CONDUCTING AN RF/MICROWAVE HAZARD SURVEY

The onsite survey should be considered the primary basis for ensuring compliance with RF/microwave radiation regulations. Survey procedure, control techniques and a report outline are detailed.

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INTRODUCTION

An onsite survey is absolutely imperative in order to have a total understanding of the RF/microwave field conditions in an area of interest. Moreover, when conducted by an experienced surveyor, it can yield highly accurate and reproducible results. On the other hand, a survey accomplished by an inexperienced person can lead to erroneous data and false conclusions, possibly even to the damaging of expensive monitoring equipment. Theoretical calculations do not possess the reliability achieved through authentic measurements and should be applied only as a starting point and general guide for conducting a "hands on" survey. At the present state of the art, the onsite survey should remain the basis for ensuring compliance with appropriate regulations.

SURVEY PROCEDURE

In general, a survey should entail consideration of the following:

- Emitter characteristics and operating parameters.
- Purpose and use of the emitter.
- Site configuration and terrain.
- Procedures followed in all phases of operation, including maintenance and testing.
- Magnitude of power densities created by the emitter.
- Extent of potentially hazardous and hazardous areas, both on and off site.
- Presence of ionizing radiation attributable to microwave generating equipment, such as klystrons, thyratrons, traveling wave tubes, etc.
- Control techniques which will effectively reduce potential hazards. In this regard, application of the ALARA principle -- "as low as reasonably achievable" -- should be paramount in the surveyor's mind.
- Any other situations which may create a hazardous area (noise, chemicals, ventilation, high voltage, etc.). If the surveyor is not an expert in these fields, he or she should refer any questionable situations to the appropriate individuals in the organization.

Control techniques to reduce necessary personnel exposure will generally fall into one of two categories:

1. Limiting the traverse of the radiated beam so it does not radiate into occupied areas, or
2. Limiting the access of personnel into areas where hazardous power densities exist.

If an evaluation of the RF/microwave hazards of an installation reveals the existence of limited occupancy or denied occupancy areas, the following measures may be used to reduce unnecessary exposures:

- Appropriate warning signs should be posted conspicuously at all potentially hazardous and hazardous areas. Standard internationally recognized RF/microwave warning signals should be used. Homemade signs or those appropriate for ionizing radiation exposure situations should never be utilized.
- Where operations allow, equipment positioning should be restricted in order to minimize the extent of exposure areas, thereby reducing unnecessary hazards. These restrictions can be implemented through the installation of cut-off devices in the electrical or mechanical components of a system which will automatically terminate transmission when the antenna is pointed in a predetermined direction. Such cut-off devices are much more desirable than simply instructing personnel not to point a system in a certain direction, even though these instructions may be in a standard operating procedure.
- During test or maintenance procedures requiring free space radiation, the use of appropriate antenna positioning restrictions is necessary if the power densities exceed the permissible exposure limit (PEL).

- The use of dummy loads to absorb microwave energy output is recommended when free space transmission is not necessary. These dummy loads should also be checked for leakage.
- The use of barriers, interlocks and visible/audible warnings is required to prevent ingress by personnel into denied occupancy areas.
- Where an antenna is not permanently installed, the antenna may be relocated to reduce power densities in exposure areas to acceptable levels.
- In situations where operations would be unduly restricted by implementation of the above methods, suitable attenuation of power density levels may be accomplished in the irradiated areas of shielding. The RF/microwave attenuation factors of wire mesh, window glass, and concrete block are well known. This method is *only* recommended in the most extreme circumstances.
- The use of microwave protective clothing and eyewear can be considered, again in the most extreme circumstances *only*. The use of engineering or administrative controls are usually sufficient to control RF/microwave radiation hazards.

SURVEY REPORT

Upon the completion of a survey, the results should be written up as a formal report. Items contained in the report should include, but are not limited to:

- Theoretical calculations carried out prior to the survey
- Types of instruments utilized in the survey and their calibration dates
- PEL hazard radius and height above the ground
- All areas in which the PEL is exceeded
- RF/microwave power density levels at work stations and in "normally accessible" areas
- The presence of "hot spots"
- Adequacy of warning signals and access-limiting devices
- Adequacy of any standard procedures use to limit or to avoid exposure
- Personnel attitudes (if appropriate)
- Conclusions and recommendations
- Diagrams and or photographs

Documentation is extremely important. In the case of legal difficulties, the contents of the report will be scrutinized very carefully.

SUMMARY

In conclusion, it should be stressed that even the most elaborate protective procedures and devices will be rendered ineffective unless all personnel concerned are cognizant of the potential hazards to which they may be exposed and of the measures employed to ensure their safety. There are many misconceptions as to the nature, magnitude, and extent of hazards attributable to RF/microwave radiation. The importance of an adequate personnel instruction and training program cannot be overemphasized. This should be considered a prerequisite for any comprehensive policy designed to minimize these hazards.

DISCLAIMER

This article was prepared when the author was an independent consultant. Any opinions, conclusions, or recommendations expressed in this article are therefore the author's own, and do not necessarily reflect the views of Battelle Pacific Northwest Laboratories.

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