

ORIGINAL ARTICLE

STUDY ON NON-IONIZING RADIATION (RADIO FREQUENCY) AT BROADCASTING SECTOR

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ABSTRACT

Application of non-ionizing radiation is growing in line with the rapid technological developments which impact on human exposure may result in danger if not controlled. As such, MEASAT Broadcast Network Systems Sdn. Bhd. has been selected to be assessed regarding electromagnetic radiation - radio frequency (RF) measurement around its broadcast facilities at ASTRO complex in Bukit Jalil, Kuala Lumpur. This study was conducted on the 3rd and 4th of February 2016. The measurement was encompassed only on the assessment of the electromagnetic radiation (radio frequency - RF) in accessible areas within and around the ASTRO'S broadcast facilities (about 1.5 meters from the floor/ground). Mapping plot measurements method on the radiation source was made for non-ionizing radiation exposure readings for the electric field and magnetic field (near field) between 1 to 5 meters and the distance (far field) between 10 up to > 100 meters in the area that can be in access. The time measurements were taken and recorded for six minutes (RF) for each point of measurement (ICNIRP 1998, IEEE 1991, HWC 1999 and ARPANSA 2002). Measured radiations were assessed and evaluated against the mandatory standard exposure limits and the recommendations issued by the Malaysian Communications and Multimedia Commission (MCMC). The electromagnetic (RF) radiations present within the ASTRO complex were measurable but of low levels. The electrical field strengths and magnetic field strength were well below the exposure limits stipulated by the MCMC guidelines for members of the public and workers. The determined level of power density measured for the public at all locations around 0.04 $\mu\text{W}/\text{cm}^2$ to 0.54 $\mu\text{W}/\text{cm}^2$ exposure where the percentage was only about 0.004% to 0.054% when compared to the limits set by the Malaysian Communications and Multimedia Commission. Based on the finding of these measurements, it was strongly believed that the presence of non-ionizing radiation emitted by the equipment within the ASTRO complex with the present loads would not lead to any significant radiation exposure received by workers around the facilities. Based on observation and preliminary inspection, at some places, especially those which were very close to the transmitting and receiving antennas, are expected to experience much higher radiation level than what was observed during the survey. This is because the range of frequencies produced by the antenna is more focused on the micro-wave frequency. It is, therefore, strongly recommended that limited accessing to these antennas to be provided with proper control measure such as by putting up radiation warning signs and notices at their entrance so that chances form personnel to get any significant or unnecessary exposure to radiation can be minimized.

Keywords: *Non-Ionizing Radiation, Electromagnetic Field, Radio Frequency, Broadcasting Sector, Electric Field, Magnetic Field, Near Field, Far Field, Mandatory Standard Exposure Limits, MCMC*

INTRODUCTION

Non-ionizing radiation is a risk of danger from the aspect of human health if the exposure level is above the permitted limit based on adverse effects that have been studied, including leukaemia, cancer and neurodegenerative diseases (CNA 2010). There are numerous assumptions and negative perceptions of the safety and health of workers and the general public near a source of non-ionizing radiation in the Broadcasting Sector. Complaints about the risk of exposure to non-ionizing radiation were often received by the authorities. This is because the increased level of public awareness of safety and health. The existence of increasingly sophisticated technology is more beneficial to the community. However, the impact of any technology to build, often become problems and disputes of various parties with respect to their health and safety aspects. The concerns of

employees work areas they are involved directly to technology audio/visual (broadcasting) has gained the attention of the authorities in identifying the level of exposure and propose measures to address issues related to exposure to non-ionizing radiation. In Malaysia, the base station is built according to strict guidelines set by the Malaysian Communications and Multimedia Commission (MCMC) and the Ministry of Urban Wellbeing, Housing and Local Government which complies with international standards and practices of safety. International standards observed by international agencies such as the "International Commission on Non-Ionizing Radiation Protection" (ICNIRP), "Institute of Electrical and Electronics Engineers" (IEEE) and the "World Health Organization"(WHO).

MCMC is responsible for the increase, regulate and enforce the communications and multimedia laws in Malaysia. Limit prescribed for exposure is mostly referring to the limit set by ICNIRP in 1998.

Table 1 shows the limits set according to Mandatory Standard for EMF Determination No. 1 of 2010 by the MCMC based on type of detector probes to be used in this research study.

Table 1: Mandatory Standard for EMF Determination No. 1 of 2010

Members of	Power Density (W/m ²)	Magnetic field (A/m) Frequency Range (10 MHz - 400 MHz)	Electric Field (V/m) Frequency Range (2 GHz - 300 GHz)
Public	10	0.073	61
Worker	50	0.16	137

METHODS

Monitoring covers only the assessment of electromagnetic radiation (radio frequency - RF) that present in accessible areas in and around the ASTRO Broadcasting Complex at about 1.5 meters from the floor / ground. Plot mapping methods of measurement on the radiation source is made for non-ionizing radiation exposure reading is close (near field) between 1 to 5 meters and the distance (far field) between 10

to > 100 meters in the area that can be accessed. The time measurement is taken and recorded for six minutes (radio frequency - RF) for each point of measurement (ICNIRP 1998, IEEE 1991, HWC 1999 and ARPANSA 2002). Figure 1 shows a method of distance measurement techniques compared with non-ionizing radiation sources.

Measurement of non-ionizing radiation (RF) made by using the apparatus NARDA Broadband Field Meter - NBM550 that characterized by scientific evidence (Isotropic detector probe through three channels / axes as shown in Table 2.

Table 2: Detector probes used for electric field and magnetic field

Detector	Magnetic Field (H)	Electric Field (E)
Isotropic	300 KHz - 30 MHz	100 KHz - 3 GHz

The obtained data were analyzed and compared with the limit set by the Malaysian Communications and Multimedia Commission (MCMC 2010). The subsequent analysis will be linked to the risk management approach to the safety and health of those working in the Broadcast Sector.

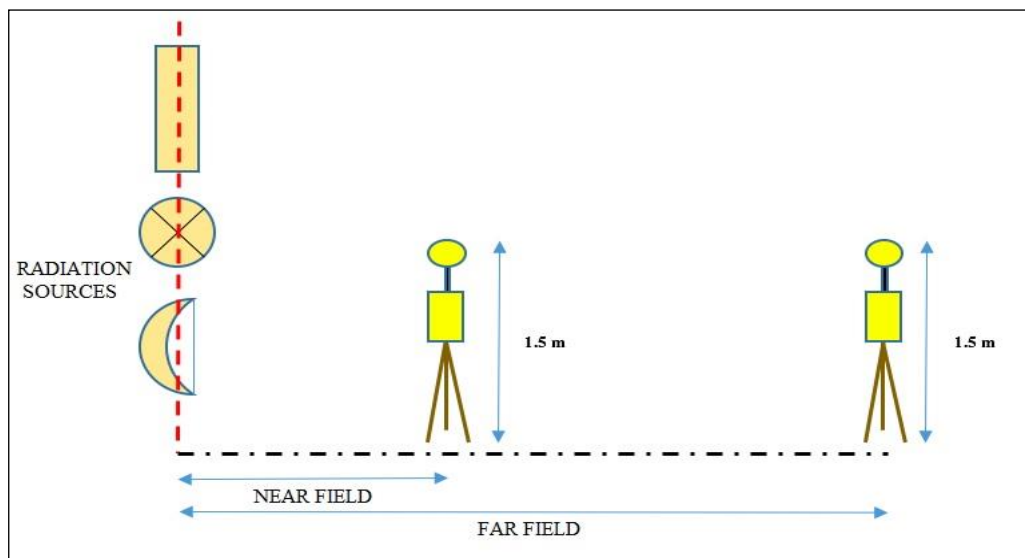


Figure 1: Non-Ionizing Radiation Distance Measurement

RESULTS AND DISCUSSION

Non-ionizing radiation measurements was carried out at 10 locations inside and outside buildings that had been identified to potentially provide exposure to non-ionizing radiation. These

measurements were undertaken in all fields, whether near or far field. The power density calculations were made manually using formula when getting the electric field measurements for each location. Table 3 shows the result of measurements for near field while Table 4 indicate result of measurements for far field.

Table 3: Result of measurements (near field)

Location	Distance	E-Field (Average) (V/m)	E-Field (Max) (V/m)	Power Density (Average) ($\mu\text{W}/\text{cm}^2$)	Power Density (Max) ($\mu\text{W}/\text{cm}^2$)	H-Field (Average) (mA/m)	H-Field (Max) (mA/m)
Master Control Room	1m	0.69 \pm 0.17	1.66	0.13 \pm 0.01	0.73	11.15 \pm 3.63	38.38
	3m	0.77 \pm 0.10	2.136	0.16	1.21	8.70 \pm 1.26	17.59
	5m	0.93 \pm 0.14	2.39	0.23 \pm 0.01	1.51	11.85 \pm 0.67	19.99
Playback and Recording System Room	1m	0.78 \pm 0.04	1.492	0.16	0.59	13.56 \pm 0.85	34.00
	3m	0.77 \pm 0.02	1.50	0.16	0.60	13.65 \pm 1.41	23.81
	5m	0.85 \pm 0.06	2.634	0.19	1.84	14.65 \pm 0.95	34.48
Network Presentation Unit Room	1m	0.97 \pm 0.02	1.167	0.25	0.36	17.23 \pm 0.33	22.32
	3m	0.90 \pm 0.01	1.081	0.22	0.31	16.77 \pm 0.44	25.36
	5m	0.88 \pm 0.02	1.754	0.21	0.82	14.67 \pm 0.30	32.19
Data Centre Room	1m	1.29 \pm 0.04	1.539	0.44	0.63	18.65 \pm 0.65	20.41
	3m	0.94 \pm 0.04	1.191	0.23	0.38	17.29 \pm 0.31	25.38
	5m	1.05 \pm 0.02	2.169	0.29	1.25	15.63 \pm 2.49	39.68
Security Control Room	1m	1.42 \pm 0.65	11.53	0.54 \pm 0.11	35.26	11.92 \pm 0.27	14.84
	3m	1.42 \pm 0.92	11.07	0.54 \pm 0.22	32.50	13.76 \pm 0.23	18.97
	5m	0.78 \pm 0.02	2.335	0.16	1.45	13.42 \pm 0.59	16.26
Radio Engineering Transmission Room	1m	0.36 \pm 0.06	2.617	0.04	1.82	23.31 \pm 8.78	69.00
	3m	0.44 \pm 0.06	0.88	0.05	0.21	27.38 \pm 8.02	67.20
	5m	0.57 \pm 0.03	1.042	0.09	0.29	31.31 \pm 1.04	65.98
Radio Engineering Edit Suite Room	1m	0.55 \pm 0.05	1.343	0.08	0.48	10.65 \pm 0.30	14.92
	3m	0.58 \pm 0.03	0.96	0.09	0.24	9.15 \pm 0.39	20.46
	5m	0.63 \pm 0.03	0.88	0.11	0.21	10.13 \pm 0.59	14.34
Receiver	5m	0.85 \pm 0.04	0.9706	0.19	0.25	12.48 \pm 0.49	14.51
	5m	0.88 \pm 0.02	0.989	0.20	0.26	13.98 \pm 0.43	16.11
	5m	0.95 \pm 0.02	1.239	0.24	0.41	14.65 \pm 0.45	16.68
	5m	1.00 \pm 0.03	1.282	0.27	0.44	16.34 \pm 0.47	28.13

Table 4: Result of measurements (far field)

Location	Distance	E-Field (Average) (V/m)	E-Field (Max) (V/m)	Power Density (Average) ($\mu\text{W}/\text{cm}^2$)	Power Density (Max) ($\mu\text{W}/\text{cm}^2$)	H-Field (Average) (mA/m)	H-Field (Max) (mA/m)
Rooftop	183 m	0.90 \pm 0.08	1.141	0.22	0.35	39.67 \pm 5.12	57.11
	161 m	1.09 \pm 0.03	1.336	0.31	0.47	35.76 \pm 4.67	45.21
	161 m	1.31 \pm 0.03	1.379	0.46	0.50	29.95 \pm 6.53	59.62
	183 m	1.28 \pm 0.01	1.373	0.43	0.50	18.09 \pm 0.91	22.51
	172 m	1.36 \pm 0.02	1.443	0.49	0.55	18.11 \pm 6.73	94.02
Transmitter	10m	0.75 \pm 0.08	1.392	0.15	0.51	17.58 \pm 1.51	23.05
	20m	1.16 \pm 0.02	1.253	0.35	0.42	17.03 \pm 0.94	35.73
	30m	1.24 \pm 0.02	1.343	0.41	0.48	19.96 \pm 0.32	24.14

10m	1.19 ±0.02	1.275	0.38	0.43	54.49 ±4.13	79.51
20m	1.19 ±0.02	1.285	0.38	0.44	23.04 ±0.92	26.65
30m	1.19 ±0.03	1.477	0.38	0.58	19.94 ±0.36	25.86
10m	1.18 ±0.02	1.449	0.37	0.56	21.64 ±7.52	59.28
20m	0.94 ±0.02	1.033	0.23	0.28	17.11 ±0.73	23.16
30m	0.91 ±0.02	1.020	0.22	0.28	29.73 ±2.52	37.38

According to this study, the overall exposure received is far less than the limit set by the Malaysian Communications and Multimedia Commission (MCMC) to the public or workers. This has been proved through measurement using equipment NARDA Broadband Field Meter - NBM550 through detector probe type Isotropic (axis x, y and z) that can be detected from all directions. The range of probes used for this study the electric field (100 kHz - 3 GHz) and magnetic field (300 KHz - 30 MHz).

In general, the results showed that radio frequencies produced have a relationship with distance from the source of non-ionizing radiation. This is in line with statement from Ronald Kitchen (2001) in which he stated, when increasing distance from the source, radio-frequency readings will be significantly reduced, and the time taken reading is not the main factor contributing to the increase or decrease in radio frequency reading. There were several areas where the findings showed radio frequency (RF) is higher than it should. This is due to the overlap of radio frequency transmission stations that include 360° angle and focus on the area around the outside of the building and the room space is limited at the measurement location in the building.

In terms of apparatus, the limited frequency probes allow the measured reading is much lower than the limits set by the MCMC. This is because the range of radio frequencies (RF) ranging from 3Hz - 300GHz. There is the possibility of exposure to radio frequency gives high values outside the range used detector probes. The absence of equipment technology in the world that can measure a whole range of radio frequencies as well as affect the accuracy of reading the actual exposure received by the public and workers

CONCLUSION

In conclusion, non-ionizing radiation (RF) at ASTRO broadcasting complex can be measured, but at a low level. This study, I suppose it is believed that the presence of non-ionizing radiation (radio frequency - RF) inside and outside the ASTRO buildings emitted by equipment with a load that is present will not lead to any exposure of non-ionizing radiation that is received by the employee on the premises and monitoring results have proved

the equipment that generates radiation sources in the study area is installed in accordance with standards set by the MCMC.

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COMPETING INTERESTS

There is no conflict of interest.

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