



Marine Radars Mounted on Small Craft

Introduction

Many small marine vessels such as pleasure craft, police launches or fishing boats are equipped with a navigational radar of modest power (up to 10 kW). Given the small size of these vessels, the radar antenna is sometimes mounted in close proximity to areas accessible to persons either on the boat itself or on nearby structures (e.g. a jetty). It is possible, although not probable, that these persons may be exposed to levels of microwave radiation above the recommended limits.

What is a Radar?

A radar emits short pulses of microwave radiation, which, like light, is reflected by obstacles. The radar detects the reflected pulses and, from the time delay between the emission of the pulse and the arrival of its reflection, calculates the distance of the obstacle. This process is repeated in every direction as the antenna scans the horizon. The resulting information is displayed on a fluorescent screen as a 360° pictorial representation of the area surrounding the craft.

Are Microwaves Hazardous?

They can be if the intensity is sufficiently high. Microwaves are absorbed by living tissue and their energy is converted to heat that may easily damage some organs, particularly the eyes, which may develop cataracts. It has also been shown that long-term exposure to low levels of microwave radiation can induce a variety of physiological effects in small laboratory animals. The importance of these effects and their relevance to the case of human exposure are not yet fully understood. Microwaves may also interfere with cardiac pacemakers.

The maximum safe levels of exposure to microwaves are specified by the ARPANSA Radiation Protection Standard - "Maximum exposure levels to radiofrequency fields - 3kHz to 300GHz" Persons on or about the craft, other than personnel specifically involved in the installation or maintenance of the radar should not be exposed to average levels higher than 10 W/m^2 or to peak levels exceeding $10,000 \text{ W/m}^2$.



What are the Radiation Levels Associated with these Radars?

Obviously they vary according to the particular make and model. However, calculations based on information supplied by the manufacturers and measurements carried out by this and other laboratories (Reference 1) indicate that at 1 metre from, and at the same height as the antenna, peak levels of approximately 0.5 W/cm^2 may be encountered. The average intensity may be between 0.5 and 0.8 mW/cm^2 , when the antenna is stationary. The average intensity drops to safe levels (i.e. below 0.2 mW/cm^2) at a distance of several metres from the antenna. At points above or below the horizontal plane containing the antenna, the radiation level is lower than that measured at a corresponding point on that plane. However, it must be noted that the radar has a rather large vertical beam-width, i.e. microwave radiation is beamed also above and below the horizontal plane. This allows the radar to track obstacles on the water surface even during strong rolling movement of the vessel. At 1.5 metres from the antenna and 50 cm below the antenna level, the average intensity can still be in excess of the 0.2 mW/cm^2 limit.

During normal operation the average exposure is reduced, because the radar antenna rotates and a person is exposed only when the beam sweeps past.* For example, a person standing one metre away from a 1.2 m (4') rotating antenna is exposed to less than 20% of the average radiation level in the beam.

Safe Practice

Exposures to microwave radiation above the recommended limits are most likely in the immediate vicinity of the antenna when it is stationary. When the antenna is rotating, as required for normal operation of the radar, average exposure is below the recommended limits, even at points as close as one metre.

Some radars are designed to prevent microwave emission unless the antenna is rotating. Other models, however, lack this safety feature. In these cases some care is required on the part of the operator to prevent unnecessary exposure of personnel. Operating procedures should be adopted which ensure that no microwave radiation is emitted except when the antenna is rotating.

A rule of good practice which applies to all small marine radars is that equipment should be turned off when not required, particularly in areas of high population density (e.g. at dockside).

References

1. D W Peak, D L Conover, W A Herman, R E Shuping - "Measurement of power density from marine radar." *US Dept of Health, Education and Welfare publication (FDA) 76-8004*, 1975.

* The average exposure is reduced by a factor equal to the ratio between the beam width at the exposure distance, and the scan circumference at that distance (at short distances the beam width is equal to the antenna size).