RF SAFETY PLAN

(A) RF SAFETY PLAN

(B) DEFINITIONS

Electromagnetic (EM) radiation is a self-propagating wave in space with electric and magnetic components. These components oscillate at right angles to each other and to the direction of propagation, and are in phase with each other. Electromagnetic radiation is classified into types according to the frequency of the wave: these types include, in order of increasing frequency, radio waves, microwaves, terahertz radiation, infrared radiation, visible light, ultraviolet radiation, x-rays and gamma rays. EM radiation carries energy and momentum, which may be imparted when it interacts with matter.

Electromagnetic radiation hazards (RADHAZ OR EMR HAZARDS): hazards caused by a transmitter/antenna installation that generates ELECTROMAGNETIC RADIATION in the vicinity of personnel, in excess of established safe levels or increases the existing levels to a hazardous level; located in an area that is illuminated by electromagnetic radiation at a level that is hazardous to the planned operations or occupancy. These hazards will exist when an electromagnetic field of sufficient intensity is generated to cause harmful or injurious effects to humans and wildlife.

Checked (Training Manager):	Checked (Safety Officer):
Checked (Facility Manager):	Checked (Production & Test):
Checked (Quality Assurance):	Checked (Director Business Operations):
Checked (Program Management Director):	Approved (General Manager):

The Institute of Electrical, Electronics, and Engineering (IEEE)[1] defines radio frequency (RF) radiation as waves that move through space residing in the frequency range of 3khz to 300 ghz. Radiation exposure is defined as being non-ionizing. Non-ionizing radiation is defined as electromagnetic waves that are not capable of ionizing matter and do not cause permanent biological changes to molecular structure. This type of radiation is what radio transmitter's produce out of an antenna. The effects of non-ionizing radiation are not cumulative and as long as the FCC rules and guidelines are followed, the exposure over a number of days, months, and years is considered safe.

(C) PURPOSE

This section provides a summary of the hazards associated with the use of RF radiation, and the basic recommended practices to prevent mishaps. It details the responsibilities for the safe use of RF energy.

DRS Surveillance Support Systems will be operating a far-field range and a near-field range. Only employee's properly trained are authorized within the controlled area without completing the DRS Surveillance Support Systems familiarization course on RF safety. Employees successfully completing this course are authorized entry to the controlled area only for the purpose of actual required work. Use of the personal protective equipment required in this section is mandatory when entering the controlled area.

(D) APPLICABILITY

This section is applicable to all DRS Surveillance Support Systems employees, to all work conducted under the authority of DRS Surveillance Support Systems, and to all equipment and property managed by DRS Surveillance Support Systems. For DRS Surveillance Support Systems contractors, it is applicable through contract clauses. Non-DRS Surveillance Support Systems and non-contractor personnel will follow the provisions of this section while at DRS Surveillance Support Systems facilities.

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[1] IEEE Std C95.1,1999 Edition

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DRS Surveillance Support Systems follows the exposure limit guidelines detailed below:

The FCC Office of Technology (OET) bulletin 65, edition 97-01, August 1997[2] incorporate two separate tiers of exposure limits that are dependent on the situation in which the exposure takes place and/or the status of the individuals who are subject to exposure. The decision as to which tier applies in a given situation should be based on the application of the following definitions.

<u>Occupational/controlled</u> exposure limits apply to situations in which persons are exposed as a consequence of their employment and in which those persons who are exposed have been made fully aware of the potential for exposure and can exercise control over their exposure. Occupational/controlled exposure limits also apply where exposure is of a transient nature as a result of incidental passage through a location where exposure levels may be above general population/uncontrolled limits (see below), as long as the exposed person has been made fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

<u>General population/uncontrolled</u> exposure limits apply to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Therefore, members of the general public would always be considered under this category when exposure is not employment-related, for example, in the case of a telecommunications tower that exposes persons in a nearby residential area.

The FCC guideline sets the maximum permissible exposure limits (MPE) for c, x, k band electro magnetic radiation exposure as follows:

<u>5 mw/cm^2, average, for occupational/controlled exposure</u>

<u>1mw/cm^2, average, for general population/uncontrolled exposure</u>

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[2] FCC OFFICE OF TECHNOLOGY (OET) BULLETIN OET BULLETIN 65, EDITION 97-01, AUGUST 1997

MPE limits specified in the reference OET bulletin are average values with averaging times of 6 minutes for occupational/controlled exposure and 30 minutes for general population/uncontrolled exposure. The exposure levels set forth by the FCC (OET) shown above apply to the peak beam width or otherwise known as the peak of the antenna radiation pattern.

Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	$(900/f^2)$*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	$(180/f^2)$*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

f = frequency in MHz *Plane-wave equivalent power density

NOTE: The averaging time for General Population/Uncontrolled exposure to fixed transmitters is not applicable for mobile and portable transmitters. See 47 CFR §§2.1091 and 2.1093 on source-based time-averaging requirements for mobile and portable transmitters.

(E) RESPONSIBILITIES

Training Manager

Provide specific training to ensure employees have read and understand this plan on the hazards of RF radiation as part of the overall DRS Surveillance Support Systems RF safety program.

Inform employees of the specific hazards associated with RF radiation, and the measures required to prevent or control the hazards.

Ensure records of on-the-job employee training and dates of training provided to the safety official are current.

Supervisors / Managers (All Levels)

Perform periodic visual inspections of work areas to ensure that safety controls are in place, are being used, and are effective.

Provide supervision to ensure employee adherence to safety requirements, special instructions, procedure compliance, and the use of personal protective equipment.

Safety official

Maintain oversight of hazard assessment activities, safe work procedures, and employee training.

Assist in the preparation of the hazard assessment at the request of the senior staff.

Provide technical safety evaluations of the work areas at the request of the senior staff.

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Provide specialized safety training at the request of the senior staff.

Employees

Comply with the safety requirements outlined in this section.

Use the personal protective equipment required in this section.

Report any potential safety hazard to your supervisor.

(F) MONITORING

Prior to any RF radiating of a new RF emitter, a radiation hazard survey shall be performed. Utilizing Paragraph (G) and (H), the exposure limits shall be verified.

The radiation hazard survey shall be performed every 6 months for all active antennas.

(G) FIELD MEASUREMENTS

Before beginning a measurement survey, it is important to characterize the exposure situation as much as possible. An attempt should be made to determine:

The frequency and maximum power of the RF source(s) in question, as well as any nearby sources.

Duty factor, if applicable, of the source(s).

Areas that are accessible to either workers or the general public.

The location of any nearby reflecting surfaces or conductive objects that could produce regions of field intensification ("hot spots").

For pulsed sources, such as radar, the pulse width and repetition rate and the antenna-scanning rate.

If appropriate, antenna gain and vertical and horizontal radiation patterns.

Type of modulation of the source(s).

Polarization of the antenna(s).

Whether measurements are to be made in the near-field, in close proximity to a leakage source, or under plane-wave conditions. The type of measurement needed can influence the type of survey probe, calibration conditions and techniques used.

If possible, one should estimate the maximum expected field levels, in order to facilitate the selection of an appropriate survey instrument. For safety purposes, the electric field (or the far-field equivalent power density derived from the E-field) should be measured first because the body absorbs more energy from the electric field, and it is potentially more hazardous. In many cases, it may be best to begin by using a broadband instrument capable of accurately measuring the total field from all sources in all directions. If the total field does not exceed the relevant exposure guideline in accessible areas, and if the measurement technique employed is sufficiently accurate, such a determination would constitute a showing of compliance with that particular guideline, and further measurements would be unnecessary.

(H) INSTRUMENTATION

Instruments used for measuring radiofrequency fields may be either broadband or narrowband devices. A typical broadband instrument responds essentially uniformly and instantaneously over a wide frequency range and requires no tuning. A narrowband instrument may also operate over a wide frequency range, but the instantaneous bandwidth may be limited to only a few kilohertz, and the device must be tuned to the frequency of interest. Each type of instrument has certain advantages and certain disadvantages, and the choice of which instrument to use depends on the situation where measurements are being made.

All instruments used for measuring RF fields have the following basic components: (1) an antenna to sample the field, (2) a detector to convert the time-varying output of the antenna to a steady-state or slowly varying signal, (3) electronic circuitry to process the signal, and (4) a readout device to display the measured field parameter in appropriate units.

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The antennas most commonly used with broadband instruments are either dipoles that respond to the electric field (E) or loops that respond to the magnetic field (H). Surface area or displacement-current sensors that respond to the E-field are also used. In order to achieve a uniform response over the indicated frequency range, the size of the dipole or loop must be small compared to the wavelength of the highest frequency to be measured. Isotropic broadband probes contain three mutually orthogonal dipoles or loops whose outputs are summed so that the response is independent of orientation of the probe. The output of the dipoles or loops is converted to a proportional steady-state voltage or current by diodes or thermocouples, so that the measured parameter can be displayed on the readout device.

There are certain characteristics, which are desirable in a broadband survey instrument. The major ones are as follows:

> **The frequency range of the instrument and the instruments response over that range should be known. Generally, this is given in terms of the error of response between certain frequency limits, e.g. + 0.5 dB from 3 to 500 MHz.**
>
> **The dynamic range of the instrument should be at least + 10 dB of the applicable exposure guideline.**
>
> **The instrument's readout device should be calibrated in units that correspond to the quantity actually being measured. An electric field probe responds to E or E^2, and a magnetic field probe responds to H or H^2, equally well in both the near-field and far-field. However, a readout device calibrated in units of power density does not read true power density if measurements are made in the near-field. This is because under plane-wave conditions, in which E, H, and power density are related by a constant quantity (the wave impedance which, for free space, is equal to 377 ohms); do not exist in the near-field where the wave impedance is complex and generally not known. Readout devices calibrated in "power density" actually read "far-field equivalent" power density or "plane-wave equivalent" power**
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> **When the amplitude of the field is changing while measurements are being made, a "peak-hold" circuit may be useful. Such a change in amplitude could result either from variation in output from the source or from moving the probe through regions of the field that are non-uniform.**

The instrument should respond to the average (rms) values of modulated fields independent of modulation characteristics. With respect to measurements of pulsed sources such as radar transmitters, many commercially-available survey instruments cannot measure high peak-power pulsed fields accurately. In such cases, the instrument should be chosen carefully to enable fields close to the antenna to be accurately measured.

When measuring fields in multiple-emitter environments, the ability of many commonly available RF broadband survey meters to accurately measure multiple signals of varying frequencies may be limited by how the meter sums the outputs of its diode detectors. This can lead to over-estimates of the total RF field that may be significant. Although such estimates can represent a "worst case," and are allowable for compliance purposes, users of these meters should be aware of this possible source of error.

(I) FAR FIELD RANGE SAFETY

Warning Signs-

Shall be placed in a visible site near the antenna under test platform.

At the door leading out to the antenna under test platform.

At both ends of the road crossing DRS Property.

At the gate to the DRS property.

At the Transponder Tower.

Any other place deemed necessary.

Personal Protection-

All new employees shall be given proper training upon employment.

All current Employees shall be given proper training.

A general announcement shall be made prior to radiating.

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Radiation Check list-

Shall be completed and signed by the safety officer prior to radiating.

Reporting-

The Test Engineer shall prepare a schedule of testing, and deliver it to the facility Manager, detailing the radiation times. This report shall be prepared 1 week in advance and approved by the General Manager or his designated Staff.

The Facility Manager will assure a radiation log is maintained to include exact date and times of RF Emissions.

(J) NEAR-FIELD RANGE (ANECHOIC CHAMBER) SAFETY

Warning Signs-

Shall be placed outside door to Anechoic Chamber.

Shall be placed outside both control room doors.

Personal Protection-

All Test personnel shall be trained in Radiation Hazards

Only authorized personnel allowed in the Chamber