British Columbia Maritime Employers Association

Serving the ports of British Columbia

500 - 349 Railway Street, Vancouver, B.C. V6A 1A4 Website: www.bcmea.com Tel (604) 688-1155 Fax (604) 684-2397

The health risks associated with the use of ships RADAR equipment in BC ports has been a recurring question for our employees and member companies. This document and its attachments are designed to provide clarification of the required safe working distances and the potential health effects of RADAR transmissions. The Canadian Coast Guard has previously responded to our questions and provided information involving RADAR safety (attached).

Marine RADAR systems operate in the high radio frequency (RF) and microwave range. Unlike X-rays and nuclear radiation the emissions are non-ionizing radiation which will not penetrate the human body. The Canadian Coast Guard states that,

> "*Calculations conducted by the Canadian Coast Guard, Telecom branch, have shown that there is no danger to persons due to transmissions from shipboard RADARS if they are more than **0.2m away** from the **rotating** scanner*."
>
> -P.J. Nelson, Senior Surveyor

Mr. Nelson's precautions go on to state that the safe working distance will increase to 6m if the RADAR scanning antenna is transmitting while in a stationary position however, this will only occur if technicians have intentionally locked the antenna in place. Modern technology prohibits a RADAR scanning antenna from transmitting while stationary.

It is common to see a vessel's RADAR scanning antenna turning during cold weather but not transmitting. This is called the "standby" mode which ensures that the scanner does not freeze during inclement conditions.

Overall, the radiation transmitted from the vessels RADAR scanning antenna will not pose a significant health risk to our employees. It will be unlikely that any worker will be within the safe working distance of 0.2m or be exposed to a continuous dose of radiation during their normal duties.

For more information regarding the safe exposure limits please refer to:

Health and Welfare Canada, *Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz - Safety Code 6 (2009),* located at http://www.hc-sc.gc.ca.

Government of Canada / Gouvernement du Canada

MEMORANDUM **NOTE DE SERVICE**

To / À: FMTC

From / De: FMTCDB

Security Classification – Classification de sécurité	
Our File – Notre référence	FM 1600-04
Your File – Votre référence	
Date	March 22, 1990

Subject / Objet: **RADAR SAFETY PROXIMITY CALCULATIONS**

Attached are the calculations you requested showing the safe distance around our VTS and shipboard RADARs.

The safe exposure limit is taken to be the lowest of values given in the listed references.

1. Health and Welfare Canada 79-EHD-30
"safety code-6
recommended safety procedures for the installation and use of radiofrequency and microwave devices in the frequency range 10 MHz - 300 GHz"
As listed in section 2.5 and also Appendices I and II, the exposure limit to the general public for 9.3 GHz radiation is;
power density 1 mW/cm^2

2. American Conference of Governmental Industrial Hygienists
"Threshold Limit Values and Biological Exposure Indices for 1987 & 1988"
Taken from Figure 10, page 103, safe worker exposure levels;
power density 10 mW/cm^2

The computations (attached) show that;

1. For our Gulf Islands RADARs in their normal scanning mode there is no danger to the public as the safety radius is 2m, and access within this proximity is guarded against.

2. For our Gulf Islands RADARs there would be a hazard within 69m of a non-rotating scanner with an active transmitter.

3. For our shipboard RADARs there is no danger outside of 0.2m while scanning.

Canada

4. For our shipboard RADARs a hazard would exist within 3m of a non-rotating scanner with an active transmitter. Note that this compares somewhat with the manufacturers literature which specifies a safety zone of 6m (1 mW/m^2) for a stationary scanner under worst possible conditions (equipment malfunction?). The 0.6m, 10 mW/m^2 spec. referred to in Mr. Andersons letter is more lenient than those I have used.

Previous measurements have been made for stationary shipboard RADARs (ref Dave Hunter, no written records) which proved that the safety zone was adequate.

Overall there is no danger to the general public due to radiation from our RADARs in their scanning mode of operation with normal PRR and pulse width settings. Access within the safety zones is possible only by a deliberate attempt. Mr. Anderson's concerns appear to be based on not understanding the scan reduction factor. A scanning antenna only radiates in a given direction for a small percentage of time, and it is the long term power average that is significant.

As no real danger exists it has not been necessary, and remains unnecessary, to implement additional precautions as suggested by Mr. Anderson in his letter. However, public perception may not be altered by these facts, and it may be prudent to have the RADAR shut off while docked unless there is a specific reason for needing it on.

A. Hellqvist
Project Officer Guidance

attach.

GULF ISLANDS RADAR EMISSION SAFETY LEVEL CALCULATION

Relevant Parameters:

$W_{T(peak)}$ = 110 kW (pulsed)	Peak transmitter power
PRR = 4000, 2500, <u>850</u> pps	Pulse repetition rate
T_{Pulse} = 50, <u>400</u> nsec	Pulse Width
G_T = 42 dB	Antenna Gain
Beam = 0.3°	3 dB beamwidth
f_{RADAR} = 9.3 GHz to 9.5 GHz	RADAR frequency
L = 1 mW/cm^2 (= 10 W/m^2)	Safe long term exposure level to general public

(the normal values of operator selectable parameters are underlined)

Useful Equations:

1. $P_{density} = W_T \cdot G_T \div (4\pi R^2)$ — Power density at distance R indirection of maximum gain

2. $W_{T(av)} = W_{T(peak)} \cdot \text{dutycycle}$
   $= W_{T(peak)} \cdot T_{Pulse} \cdot PRR$ — Average power of pulsed transmitter

3. $P_{density(scan)} = P_{density} \cdot S$ — Average Power density for a scanning antenna, where S is the scan reduction factor.

4. S = Beam ÷ 360° — Scan reduction factor

Safe Distance Calculation:

Substituting equation 2 into 1 ($W_T = W_{T(av)}$) and 1 into 3 gives;

$$P_{density(scan)} = S \cdot W_{T(peak)} \cdot T_{Pulse} \cdot PRR \cdot G_T \div (4\pi R^2)$$

Setting $P_{density(scan)}$ = L, and solving for R using the given parameter values gives R = 2.0m as the "safe" distance in the horizontal (worst case) plane.

Note that for a stationary scanner the scan reduction factor is eliminated and we get R = 69m, but only in the direct line of transmission.

SHIPBOARD RADAR EMISSION SAFETY LEVEL CALCULATION

Relevant Parameters:
(for Decca RD370 on board Skua, Ganges Hrbr:

$W_{T(peak)}$ = 5 kW (pulsed)	Peak transmitter power
PRR = 1500, 750 pps	Pulse repetition rate
T_{Pulse} = 80, 650 nsec	Pulse Width
G_T = 27 dB	Antenna Gain
Beam = 2°	3 dB beamwidth
f_{RADAR} = 9.4 GHz	RADAR frequency
L = 1 mW/cm^2 (= 10 W/m^2)	Safe long term exposure level to general public

(the normal values of operator selectable parameters are underlined)

Useful Equations:

1. $P_{density} = W_T \cdot G_T \div (4\pi R^2)$ — Power density at distance R indirection of maximum gain

2. $W_{T(av)} = W_{T(peak)} \cdot \text{dutycycle}$
   $= W_{T(peak)} \cdot T_{Pulse} \cdot PRR$ — Average power of pulsed transmitter

3. $P_{density(scan)} = P_{density} \cdot S$ — Average Power density for a scanning antenna, where S is the scan reduction factor.

4. $S = \text{Beam} \div 360°$ — Scan reduction factor

Safe Distance Calculation:

Substituting equation 2 into 1 ($W_T = W_{T(av)}$) and 1 into 3 gives;

$$P_{density(scan)} = S \cdot W_{T(peak)} \cdot T_{Pulse} \cdot PRR \cdot G_T \div (4\pi R^2)$$

Setting $P_{density(scan)} = L$, and solving for R using the given parameter values gives R = 0.23m as the "safe" distance in the horizontal (worst case) plane.

Note that for a stationary scanner the scan reduction factor is eliminated and we get R = 3.1m, but only in the direct line of transmission.

Canadian Coast Guard / Garde côtière canadienne

Suite 620 - 800 Burrard Street
Vancouver, B.C.
V6Z 2J8

Phone: (604) 631-3841
Fax: (604) 631-3858

Your file / Votre référence

Our file / Notre référence FMS 8116-01 (P)

June 17, 1992

ACTION	JAE	DO NOT CIRCULATE
INFO.		
	JUN 22 1992	

Casco Terminals
1285 Franklin Street
Vancouver, B.C.
V6A 1J9

Attention: Mr. J.A. Edwards
Manager, Safety Department

Dear Sir:

Re: Ship's Radar Antenna Operation

We are in receipt of your letter dated June 15th, 1992, in which you refer to concerns of the Centerm Safety Committee regarding RADAR antenna operation of vessels while alongside.

Calculations conducted by Canadian Coast Guard, Telecom branch, have shown that there is no danger to persons due to transmissions from shipboard RADARs if they are more than 0.2m away from the rotating scanner.

The safety radius does increase to 6m if the RADAR is transmitting and the scanner is stationary. However, the design of modern RADARS generally prohibits this function and it should only occur if technicians have deliberately locked the scanner in place.

It should also be noted that during cold weather ships may leave their RADAR scanners turning, but the RADAR itself would not be transmitting. This is done in the "standby" mode, and ensures that the scanner will not freeze during inclement conditions.

We hope the above addresses your concerns.

Yours truly,

P.J. Nelson
Senior Surveyor
Operational Services
Ship Safety

PJN/sj

Canada

Fait de papiers récupérés