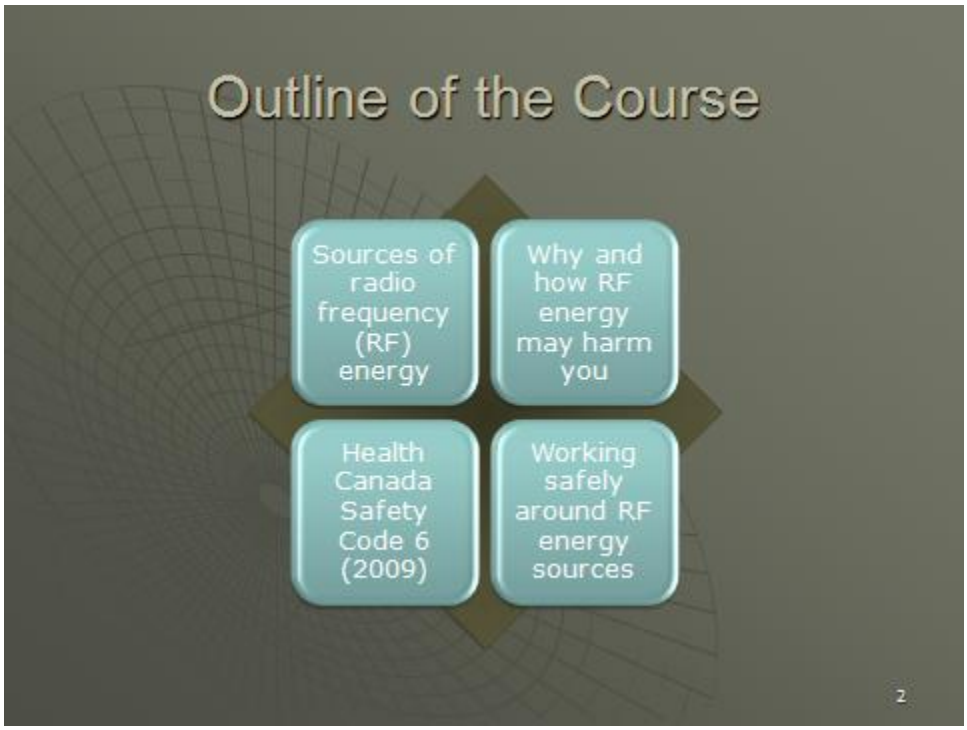
Slide 1

Canadian Coast Guard staff may be exposed to sources of radio frequency energy during their work. Radio frequency energy may cause harm to humans under certain conditions. This RF Awareness Training video has been developed for personnel who work on or near equipment that emits RF energy, their supervisors and their managers.

Even though the possibility of harm from RF energy sources on Coast Guard vessels or at shore-based sites is very unlikely, this course has been developed to ensure that you know what the risks are and how to work with awareness in these environments.

Slide 2



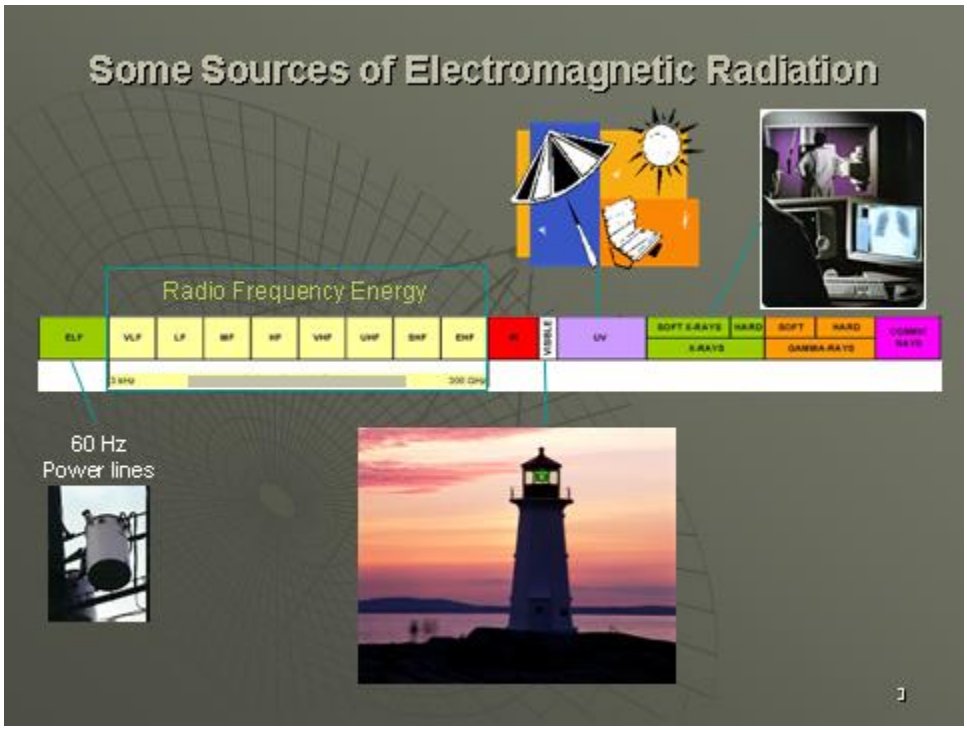
First, this course shows common sources of RF energy around us in everyday life. Your job may require that you work in an environment where RF energy is emitted. This part also explores the equipment that emits RF energy in a work environment.

Second, it is important to understand the risks involved. So, this course explores why and how RF energy may cause harm to humans.

Health Canada researched and developed safe limits of exposure to radio frequency energy and published them in Safety Code 6. This course reflects the changes to Health Canada's Safety Code 6 as a result of their December 2009 revision. The Safety Code 6 compliance limits in the 2009 revision are identical to those in the previous 1999 revision. We'll review the safety limits and what they mean.

This course concludes by discussing what you need to be aware of when working in an RF environment.

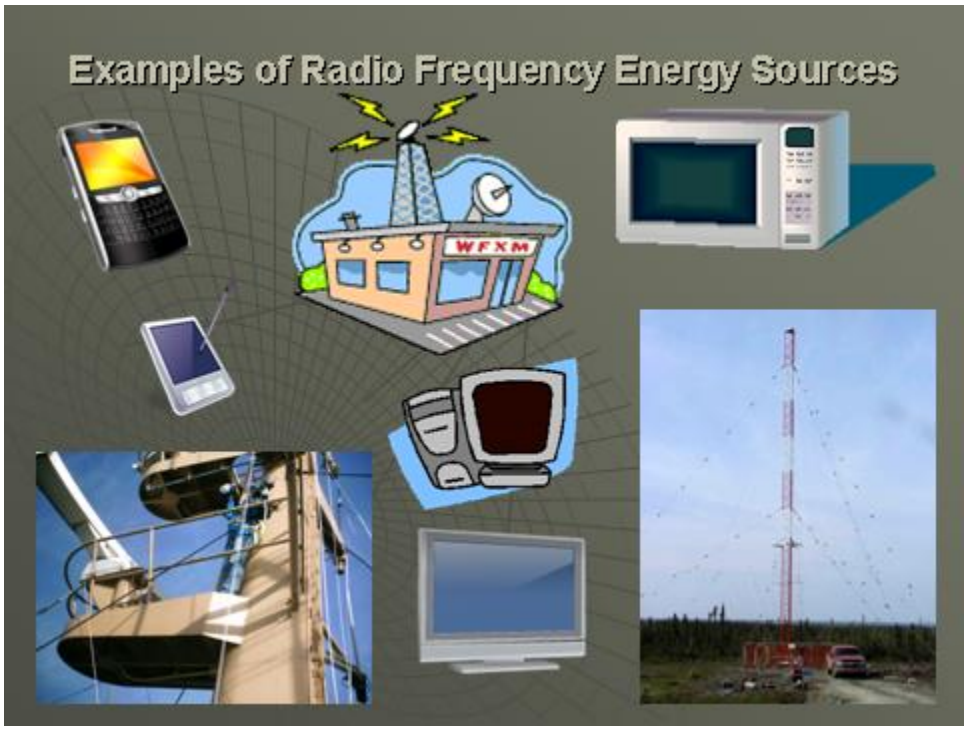
Slide 3



RF energy is one form of electromagnetic radiation, which is all around us and a fundamental reality of our daily lives. Here are some examples.

- The sun generates electromagnetic radiation, warming our planet. The sun's UV waves have sufficient energy to start causing cell damage, such as sunburn, when the skin is exposed unprotected over enough time.
- X-rays penetrate much deeper than UV rays, and can cause serious cell damage. That is why the exposure time is kept very short for human x-rays.
- Radio frequency energy, also called RF energy, is the portion of the electromagnetic spectrum with frequencies ranging from 3 kilohertz to 300 gigahertz.
- As you can see, RF energy is below visible light – those are the frequencies that we can see – and the infrared frequency.
- RF energy frequencies are above the Extremely Low Frequency electromagnetic energy. 60 hertz power lines and Direct current fall in that frequency band.

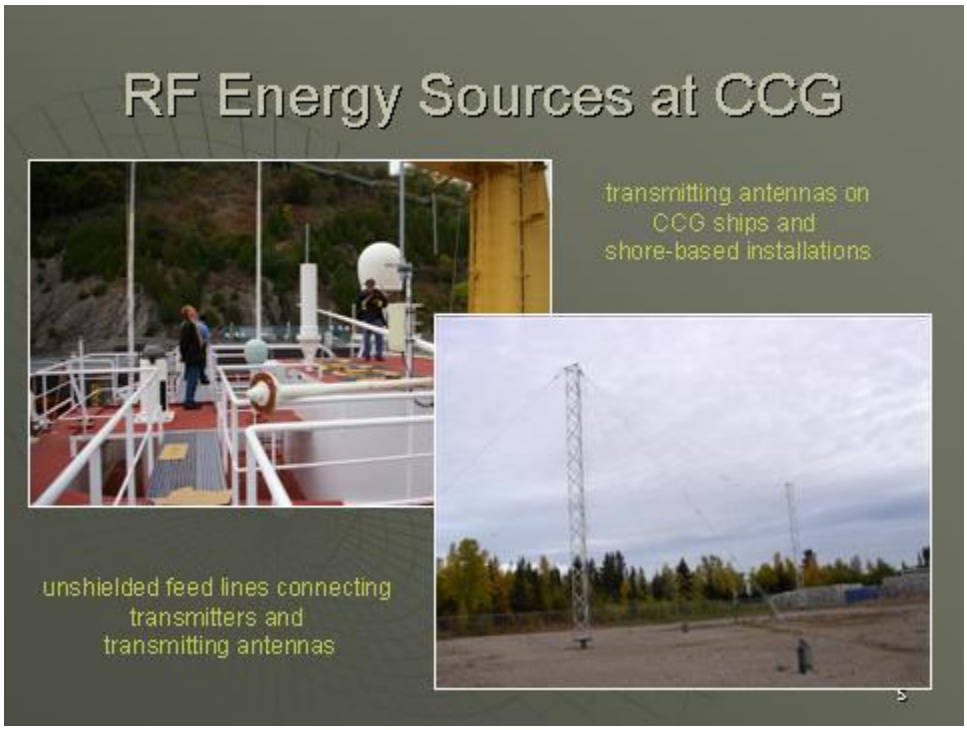
Slide 4



RF energy is produced by many man-made sources, such as:

- mobile and cellular phones;
- base stations;
- television and radio broadcasting facilities;
- radar;
- microwave ovens;
- medical equipment; as well as
- many other electronic devices within our living and working environment.

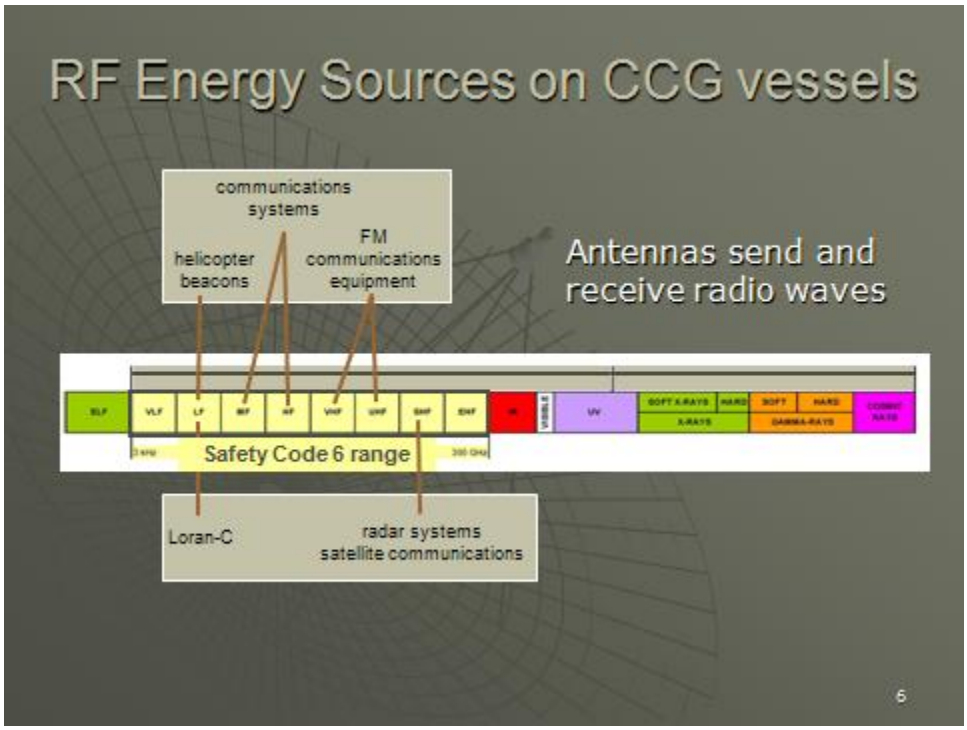
Slide 5



RF energy is emitted primarily by the transmitting antennas on Coast Guard ships and shore-based installations when they send and receive radio signals or waves.

RF energy may also be emitted by unshielded feed lines that connect transmitters to transmitting antennas.

Slide 6

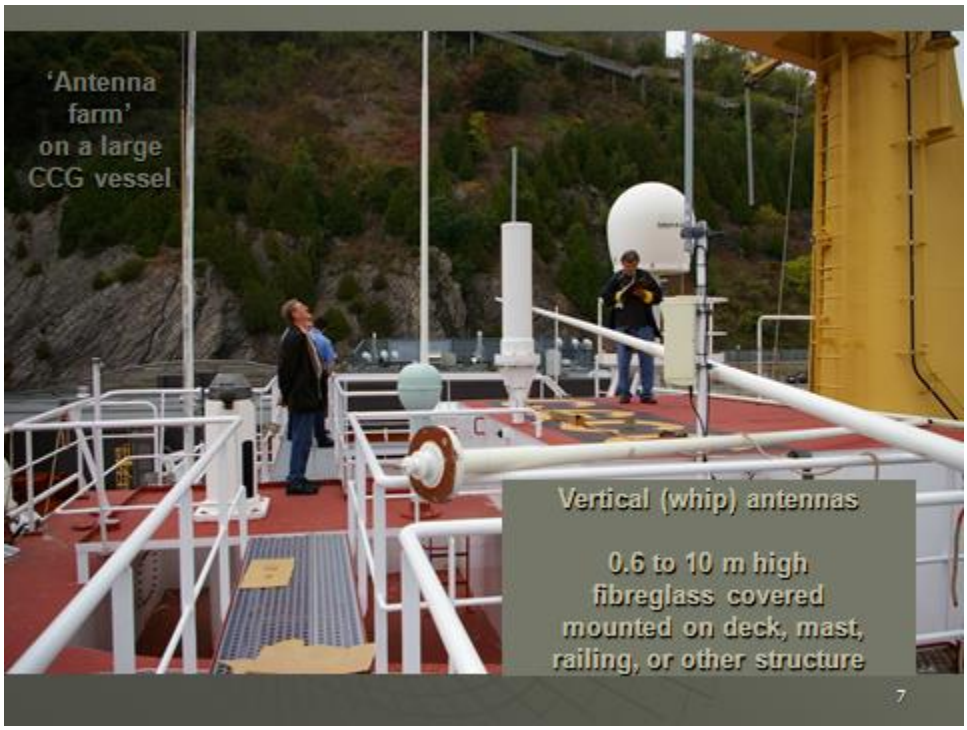


On Coast Guard vessels, all the RF energy comes from communication antennas.

The Canadian Coast Guard uses these antennas to send and receive radio signals required for communications utilizing different parts of the radio spectrum. For example:

- Low Frequency helicopter beacons;
- Medium Frequency and High Frequency radio communications;
- Very High Frequency and Ultra High Frequency radio communications; and
- Super High Frequency for radar systems and satellite communications.

Slide 7



On large Coast Guard vessels, antennas are very often located in a common "antenna farm." These antennas are usually found on top of the wheelhouse, commonly known as the "Monkey Island," or the masts.

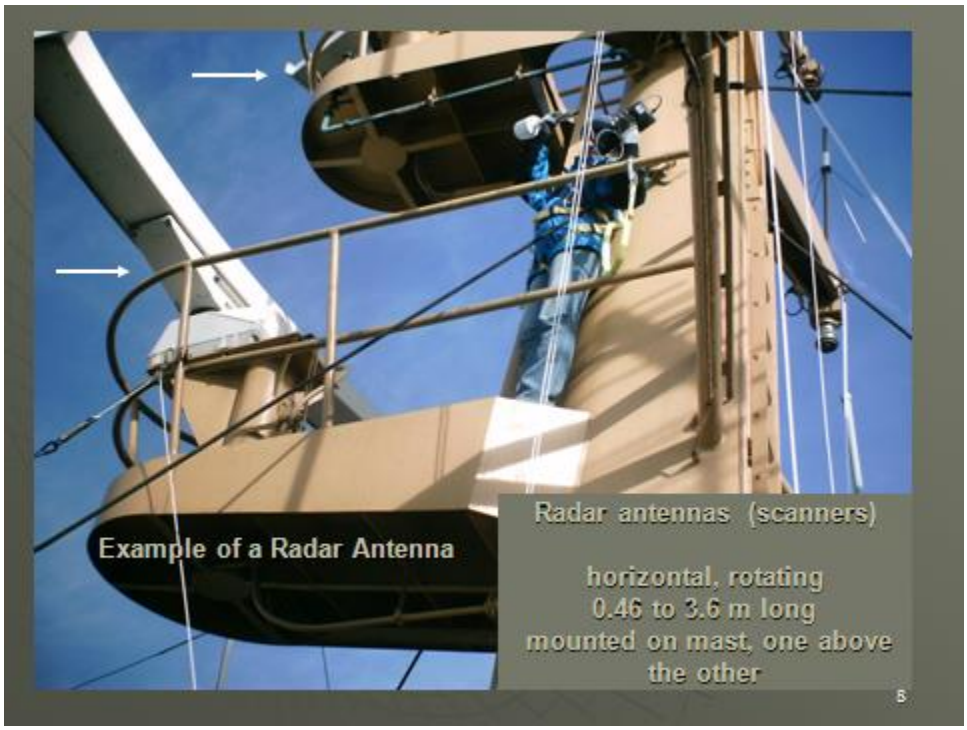
There are many types of shipboard antennas, and they tend to fall into one of three categories.

Vertical antennas, shown in this picture, are one category. Vertical Antennas or Whips look like an upright pole. They may vary in size from 0.6 m to over 10 m. They are usually fiberglass covered.

The shorter ones, 0.6 m to 10 m, are usually used for Very High Frequency FM or AM frequencies, and the very tall ones are used for Low Frequency Beacons and Medium or High Frequency single side band communications.

They may be mounted on the deck, on a mast, a railing, or other structure.

Slide 8



The second category of antennas on vessels is the Radar Antenna, which is sometimes also called a Radar Scanner. These are horizontal rotating antennas that may vary from about 0.46 m to 3.6 m or more in length. The one shown here is a slotted waveguide antenna.

Radar antennas are usually mounted on masts. Most often, there will be two radar scanners mounted one above the other on the front mast of the ship. The larger of the two is usually an S-Band radar antenna which typically operates on 3050 megahertz, and the smaller one is an X-Band radar antenna which typically operates on 9410 megahertz.

Sometimes you will find a small X-Band scanner mounted on the rear mast such that it is aft looking.

Slide 9

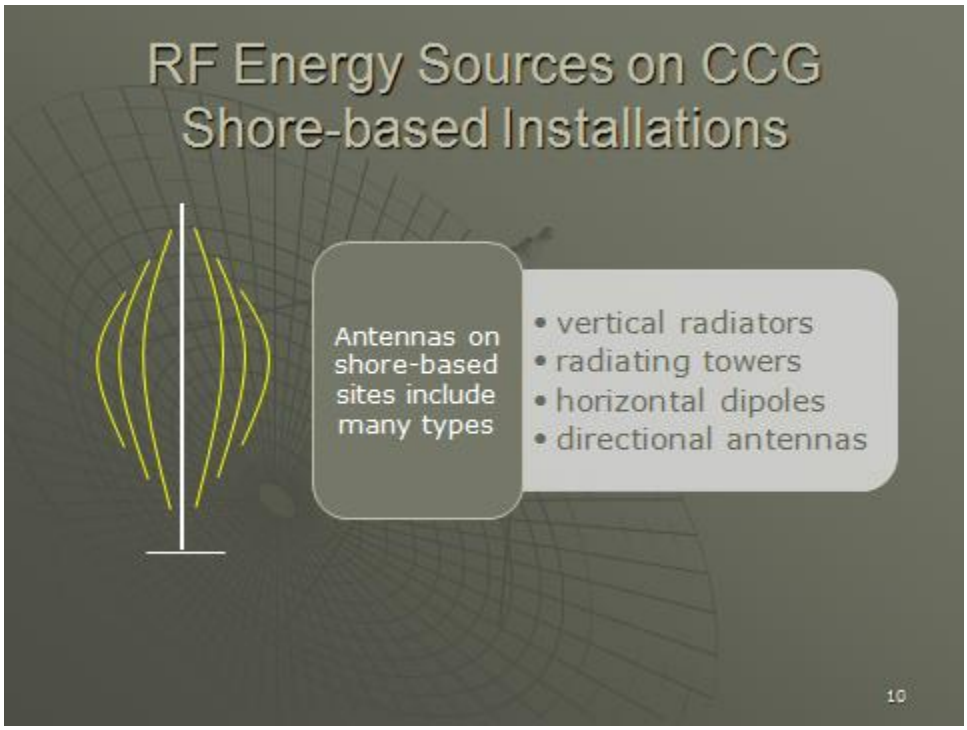
This photo shows a typical shipboard Satellite Communication Antenna, the third general antenna category.

They can vary from 1 to 3 meters in diameter. These antennas are usually housed in fiberglass domes and can be mounted on a mast or on the deck of a larger vessel.

They are typically used for Inmarsat satellite communications and the recently installed E-mail at Sea system.

Inmarsat-B operates around 1.4 to 1.6 gigahertz – the L-Band – and E-mail at Sea operates around 14 gigahertz – the Ku-Band.

Slide 10



The antennas on shore-based sites include many types such as vertical radiators and radiating towers, horizontal dipoles, and directional antennas.

Slide 11

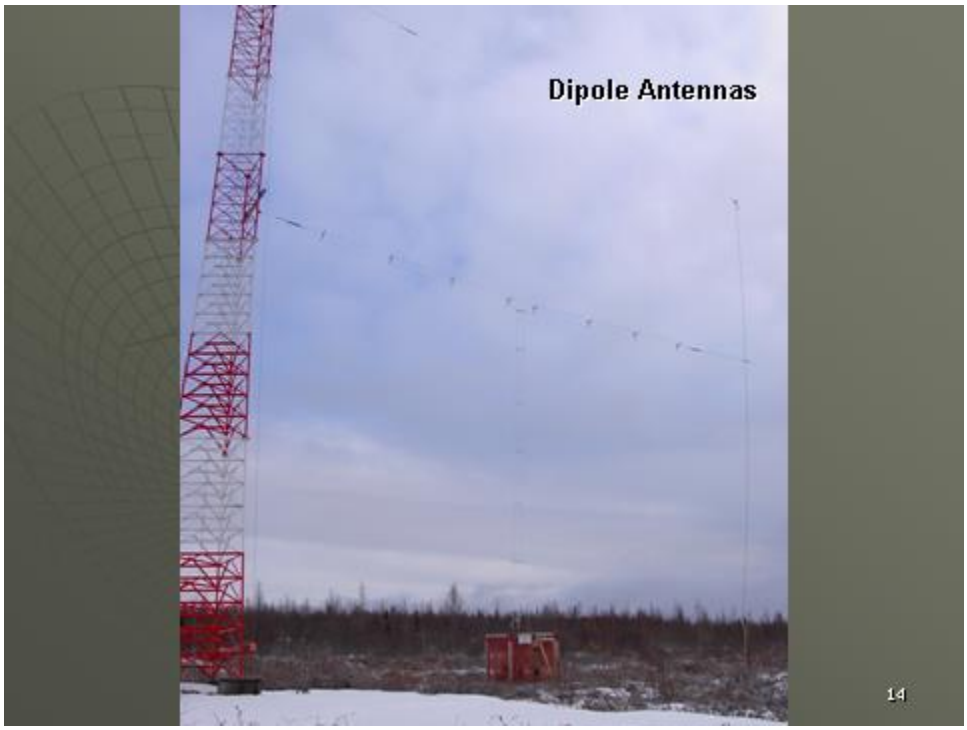
This slide and the next ones show examples of transmitting antennas used at some of the Canadian Coast Guard shore-based sites in the various regions.

Slide 12

Some vertical radiators are quite tall. For example, radiating or beacon towers can vary from 24 to 305 m.

Slide 13

Slide 14



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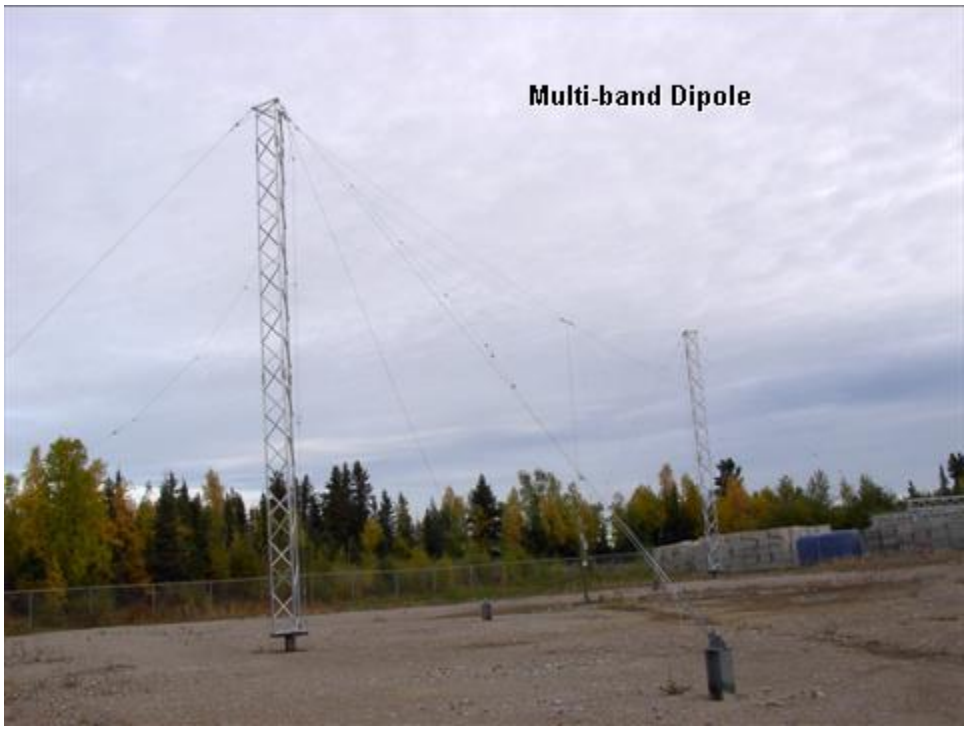

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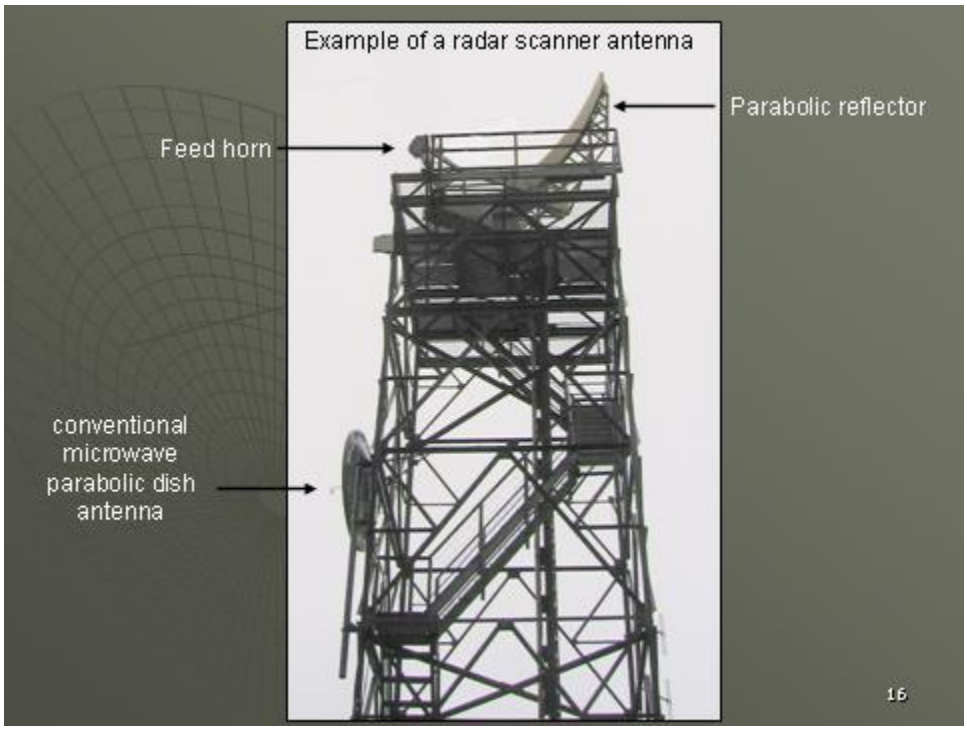

This is a shore-based radar antenna. This particular type of antenna uses a feed horn, visible to the left of the picture, to bounce the radar beam off the curved surface of the parabolic reflector.

The long and narrow shape of the reflector determines the shape of the radar beam. You are more likely to see a large antenna like this one – 3.6 to 7.3 m in length – on a shore-based installation. It is a larger version of the shipboard radar scanners.

The second shore-based antenna mounted on the left side of the tower is a conventional microwave parabolic dish antenna, used for communications.

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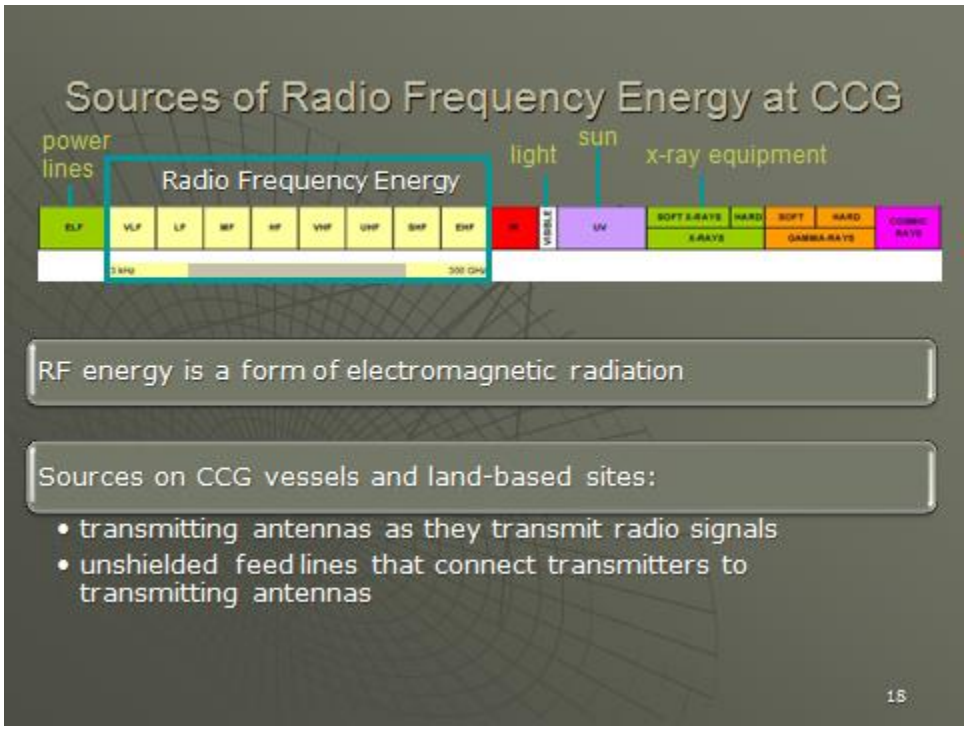
The physical working environment is many times larger at shore-based installations than aboard Coast Guard vessels.

Most shore-based antenna installations have fences and signage around the radiating antennas to warn people away, especially from the vertical radiators.

The signage depends upon the type of antenna being used.

Slide 18



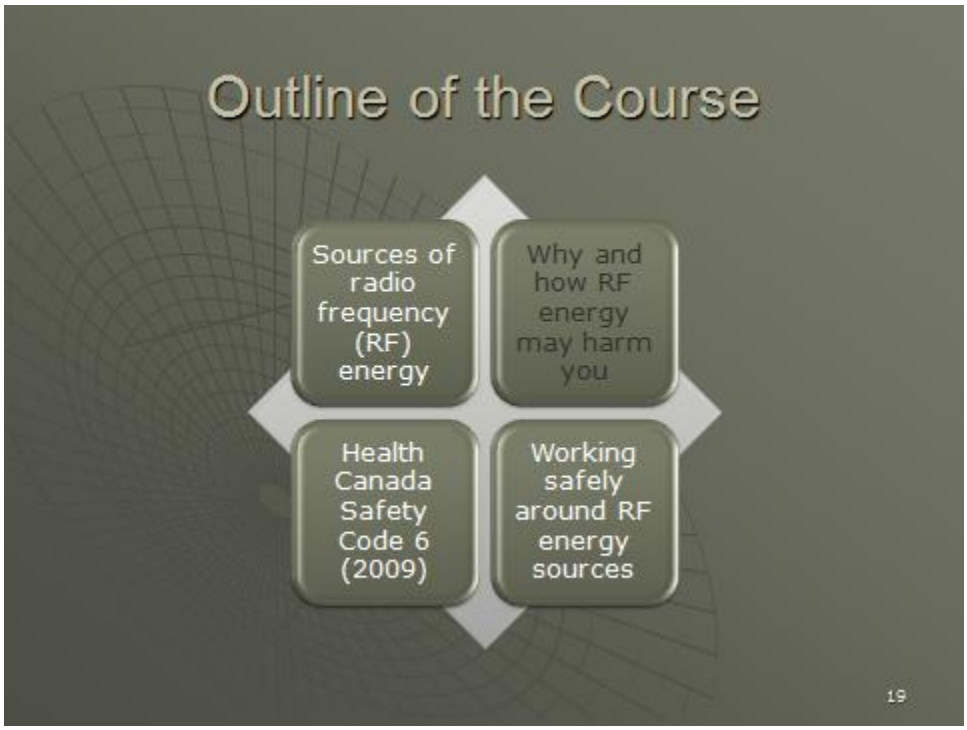
Here is a summary of the key points so far.

- Radio frequency energy is a form of electromagnetic radiation, and that energy is all around us in our every day lives. The sun is a natural source of electromagnetic radiation. Man-made sources include cell phones, microwave ovens, computer screens, and antennas, to name but a few.

- This course focuses on the radio frequency energy because transmitting antennas are found on Canadian Coast Guard ships and at shore-based installations. There are many types of antennas in a large variety of sizes and shapes. Antennas are of interest because they are the primary source of radio frequency energy when they transmit radio signals.

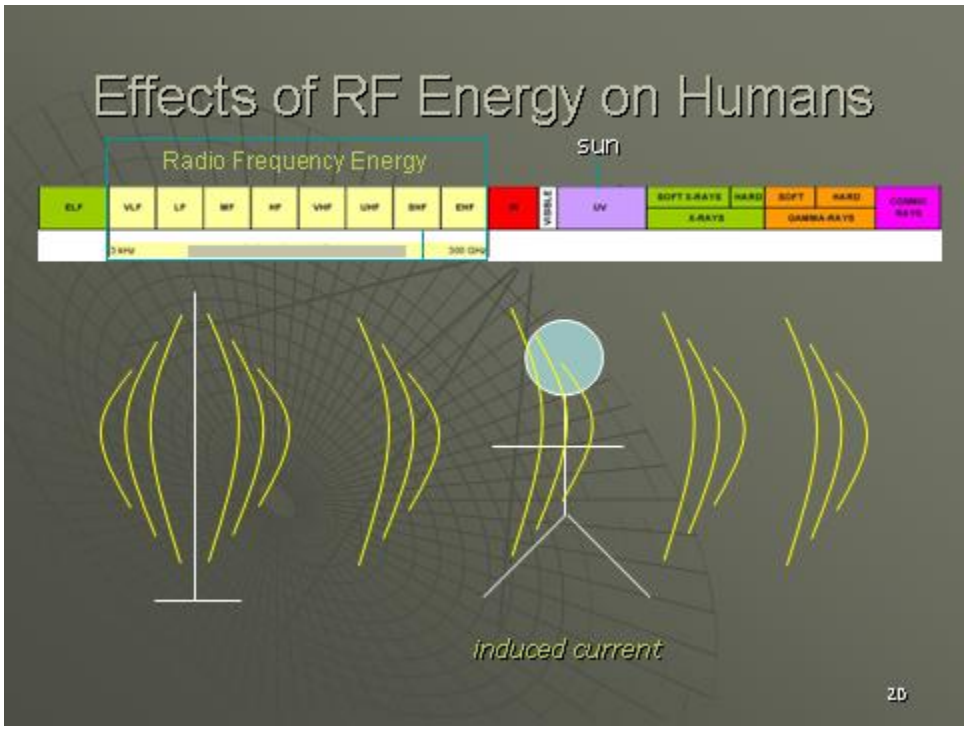
- RF energy may also be emitted by unshielded feed lines that connect transmitters to transmitting antennas.

Slide 19



This part of the course explores why and under what conditions RF energy may cause harm to humans.

Slide 20

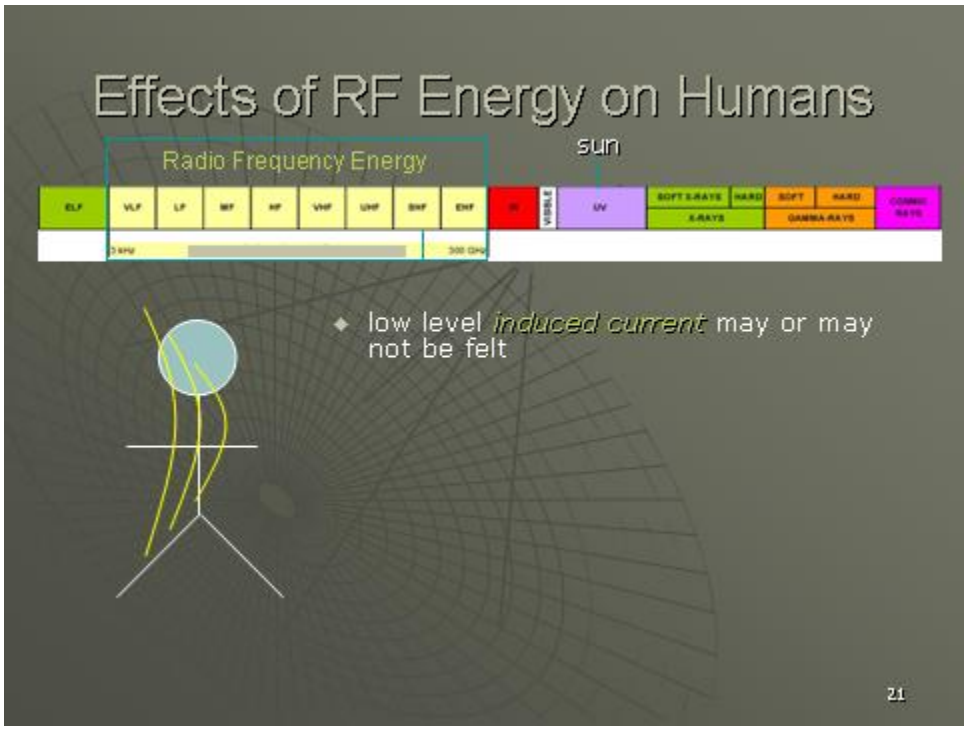


As discussed earlier, RF energy is emitted primarily by the transmitting antennas on Coast Guard ships and shore-based installations when they send radio signals or waves. What happens if a person is exposed to these radio waves while an antenna is transmitting?

The human body is like a grounded vertical antenna. When exposed to a source of radio frequency energy, an electro-magnetic current flows through the body from head to feet.

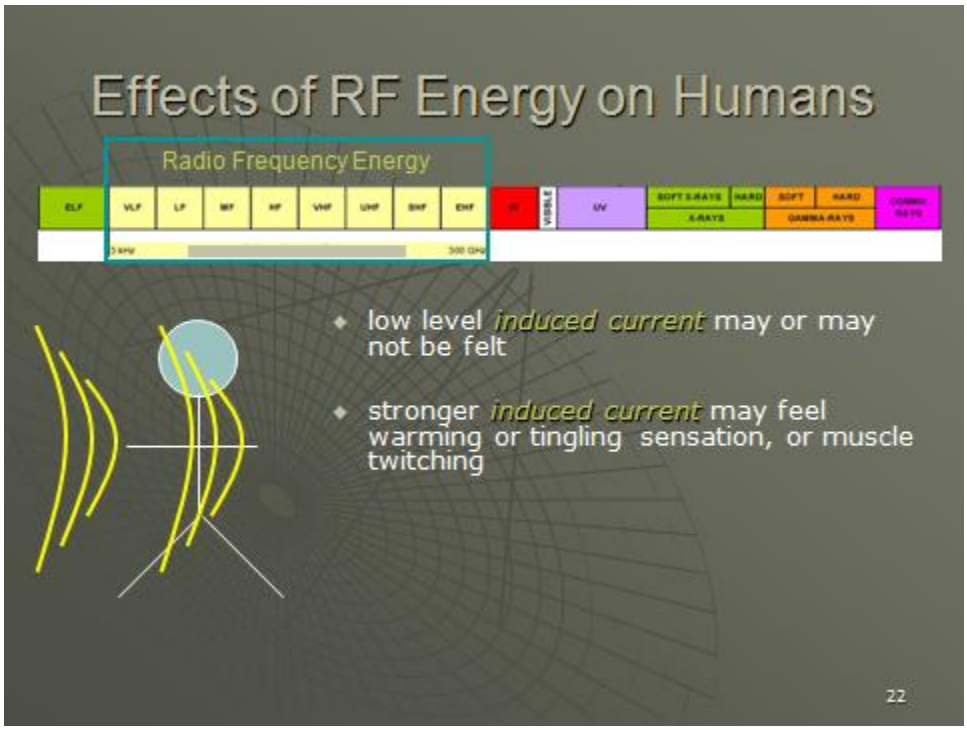
This is called an induced current.

Slide 21



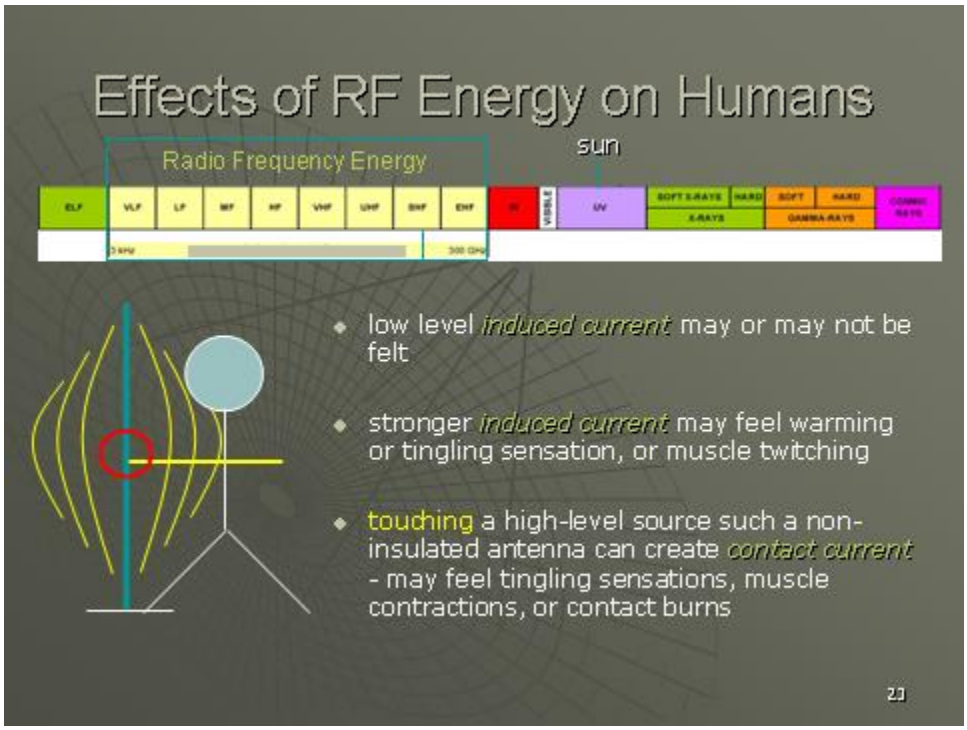
Low level electromagnetic waves flowing through a person may or may not be felt.

Slide 22



When the induced current is strong enough, it may be felt as a warming sensation, a tingling sensation, or it may cause muscles to twitch.

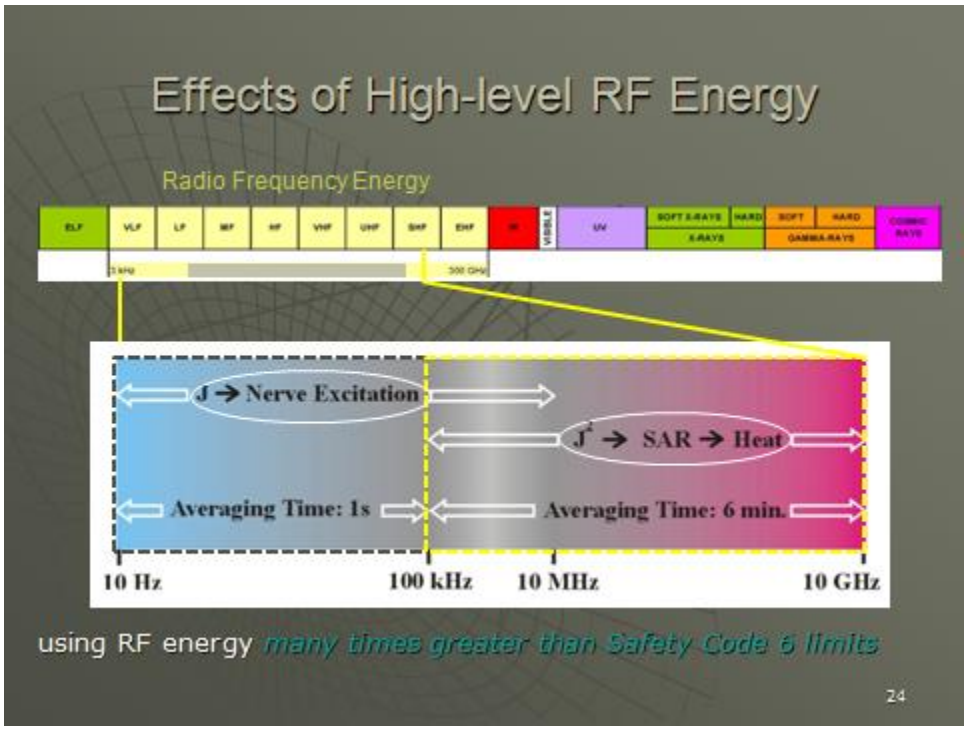
Slide 23



Touching or coming into contact with a source of RF energy, such as a non-insulated transmitting antenna, may create *contact* current. The current from the antenna runs along the surface of the body.

At high frequencies, the current may cause muscle twitching, tingling or body heating. It can also cause serious burns at the point of contact.

Slide 24

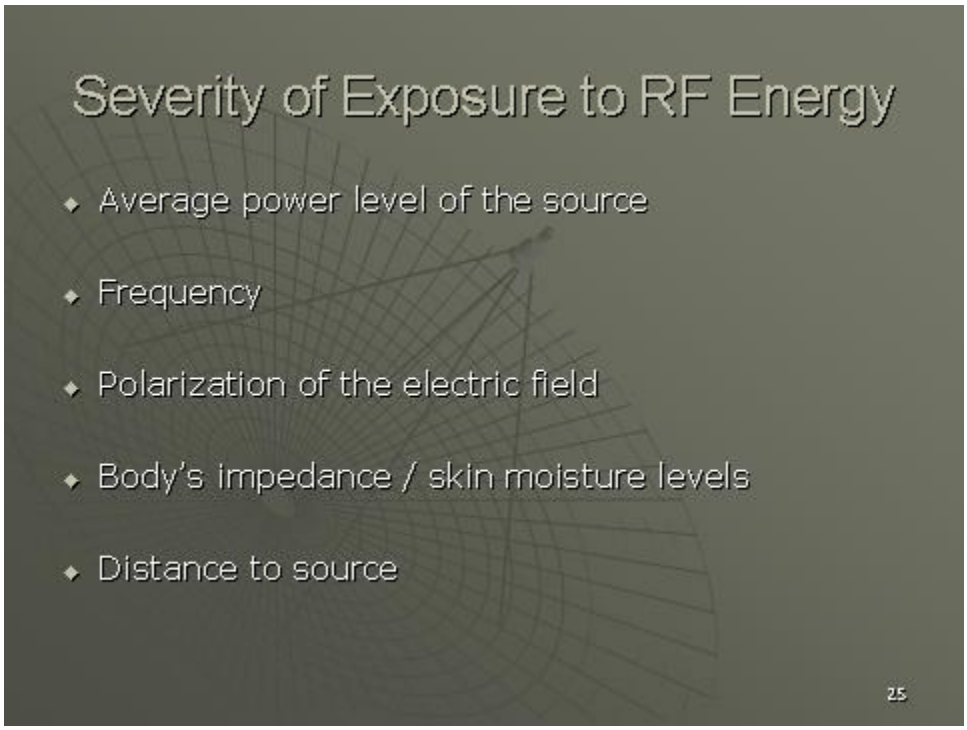


Research was done to determine whether the effects of exposure to electro-magnetic waves were the same across all the radio frequencies. This slide shows the effects under extreme research conditions using very high levels of RF energy – 100 times higher than the safe limits established by Health Canada in Safety Code 6.

The research found that:

- at frequencies less than 100 kilohertz, the predominant sensation is one of muscle twitching; and
- at frequencies greater than 100 kilohertz, the predominant sensation is one of heating.

Slide 25

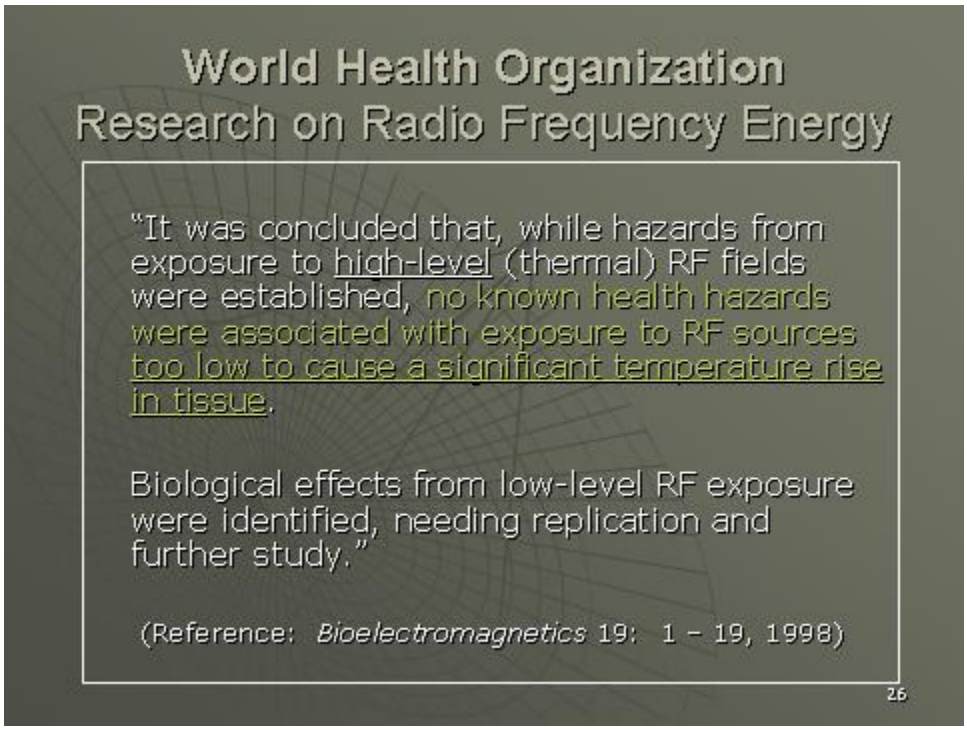


What factors influence how severely a person is affected by exposure to RF energy?

1) the average power level of the source – higher power levels produce more energy;
2) the frequency of the RF energy – as we saw just now, the higher frequencies cause a rise in the temperature of body tissue;
3) the polarization of the RF energy's electric field, that is to say whether the waves are emitted from the antenna horizontally, vertically or in a circular fashion. The orientation of the body and the wave polarization must be the same for there to be adverse effects. A *horizontal* wave hitting a *vertical* body will have little effect.
4) the body's impedance and/or skin moisture levels; higher moisture levels absorb more energy and heat up more easily;
5) the distance you are from the source. The closer a person is to the source, the stronger the effects will be.

Change any one of these variables, particularly distance, and the effects will be drastically reduced.

Slide 26



Under what conditions can Radio frequency energy cause harm to humans?

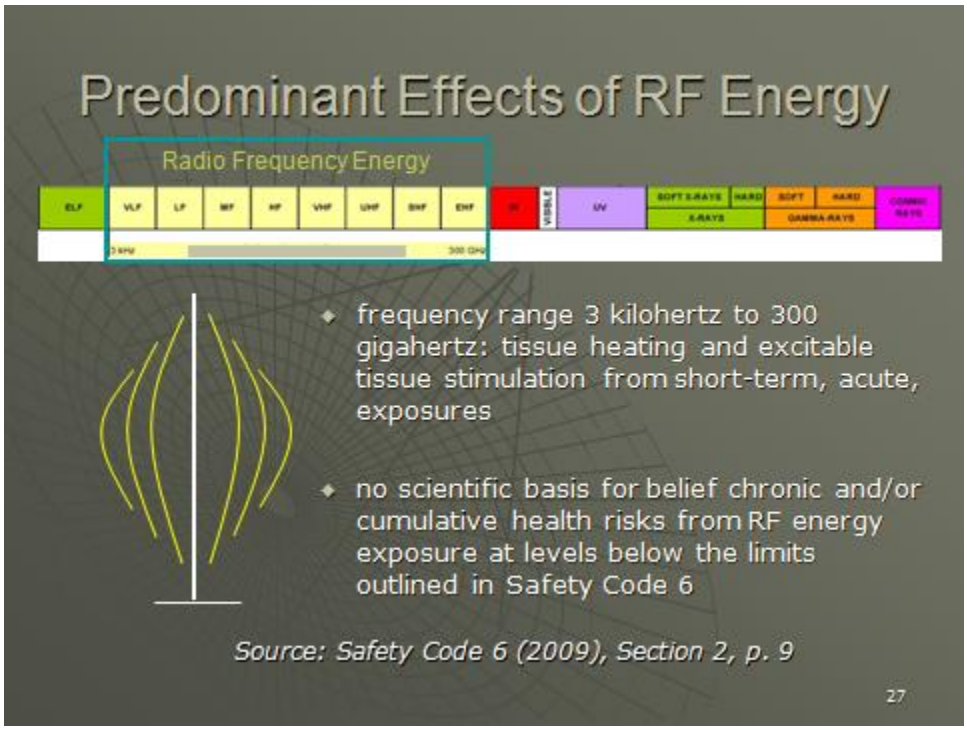
For more than 30 years, the World Health Organization has been conducting research to assess current scientific knowledge of health and biological effects of RF energy fields. These are their findings.

"It was concluded that, while hazards from exposure to high-level (thermal) RF fields were established, *no known health hazards were associated with exposure to RF sources too low to cause a significant temperature rise in tissue*.

Biological effects from low-level RF exposure were identified, needing replication and further study."

In the 10 years since the previous version of Safety Code 6, these conclusions have not changed.

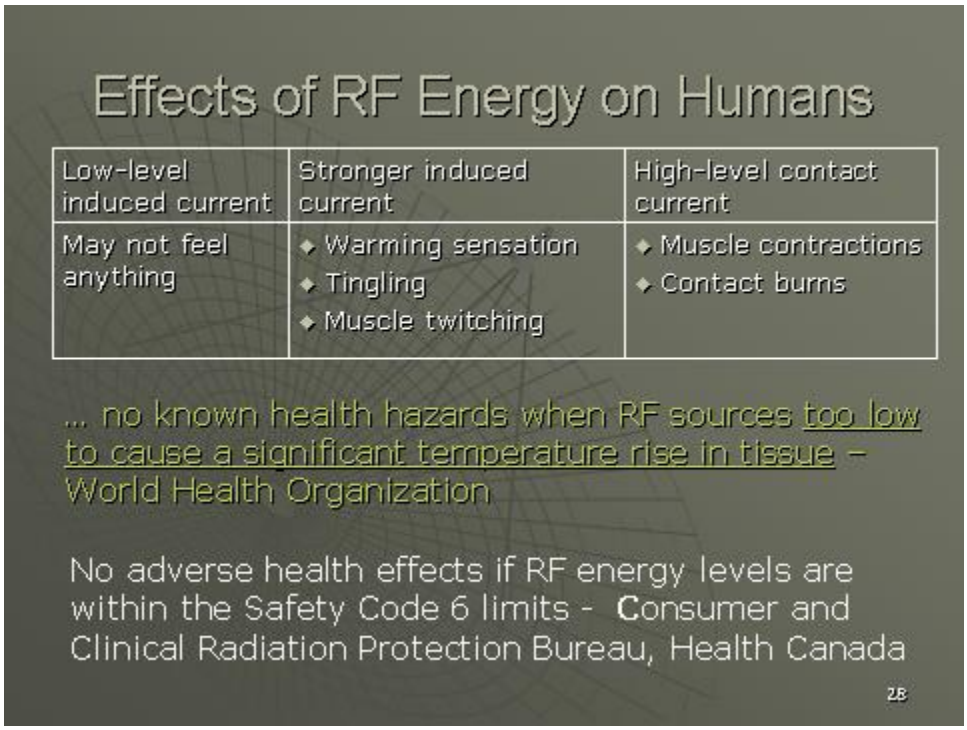
Slide 27



"Despite the thousands of additional research studies on RF energy and health since 1999, the predominant adverse health effect associated with high levels of RF energy exposure, in the frequency range from 3 kilohertz to 300 gigahertz, is still related to the occurrence of tissue heating and excitable tissue stimulation from short-term, acute, exposures."

"At present, there is no scientific basis for the belief in chronic and/or cumulative health risks from RF energy exposure at levels below the limits outlined in Safety Code 6."

Slide 28



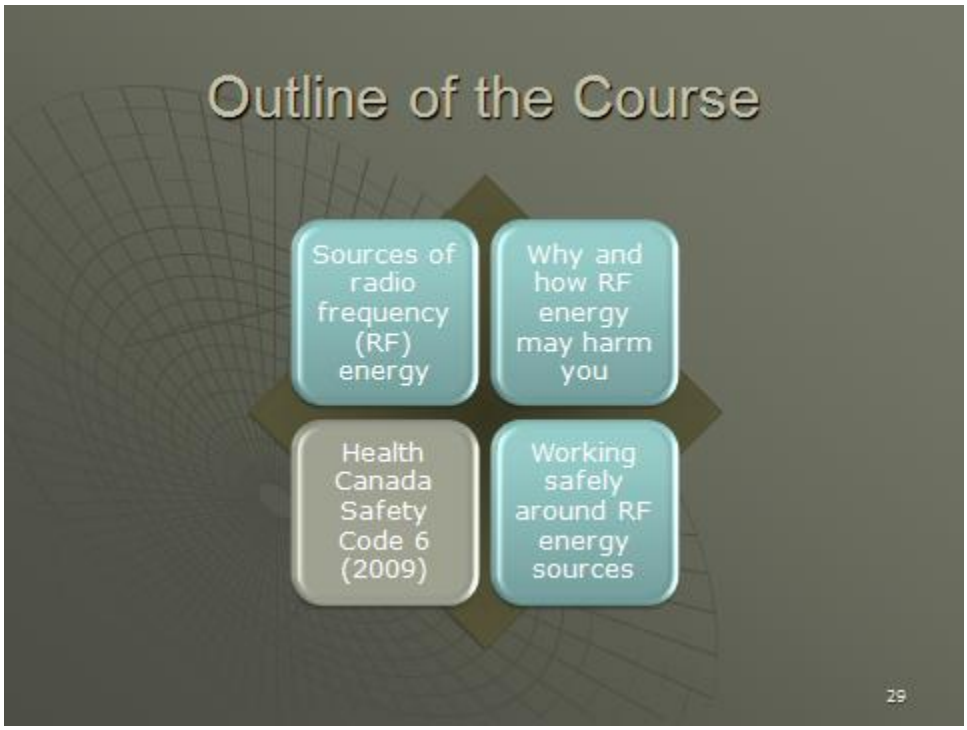
So there you have it.

A person exposed to low levels of radio frequency energy may not feel anything at all. If the induced current is strong enough, the body may warm up and a person may feel tingling sensations and muscle twitching. A person touching a transmitting antenna that is operating at high levels might experience muscle contractions or get contact burns.

As the World Health Organization research points out, there are no known health hazards when the radio frequency energy is too low to cause a significant rise in tissue temperature.

The Canada Labour Code requires that Safety Code 6 be applied across the federal public service to ensure safe working conditions in an RF environment. Health Canada's Consumer and Clinical Radiation Protection Bureau stated that there will be no adverse health effects when RF energy levels are within the Safety Code 6 limits.

Slide 29



Canadian Coast Guard staff may be required to work on and around antennas on vessels and at shore-based sites.

Health Canada researched and developed safety limits to protect persons who may be exposed to radio frequency energy. This part briefly discusses this research and presents the safety limits.

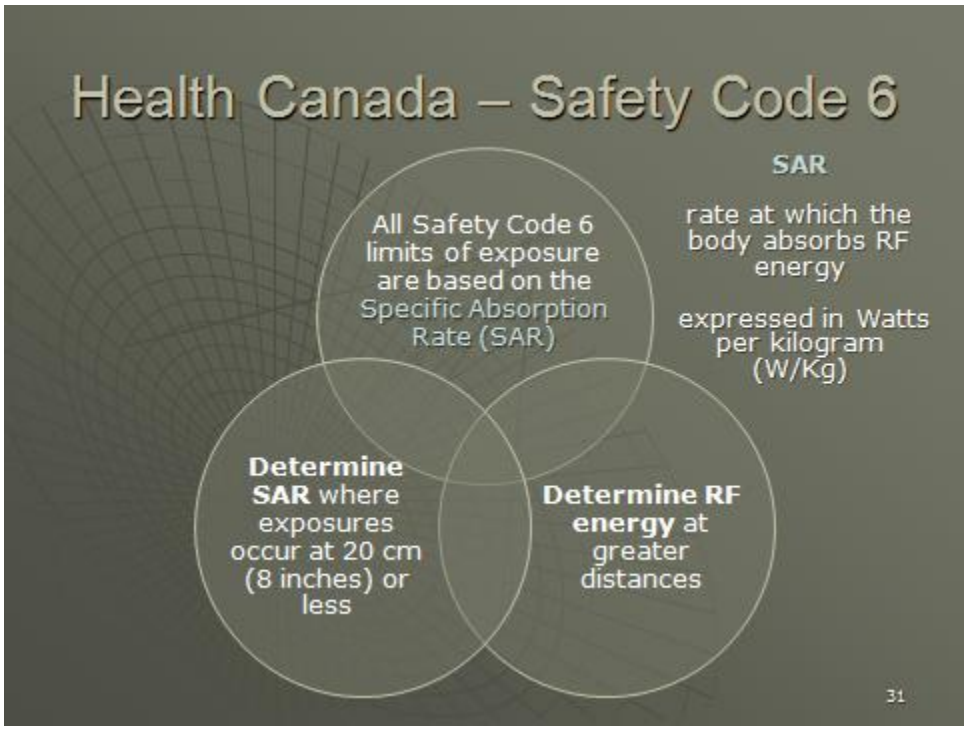
Slide 30

Health Canada's Safety Code 6 is a set compliance criteria. The Code specifies the safe limits of exposure to harmful conditions that exist in radio frequency energy environments. These frequencies range from 3 kilohertz to 300 gigahertz.

Safety limits are expressed in terms of:

- how much heating the body can safely be exposed to;
- the safe periods of time a person may be near an antenna, based on the transmission frequency and the other factors that contribute to harmful exposure.

Slide 32

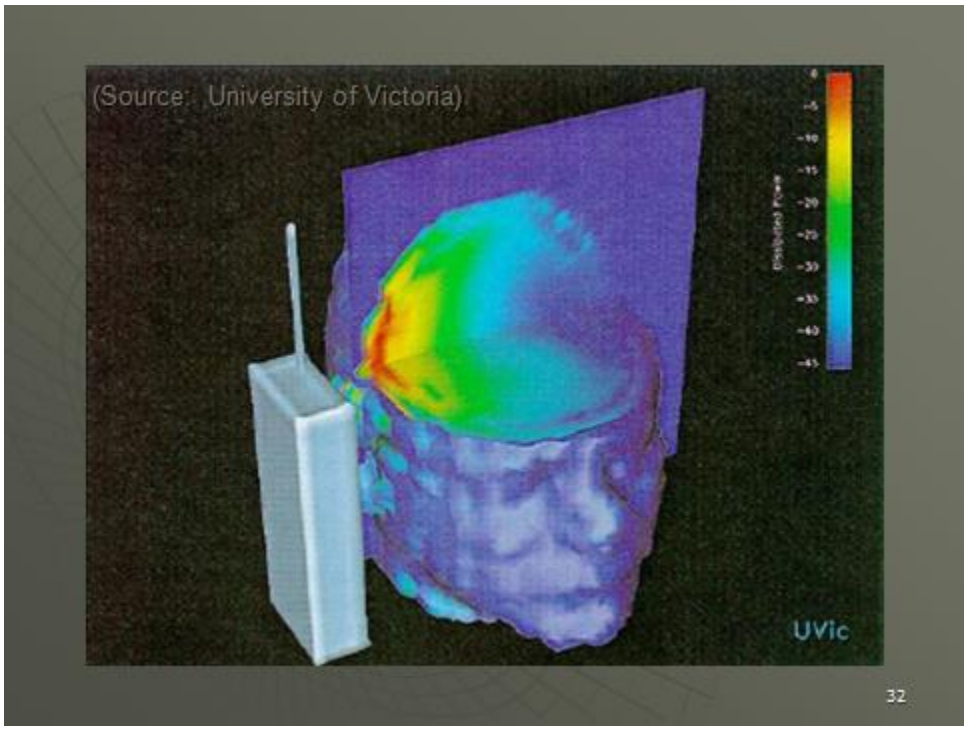


All Safety Code 6 limits of exposure are based on the Specific Absorption Rate – or, SAR – which is the rate at which the body heats up as a result of absorbing RF energy. The specific absorption rate is expressed in Watts per kilogram.

SAR should be determined for situations where exposures occur at distances of 20 centimeters or less. This is primarily due to the interaction between the measuring device and the RF Energy source.

In situations greater than 20 centimeters, direct measurement of the RF energy using commercially available survey instruments is employed.

Slide 32



Specific Absorption Rate was originally determined through research by exposing flesh of small animals, mostly rodents, to increasing electric and magnetic field strengths, in different frequency bands, while measuring the internal temperature rise.

This picture and the next one show how Specific Absorption Rate is measured in a laboratory using mock-ups equivalent to the size and density of a human body.

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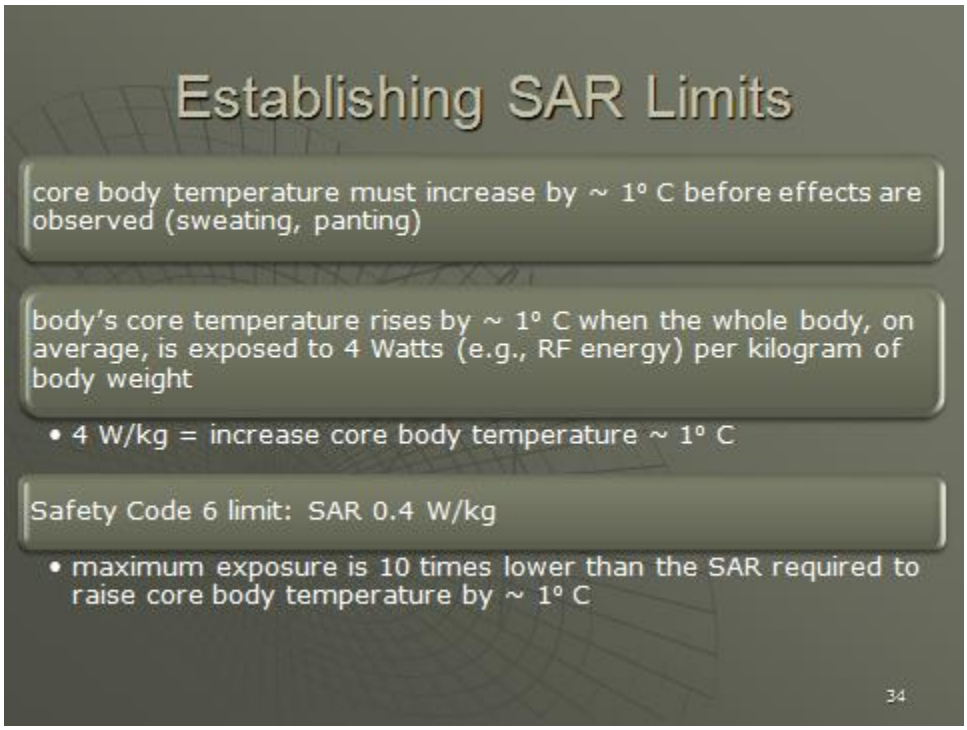
Direct measurement of SAR is only feasible under laboratory conditions.

Slide 34



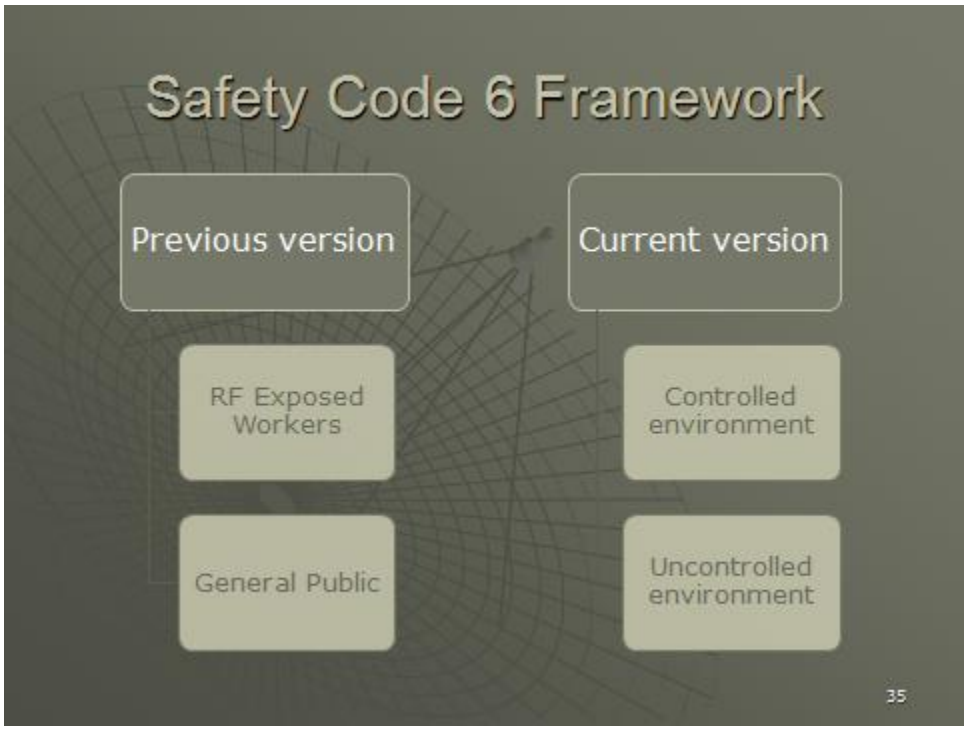
Studies on animals, including non-human primates, have consistently shown that the core body temperature has to increase by approximately 1 degree Celsius before we observe any behavioural changes such as sweating or panting.

The body's core temperature rises by 1 degree Celsius when the whole body, on average, is exposed to 4 Watts of heat per kilogram of body weight.

To ensure that harmful thermal effects are avoided from exposure to RF energy, Safety Code 6 has set the standard in the following way. In Controlled Environments, the SAR limit over the whole body is 4/10ths of a Watt per kg. In other words, the maximum exposure allowed by the Safety Code 6 is 10 times lower than the SAR required to raise core body temperature by 1 degree Celsius.

All of the other limits in Safety Code 6 are all based upon this fact.

Slide 35



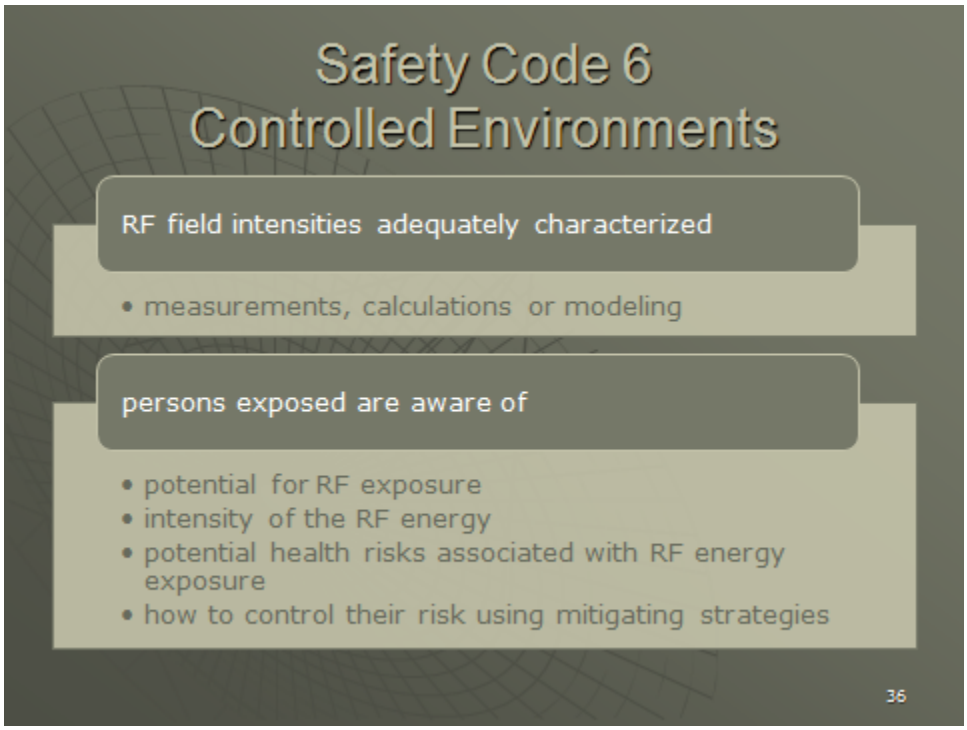
Health Canada determined that it was necessary to develop two sets of safety limits to cover all persons who could possibly be exposed to RF energy.

In the previous version of Safety Code 6, Health Canada set exposure limits based on a distinction between RF Exposed Workers and the General Public.

The current version of Safety Code 6 has dropped that distinction in favour of the conditions under which persons are exposed to RF energy. Safety limits are defined for Controlled environments and Uncontrolled environments.

How do these environments differ?

Slide 36



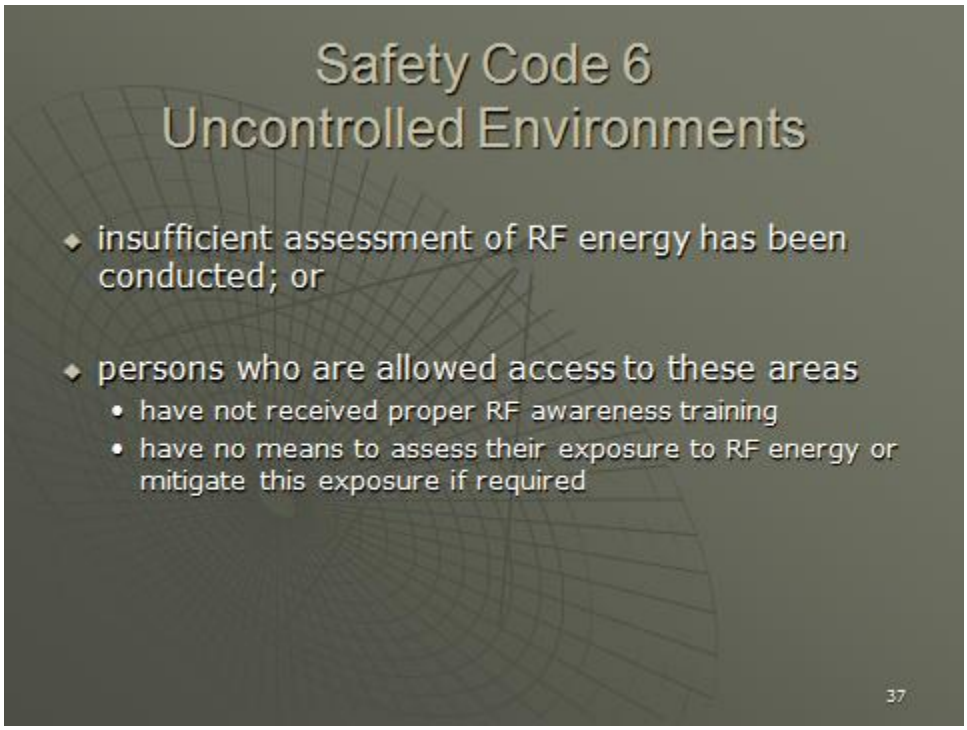
In Controlled Environments, the RF field intensities have been adequately characterized by means of measurements, calculations or modeling.

Persons in controlled environments:

- are aware of the potential for RF exposure; and
- know the intensity of the RF energy in their environment.

They understand the potential health risks associated with RF energy exposure; and can control their risk using mitigating strategies.

Slide 37



In Uncontrolled Environments:

• RF energy has not been sufficiently assessed; or

• persons who are allowed access to these areas have not received proper RF awareness training and have no means to assess their exposure to RF energy or to mitigate this exposure if they needed to do so.

Slide 38

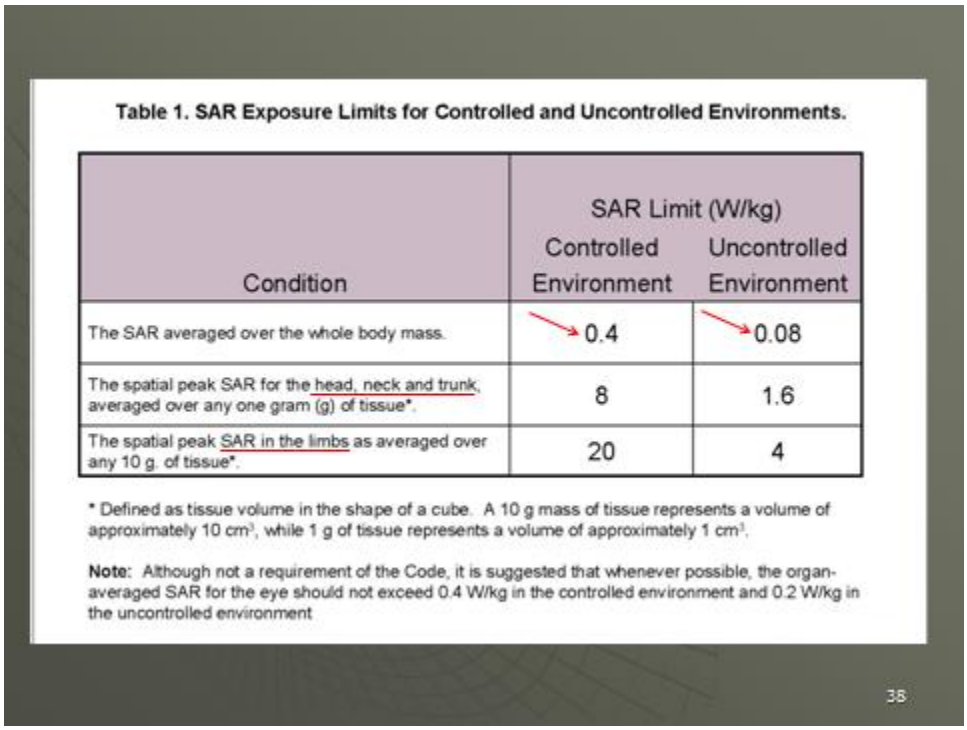


Table 1. SAR Exposure Limits for Controlled and Uncontrolled Environments.

Condition	SAR Limit (W/kg) Controlled Environment	Uncontrolled Environment
The SAR averaged over the whole body mass.	0.4	0.08
The spatial peak SAR for the head, neck and trunk, averaged over any one gram (g) of tissue*.	8	1.6
The spatial peak SAR in the limbs as averaged over any 10 g. of tissue*.	20	4

* Defined as tissue volume in the shape of a cube. A 10 g mass of tissue represents a volume of approximately 10 cm^3, while 1 g of tissue represents a volume of approximately 1 cm^3.

Note: Although not a requirement of the Code, it is suggested that whenever possible, the organ-averaged SAR for the eye should not exceed 0.4 W/kg in the controlled environment and 0.2 W/kg in the uncontrolled environment

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Table 1 of Safety Code 6 shows the SAR exposure limits for both environments.

In Controlled environments, the SAR limit is 0.4 Watts per kilogram, a measurement that is averaged over the whole body. As noted a moment ago, this level of exposure is 10 times lower than the SAR required to raise core body temperature by 1 degree Celsius.

The SAR safety limits for uncontrolled environments are even more stringent because the risks are greater. Persons may be exposed to only 20% of the safety limits in the controlled environments. That is 50 times lower than the SAR required to raise core body temperature by 1 degree Celsius.

This table also includes safety limits expressed in terms of how many Watts per kilogram are allowable exposure over various parts of the body.

Slide 39

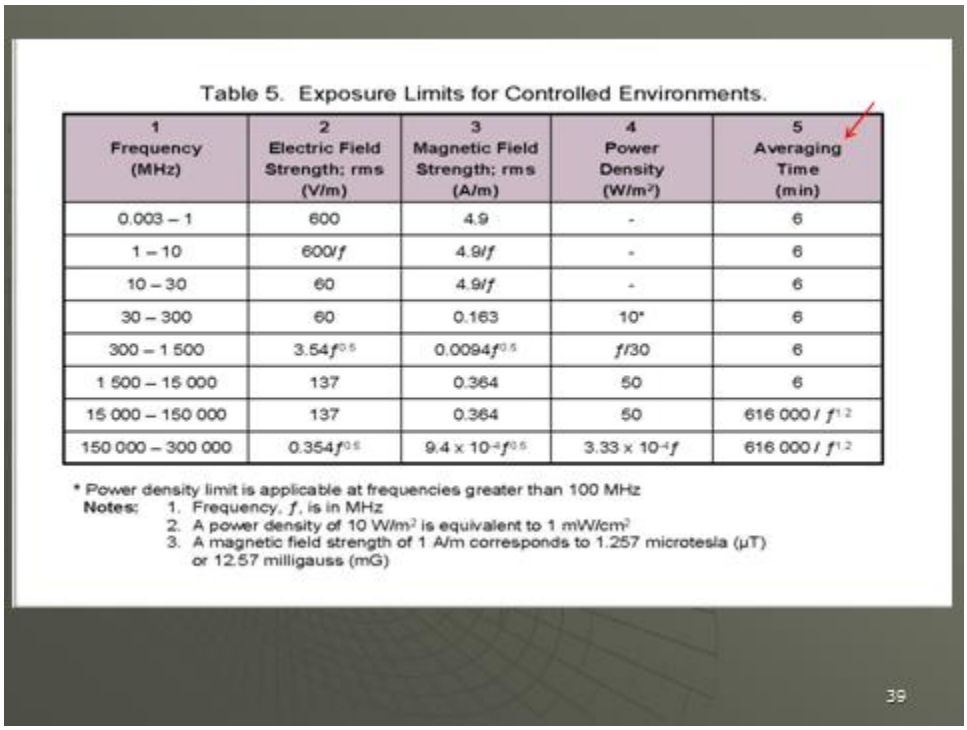

Table 5. Exposure Limits for Controlled Environments.

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m^2)	5 Averaging Time (min)
0.003 – 1	600	4.9	-	6
1 – 10	$600/f$	$4.9/f$	-	6
10 – 30	60	$4.9/f$	-	6
30 – 300	60	0.163	10*	6
300 – 1 500	$3.54f^{0.5}$	$0.0094f^{0.5}$	$f/30$	6
1 500 – 15 000	137	0.364	50	6
15 000 – 150 000	137	0.364	50	$616\,000 / f^{1.2}$
150 000 – 300 000	$0.354f^{0.5}$	$9.4 \times 10^{-4}f^{0.5}$	$3.33 \times 10^{-4}f$	$616\,000 / f^{1.2}$

* Power density limit is applicable at frequencies greater than 100 MHz

Notes:
1. Frequency, f, is in MHz
2. A power density of 10 W/m^2 is equivalent to 1 mW/cm^2
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG)

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As noted earlier, the severity of exposure to RF energy is influenced by several factors, such as the frequency of the radio waves, the strength of the electric and magnetic fields, the amount of power used, and the amount of time a person is exposed to the energy.

Table 5 spells out the safe limits of exposure to these factors in controlled environments.

Slide 40

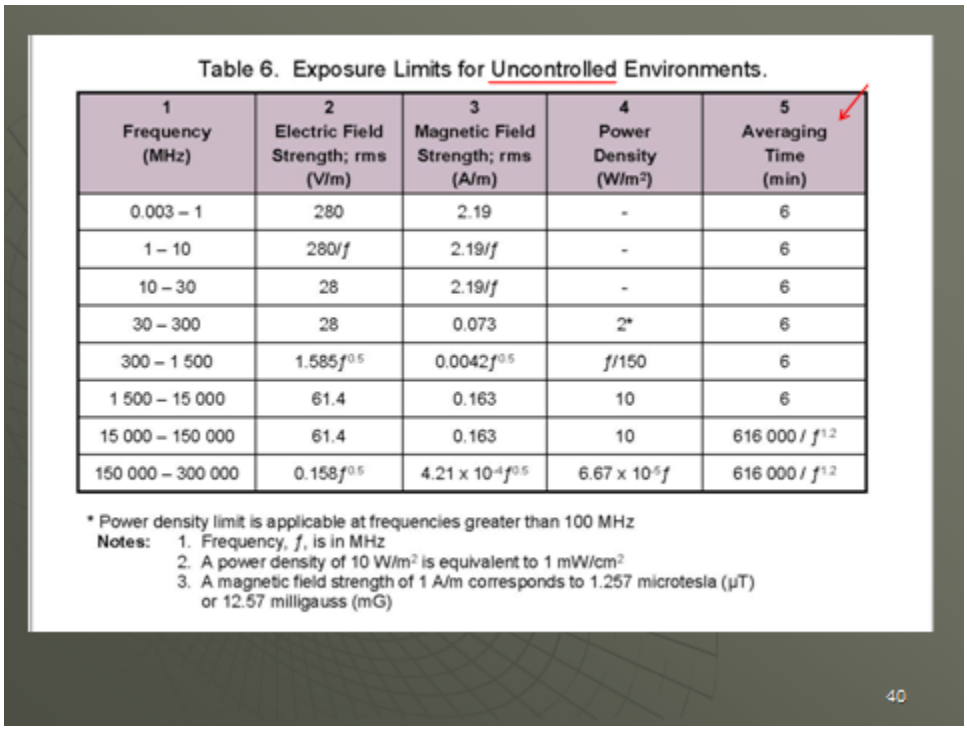

Table 6. Exposure Limits for Uncontrolled Environments.

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m^2)	5 Averaging Time (min)
0.003 – 1	280	2.19	-	6
1 – 10	$280/f$	$2.19/f$	-	6
10 – 30	28	$2.19/f$	-	6
30 – 300	28	0.073	2*	6
300 – 1 500	$1.585f^{0.5}$	$0.0042f^{0.5}$	$f/150$	6
1 500 – 15 000	61.4	0.163	10	6
15 000 – 150 000	61.4	0.163	10	$616\,000 / f^{1.2}$
150 000 – 300 000	$0.158f^{0.5}$	$4.21 \times 10^{-4}f^{0.5}$	$6.67 \times 10^{-5}f$	$616\,000 / f^{1.2}$

* Power density limit is applicable at frequencies greater than 100 MHz

Notes:
1. Frequency, f, is in MHz
2. A power density of 10 W/m^2 is equivalent to 1 mW/cm^2
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG)

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Table 6 sets the safe limits of exposure for uncontrolled environments.

These and the other safety limits in Safety Code 6 are used to assess the actual or potential exposure in controlled and uncontrolled environments on Coast Guard vessels and at shore-based sites.

These assessments make it possible to put in place appropriate safety measures and controls.

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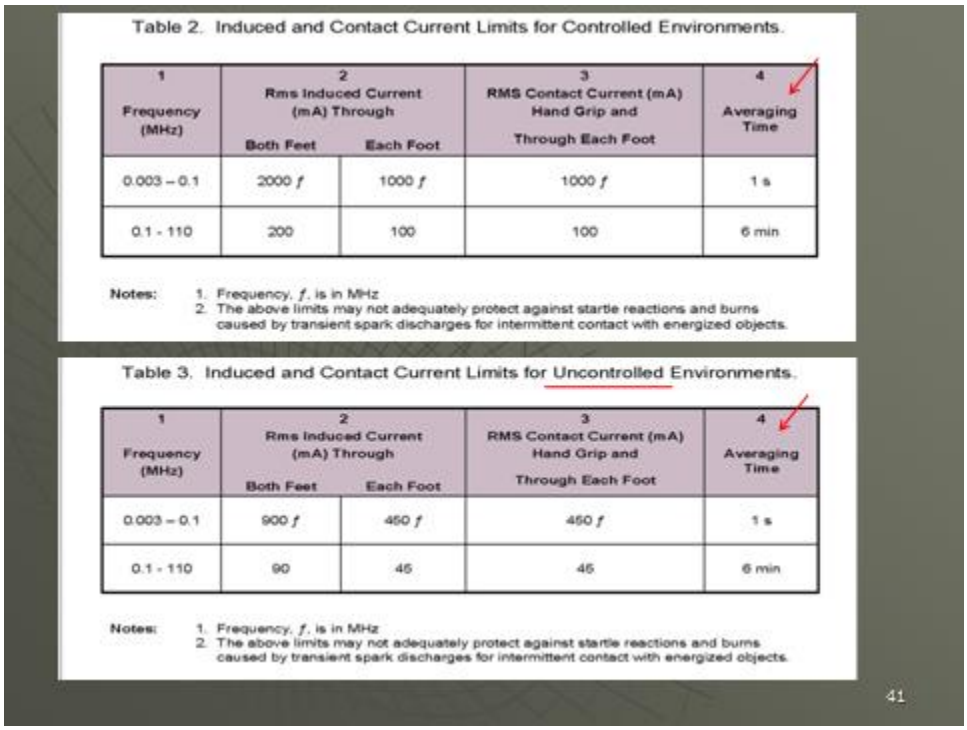

Table 2. Induced and Contact Current Limits for Controlled Environments.

1 Frequency (MHz)	2 Rms Induced Current (mA) Through		3 RMS Contact Current (mA) Hand Grip and Through Each Foot	4 Averaging Time
	Both Feet	Each Foot		
0.003 – 0.1	2000 *f*	1000 *f*	1000 *f*	1 s
0.1 - 110	200	100	100	6 min

Notes:
1. Frequency, *f*, is in MHz
2. The above limits may not adequately protect against startle reactions and burns caused by transient spark discharges for intermittent contact with energized objects.

Table 3. Induced and Contact Current Limits for Uncontrolled Environments.

1 Frequency (MHz)	2 Rms Induced Current (mA) Through		3 RMS Contact Current (mA) Hand Grip and Through Each Foot	4 Averaging Time
	Both Feet	Each Foot		
0.003 – 0.1	900 *f*	450 *f*	450 *f*	1 s
0.1 - 110	90	45	45	6 min

Notes:
1. Frequency, *f*, is in MHz
2. The above limits may not adequately protect against startle reactions and burns caused by transient spark discharges for intermittent contact with energized objects.

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Table 2 defines safety limits for controlled environments based on:

- the frequencies being transmitted; and
- whether the exposure is to induced currents or from coming into contact with the energy source.

Table 3 has those safety limits for uncontrolled environments.

Slide 42

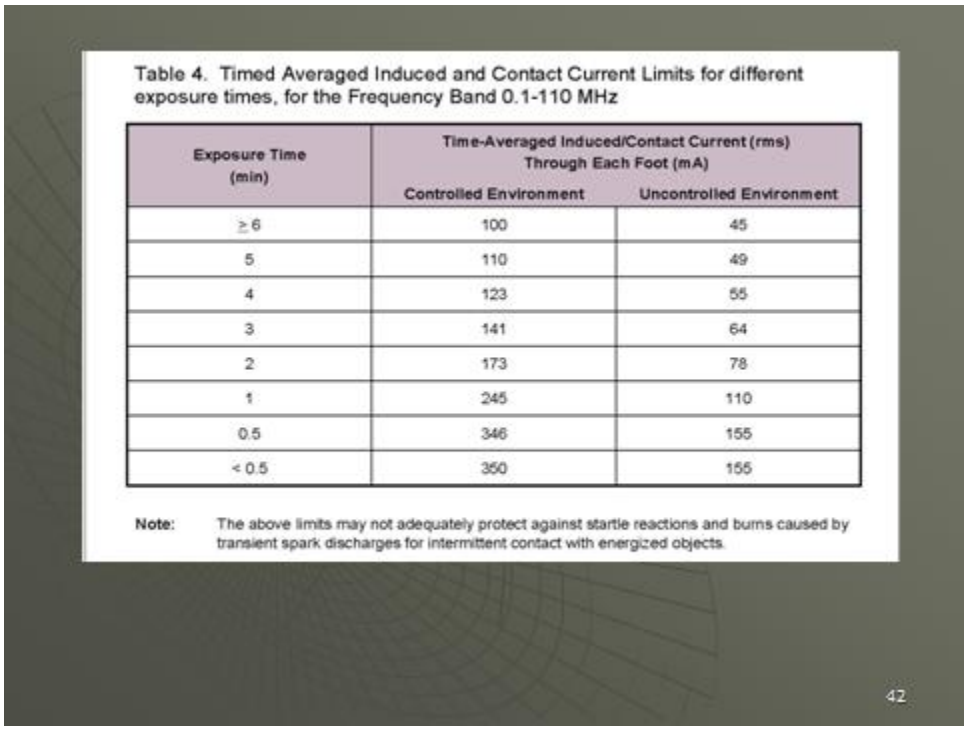

Table 4. Timed Averaged Induced and Contact Current Limits for different exposure times, for the Frequency Band 0.1-110 MHz

Exposure Time (min)	Time-Averaged Induced/Contact Current (rms) Through Each Foot (mA)	
	Controlled Environment	Uncontrolled Environment
≥ 6	100	45
5	110	49
4	123	55
3	141	64
2	173	78
1	245	110
0.5	346	155
< 0.5	350	155

Note: The above limits may not adequately protect against startle reactions and burns caused by transient spark discharges for intermittent contact with energized objects.

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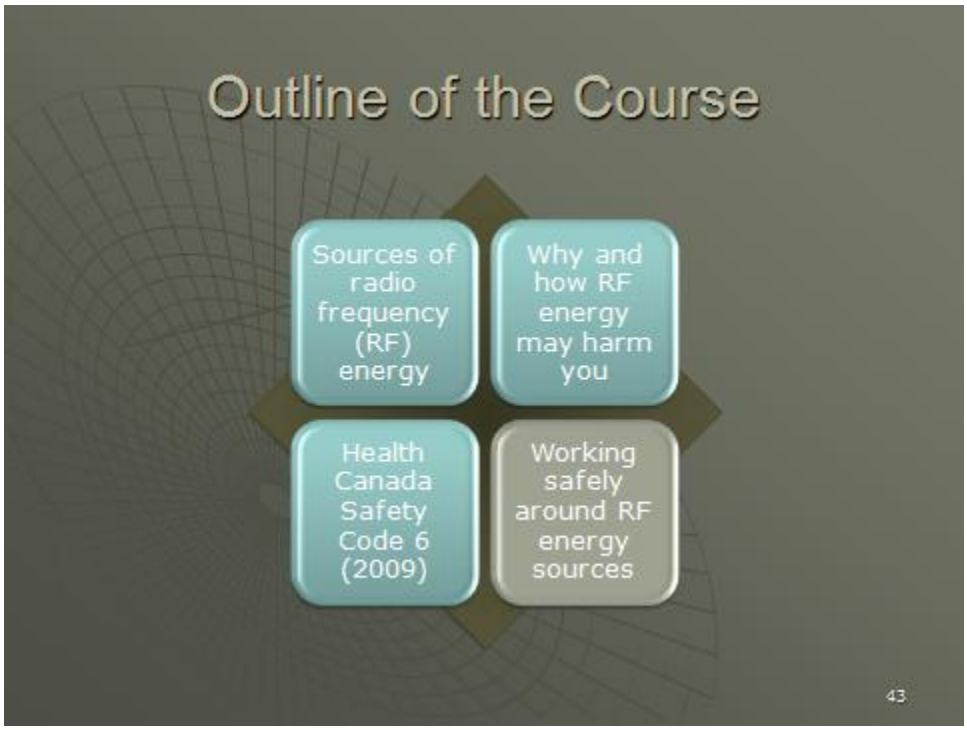
Table 4 sets the safe periods of time a person may be exposed to RF energy based on the amount of energy they absorb from induced or contact currents.

The safety limits are more stringent for the uncontrolled environments.

Slide 43



The last part of this course discusses considerations, recommendations and safe practices to follow

- when carrying out RF surveys around communications antennas; and
- when working on and around antennas.

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An RF survey measures the RF energy that is emitted by an antenna.

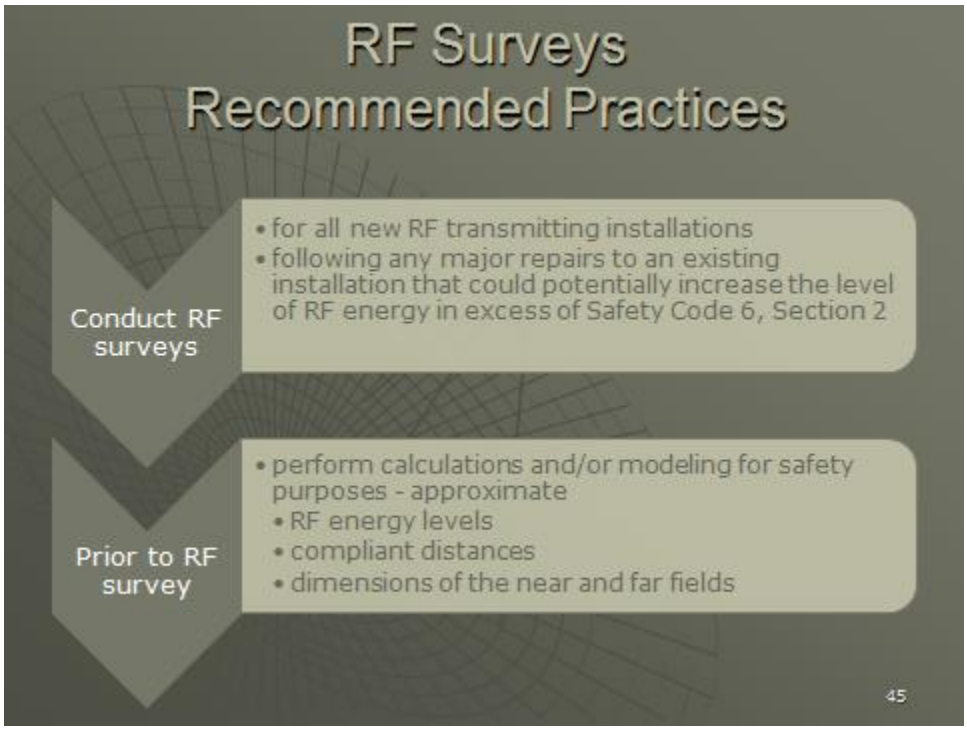
RF surveys are the only accurate means of determining if the levels of RF energy within a work area or area of public access comply with the Controlled or Uncontrolled limits in Safety Code 6.

Any reading in excess of Safety Code 6 is non-compliant. More measurements are taken moving away from the source until the reading is in compliance. This will be the Minimum Compliant Distance from the source and will to be marked by a painted line, barrier, or signage.

RF surveys are more precise than doing theoretical calculations or computer modeling because they measure the effects re-radiating nearby structures.

RF surveys provide a permanent record of the RF environment, at a particular point in time, which can then be used as a baseline for future reference.

Slide 45



RF surveys should be conducted for all new RF transmitting installations and following any major repairs to an existing installation that could potentially increase the level of RF energy in excess of Safety Code 6.

Before carrying out a radiofrequency survey, calculations and/or modeling of the emitting devices should be done for safety purposes to determine approximate RF energy levels, compliant distances, and the dimensions of the near and far fields. This would be done by a technically qualified person.

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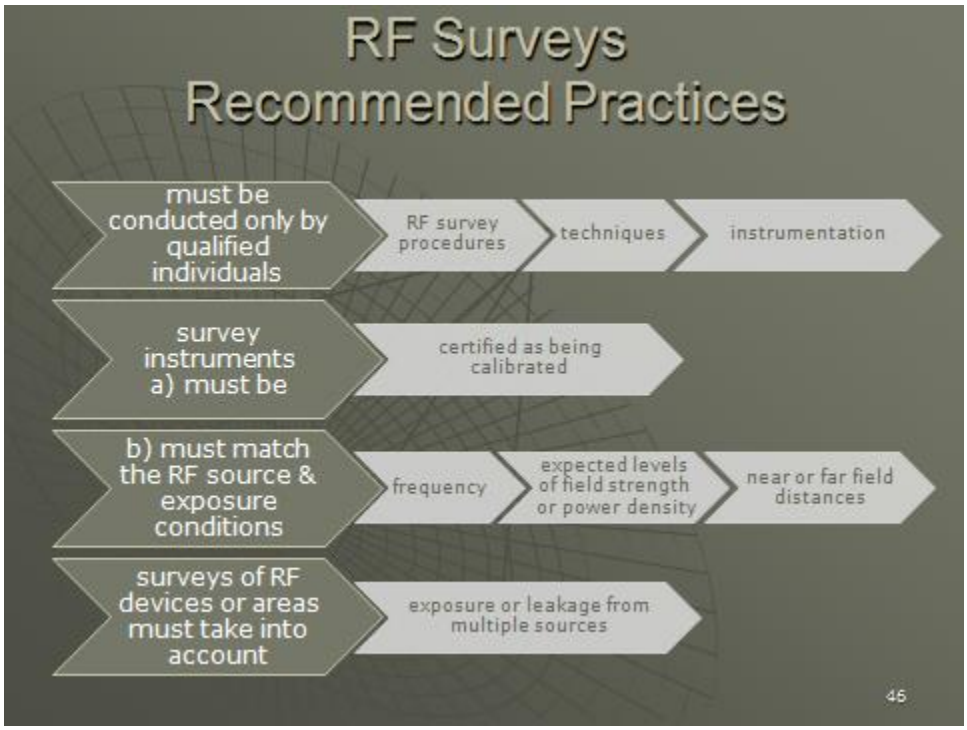

RF surveys must be conducted only by qualified individuals, with specific training and experience with RF survey procedures, techniques and instrumentation.

Survey instruments must be certified as being calibrated before a survey is performed.

Survey instruments must be selected to match the RF source and exposure conditions, taking into account such parameters as frequency, expected levels of field strength or power density, and near or far field distances.

Surveys of RF devices or areas must take into account exposure or leakage from multiple sources.

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These are the considerations for Controlled environments on Coast Guard vessels and shore-based sites.

RF exposure levels must be well characterized by RF surveys in the controlled environments where restrictions on occupancy are in place.

RF exposure levels, induced currents, and contact currents must not exceed the limits for controlled environments, except under special circumstances.

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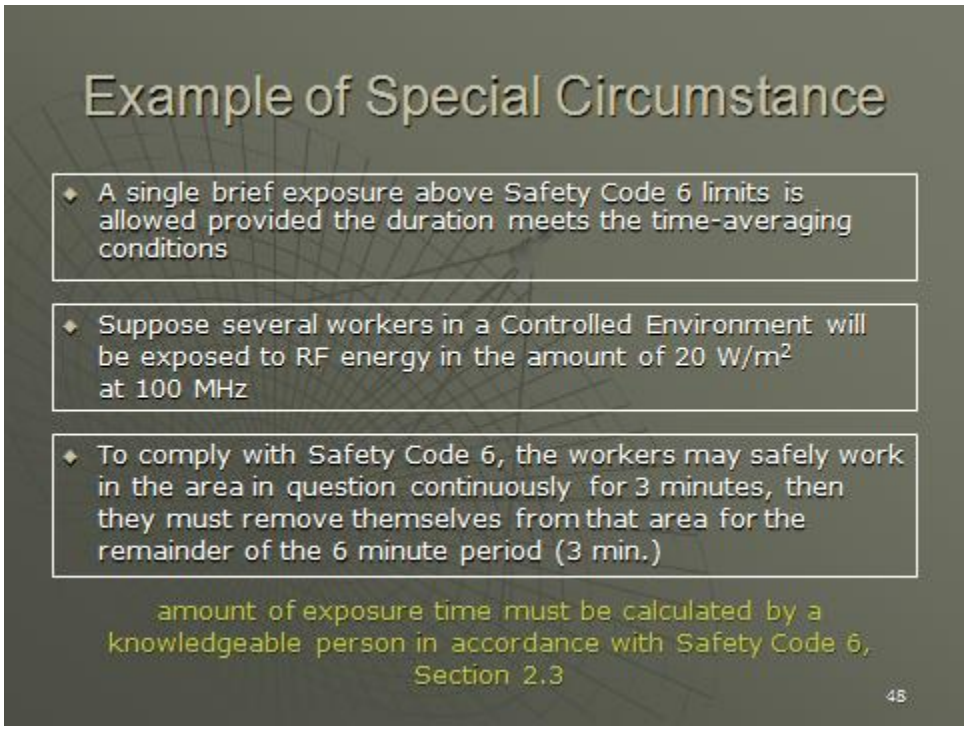

For operational or special maintenance purposes, it may be necessary for workers to enter or pass through areas where the RF exposure limits exceed Safety Code 6 for short durations. If they are exposed for less than 6 minutes, the higher exposure levels are permitted provided that the duration meets the Time Averaging conditions of Safety Code 6.

For example, suppose several workers in a Controlled Environment will be exposed to RF energy in the amount of 20 Watts per meter squared at 100 megahertz. Table 5 states a maximum limit of 10 Watts per meter squared for 6 minutes. Therefore, to be compliant with the limits of Safety Code 6, the workers may safely work in the area in question continuously for 3 minutes, then they must remove themselves from that area for the remainder of the 6 minute period or 3 minutes. As long as this procedure is observed, it may be repeated indefinitely.

Note that the amount of exposure time must be calculated by a knowledgeable person in accordance with Safety Code 6, Section 2.3, which deals with Time Averaging.

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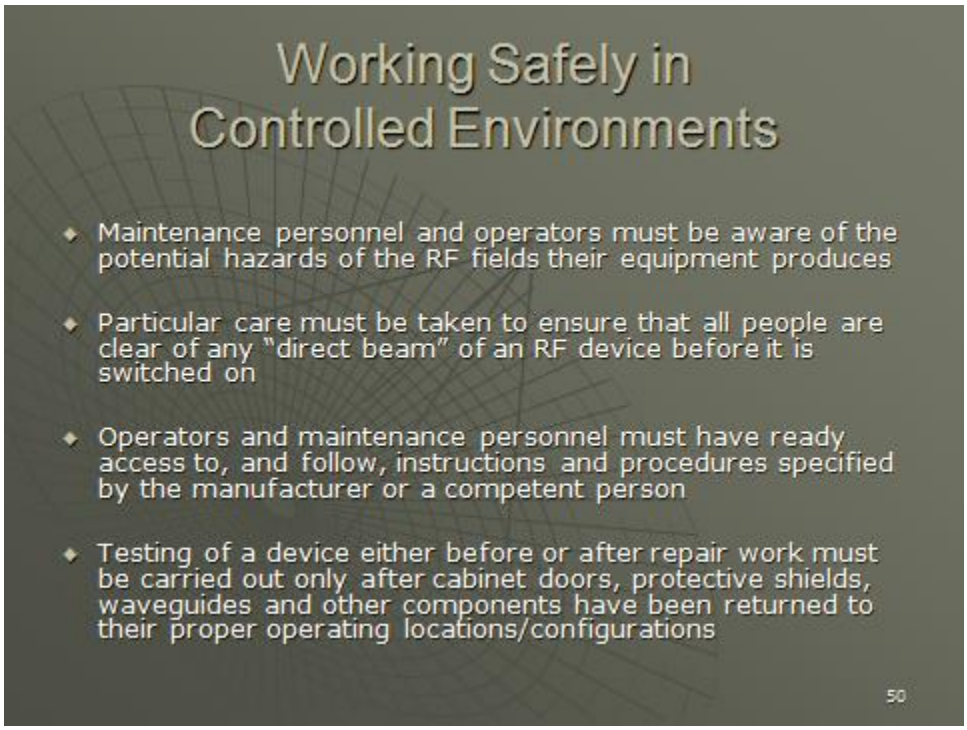
These are other considerations for working safely in Controlled Environments.

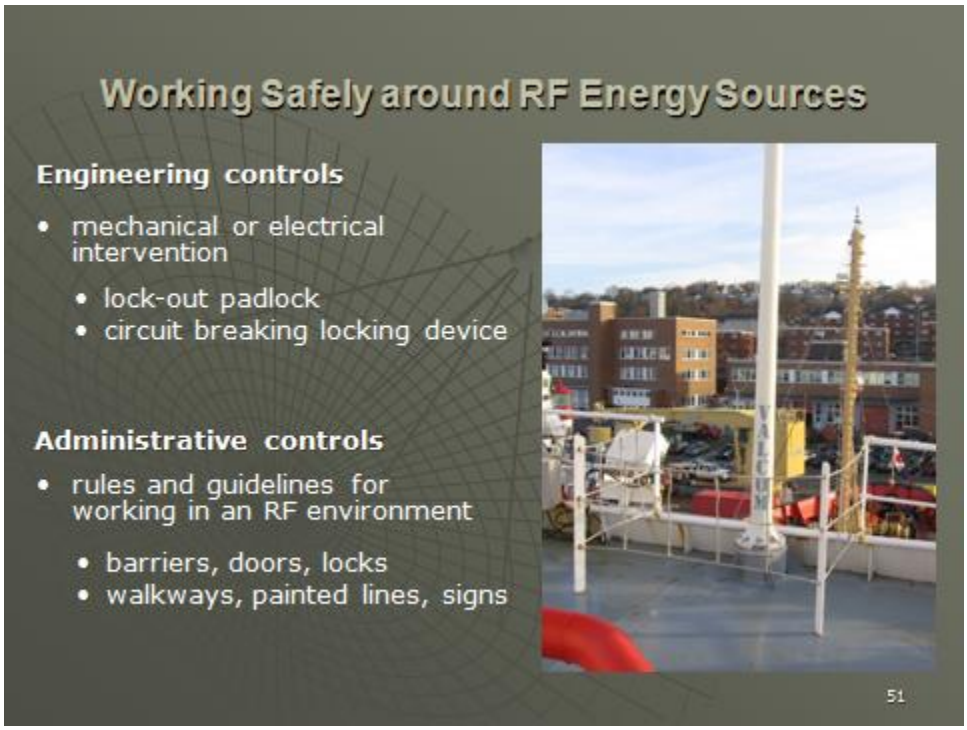
- Danger or Warning signs must be posted indicating the presence of RF fields.
- The areas surrounding unmanned, high-power sources of RF energy must be fenced off to prevent unauthorized access.
- The surveying of RF devices or areas must take into account exposure or leakage from multiple sources.
- Unnecessary metallic objects should not be located near any radiating RF device as they may become a source of induced currents or cause high reflected fields in some locations, under certain conditions.

Slide 50



- Maintenance personnel and operators of RF equipment must be aware of the potential hazards of the RF fields that their equipment produces.
- Particular care must be taken to ensure that all people are clear of any "direct beam" of an RF device before it is switched on. This usually applies to microwave devices.
- Operators and maintenance personnel must have ready access to, and follow, instructions and procedures for repair, maintenance and operation of RF devices as specified by the manufacturer or a competent person.
- Testing of a device either before or after completion of any repair work must be carried out only after cabinet doors, protective shields, waveguides and other components have been returned to their proper operating locations and configurations.

Slide 51



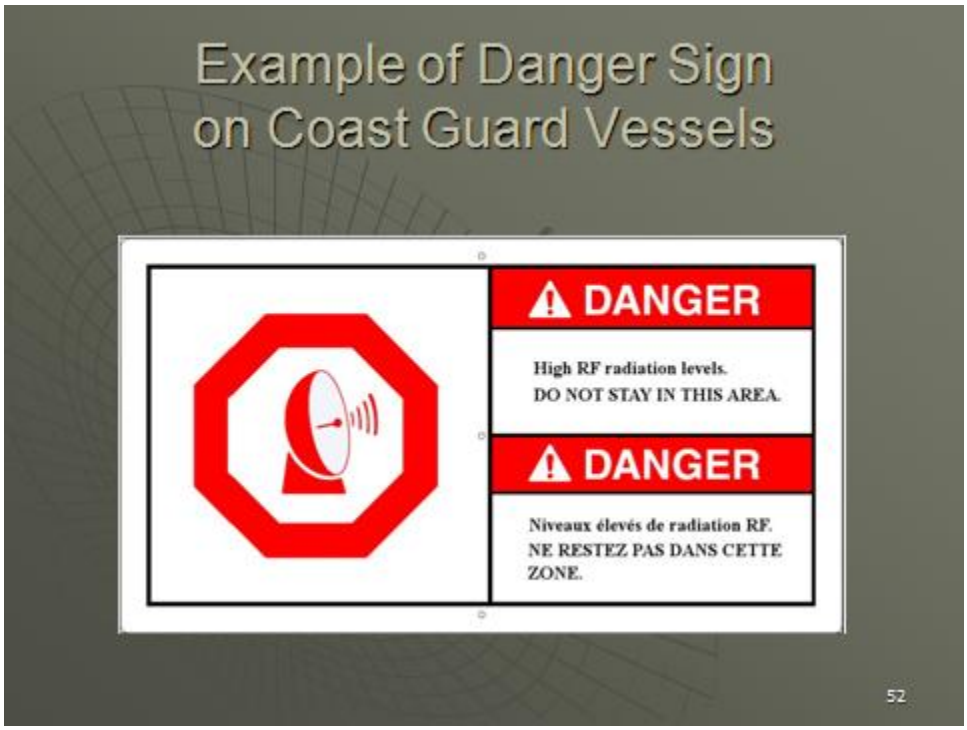
Controls have been put in place to ensure that you can work safely around RF energy sources.

There are Engineering controls, which are typically a mechanical or electrical intervention, such as a lock-out padlock or a circuit breaking locking device.

There are also Administrative controls, which include rules and guidelines for working in an RF environment. They could involve barriers, doors, locks, walkways, painted lines, and signs.

Where access to Controlled Environments is possible, demarcation zones and other safety signage must be clearly visible and identifiable before reaching areas where significant exposure could occur.

Slide 52

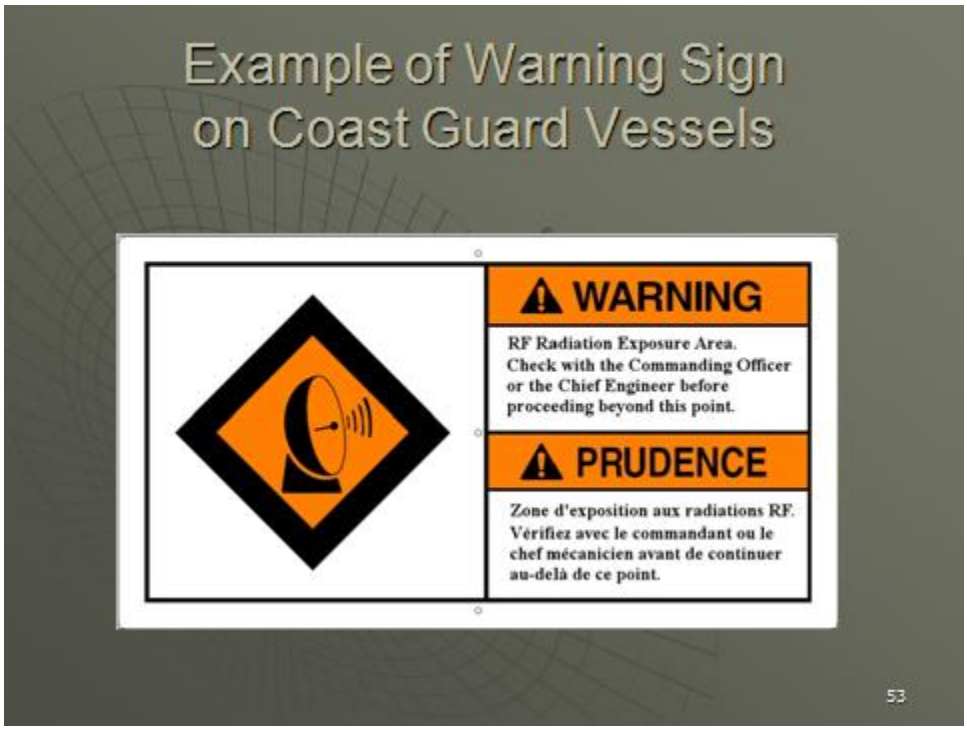


A DANGER sign must be placed at the entrance of any zone where RF levels exceed the Safety Code 6 safety limits for Controlled Environments. The DANGER sign designates a zone as DENIED OCCUPANCY and indicates that critical injury is possible.

The "Danger" sign is posted 5 metres from a transmitting Low Frequency beacon antenna to prevent anyone from coming any closer to these antennas.

One must not linger in this area if it is necessary to pass by this antenna when performing a task.

Slide 53



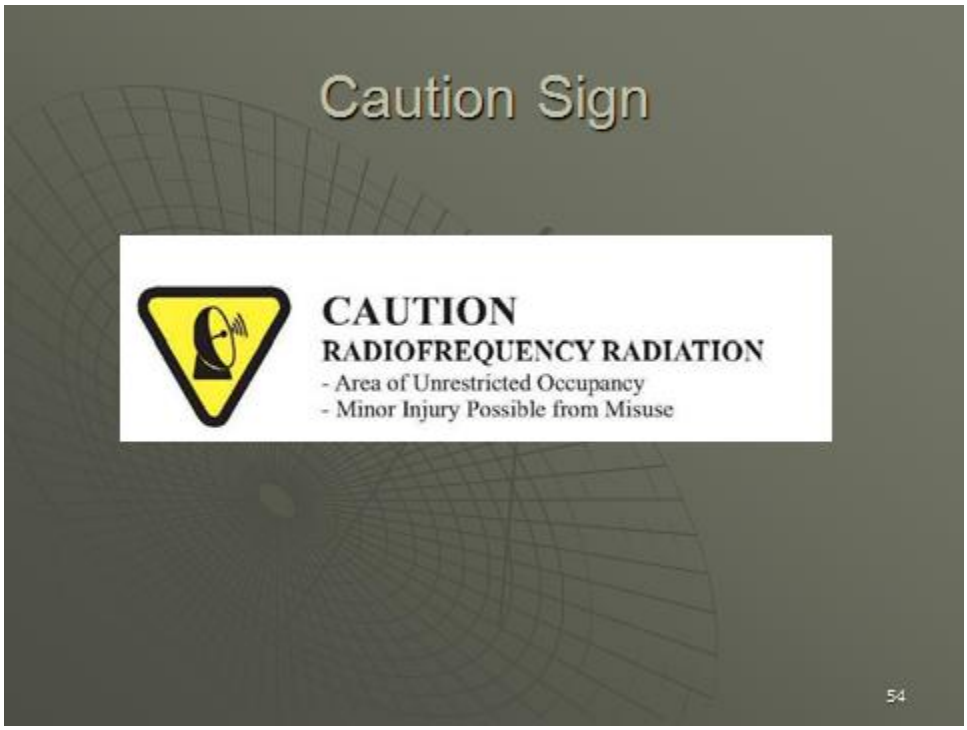
A WARNING sign must be placed at the entrance of any zone where RF levels exceed Safety Code 6 limits for Uncontrolled Environments but are below those for Controlled Environments.

The WARNING sign indicates areas of restricted occupancy, where transmitting antennas are operating. You should see these signs at the bottom of ladders leading up to Monkey Island or other locations with deck-mounted antennas on the vessel.

Only people who need to work on the antennas are allowed in this area.

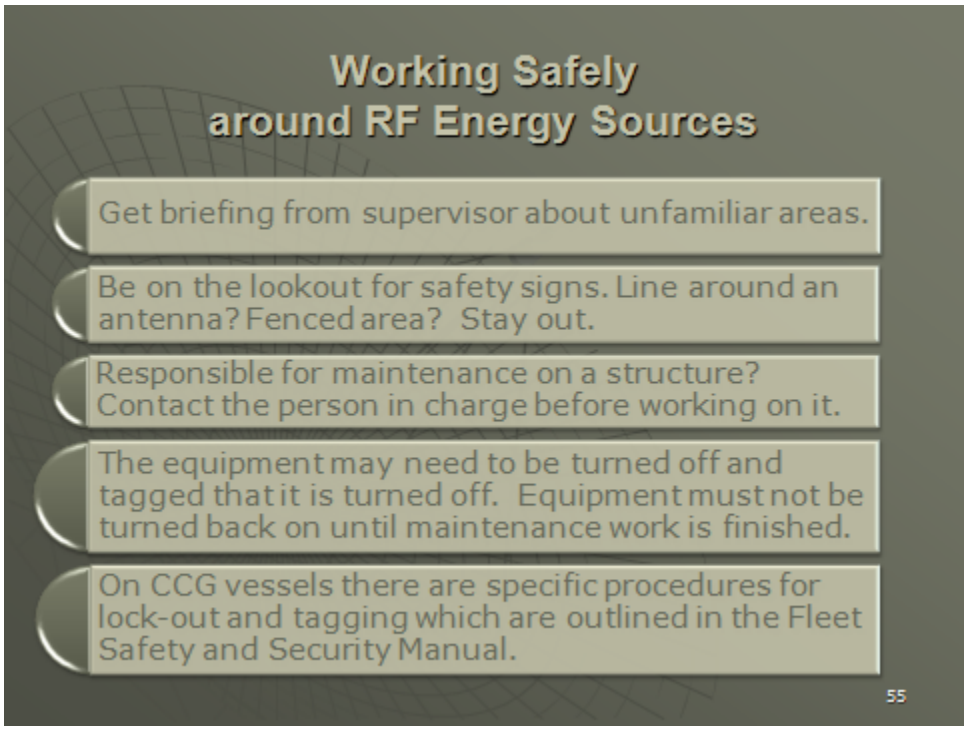
A person who needs access to work on an antenna must check with the bridge to ensure the antenna is turned off.

Slide 54



A CAUTION sign is used to identify RF energy emitting devices. The CAUTION sign is usually limited to devices such as microwave ovens and microwave components covered by regulations under the Radiation Emitting Devices Act. The CAUTION sign is part of their labeling requirements.

Slide 55



You should be briefed by your supervisor before entering an unfamiliar RF emitting area.

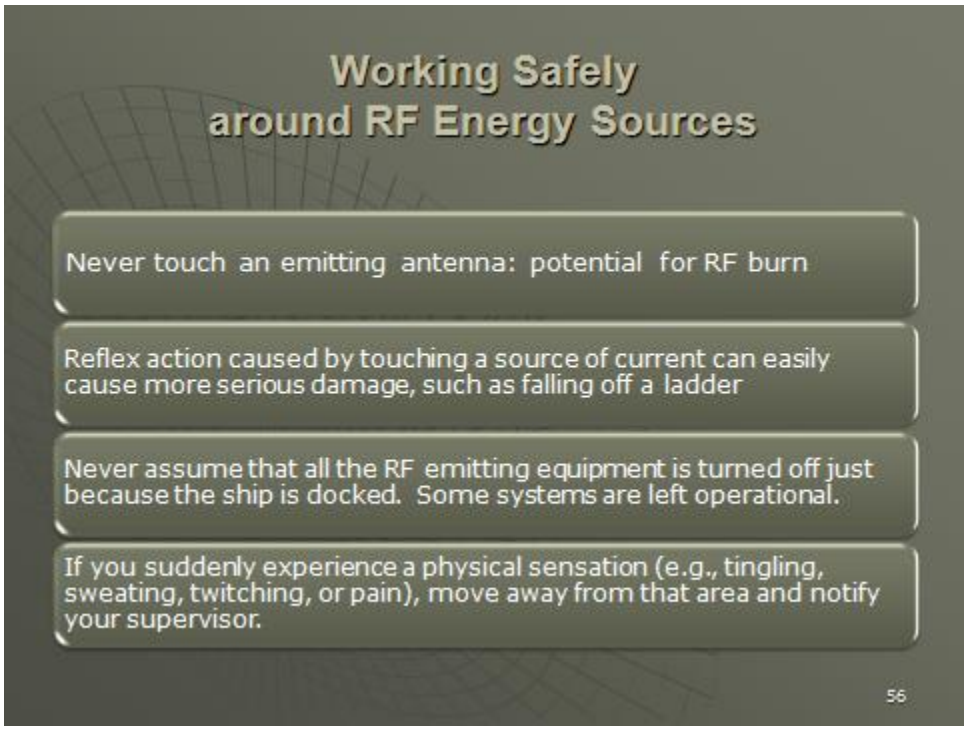
Be on the lookout for safety signage or other demarcations that are posted before entering an area, or while in the area itself.

- If there is a demarcation line or barrier around an antenna, stay outside of the line unless you are qualified to be working in a Controlled Environment.
- On shore-based sites, potential sources of RF burns or high contact currents are usually surrounded by safety fences. Unless you have a reason for being in there, keep out!

If you are responsible for maintaining an RF emitting structure or equipment, you must contact the person in charge before working on it.

- Depending upon the particular situation, the equipment may need to be turned off and tagged that it is turned off. The equipment must not be turned back on until you are finished your maintenance work.
- On Coast Guard vessels there are specific procedures for lock-out and tagging which are outlined in the Fleet Safety and Security Manual.

Slide 56



Under no circumstances should you touch a transmitting antenna, as there is the potential for suffering an RF burn by doing this. The severity of the burn depends on the amount of power being emitted and the frequency of the RF energy.

The reflex action caused by touching a source of current can easily cause more serious damage than the actual current itself. For example, reflexively jerking away from a contact with a transmitting antenna could cause a person to fall off a ladder.

Never assume that all the RF emitting equipment is turned off just because the ship is docked. Some systems are left operational.

If you suddenly experience a physical sensation such as tingling, sweating, twitching, or pain, move away from that area immediately and notify your supervisor.

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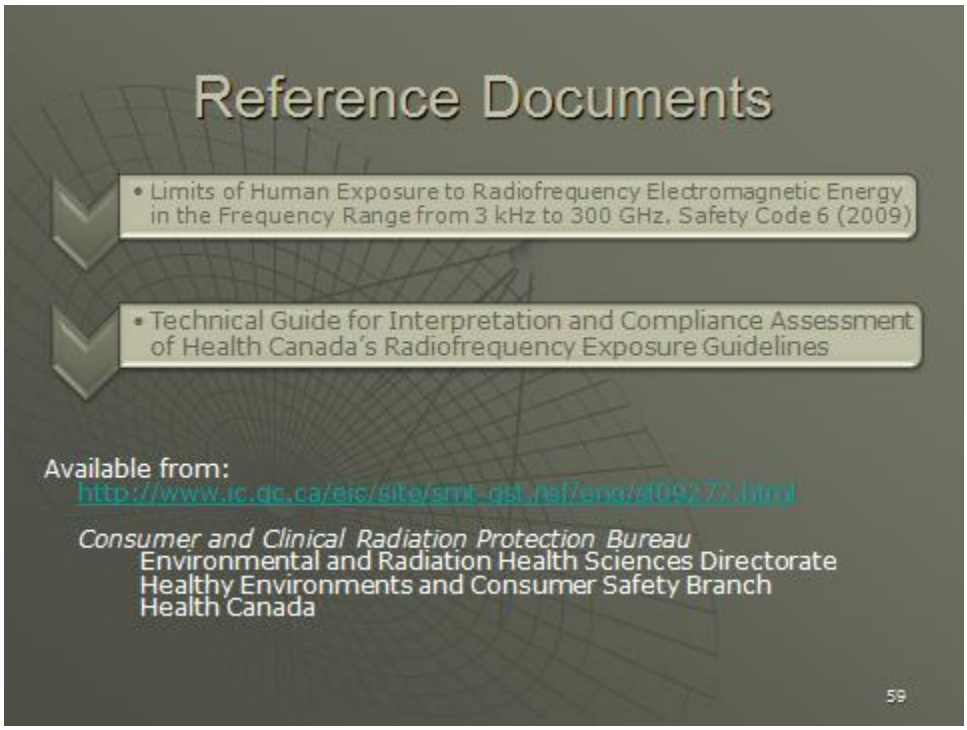
Members of the general public must not be allowed access to Controlled Environments where RF exposure levels may exceed the basic safety limits for Uncontrolled environments.

In areas which allow public access, periodically check any devices that may produce leakage at levels close to the Safety Code 6 safety limits for Uncontrolled Environment.

Slide 59



This concludes the course on Radio Frequency Safety Awareness.

There are no changes to the safety limits between the current revision (2009) and the previous revision (1999) of Safety Code 6.

For more information, please consult these documents that were published in December, 2009 and were produced by Health Canada's Consumer and Clinical Radiation Protection Bureau.