



6th Asian and Oceanic Congress for Radiation Protection

07-11 February 2023, Mumbai, India

Radiation Protection and Surveillance in Nuclear, Medical, Industrial facilities and the Environment

Human Exposure to Non-ionizing Radiation

Roha Tukimin

**Malaysian Association for Radiation Protection
(MARPA)**

CONTENT

- Introduction to Non-ionising Radiation
- Source of NIR and application
- Risk & benefit
- Standard & regulations
- Research & development



FINANCIAL TIMES

Switzerland halts rollout of 5G over health concerns

The country's environment agency has called time on the use of all new towers



Sam Jones in Zurich FEBRUARY 12 2020

Subang Jaya telco tower project halted after residents' protest

Antina Yap
3, 2016 22:27 MYT



Public protest on telco structure



Restore Session X malaysia airlines - Goo X Penang 2019 - Invitati X Penang 2019 - Google X Perlaksanaan 5G Di M: X New Tab X

https://drive.google.com/drive/folders/1R4Q8jxCwE53alFnOOHl6_FAQ3vuiimNY7

Drive Search Drive

New

My Drive

Shared with me

Recent

Starred

Bin

Backups

Storage


9.4 GB of 15 GB used

UPGRADE STORAGE

Get Backup and Sync for Windows

10:40 AM 1/10/2019

Say NO to Telco Tower Near Residential Areas



RADIOACTIVE??????

NIR IN DAILY LIFE

Power generation & distribution

Sources of EMF

Office appliances

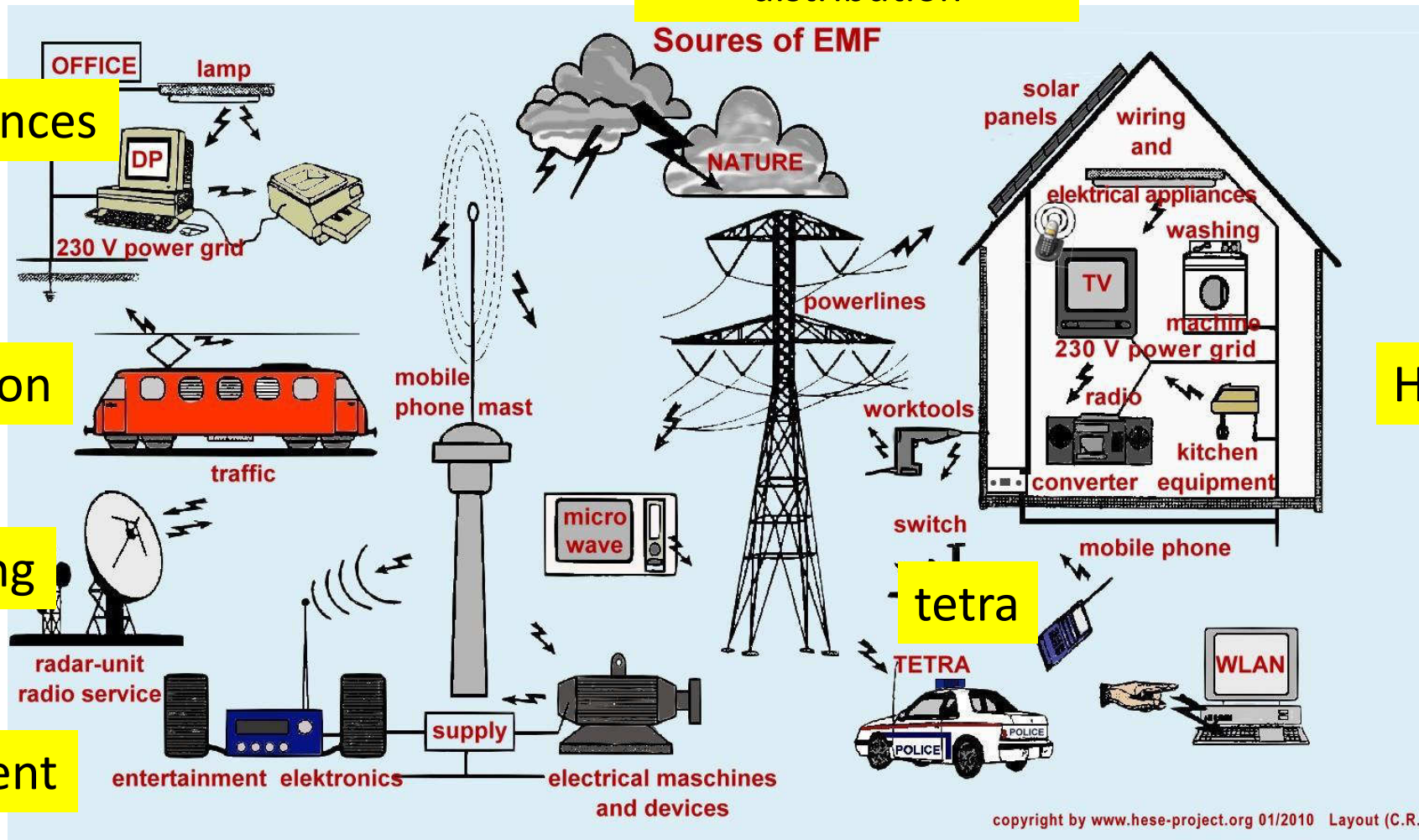
transportation

broadcasting

entertainment

Home appliances

Wireless communication



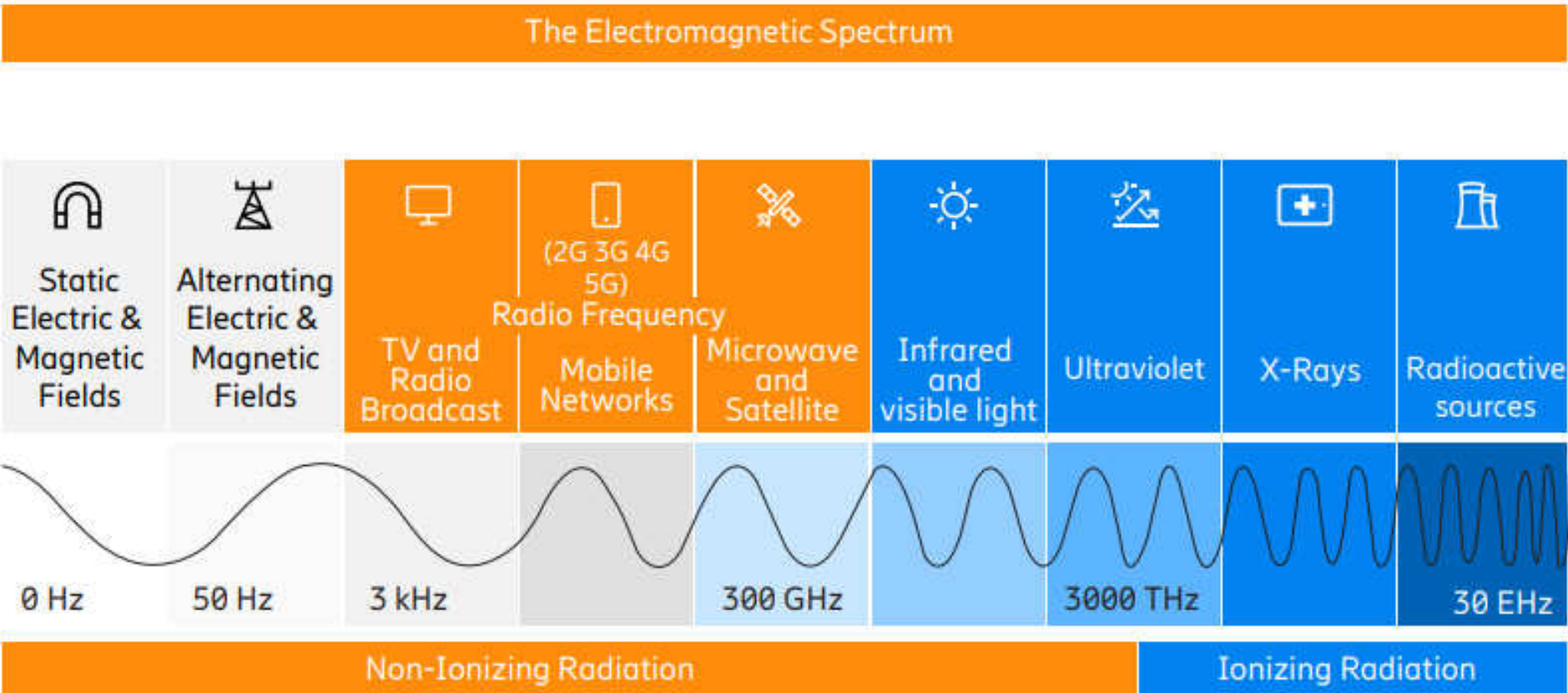
We are expose to NIR everywhere !

Introduction to Non-ionising radiation

Non-ionizing radiation (NIR) is part of the electromagnetic spectrum ;

- NIR has insufficient energy to cause ionization
- It includes electric and magnetic fields, radio waves, microwaves, and optical radiation, which consists of infrared, visible, and ultraviolet radiation.
- Non-ionizing radiation is any kind of radiation in the electromagnetic spectrum that does not have enough energy to remove an electron from an atom and turn it into an ion.
- This contrasts with ionizing radiation like x-rays, gamma rays and alpha particles, which come from the other end of the spectrum and are unstable and reactive

Electromagnetic field spectrum



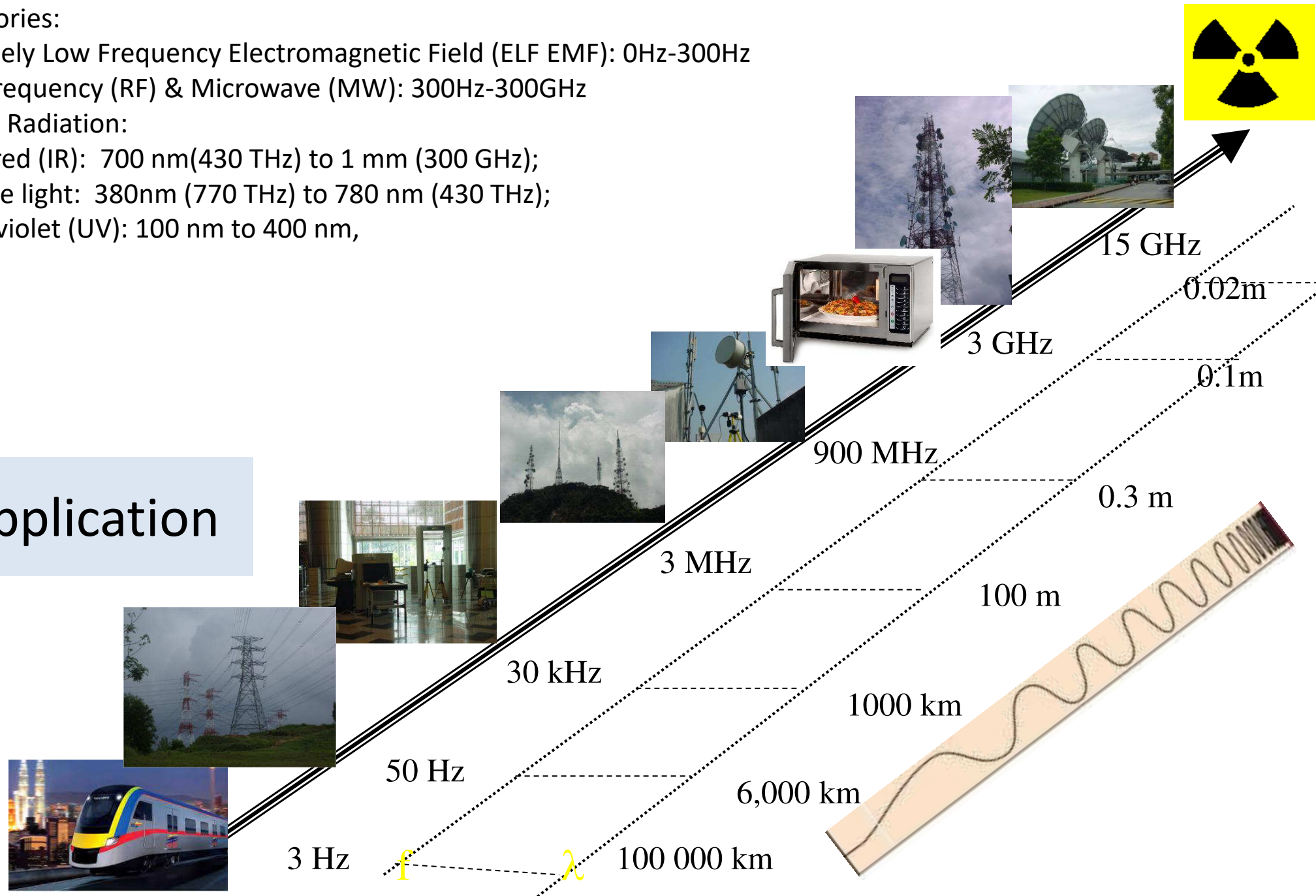
Non-ionizing radiation (NIR)

Ionizing radiation (IR)

NIR categories:

- Extremely Low Frequency Electromagnetic Field (ELF EMF): 0Hz-300Hz
- Radiofrequency (RF) & Microwave (MW): 300Hz-300GHz
- Optical Radiation:
 - Infrared (IR): 700 nm(430 THz) to 1 mm (300 GHz);
 - Visible light: 380nm (770 THz) to 780 nm (430 THz);
 - Ultraviolet (UV): 100 nm to 400 nm,
 - Laser

NIR application

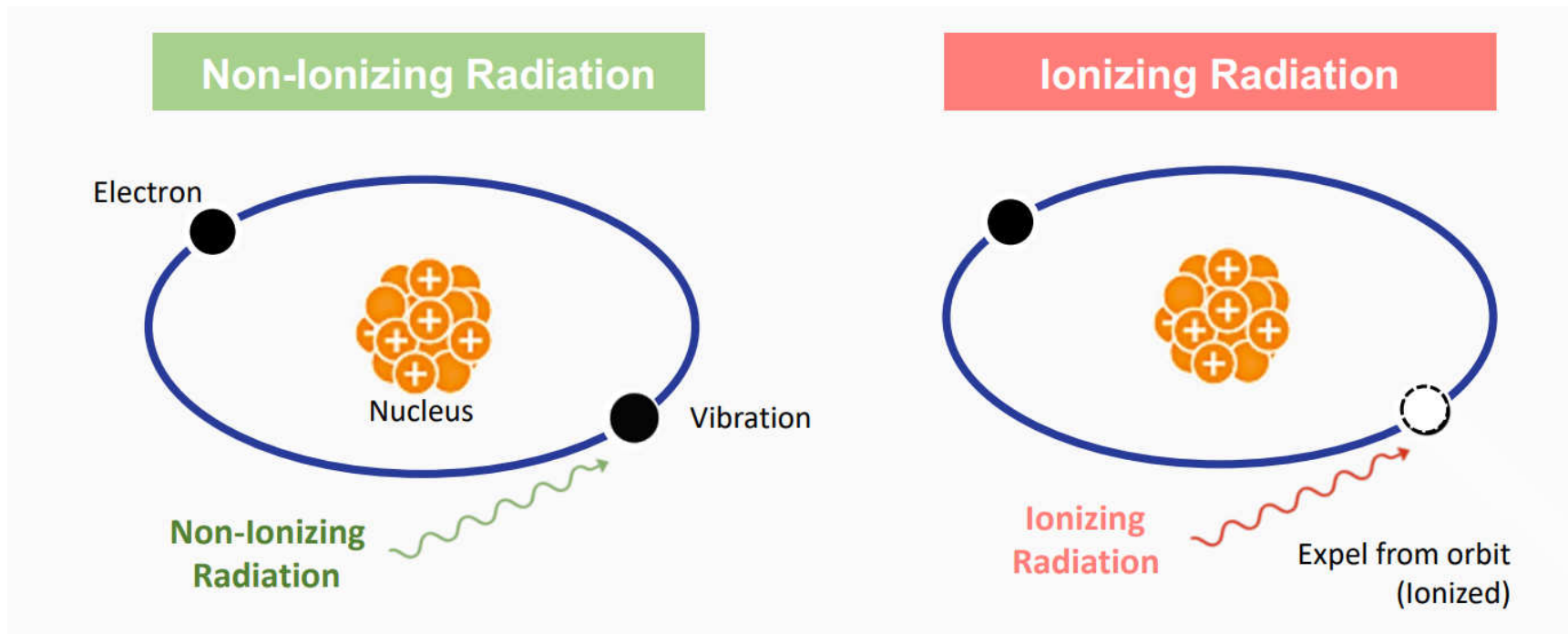


Ionizing vs. Non-ionizing Radiation

Non-ionizing radiation is electromagnetic radiation with insufficient photon energy to ionize matter.

- Generally, the division between non-ionizing (NIR) and ionizing radiation is photon energy of 10 electron volts (eV) [Photon of this energy has a wavelength of 100 nm.]
- Photons with energy less than this value are non-ionizing radiation.
- Unlike ionizing radiation, non-ionizing radiation cannot dislodge electrons from atoms/molecules with which it interacts – cannot ionize biological matter

Non-ionising Radiation vs Ionizing radiation



- Low external radiation energy
- Electron vibrates in the orbit
- No changes to atom structure

- High external energy
- Electron being expelled from the orbit
- Atom structure is changed – ionized

Non-ionising Radiation vs Ionizing radiation

Ionizing radiation

- removes electron from atom
- enough energy to break down the bonds between atoms and molecules.
- examples of ionizing radiation include X-rays and gamma rays

Non-ionizing radiation

- does not break down the bonds between atoms and molecules,
- does not break down chemical bonds within cells and tissues.
- examples of non-ionizing energy include visible light, Laser and RF energy

Categories of NIR

- ❑ Static Electric & Magnetic Field: 0Hz
- ❑ Low/Extremely Low Frequency Electromagnetic Field (ELF EMF): 1 Hz-100kHz
- ❑ Radiofrequency (RF) & Microwave (MW): 100kHz-300GHz
- ❑ Optical Radiation:
 - Infrared (IR): 780 nm to 1 mm;
 - Visible light: 400 nm to 780 nm ;
 - Ultraviolet (UV): 100 nm to 400 nm,
 - Laser (Covers IR, Visible Light & UV)

Source of NIR

Radiofrequency and microwave

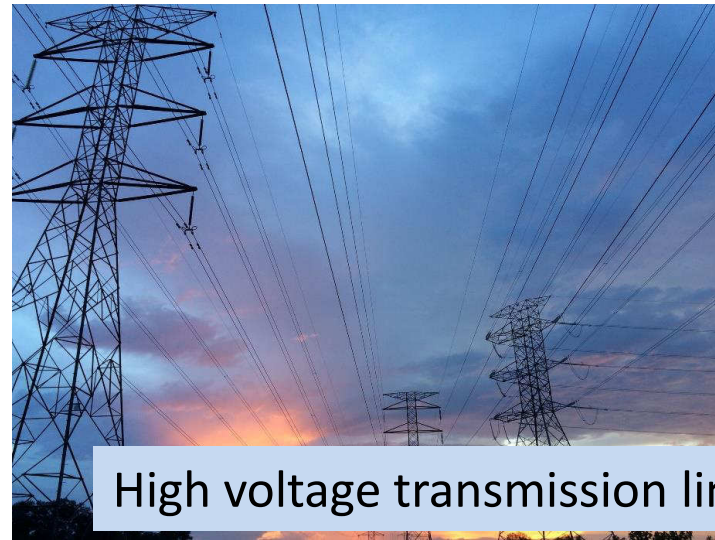
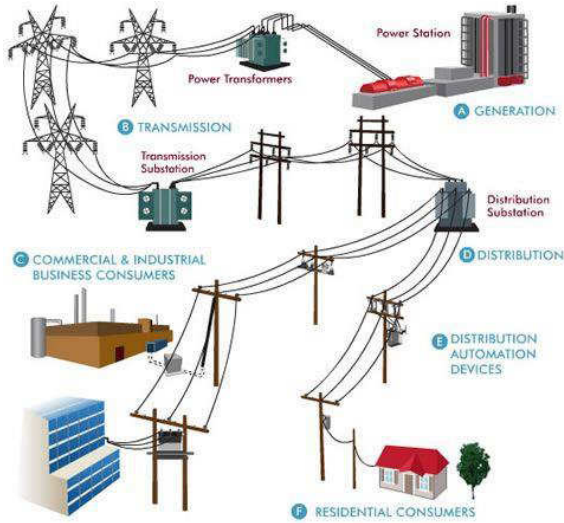
The sources of radiofrequency electromagnetic fields are including the RF-EMF emits by telecommunications infrastructure (radio base stations), broadcasting facility & antennas, mobile phone, WiFi, TV & radio as well as microwave ovens.



AOCR P6, Mumbai, Feb 7-11, 2023

Extremely low frequency (ELF)

Anything associate with electricity emits ELF EMF. Electrical power supplies and appliances are the most common sources of low frequency electric and magnetic fields in our living environment.



High voltage transmission line



ELF in manufacturing plant

Electricity generation, transmission & distribution



transformer



Railway mode of transportation



Electrical appliances

Ultraviolet radiation (UVR) application

Optical radiation technologies, such as lasers, light bulbs and UV lamps, are used in industry, research and medicine. Non-ionizing radiation also encompasses mechanical waves such as infrasound and ultrasound.



UV tanning equipment



Tanning bed



UVGI robot in hospital



Arc welding equipment



Dental polymerizing equipment



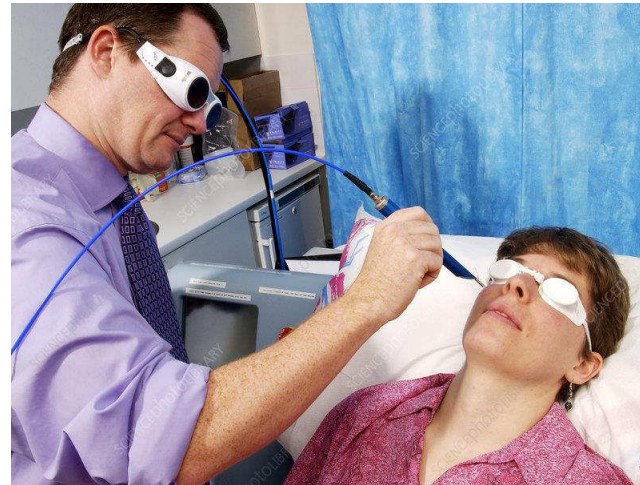
germicidal lamps

Laser in various industry

military



cosmetic



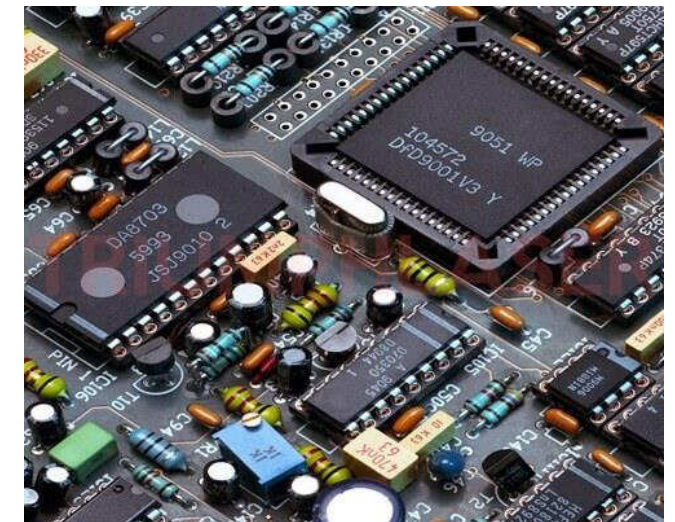
Laser in health care industry,
Diagnostic & treatment



Eye treatment



Laser cutting



Laser soldering & marking

Technology advancement in NIR

- Technological advancement occurs when technologies or applied sciences become more precise, accurate, efficient, or more powerful or capable.
- Technology advancement that relate with NIR ; Communication technology – game changer – changing not only life style but very impactful to the economy.
- Scientific and technological advancements have made many important changes throughout history, which improves our life style.
- High quality science has progressed all forms of technology, improved lifestyles and advanced medical diagnosis and treatments that have hugely extended human lifespans.

Benefit of NIR

The NIR technology benefits more than 6 billions peoples in the world due to technology advancement. We progressed all forms of technology, improved lifestyles and advanced medical diagnosis and treatments that have hugely extended human lifespans



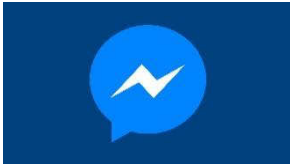
Health care industry



Manufacturing industry



Smart city



Communication



WhatsApp

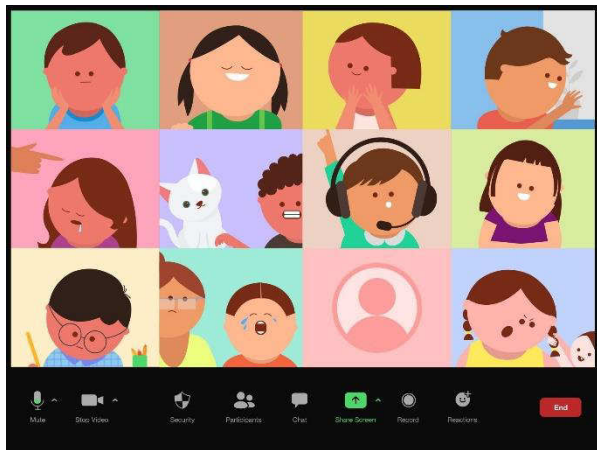


Autonomous car

Technology change our life style



Whatsapp group



Virtual classroom

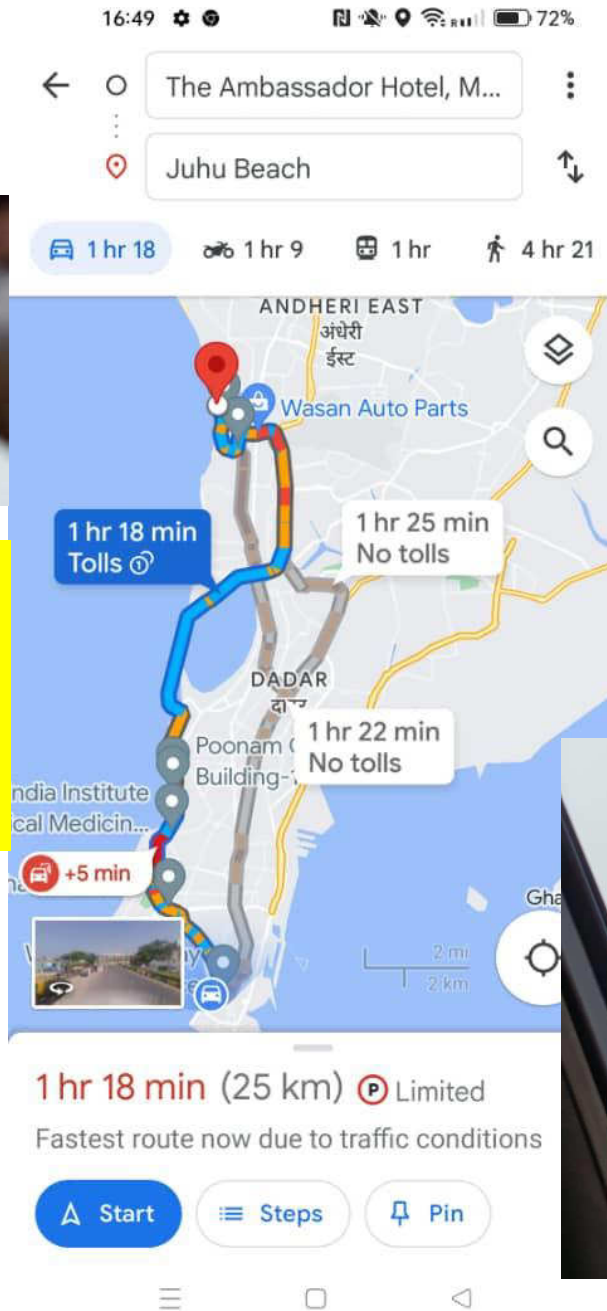


How Communication technology make our life easier

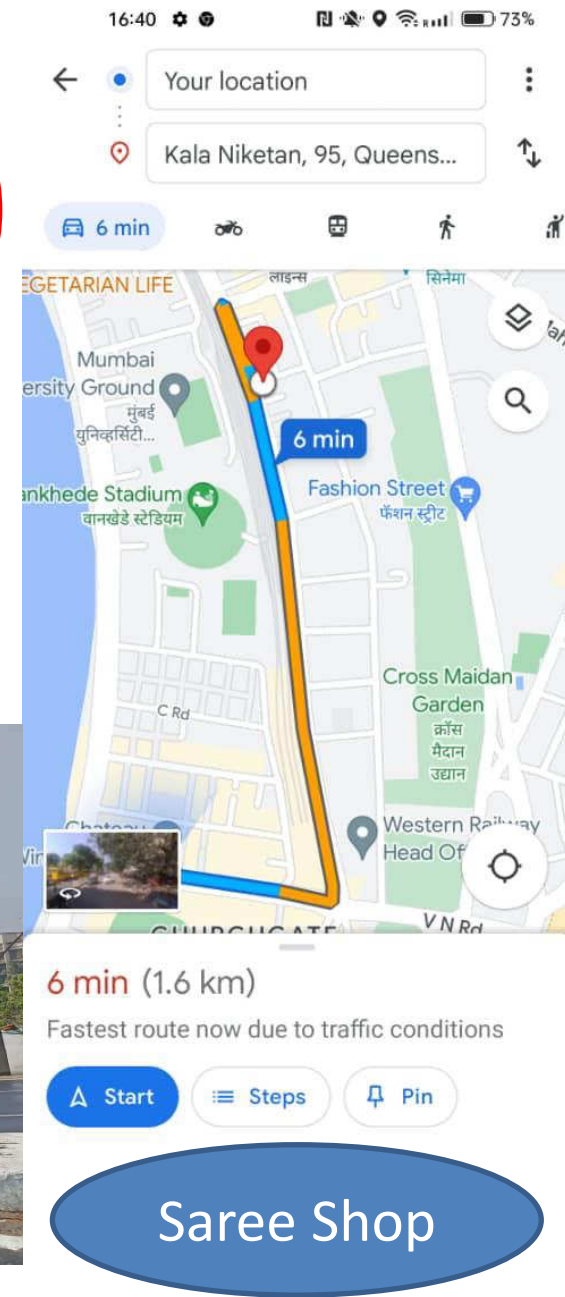
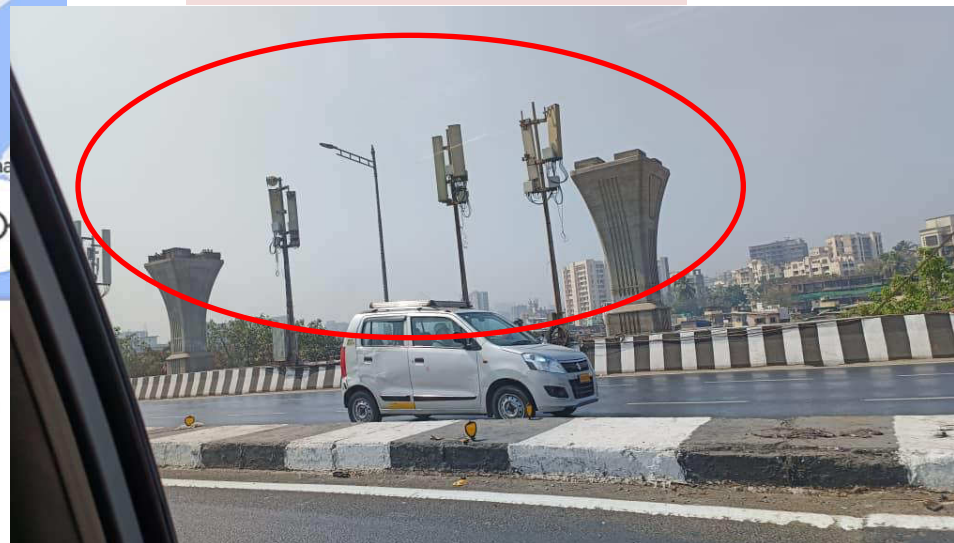
Google map



- Location – direction
- Duration
- **Expected time to arrive**



Radio base station



Saree Shop

JUHU
BEACH
& Shah Rukh
Khan House

Risk vs Benefit





NEWS



ONLINE BUSINESS



BENEFITS

ISSUES

Communication technology

RADIATION

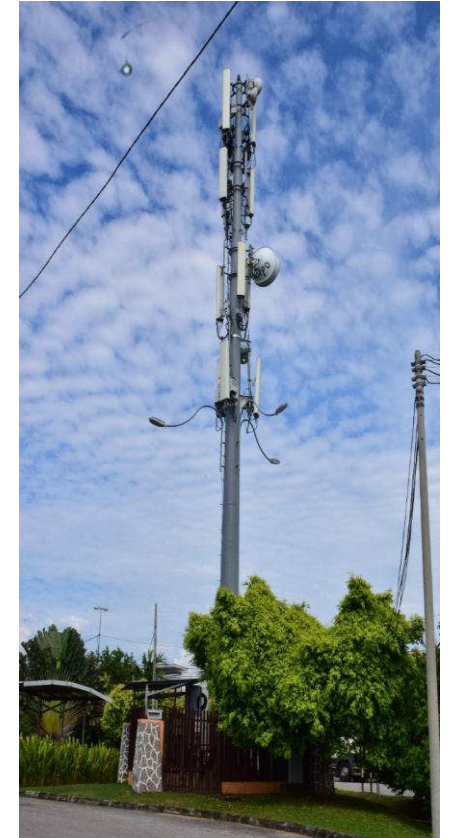
Health & med technology

HEALTH EFFECTS

Online banking & business

NO MONITORING

NO CONCLUSIVE EVIDENCE



Benefit vs Risk

Public perspective on NIR

Public concern on NIR as expansion of technology especially in telecommunication

- **The word of 'radiation'** – public associates it with radioactivity as many of them are not aware with 2 types of radiation : Ionising radiation & Non-ionising radiation
- Public get information from **unreliable sources**
- Public **do not understand** how the technology works
- **Too near** to residential area
- No database of the NIR exposure
- No schedule monitoring - **who monitor the risk? How much the radiation?**
- Public do **not familiar with regulations and standard** related to compliance requirement (local and international)

Public perspective on EMF emits by the base station



Distance - too

near to residential and commercial area



Public not aware on regulations and standard



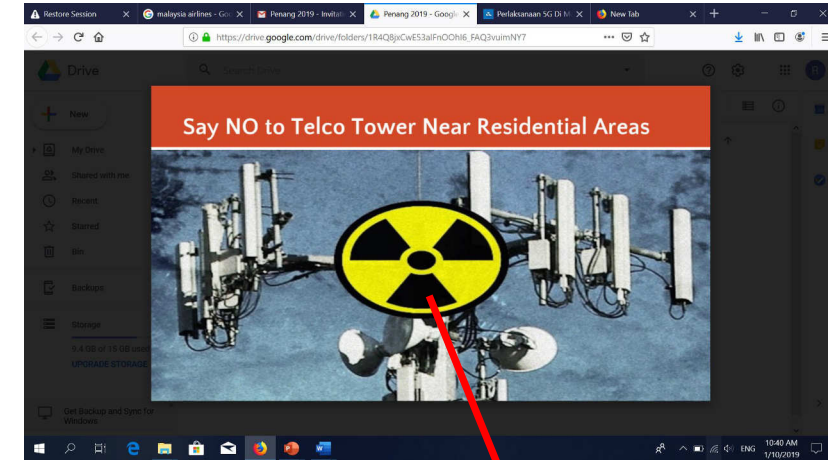
22:41 5G Tower (Menara 5G) 2.4K subscribers

Beat EMF
How to Block Mobile Tower Radiation [The Easy Way!] - Beat EMF
Want to learn how to block cell tower radiation effectively? We can help! Learn practical shielding strategies to protect your family today.



Unreliable source of information; Social media, websites,

Media attention on RF issues, prolonged exposure and lack of knowledge are among the reason that triggered negative public perception towards the RF EMF exposure emits by telecommunication structure.

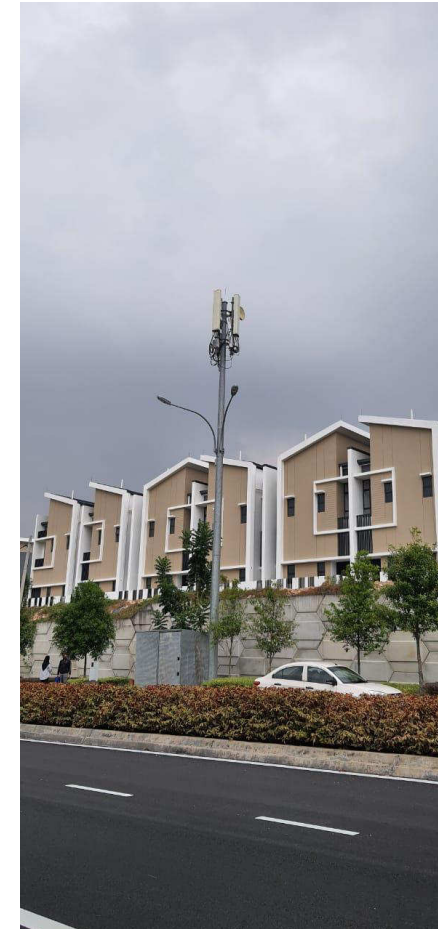


Radiation? Wrong symbol
Radioactive & wrong interpretation
The West Australian

Subscriber deal: How to save on baby products at Coles
Health | WA News | Australia | Technology | Smartphones | Telecommunications
Radiofrequency expert warns 5G radiation could be carcinogenic
Miriam Fisher | The West Australian
Fri, 15 February 2019 10:11AM

No conclusive evidence on health effects

Public protest on telco structure



cancer

standard? Guidelines?

Not in front of our house!!



Not in my back yard!!

Addressing public concern

In addressing the public concern pertaining the NIR issues, the approach are usually as follow;

Public engagement program

Compliance
safety assessment
(evidence for EMF compliance)

Standard and
regulations

Education is the best medicine !

Public engagement program

To listen on public concern

To understand their concern

To share knowledge and facts

To make them understand on how the technology works

To give information on standard and regulations

To share information on scientific evidence and compliance

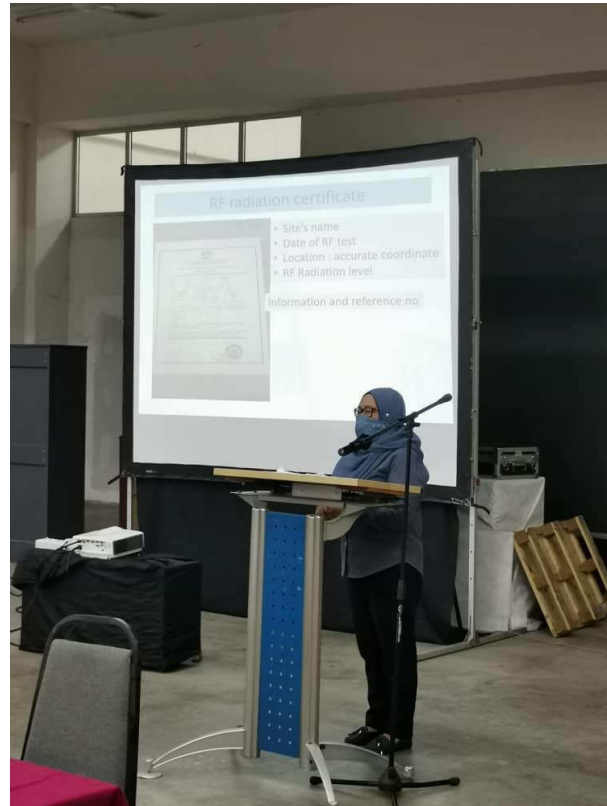
Public engagement & Addressing public concern

Education is the best medicine..!



Public engagement in Penang, January 2022

- Include all the stakeholders
 - ✓ Government agencies
 - ✓ Regulator
 - ✓ Local council
 - ✓ Public
 - ✓ Resident association
 - ✓ Telco industry
- Who can provide advice /
Who has the scientific expertise?



Communicating on;
Concern / issues
Helping them to
understand the
technology – benefits



Conference & seminar



NIR conference since 2009 -2022



Seminar on radiation protection

- Expert sharing information
- Research findings
- Updated standard and guidelines
- Sharing experience



Risk Perception: *Public Advocacy Program*

Brochures on EMF & Public Health Issues

SINARAN MEDAN ELEKTROMAGNET (EMF) & KESIHATAN ANDA

Adakah EMF dan stesen pemancar telekomunikasi membahayakan orang ramai?

Apakah yang dimaksudkan dengan 'Medan Elektromagnet' (EMF)?

Bagaimanakah anda boleh mengurangkan paparan EMF?

MCMC menyediakan Kempen Kesedaran tentang Telekomunikasi Radio - Medan Elektromagnetik secara berterusan.

4G TECHNOLOGIES & EFFECTS ON CHILDREN

ELECTROMAGNETIC HYPERSENSITIVITY & CHILDREN

ELECTROMAGNETIC HYPERSENSITIVITY (EHS)

A study of possible effects on Malaysians

4G LTE Emission & Health

A STUDY ON THE BIOLOGICAL EFFECTS OF 4G LTE AND 2000 MHz ELECTROMAGNETIC FIELDS (EMF) EXPOSURE

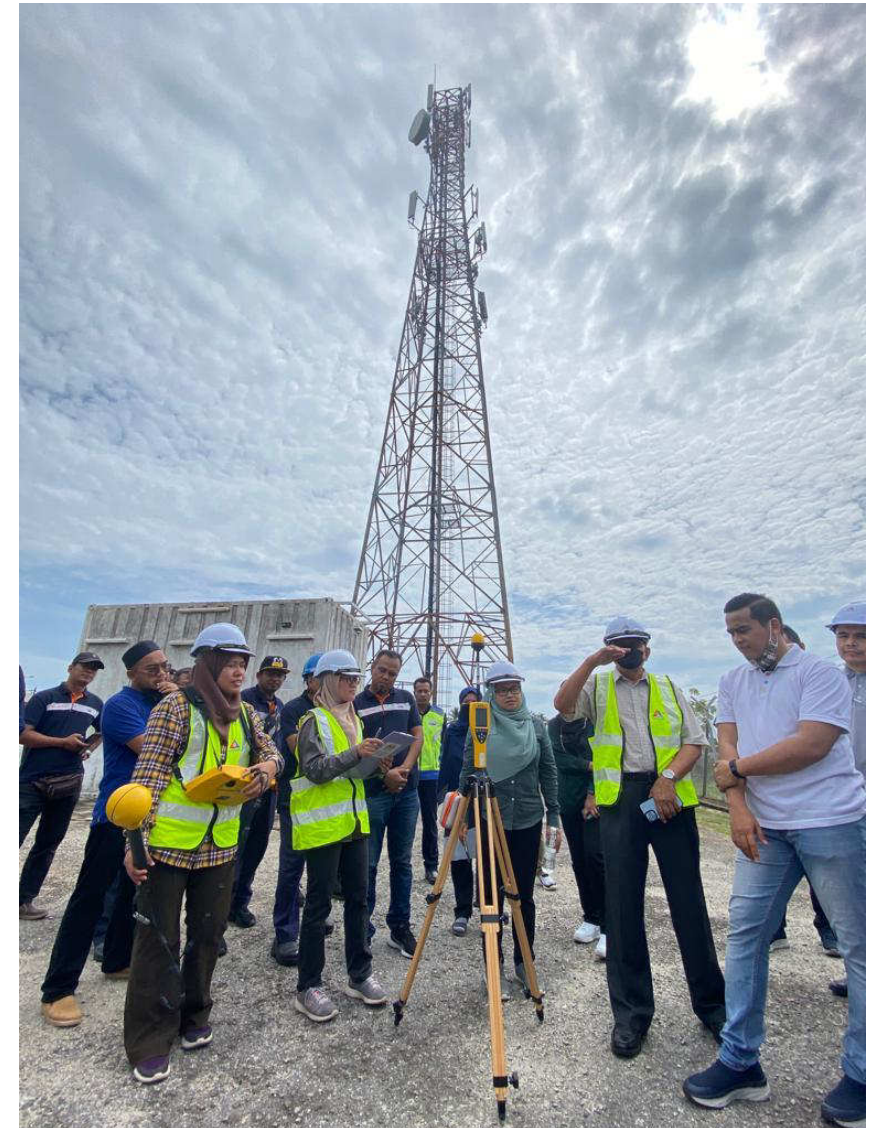
10 SOALAN 10 FAQ's RADIO FREQUENCY EMISSION

Training & course

Surveillance of Radio Frequency (RF) Radiation for Telecommunication Structure



Theory & practical (hands – on)



Laser safety training

Nuclear Malaysia is the pioneer of training provider for Laser safety in Malaysia ;

- Laser Safety awareness
- Laser safety officer (LSO)
- Various industry concern about the safety of laser usage, e. g ; health care industry (using class 3B and class 4 laser)
- They start to create awareness among the workers and management
- train their workers ; certification
- Started to have laser safety management program and safety audit



Laser safety course

AWARENESS ON TECHNOLOGY

Live WEBINAR 

09th Sept. 2021
Thursday
9.00 am to 12.30 pm

DOES UV RADIATION KILL COVID-19 VIRUSES?

Who should attend? OPEN TO ALL, FREE

Scope:

- Application
- Safety & hazard
- Guidelines
- International standard

The effectiveness of UVC radiation in combating COVID-19 is very promising. However, there is concern on its safety towards human. This webinar goals are to disseminate information and create awareness on UV radiation safety and its efficacy for COVID-19 viruses disinfection.

Ms. Roha binti Tukimin
(Malaysian Nuclear Agency)

Prof. Dr. Siti A'asah binti Hashim
Director General
Malaysian Nuclear Agency

Dr. Tsutomu Okuno
(ICNIRP)

Dr. Mohd Yusof bin Hamzah
(Malaysian Nuclear Agency)

Dr. Rasif bin Mohd Zain
Moderator

Dr. Roza Sarimin
(Ministry of Health)

Please scan this QR code for registration



SCAN ME

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ski5668@gmail.com
018-3557903

Ms. Roha Tukimin
roha@nm.gov.my
roha2000@gmail.com
013-2945954

Organized by:
MALAYSIAN NUCLEAR AGENCY

MINGGU SAINS NEGARA 2022

MERAKYATKAN SAINS MENGINSAHKAN TEKNOLOGI

WWW.MINGGUSAINSNEGARA.COM

FORUM

"SEMBANG KEPERLUAN TEKNOLOGI DAN ASPEK KESELAMATAN"

02 Jun 2022 (Khamis)
10.00 - 12.00 tgh

Moderator: Habibah Adnan
Agensi Pelaksana:

Prof. Dr. Tharek A. Rahman
Ahli Suruhanjaya Suruhanjaya Komunikasi dan Multimedia Malaysia (SKMM)

Malini Ramalingam
Ketua Jabatan Penciptaan Permintaan Digital
Suruhanjaya Komunikasi dan Multimedia Malaysia (SKMM)

Roha Tukimin
Pegawai Penyelidik
Agensi Nuklear Malaysia

Organized by: NUKLEAR MALAYSIA, KELB (Atomic Energy Licensing Board), PUSAT SAINS NEGARA

'KEGUNAAN AMAN NUKLEAR'

Rakan Strategik: KEMENTERIAN SAINS, TEKNOLOGI DAN INOVASI; UNIVERSITI MALAYSIA TERENGGANU; UMS; UTM; Agensi Nuklear Malaysia; Lembaga Perlesenan Tenaga Atom



Target participants :

- Public
- Government
- Related industry

WEBINAR ON UV RADIATION

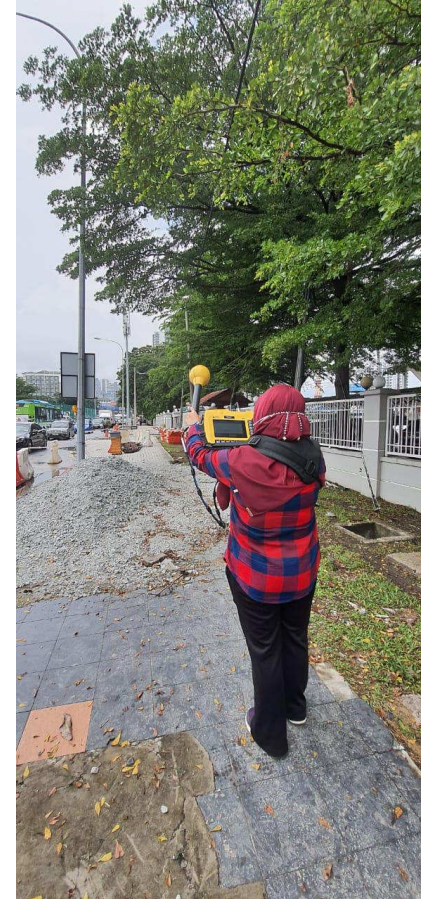
- AWARENESS ON UV RADIATION
- APPLICATION -UVGI
- SAFETY ASPECT

WEBINAR - SEMBANG 5G 2022 – ADVANCEMENT, BENEFITS OF THE TECHNOLOGY AND SAFETY ASPECT

Compliance

The second approach for addressing public concern is by having the compliance and safety assessment ;

- safety assessment through prediction (calculation & simulation) of the NIR
- On-site measurement and lab testing of radiation exposure emits by the NIR source



To achieve compliance , we need to refer to standard, guidelines and regulation

Standard & guidelines

There are standards & guidelines for NIR in limiting the exposure of NIR in balancing the benefit and the risk – mainly refer to;

International Commission on Non-Ionizing Radiation Protection (ICNIRP)

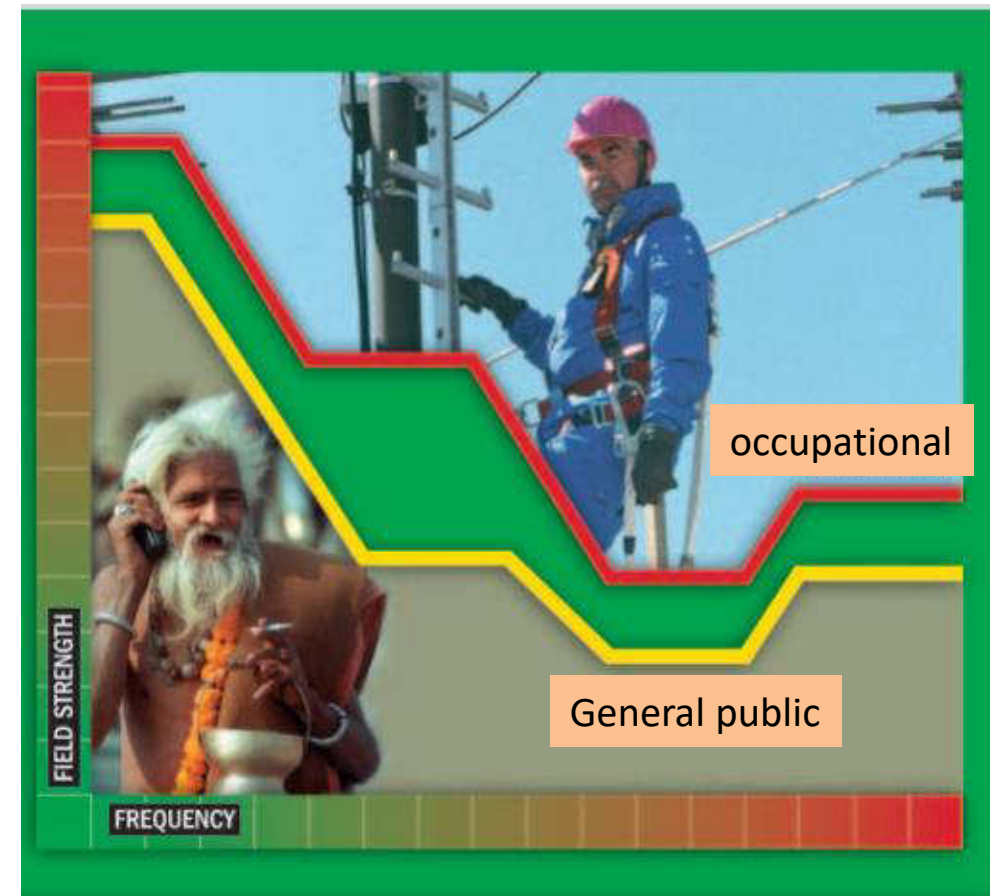
ICNIRP : Chartered as an independent commission in 1993 by the International Radiation Protection Association (IRPA);

- To develop and disseminate science-based advice on limiting exposure to non-ionizing radiation (Static Magnetic Field, ELF, RF, IR, Laser & UV)
- Not-For-Profit Non-Governmental Organization in official relations with World Health Organization & International Labour Organization
- Independent from industry; members declarations of interests available at www.ICNIRP.org



Categories of exposure restrictions

- Occupational – For exposure during occupational duties – Must be subject to risk mitigation program, including training
- General Public – For everybody else – Use larger reduction factors (lower restrictions) to ensure safety – Fetus is always treated as member of the general public.
- Basic Restrictions (exposure in body).
- Reference Levels (external fields)



ICNIRP guidelines for occupational and general public

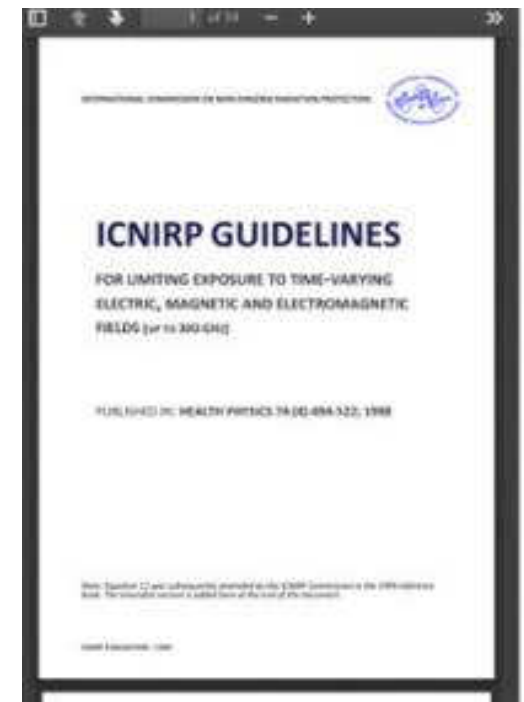
Source: <https://www.who.int/publications>

Standard & guidelines on NIR by ICNIRP



International Commission on Non-Ionizing Radiation Protection (ICNIRP)

- **ICNIRP 2020** : Guidelines for limiting exposure to electromagnetic fields (100 kHz to 300 GHz), 2020
- **ICNIRP 2010** Guidelines For Limiting for Exposure To Time-varying Electric And Magnetic Fields (1HZ – 100 kHz).
- **ICNIRP 2004** ICNIRP Guidelines On Limits of Exposure to Ultraviolet Radiation of Wavelengths Between 180nm and 400nm
- **ICNIRP 2013** ICNIRP Guidelines On Limit Exposure to Laser Radiation of Wavelengths between 180nm and 1000 μm



Standard & guidelines on NIR



Institute of Electrical and Electronics Engineers (IEEE)

International Committee on Electromagnetic Safety (ICES)

IEEE C95.1-2019 : IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz



ITU Telecommunication Standardization Sector (ITU-T)

ITU-T Study Group 5 – K series: Protection against interference

K.52 Guidance on complying with limits for human exposure to electromagnetic fields



International Electrotechnical Commission (IEC) Prepares and publishes international standards for all electrical, electronic and related technologies.



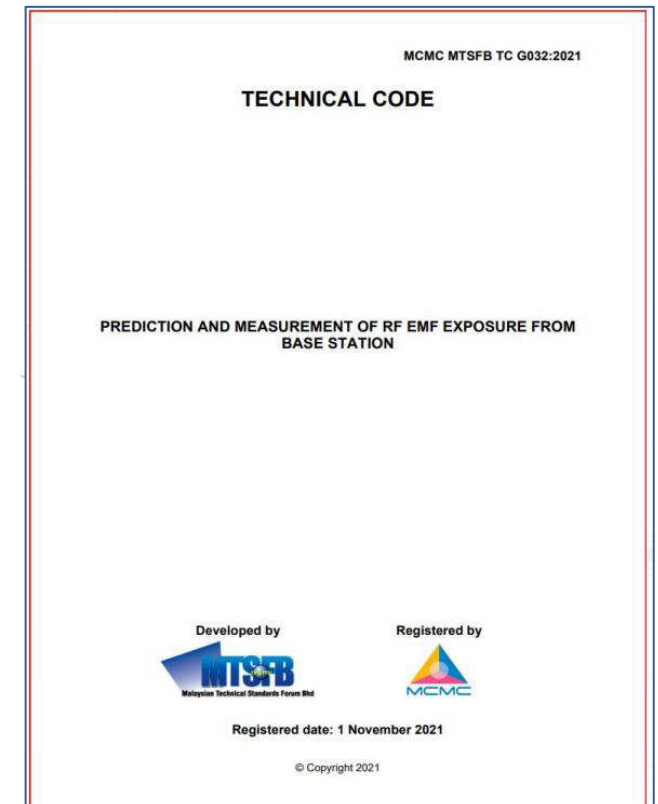
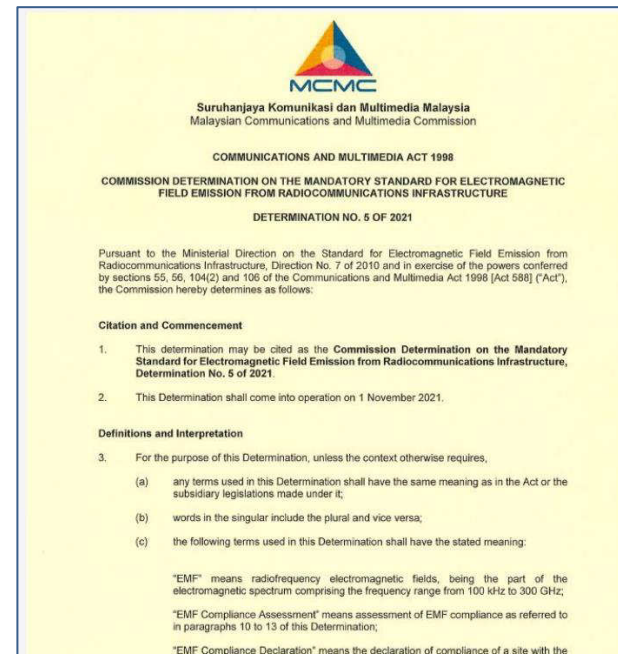
Malaysian Communications and Multimedia Commission (MCMC) Regulatory body – responsible for the regulation of the communications and multimedia industry in Malaysia.

Mandatory Standard (MS) for EMF Compliance

In regulating the EMF compliance , there are documents which we shall refer to;

Mandatory Standard (MS) for Electromagnetic Field Emission From Radiocommunication Infrastructure; Determination No.5 of 2021

- MS was 1st published in 2010 , but has been updated to be inline with International Commission on Non-ionising Radiation Protection (ICNIRP) Guidelines 2020 and the latest is **MS EMF –Determination No.5 of 2021**
- **Objective : to achieve EMF Compliance** and applicable to all Network Service Provider (NSP) and Network Facilities Provider (NFP)
- Radio communication infrastructure including :
 - ✓ Base station (BS) transmitter
 - ✓ Repeaters
 - ✓ Broadcast transmitter



Technical code



Suruhanjaya Komunikasi dan Multimedia Malaysia
Malaysian Communications and Multimedia Commission

COMMUNICATIONS AND MULTIMEDIA ACT 1998
COMMISSION DETERMINATION ON THE MANDATORY STANDARD FOR
ELECTROMAGNETIC FIELD EMISSION FROM RADIOCOMMUNICATIONS
INFRASTRUCTURE

DETERMINATION NO. 1 OF 2010

Pursuant to the Ministerial Direction on the Standard for Electromagnetic Field Emission from Radiocommunications Infrastructure, Direction No. 7 of 2010 and in exercise of the powers conferred by sections 55 and 104(2) of the Communications and Multimedia Act 1998 [Act 588], the Commission hereby determines as follows:

Citation: MCMC(T)13-TDD/170/001 Jld. 1 (02)

1. Mar
Rac
2.

**Compliance
purpose**

**MCMC Determination No. 1
of 2010**

Commission determination on the **mandatory standard** for electromagnetic field emission from radiocommunications infrastructure.



GUIDELINE ON THE MANDATORY STANDARD

FOR ELECTROMAGNETIC FIELD EMISSION FROM
RADIOCOMMUNICATIONS INFRASTRUCTURE

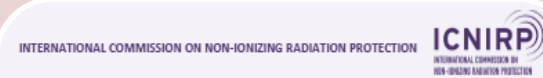
(COMPLIANCE TOWARDS DETERMINATION NO. 1 OF 2010)

MCMC(T)13-TDD/170/001 Jld. 1 (02)

**Procedures to achieve
compliance**

**MCMC(T)13-TDD/170/001
Jld.1 (02)**

Guideline on the mandatory standard for electromagnetic field emission from radio communications infrastructure



ICNIRP GUIDELINES

FOR LIMITING EXPOSURE TO
ELECTROMAGNETIC FIELDS (100 kHz TO 300 GHz)

PUBLISHED IN: HEALTH PHYS 118(5): 483-524; 2020

**Exposure (safe)
limit**

**ICNIRP Guideline,
118(5):483-524; 2020**
Guidelines for **limiting exposure** to electromagnetic fields (100 kHz to 300 GHz)



IEC 62232

Edition 2.0 2017-08

INTERNATIONAL STANDARD



Determination of RF field strength, power density and SAR in the vicinity of radiocommunication base stations for the purpose of evaluating human exposure

**Evaluation
process**

IEC 62232:2019
Determination of **RF field strength, power density** and SAR in the vicinity of radiocommunication base stations for the purpose of evaluating human exposure

Equipment for ELF EMF Radiation Safety Assessment



Spot measurement



LINDA Mapping

Probe Type and Antenna	Frequency Range
PMM instrument Model 8053 attached with probe Model PMM EHP- 50C	5Hz-100 kHz
Linear Data Acquisition System (LINDA), which includes a measurement wheel and attachment to EMDEX II	40Hz-800Hz

UV Radiation Safety Assessment

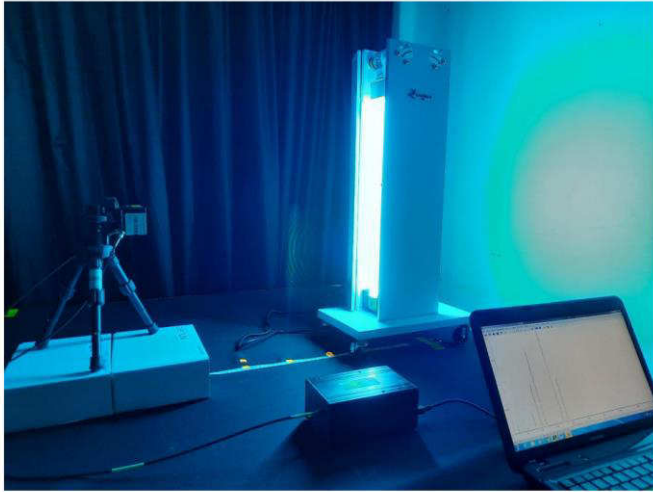
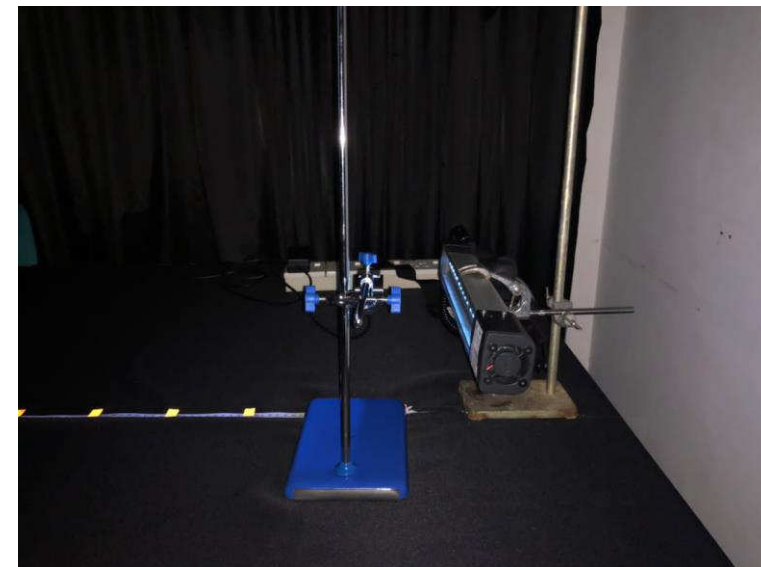
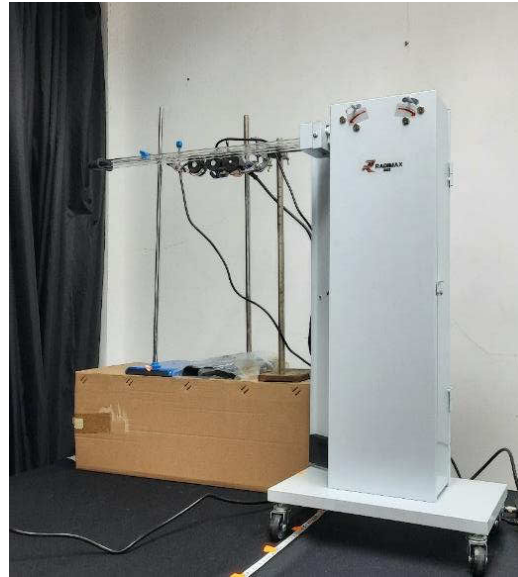
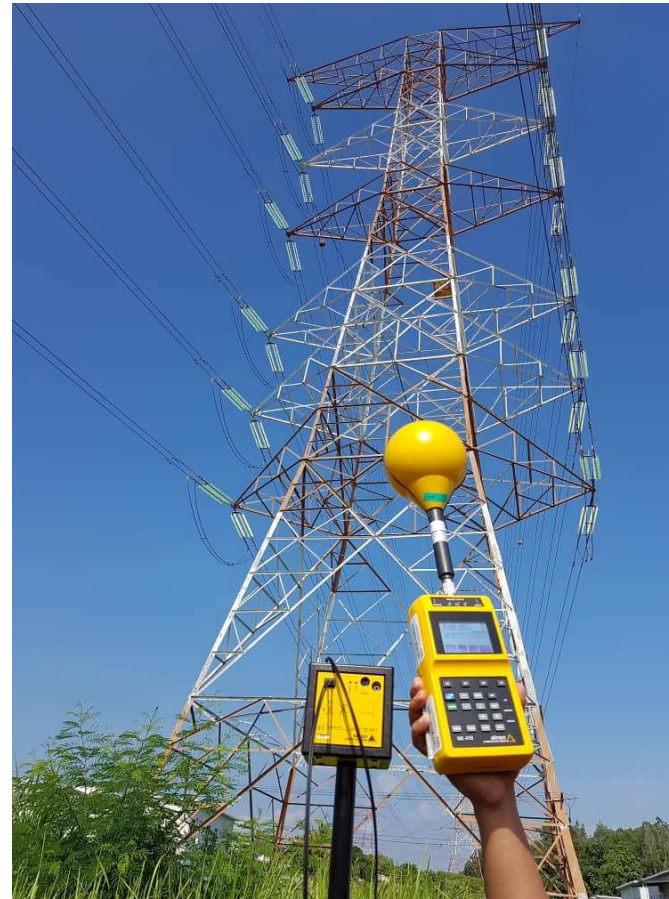


Figure 14: Measurement of wavelength

Wavelength measurement



Irradiance measurement



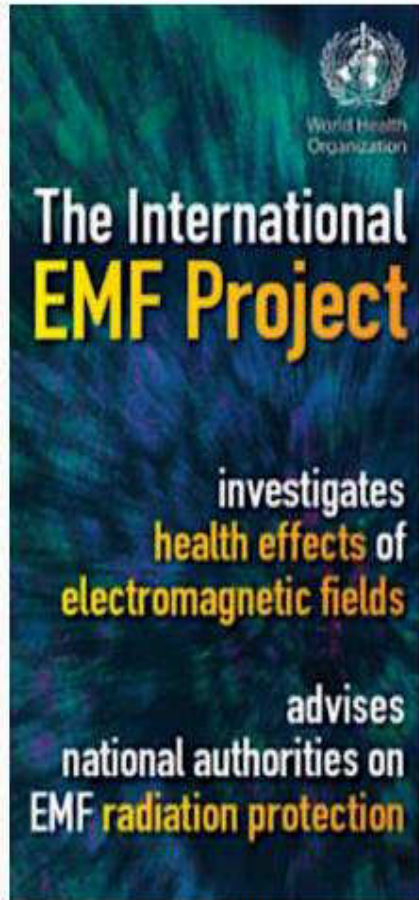
Extremely low frequency electromagnetic field at high voltage cable and substation

Research on NIR

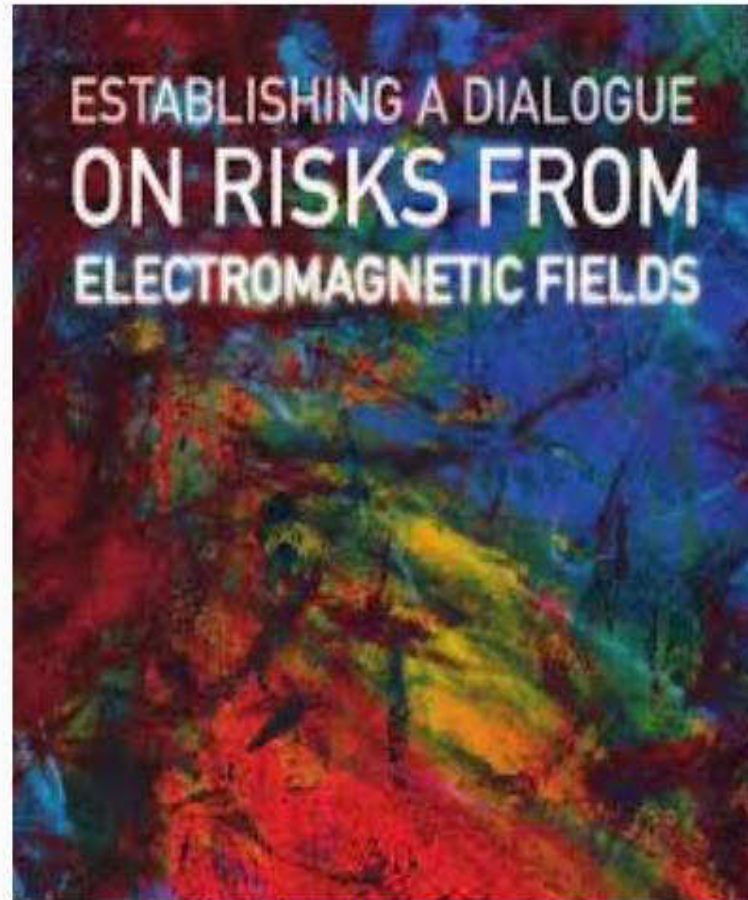
- Thousands of research has been conducted around the world in NIR field
- WHO coordinates **The International EMF Project** which has been established to assess health and environmental effects of exposure to static and time varying electric and magnetic fields in the frequency range 0-300 GHz.
- **provide a coordinated international response to concerns about possible health effects** of exposure to EMF & assess the scientific literature and make a status report on health effects
- The EMF Project encourages focused research to fill important gaps in knowledge and **to facilitate the development of internationally acceptable standards limiting EMF exposure.**
- To provide **advice about possible hazard** and to **identify suitable mitigation measures**



EMF handbook



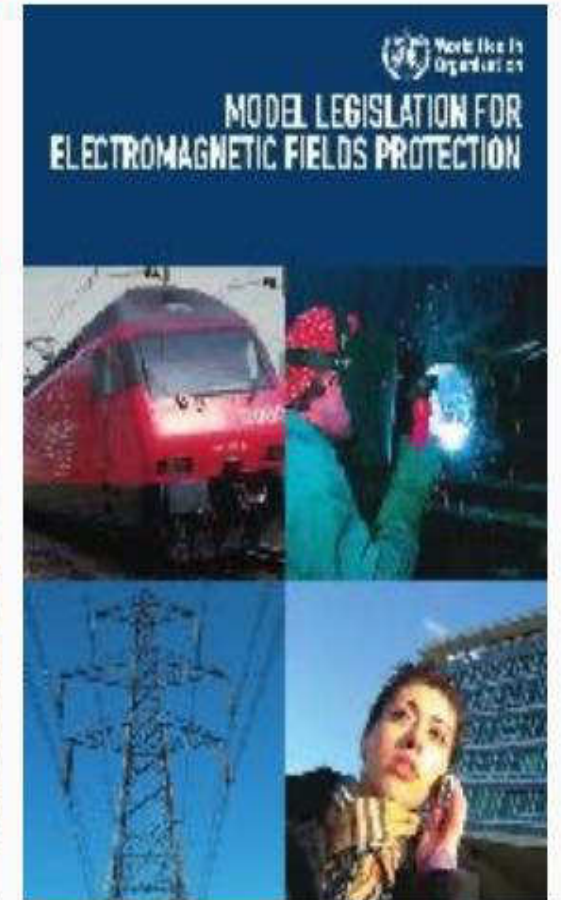
*International EMF Project
(Since 1996)*



*Handbook on
Effective EMF Risk Communication*



*Handbook on
EMF Policy Making*



Research and development in NIR field



Measurement and mapping of radiofrequency electromagnetic fields (RF-EMF) radiation exposure in the environment around Malaysia 2021 - 2023

Research is on-going



Research on Electromagnetic Hypersensitivity Effect on Short term GSM and 3G Base station Exposure on Cognitive Performance, Well being and Physiological Parameters of the Malaysian People (2019 - 2021)

Findings: There is no significant effects of short term GSM and UMTS base Station signal exposure performance, well being and physiological parameters



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Investigation of risk communication In the media and stakeholders

Findings: Public anxiety is heavily influence by media



Development of UV radiation safety Guidelines and UVGI

The guidelines –in process to publish The UVGI – to be commercialised

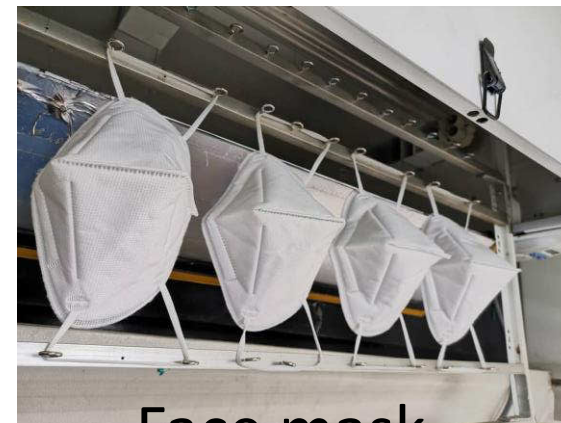
Development of UVGI

- Nuclear Malaysia has conducted research and development activities regarding the usage of UV radiation.
- During the covid -19 pandemic, Nuclear Malaysia has developed UVGI for PPE disinfection.

We can see that this technology has a very big potential to be commercialised and brings enormous benefits to people when it is used



UVGI prototype testing



Face mask
on the UVGI
tray

- Besides that, Nuclear Malaysia is developing the guidelines for UV safety assessment and UV device installation.

Are There Any Health Effects?

- ❑ A large number of studies have been performed over the last two decades to assess whether mobile phones pose a potential health risk. to date, no adverse health effects have been established as being caused by mobile phone use.
- ❑ Short-term effects of radiofrequency fields on brain electrical activity, cognitive function, sleep, heart rate and blood pressure in volunteers., result no consistent evidence. to date, research does not suggest any consistent evidence of adverse health effects.



Current evidence **does not confirm the existence of any health consequences** from exposure to low level electromagnetic fields (RF).



EMF-Portal: (<https://www.emf-portal.org/en>)

An extensive literature database with an inventory of **32,525** publications and **6,824** summaries of individual scientific studies on the effects of EMF collected worldwide since year 2015.

WHO International Advisory Committee (IAC) Meeting on NIR



Non-ionising Radiation Task Group



2023 IAC meeting
Will be in Geneva
6 -8 June 2023

- Country report on NIR
- Sharing research findings
- Collaboration

The objective;

- To support of AS in informing the general public about health risks of NIR
- explanation of the recommendations by ICNIRP on exposure limits
 - support of the organizers of Regional Congresses in order to contribute to a substantial NIR program

Malaysia Inter - Agency Working Committee (IAWC) on The Health Effects of NIR

Coordinated by Ministry of Health (MOH)



IAWC meeting 31st Jan 2023



IAWC meeting on 1st October 2019
Hotel Istana, Kuala Lumpur



Conclusion

New technology and NIR in applications will be created and it will cause more challenges and based on our expertise , experience and facilities, we will continue to work closely with the stake holders in related industries to ensure that NIR applications remain safe for the public.



6th Asian and Oceanic Congress for Radiation Protection
07-11 February 2023, Mumbai, India

Radiation Protection and Surveillance in Nuclear, Medical, Industrial facilities and the Environment

