reasonable assurance that EMI/RFI emissions from the MILES equipment will not affect the safety related instrumentation in nuclear power plants.

#### 3.2 Laser Light Emissions

There is no specific NRC regulation concerning for the use of laser light within a nuclear power plant. Honeywell Federal Manufacturing & Technologies, the manufacturer of the MILES equipment, has stated that the MILES small arms transmitter is certified to be ANSI Class 1 devices. 21 CFR 1040.10(b)(5) defines Class 1 laser products as not considered to be

hazardous. This provides reasonable assurance that the MILES equipment will not present a personnel hazard.

### 3.3 Smoke Emissions

The smoke produced by blank cartridges has the potential for damaging electronic circuit boards within the electronic equipment within the power plant; but again, there are no specific NRC regulations concerning the smoke emissions from gunfire. There have been five NUREGs that address the effect of smoke on electronic equipment, NUREG/CR-6476, NUREG/CR-6406, NUREG/CR-6543, NUREG/CR-6579, and NUREG/CR-6597. The determination was that since there is no practical repeatable testing methodology, it was not feasible to assess smoke susceptibility. In general, the NRC has determined that the electronic equipment is less susceptible to smoke damage than personnel, therefore, unless the smoke is sufficiently dense that the location must be evacuated, the probability of smoke damage to electronic plant equipment is minimal.

The second possibility of smoke problems concerns the possibility of smoke interfering with or activating smoke detectors within the power plant. The amount of smoke and the potential hazard would depend on the amount of blank shells fired, the location, and the ventilation. In addition, smoke detector sensitivity and location are plant specific. These make it impossible to determine, on a generic basis, that the smoke will not trigger the smoke detectors. This must be a plant specific determination.

### 4.0 CONCLUSION

The NRR staff has concluded, based on the considerations discussed above, that there is reasonable assurance that the MILES equipment will not affect the safety related instrumentation in nuclear power plants. In addition, there is reasonable assurance that the use of MILES equipment will not present a personnel hazard. The effect of smoke on the smoke detectors within nuclear power plants is undetermined, and will require plant specific analysis.

Principal Contributor: Paul J. Loeser

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