REPORT

Compliance with emissions limits for non-ionising radiation

Third Audit Report 2001

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Foreword by the Director

Radio is required for a variety of purposes for the benefit of both private individuals and commercial organisations. These purposes include radio and television broadcasting, telecommunications services including fixed telecommunications services, mobile telephony, satellite services, radio navigation systems and equipment used in industry, medicine and commerce.

The growth in the use of radio in this country in recent years is evident with the increased expansion in areas such as the mobile telephony industry where the market in Ireland has seen an unprecedented rise in penetration levels from 22% in 1998(1December 1998) to 70% in 2001(1 June 2001).

This growth is also evident in other areas of radio technology, including digital television and fixed wireless access systems. Further developments may be expected following the ODTR rulings[1,2] this summer for additional types of access both for private and public use.

As a result of the expansion in this area consumer demand has increased and subsequently the number of masts required to deliver these services also continues to increase. In order to alleviate concern in relation to the non-ionising radiation emissions from these masts, the ODTR has included a provision in relevant licences to ensure compliance with the international guidelines for general public exposure to electromagnetic fields.

This is the third audit of major licensed operators to be carried out by the office. It was carried out by Enterprise Ireland who were awarded the contract following a tender process. The audit has investigated the extent to which the major licensed operators have procedures in place and are taking a responsible approach to ensuring compliance with the international guidelines for general public exposure to electromagnetic fields.

[1] ODTR 01/70 – New Opportunities in the Radiocommunications Market - Fixed Wireless Access (FWA) - Response to Consultation
[2] ODTR 01/71 - New Opportunities in the radio communications market- Public Mobile Data and Automatic Vehicle Location/Tracking - Response to Consultation

On the basis of the auditor's work, I have concluded that all the companies audited have procedures and arrangements in place to ensure compliance with the general public exposure limits. I have also concluded that these companies are taking a responsible approach to ensuring compliance, and have noted that written statements of Compliance endorsed by senior management from each company have been provided.

The full report is available for inspection from my Office and contact details are in Section 1.1.2.

I hope this report on the audit will serve to inform and reassure the public about the measures being taken by operators of radio installations to ensure compliance with the international guidelines for public exposure limits for non-ionising radiation.

I intend to arrange for further audits to be carried out as necessary, in order to continue to be satisfied that compliance requirements by operators are being met.

Etain Doyle,
Director of Telecommunications Regulation.

Executive Summary

This is the third audit report commissioned by the Office of the Director of Telecommunications Regulation (ODTR) to ensure that licensed operators are in compliance with their licence conditions relating to emission limits for non-ionising radiation.

As the licensing authority for radiocommunications, the ODTR is responsible for ensuring that telecommunications operators comply with their licence condition relating to non-ionising radiation, i.e. the radiation emissions from telecommunications masts must be within the levels set down in the latest international guidelines. In this regard, licensees must take full account of these guidelines when designing, constructing, and operating radio installations.

In 1998 and 1999, in order to ensure that operators comply with this licence condition the ODTR arranged for an audit of major licensed operators to be carried out by Enterprise Ireland to check that the radiation emissions from telecommunications masts were within the International guidelines for non-ionising radiation emission levels. As a result of these audits it was concluded that, the telecommunications operators had adequate procedures in place to ensure compliance with their licence condition.

The results of the first audit were published in July 1998 and the results of the second audit were published in February 2000. Both reports are available from the ODTR[3]. In January 2001, the ODTR arranged for a further audit to be conducted and, following a competitive tender process, Enterprise Ireland was contracted to carry out the audit. The audit was delayed by the restrictions relating to Foot and Mouth Disease earlier this year.

[3] Documents ODTR 98/23 and 00/06

As with the previous audits, the independent consultants were contracted to:

- Audit the procedures put in place by the operators to ensure that their sites are in compliance with the latest international guidelines relating to non-ionising radiation emissions.

- Verify that the sites are in compliance with these guidelines by taking a series of test measurements on a number of sample sites.

Audits were carried out on the following companies:

MMDS Licensee

Chrous

Cellular Telephony Licensees

Eircell 2000 Ltd.

Esat Digifone

Meteor Mobile Communications

Fixed Wireless Access (FWA) Licensee

Esat Business

Broadcasters

Radio Telefis Eireann (RTE)

TV Deflector Licence Operators

Southcoast Community Television Ltd.

Mayo Community Television Ltd.

Mr. Thomas Nallen

On the basis of this work, Enterprise Ireland concluded that all companies audited have the procedures and arrangements in place to ensure compliance with the general public exposure limits specified in the International Commission on Non-Ionising Radiation Protection (ICNIRP) guidelines 1998 and are in compliance with these guidelines.

The audits included 25 sites picked at random by Enterprise Ireland and 5 chosen by the ODTR. For each site the ODTR requires that the measured levels of non-ionising radiation emissions should not exceed the ICNIRP limits in any part of a site or surrounding area where the general public have access.

Of the 30 sites selected, RTE's site in Montrose, Donnybrook was the only site chosen during the previous audit. The number of users at this site has expanded since that audit and it was examined for this reason. All 30 of the sites were within the ICNIRP guideline limits for general public exposure to non-ionising radiation.

Further audits will be conducted as necessary.

1 INTRODUCTION

1.1 Introduction

This report presents the results of the third audit of compliance with the emission limits for non-ionising radiation (NIR). The audit examined the procedures put in place by radio operators to ensure compliance with the general public exposure limits of the International Commission on Non-Ionising Radiation Protection (ICNIRP) Guidelines 1998[4]. The audit also included measurements at 30 sites throughout the country. The audit was carried out by Enterprise Ireland on behalf of the Office of the Director of Telecommunications Regulation (ODTR).

For each site, the ODTR requires that the measured levels of non-ionising radiation emissions should not exceed the ICNIRP limits in any part of the site or surrounding area where the general public have access. For areas close-up to the transmitter, in cases where the ICNIRP limits may be exceeded, adequate measures such as notices and fencing must be in place to prevent the public from gaining access.

This report is arranged as follows:
The first section outlines the role of the ODTR in the area of NIR. This section also contains a brief description of what NIR is and the relevant international guidelines. The section concludes by outlining Enterprise Ireland's appointment to carry out the audit.

The second section is Enterprise Ireland's report on the audit of compliance. It contains the results of the audit of compliance for each of the licensed operators together with the results of the site measurements. Each audit report contains a conclusion by Enterprise Ireland on the extent of procedures and arrangements in place and on measurements recorded to ensure compliance with the general public exposure limits of the ICNIRP Guidelines 1998.

The third section contains the conclusions of this Office.

[4] ICNIRP Secretariat c/o Dipl.-Ing Rüdiger Matthes, Bundesamt für Strahlenschultz, Institut für Strahlenhygiene, Ingolstädter Landstrasse 1, D-85764 Oberschleissheim, Germany. http://www.icnirp.de/

1.2 Viewing the Full Audit Report

A copy of the NETC's full audit report with the site measurements is available for inspection at this Office during normal working hours. Requests to view the Compliance with emission limits for non-ionising radiation full report should be made to

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2 BACKGROUND

2.1 Role of the Office of the Director of Telecommunications Regulation

The Office of the Director of Telecommunications Regulation (ODTR) is the licensing authority for the use of the radio frequency spectrum in Ireland. The frequency spectrum is a very valuable national resource, used for the transmission of a wide range of services including radio and television broadcasting, mobile telephony, telecommunications services, etc.

The frequencies used for radio communications are in the non-ionising part of the electromagnetic spectrum. The ODTR is not responsible for licensing the use of frequencies in the ionising part of the spectrum.

The ODTR reviewed the situation in relation to non-ionising radiation shortly after its establishment, in July 1997. It was decided to include a provision in relevant licences, which already existed in the mobile phone licences, relating to non-ionising radiation, i.e. the radiation emissions from telecommunications masts must be within the international guidelines for exposure to electromagnetic fields. In this regard, licensees must take full account of these Guidelines when designing, constructing, and operating radio installations.

In order to ensure that operators comply with this licence condition the ODTR, in 1998 and 1999, contracted independent consultants, to:

- Audit the procedures put in place by the operators to ensure that their sites are in compliance with the International non-ionising radiation emission limits.
- Verify that the sites are in compliance with these limits by taking a series of test measurements on 30 sample sites.

The results of these audits were published by the ODTR in July 1998 and February 2000. From these audits, the ODTR concluded that the telecommunications operators have adequate procedures in place to ensure compliance with their licence conditions.

The aims of the third audit on compliance with emission limits were to check previous audited operators continued compliance with their licence conditions relating to non-ionising radiation, new licencees compliance with licence conditions and to examine, in particular, mobile telephony masts in built up areas, and the use of shared sites.

Specific concerns for the audit were similar to those highlighted in the second audit and they were:

- To carry out site measurements at multiple user or shared sites to ensure that the total emissions from these sites are within the ICNIRP guidelines
- To carry out site measurements near population centres

Enterprise Ireland audited the procedures put in place by 9 licensed operators. The audit also includes measurements at 30 sites throughout the country. With the exception of the RTE site at Montrose, Donnybrook all 29 sites are different from the sites measured during the second audit. Levels at the RTE site were re-measured as the growth in the Telecommunication and Broadcasting sectors in Ireland has resulted in an increase of services transmitting from the mast at this site.

Several different types of radio systems, operating at different frequencies and output power levels were audited. These included:

- MMDS systems operated by Chrous.
- Eircell 2000 Ltd., Esat Digifone, Meteor Mobile Communications mobile telephony base stations.
- RTE's radio and television broadcasting transmitters
- Fixed Wireless Access systems operated by Esat business
- TV deflector systems operated by the TV Deflector Licence Operators
- Microwave point to point links operated by various users for local access and infrastructure

2.2 What is non-ionising radiation?

Non-ionising radiation is that part of the electromagnetic spectrum below 2420 million MHz. Radio waves, infra-red radiation and visible light are examples of NIR. Electromagnetic waves at frequencies above 2420 million MHz are known as ionising radiation and this includes X-rays and Gamma rays. A more detailed explanation of NIR is given in Annex A.

2.3 Standards for emissions limits for non-ionising radiation

The International Commission for Non-Ionising Radiation Protection (ICNIRP) is an independent, scientific organisation established in 1992. The ICNIRP was established for the purpose of advancing Non-Ionising Radiation Protection for the benefit of people and the environment and in particular to provide guidance and recommendations on protection from NIR exposure. ICNIRP operates in co-operation with the Environmental Health Division of the World Health organisation and the United Nations Environment Programme. In 1998 ICNIRP issued a position paper on the health and safety aspects of NIR. This reviewed both thermal and athermal effects and its conclusion endorsed the 1988 guidelines produced by the IRPA.

This third audit required operators to ensure compliance to the ICNIRP (1998) guidelines.

A summary of the maximum public exposure levels in the ICNIRP Guidelines for the radio systems in this audit are shown in section 3.3.2.

It should be noted that in 1999 the European Commission put out a recommendation[5] which proposed to limit exposure of the general public to electromagnetic fields 0 Hz-300 GHz based on a set of basic restrictions and reference levels developed internationally under the advice of the International Commission on Non-Ionising Radiation Protection. In relation to emissions within the radio spectrum, these limits are equivalent to the ICNIRP guideline limits used by the ODTR.

[5] Recommendation of the European Council 1999/519/EC of July 12, 1999

2.4 Appointment and independence of Enterprise Ireland

Following a competitive tender process held in early 2001, the National Electronic Technology Centre (NETC) in Enterprise Ireland was chosen to carry out the external audits. The audits were carried out by the Quality Assurance Section of NETC while the site measurements were carried out by the Safety and Environmental Test Section of NETC.

NETC is the only Irish agency accredited by the National Accreditation Board (NAB) to measure the levels of non-ionising radiation from telecommunications masts. The NETC is accredited in accordance with the European harmonised standards where the requirements of independence, impartiality and integrity must be complied with.

3 NETC Report on Audit of Compliance

3.1 Introduction

As part of its general obligations to ensure compliance with radio licensing conditions, the Office of the Director of Telecommunications Regulation (ODTR) has initiated an ongoing programme to monitor the procedures in place by specified licensed operators, in order to ensure compliance with the prescribed general public exposure limits for non-ionising radiation. These limits are contained in the "International Commission on Non-Ionizing Radiation Protection" (ICNIRP) Guidelines published in 1998.

The National Electronics Technology Centre (NETC) of Enterprise Ireland were contracted by the Office of the Director of Telecommunications Regulation to be responsible for the 2001 programme, which was to consist of the following:

- An audit of the procedures and arrangements put in place by specified licensed operators, to ensure compliance with the general public exposure limits of the ICNIRP Guidelines of 1998.
- Detailed measurement of the actual non-ionising radiation emitted from a number of selected transmitters of each of the specified operators, at various locations around Ireland.

This report contains the major results of both the audit and the measurement programmes carried out by NETC, Enterprise Ireland.

3.2 Scope and framework of Audits of Compliance

The audits of compliance were planned and carried out by the Quality Assurance Section of NETC. To establish the structure of these audits, International Standard ISO 10011-1 "Guidelines for Auditing Quality Systems - Part 1: Auditing (1993-05-01) was used.
The scope of the audit was to ensure that each specified licensee was meeting the general public exposure limits requirements of its licence conditions with respect to non-ionising radiation and that the documentation, in respect of this scope, was available and adequate.

The Office of the Director of Telecommunications Regulation had written to each of the specified operators, in advance of the audit, informing them that an audit was scheduled and that appropriate documentation should be available for inspection, including the following:

- Written procedures in place to ensure compliance with licence conditions regarding non-ionising radiation.
- Any documentation necessary to give effect to these procedures.
- An inventory of sites as per a provided schedule.
- Any emission test reports for specific sites.
- The most recent internal audit to satisfy the company that ICNIRP emission limits are being fully complied with.

An audit programme was drawn up in advance of the audit visit and presented to the company representatives at the audit-opening meeting. The programme was as follows:

- Review of the operation of the licensee and the procedures and documentation in place to ensure that the ICNIRP Guidelines (1998) limits for general public exposure are not exceeded.
- Review of the internal audit data.

On the basis of this review all observations were collected and recorded. These observations were assessed by the auditor to determine the degree of compliance of the licensee. Any areas of non-compliance were documented and made known to the company representatives at the audit-closing meeting.

3.3 Scope and framework of site measurements

3.3.1 Overview

The site measurements were planned and carried out by the Safety and Environmental Test Section of NETC. At the request of the Office of the Director of Telecommunications Regulation, site measurements were performed at five defined sites prior to the audit of the licensees. In conjunction with each audit of compliance, and using as a basis the complete listing of transmitting sites provided by the licensee, a number of sites were chosen from each listing which represented typical or maximum output configurations for each operator. Detailed measurements were then carried out of the non-ionising radiation emitted from these sites.

All measurements were carried out to the following criteria:

- The sites were measured against the reference levels for general public exposure contained in the ICNIRP Guidelines: 1998.
- No licensee was aware at which site or during what period the measurements would be made.
- The measurements were made using broadband equipment in the frequency range 100 kHz to 40 GHz and narrowband equipment over the frequency range from 30 MHz to 18 GHz, depending on the particular site characteristics.
- Measurements were made according to documented test procedures, using calibrated and traceable test equipment, by fully trained engineers.
- All measurement data and associated test records have been maintained and filed.

3.3.2 Site Measurements Specification and Limits

The ICNIRP document “Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz)”, published in 1998, contains both occupational and general public exposure limits to non-ionising radiation over the frequency bandwidth from up to 1 Hz to 300 GHz. Its main purpose is to provide guidelines for limiting ElectroMagnetic Field (EMF) exposure that will provide protection against known adverse health effects.

The ICNIRP states in this document that the limits are based on scientific data alone, i.e. that no consideration was given to economic impact or other non-scientific priorities. It further states that, from currently available knowledge, the limits should provide an adequate level of protection from exposure to time-varying electromagnetic fields.
Two classes of guidance are presented in the ICNIRP Guidelines:

Basic Restrictions

Restrictions on exposure to time varying electric, magnetic, and electromagnetic fields that are based directly on established health effects. Different scientific bases were used in the development of basic exposure restrictions for various frequency ranges:

- Between 1Hz and 10 MHz, basic restrictions are provided on current density to prevent effects on nervous system functions.
- Between 10 kHz and 10 GHz, basic restrictions on Specific Absorption Rate (SAR) are provided to prevent whole-body heat stress and excessive localised tissue heating; in the 100 kHz to 10 MHz range, restrictions are provided on both current density and SAR.
- Between 10 GHz and 300 GHz, basic restrictions are provided on power density to prevent excessive heating in tissue at or near the body surface.

Only power density in air, outside the body, can be readily measured in exposed individuals.

Reference Levels

These levels are provided for practical exposure assessment purposes to determine whether the basic restrictions are likely to be exceeded. Some reference levels are derived from basic restrictions using measurement and/or computational techniques, and some address perception and adverse indirect effects of exposure to EMF. Compliance with the reference levels will ensure compliance with the relevant basic restriction. If the measured or calculated value exceeds the reference level, it does not necessarily follow that the basic restriction will be exceeded. However, when a reference level is exceeded, it is necessary to test compliance with the relevant basic restriction and to determine whether additional protective measures are necessary.

The ICNIRP Guidelines: 1998 reference levels appropriate to the frequency range 100 kHz to 40GHz, covered by this report are as follows:

FOR MEMBERS OF THE GENERAL PUBLIC

Frequency f (MHz)	Unperturbed RMS Electric Field Strength E (V/m)	Unperturbed RMS Magnetic Field Strength H (A/m)	Equivalent Plane Wave Power Density (mW/cm^2)	Radio Service
0.003-0.15	87	5	-	
0.15-1	87	0.73/f	-	LW and MW Radio Broadcasting
1-10	$87/f^{1/2}$	0.73/f	-	
10-400	28	0.073	0.2	VHF Radio and Television Broadcasting
400-2000	$1.375f^{1/2}$	$0.0037f^{1/2}$	f/2000	UHF Television Broadcasting and Mobile Telephony Systems
2000-300000	61	0.16	1	Microwave Links, and MMDS

The guideline levels are lowest in the 10 MHz to 400 MHz frequency range as at these wavelengths resonance in parts or all of the body may occur resulting in optimum coupling of the radio frequency energy.

The ICNIRP guidelines require that in instances of simultaneous exposure to multiple sources, the sum of the exposure levels should be considered. In the case of the frequency range 30 MHz to 18 GHz, covered by the narrowband equipment used to generate this report, both the electric field strength and the magnetic field strength at each frequency should be expressed as a fraction of the limit at that frequency and both the sum of the electric field strength fractions squared and the sum of the magnetic field strength fractions squared should not exceed unity.

3.3.3 Characteristics of Measuring Equipment Used

NETC used both broadband and narrowband monitors in order to measure the non-ionising radiation emitted from each transmission site.

The broadband radiation hazard monitors measure and display the total power density over its frequency bandwidth. However, as the ICNIRP Guideline limit is frequency dependent, it is not possible to easily identify the margin of compliance of a particular emitter of non-ionising radiation.

Broadband emissions were measured over the frequency range of 100 kHz to 40 GHz. This frequency bandwidth covers long-wave, medium-wave and FM radio broadcasts, VHF & UHF television, cellular mobile telephone services, MMDS transmissions and microwave point-to-point links up to 40 GHz.

Narrowband emissions were measured, using measurement antennas and a spectrum analyser, over the frequency range of 30 MHz to 18 GHz. This enables the power level from each transmitter to be determined. This frequency range includes FM radio broadcasts, VHF & UHF television, cellular mobile telephone services, MMDS transmissions and microwave point-to-point links up to 18 GHz.

The uncertainty of measurement has been estimated by NETC, both for the broadband and narrowband monitors. In relation to all the results documented in this report, NETC has determined that consideration of the calculated uncertainty of measurement has no influence on the compliance to the General Public Guidelines of ICNIRP:1998.

3.3.4 Measurement Techniques

Initially, broadband measurements were made to determine the position of maximum field strength. This reading was noted and subsequently narrowband measurements were taken at that point. At sites where the field strengths were less than the minimum sensitivity of the broadband monitor, engineering judgement was used to choose a measurement location where the fields would be expected to be at a maximum.

Narrowband measurements were initially taken over a broad frequency range, in order to identify the bands where there was a significant power density. Then narrower, more accurate plots were taken over these frequency bands of interest, such as the 930 MHz to 970 MHz band, and the 1830 MHz to 1880 MHz band, for the cellular telephone frequencies. It is the narrowband results that are documented in this report. The results at each site are typically tabulated as four individual results. These are:

- The power density, over the frequency range of interest for the individual licence holder (e.g. the MMDS band, from 2.5 to 2.686 GHz for Chorus).
- The times below the ICNIRP Guideline limit for this limited frequency range.
- The power density, over the entire frequency from 30 MHz to 18 GHz (covering VHF radio and television, UHF television, mobile telephony systems, microwave Point-to-Point links and MMDS).
- The times below the ICNIRP Guideline limit for this broad frequency range from 30 MHz to 18 GHz.

In addition, at sites where there were significant transmissions from more than one operator transmitting in the specific frequency range of interest (e.g. at Ennis, where Eircell, Esat Digifone, and Meteor were all transmitting in the GSM 900 band), two extra results are included. These are:

- The power density, over the frequency range of interest for all licence holders transmitting in that frequency range.
- The times below the ICNIRP Guideline limit for all operators transmitting in this limited frequency range.

As the antennas used for narrowband measurements are directional and polarised, measurements were taken with the antennas oriented both horizontally and vertically, so as to obtain the maximum field strength and to ensure that ground reflected components were measured. The measurement height was approximately 1 metre.

Based on the results of these measurements the total power density for each site was calculated, making worst-case assumptions regarding the number of transmitters operating at any one time. The temperature and Relative Humidity at each location was recorded. It was also noted whether the ground conditions were wet or dry.

3.4 Results of Audits of Compliance and Site Measurements

3.4.1 MMDS Licensees

3.4.1.1 Chorus

3.4.1.1.1 Results of Audits of Compliance

NETC carried out an audit at Chorus, Limerick Enterprise Development Park, Roxboro Road, Limerick, on the 8 August 2001. Chorus is the trading identity of Princes Holdings Ltd., and it has licenses for the provision of Multi-point Microwave Distribution System (MMDS) television service. The company has acquired Cable Management Ireland Ltd. and Suir Nore Relays Ltd., both having been issued with MMDS licenses.

The company representative was Mr. Umberto Bini, Transmission Manager.

The assurance that the company is meeting the ICNIRP Guideline limits for general public exposure is contained in the company's compliance document "Procedures for Complying with Limits for Non-ionising Radiation", dated 22 November 1999.

An audit of the requirements of this document, which included written procedures to ensure compliance with licence conditions, and an audit of the associated records, indicated the following:

- That the maximum transmitter power per installation was specified and the requirement that the power output was checked, on a regular basis.
- That there was measurement data showing compliance with the ICNIRP Guideline limits, made by a third party testing agencies, on one of the company's transmitting installations.

As a consequence of this audit three non-compliances were raised and presented to the company representative at the closing meeting. The non-compliances related to the failure to update both the procedures and the site listing to take account of the Cable Management Ireland and Suir Nore Relays transmitters which have been acquired by Chorus, and the fact that no an internal audit had been carried out as required by the procedure.

Subsequent to this audit the company re-issued the compliance document, updated the site listing and carried out the specified internal audit. These actions discharge the non-compliance detected during the audit of 8 August 2001.

As a result of the audit and the subsequent actions of the company, NETC concluded that Chorus has the procedures and arrangements in place and is operating in compliance with the general public exposure limits of the ICNIRP Guidelines: 1998.

3.4.1.1.2 Results of Site Measurements

The summary results of measured non-ionising radiation emitted from a number of Chorus transmitters are as follows:

Site Location	Frequency Range	Total Power Density Value Recorded – mW/cm^2	Times Below ICNIRP General Public Guideline Limit
Wolf Trap Mountain, Mountrath, Co. Laois	MMDS Frequency	2.6×10^{-6}	380,000
	30 MHz – 18 GHz	4.3×10^{-4}	798
Forth Mountain, Co.Wexford	MMDS Frequency	8.7×10^{-5}	11,000
	30 MHz – 18 GHz	2.4×10^{-4}	2000

All the measurements recorded by NETC at the selected sites of Chorus were within the ICNIRP Guidelines: 1998 limits for general public exposure to non-ionising radiation.

3.4.2 Cellular Telephony Licensees

3.4.2.1 Eircell Ltd.

3.4.2.1.1 Results of Audits of Compliance

NETC carried out an audit at Eircell Ltd., Blackthorn House, Blackthorn Road, Sandyford Industrial Estate, Dublin, on the 7 August 2001. Eircell provide a digital national cellular telephone system, using both GSM 900 and DCS 1800, and use microwave point to point links to provide communication between cellular telephone base stations and other points in the network. The company also provided, until 31 July 2001, an analogue (TACS) national cellular telephone system.

The company representatives were Dr. Diarmuid Moran, Health, Safety and Environmental Manager, Mr. Eamon Farrell, Head – Radio Networks and Mr. Colm Scully, Radio Networks Department.

The assurance that the company is meeting the ICNIRP Guideline limits for general public exposure is contained in the company's compliance document "Guidance Document on the Protection of Staff, Other Parties and Members of the General Public from the effects of Non-Ionising Electromagnetic Fields" Rev. 1– dated March 2001.

An audit of the requirements of this document, which included written procedures to ensure compliance with licence conditions, and an audit of the associated records, indicated the following:

- That there was extensive calculation and measurement data showing compliance with the ICNIRP Guideline limits, made by the company and third party testing agencies, on a large percentage of Eircell's installations.
- That the assessment data, made by third party agencies and the company, on Eircell's Cellular Telephone Transmitter Base Stations, indicated compliance to the ICNIRP Guideline limits.
- That an inventory of sites was maintained.
- That an internal audit, to satisfy the company that ICNIRP emission limits are being fully complied with, was carried out and the results were available.

As a consequence of this audit no non-compliances were raised.

As a result of the audit NETC concluded that Eircell Ltd. has the procedures and arrangements in place and is operating in compliance with the general public exposure limits of the ICNIRP Guidelines: 1998.

3.4.2.1.2 Results of Site Measurements

The summary results of measured non-ionising radiation emitted from a number of Eircell's transmitters are as follows. The calculations for total power density make the worst-case assumption that all the phone channels are transmitting simultaneously in a particular sector. At sites where there were significant emissions from Esat Digifone and / or Meteor, the results for the entire mobile telephony bands are included in addition to the results for the Eircell transmissions only.

Site Location	Frequency Range	Total Power Density Value Recorded – mW/cm^2	Times Below ICNIRP General Public Guideline Limit
Westminster Road, Foxrock, Dublin 18	Mobile Telephony Frequencies for Eircell	1.9×10^{-3}	280
	30 MHz – 18 GHz	1.9×10^{-3}	280
The Goat Inn, Goatstown, Co. Dublin	Mobile Telephony Frequencies for Eircell	4.8×10^{-3}	99[6]
	30 MHz – 18 GHz	4.8×10^{-3}	99[6]
Virginia, Co. Cavan	Mobile Telephony Frequencies for Eircell	3.4×10^{-5}	14,000
	30 MHz – 18 GHz	3.4×10^{-5}	14,000
Ennis, Co. Clare	Mobile Telephony Frequencies for Eircell	2.3×10^{-4}	2,000
	Mobile Telephony Frequencies for all Operators	3.7×10^{-4}	1,300
	30 MHz – 18 GHz	3.7×10^{-4}	1,300

[6] The value recorded at this site is a consequence of the height of the antenna, at ten metres, and the use of a very low-loss combiner to each antenna

Site Location	Frequency Range	Total Power Density Value Recorded – mW/cm^2	Times Below ICNIRP General Public Guideline Limit
Lapp's Quay, Cork, Co.Cork	Mobile Telephony Frequencies for Eircell	4.5×10^{-5}	13,000
	Mobile Telephony Frequencies for all Operators	6.5×10^{-5}	9,300
	30 MHz – 18 GHz	6.5×10^{-5}	9,100
Falcarragh, Co. Donegal	Mobile Telephony Frequencies for Eircell	2.2×10^{-6}	210,000
	Mobile Telephony Frequencies for all Operators	8.3×10^{-6}	57,000
	30 MHz – 18 GHz	8.3×10^{-6}	57,000
Manorhamilton, Co. Leitrim	Mobile Telephony Frequencies for Eircell	3.6×10^{-5}	13,000
	30 MHz – 18 GHz	3.7×10^{-5}	13,000
Kilmallock Exchange, Limerick, Co. Limerick	Mobile Telephony Frequencies for Eircell	4.4×10^{-5}	11,000
	30 MHz – 18 GHz	4.4×10^{-5}	11,000
Horseleap, Co. Westmeath	Mobile Telephony Frequencies for Eircell	2.0×10^{-6}	230,000
	Mobile Telephony Frequencies for all Operators	3.8×10^{-5}	12,000
	30 MHz – 18 GHz	3.8×10^{-5}	12,000

All the measurements recorded by NETC at the selected sites of Eircell Ltd. were within the ICNIRP Guidelines: 1998 limits for general public exposure to non-ionising radiation.

3.4.2.2 Esat Digifone

3.4.2.2.1 Results of Audits of Compliance

NETC carried out an audit at Esat Digifone, Digifone House, 76 Lower Baggot Street, Dublin 2, on the 16 August 2001. Esat Digifone provides a digital national cellular telephone system, using both GSM 900 and DCS 1800, and uses microwave point to point links to provide communication between cellular telephone base stations and other points in the network.

The company representatives were Mr. Declan Roe – Health and Safety Manager, Mr. Des Coburn – Head of Group: Transmission, Planning & Engineering and Mr. Ian Hillhouse – Construction Team Leader.

The assurance that the company is meeting the ICNIRP Guideline limits for general public exposure is contained in the company's compliance document "Procedure for GSM Site Power Density Monitoring" – Version 3, dated 7/03/01

An audit of the requirements of this document, which included written procedures to ensure compliance with licence conditions, and an audit of the associated records, indicated the following:

- That the maximum possible transmitted power for an Esat Digifone Base Transmission Station (BTS) was specified.
- That there was measurement data showing compliance with the ICNIRP Guideline limits, made in the past year, on a sample number of Esat Digifone's Base Transmission Stations (BTS).
- That an inventory of sites was maintained.

As a consequence of this audit no non-compliances were raised.

As a result of the audit NETC concluded that Esat Digifone has the procedures and arrangements in place and is operating in compliance with the general public exposure limits of the ICNIRP Guidelines: 1998.

3.4.2.2.2 Results of Site Measurements

The summary results of measured non-ionising radiation emitted from a number of Esat Digifone's transmitters are as follows. The calculations for total power density make the worst-case assumption that all the phone channels are transmitting simultaneously in a particular sector. At sites where there were significant emissions from Eircell and / or Meteor, the results for the entire mobile telephony bands are included in addition to the results for the Esat Digifone transmissions only.

Site Location	Frequency Range	Total Power Density Value Recorded – mW/cm^2	Times Below ICNIRP General Public Guideline Limit
Ballinteer Avenue, Ballinteer, Dublin 16	Mobile Telephony Frequencies for Esat Digifone	1.2×10^{-2}	40[7]
	30 MHz – 18 GHz	1.2×10^{-2}	40[7]
Carlow Shopping Centre, Carlow, Co. Carlow	Mobile Telephony Frequencies for Esat Digifone	6.3×10^{-4}	760
	Mobile Telephony Frequencies for all Operators	6.5×10^{-4}	730
	30 MHz – 18 GHz	6.5×10^{-4}	730
Killarney Garda Station, Killarney, Co. Kerry	Mobile Telephony Frequencies for Esat Digifone	2.1×10^{-4}	2,600
	30 MHz – 18 GHz	2.1×10^{-4}	2,600
Callan, Co. Kilkenny	Mobile Telephony Frequencies for Esat Digifone	1.4×10^{-4}	3,400
	30 MHz – 18 GHz	1.4×10^{-4}	3,400
Donore, Co. Louth	Mobile Telephony Frequencies for Esat Digifone	1.0×10^{-3}	470
	30 MHz – 18 GHz	1.0×10^{-3}	470

[7] The value recorded at this site is a consequence of the height of the antenna, at ten metres.

Site Location	Frequency Range	Total Power Density Value Recorded – mW/cm2	Times Below ICNIRP General Public Guideline Limit
Swinford Garda Station, Swinford, Co. Mayo	Mobile Telephony Frequencies for Esat Digifone	1.6×10^{-4}	2,900
	30 MHz – 18 GHz	1.6×10^{-4}	2,900
R&H Hall, Waterford, Co. Waterford	Mobile Telephony Frequencies for Esat Digifone	2.4×10^{-5}	20,000
	Mobile Telephony Frequencies for all Operators	2.6×10^{-5}	19,000
	30 MHz – 18 GHz	2.6×10^{-5}	19,000
ESB Office, Wexford, Co. Wexford	Mobile Telephony Frequencies for Esat Digifone	2.6×10^{-4}	1,800
	Mobile Telephony Frequencies for all Operators	8.9×10^{-4}	530
	30 MHz – 18 GHz	1.5×10^{-3}	390

All the measurements recorded by NETC at the selected sites of Esat Digifone were within the ICNIRP Guidelines: 1998 limits for general public exposure to non-ionising radiation.

3.4.2.3 Meteor Mobile Communications Ltd.

3.4.2.3.1 Results of Audits of Compliance

NETC carried out an audit at Meteor Mobile Communications Ltd., 4030 Citywest Business Park, Naas Road, Dublin 24, on the 9 July 2001. Meteor are licensed to provide a digital national cellular telephone system, using both GSM 900 and DCS 1800, and use microwave point to point links to provide communication between cellular telephone base stations and other points in the network.

The company representatives were Ms. Rosaleen Geaney - Health & Safety Manager, Mr. Oliver Mulligan - RF Manager, Mr. John Reilly – Transmission Manager, Mr. Michael Moloney – Network Operations Centre Supervisor and Mr. Liam Hamilton – Technical Director.

The assurance that the company is meeting the ICNIRP Guideline limits for general public exposure is contained in the company's compliance documents that include:

- The specification of the maximum transmitter power and antenna configuration per installation.
- The requirement for a 'worst case' analysis prior to the commissioning of a new transmission site.
- The provision of an inventory of sites.

Measurement data, showing compliance with the ICNIRP Guideline Limits 1998, made by third party testing agencies, on several of Meteor's transmission sites.

As a consequence of this audit no non-compliances were raised.

As a result of the audit NETC concluded that Meteor Mobile Communications Ltd. has the procedures and arrangements in place and is operating in compliance with the general public exposure limits of the ICNIRP Guidelines: 1998.

3.4.2.3.2 Results of Site Measurements

The summary results of measured non-ionising radiation emitted from a number of Meteor's transmitters are as follows. The calculations for total power density make the worst-case assumption that all the phone channels are transmitting simultaneously in a particular sector. At sites where there were significant emissions from Eircell and / or Esat Digifone, the results for the entire mobile telephony bands are included in addition to the results for the Meteor transmissions only.

Site Location	Frequency Range	Total Power Density Value Recorded – mW/cm^2	Times Below ICNIRP General Public Guideline Limit
R&H Hall, Alexandra Basin, Alandra Road, Dublin 3	Mobile Telephony Frequencies for Meteor	1.0×10^{-6}	900,000
	Mobile Telephony Frequencies for all Operators	8.3×10^{-5}	6,200
	30 MHz – 18 GHz	8.5×10^{-5}	5,800
Grand Bingo Hall, Yellow Road, Whitehall, Dublin 9	Mobile Telephony Frequencies for Meteor	7.1×10^{-5}	13,000
	Mobile Telephony Frequencies for all Operators	1.3×10^{-4}	5,700
	30 MHz – 18 GHz	1.3×10^{-4}	5,600
Palmerston, Dublin 20	Mobile Telephony Frequencies for Meteor	3.0×10^{-4}	1,800
	Mobile Telephony Frequencies for all Operators	3.7×10^{-4}	1,500
	30 MHz – 18 GHz	3.7×10^{-4}	1,500
Old Kilcullen, Co. Kildare	Mobile Telephony Frequencies for Meteor	2.2×10^{-4}	2,200
	Mobile Telephony Frequencies for all Operators	2.3×10^{-4}	2,100
	30 MHz – 18 GHz	2.3×10^{-4}	2,100

All the measurements recorded by NETC at the selected sites of Meteor Mobile Communications Ltd. were within the ICNIRP Guidelines: 1998 limits for general public exposure to non-ionising radiation.

3.4.3 Fixed Wireless Access (FWA) Licensees

3.4.3.1 Esat Business

3.4.3.1.1 Results of Audits of Compliance

NETC carried out an audit at Esat Business, Unit 2, Dundrum Business Park, Dundrum, Dublin 14, on the 5 July 2001. Esat Business is licensed to provide a national broadband Fixed Wireless Access (FWA), often referred to as Wireless in the Local Loop (WLL). This is a method of connecting a subscriber to a telecommunications network using radio rather than traditional wires. The wireless service operates in the 26 GHz band.

The company representatives were Mr. Steve Coakley - Senior Radio Planning Engineer, Mr. Ian Watson - RF Engineering Manager and Ms. Niamh Coll – Business Excellence Group.

The assurance that the company is meeting the ICNIRP Guideline limits for general public exposure is contained in the company's compliance document "ICNIRP Guideline Compliance Procedures Density Monitoring"

An audit of the requirements of this document, which included written procedures to ensure compliance with licence conditions, and an audit of the associated records, indicated the following:

- That the maximum transmitter power and antenna configuration per installation was specified.
- That a 'worst case' analysis is required prior to the commissioning of a new transmission site, or any change to an existing site.
- That an inventory of sites was available.
- That calculations for all microwave point-to-point links showing the power density value at various distances from the antenna, were documented.
- That an internal audit, to satisfy the company that ICNIRP emission limits are being fully complied with, is documented.

As a consequence of this audit no non-compliances were raised.

As a result of the audit NETC concluded that Esat Business has the procedures and arrangements in place and is operating in compliance with the general public exposure limits of the ICNIRP Guidelines: 1998.

3.4.3.1.2 Results of Site Measurements

The summary results of measured non-ionising radiation emitted from a number of Esat Business' transmitters are as follows.

Site Location	Frequency Range	Total Power Density Value Recorded – mW/cm^2	Times Below ICNIRP General Public Guideline Limit
RTE Office, Sligo, Co. Sligo	30 MHz – 18 GHz	2.0×10^{-6}	180,000
Galway, Co. Galway	30 MHz – 18 GHz	2.4×10^{-4}	2,000

Note that the frequency of the Esat Business wireless local loop transmitters are outside the range 30 MHz – 18 GHz. Measurements using broadband equipment, which encompasses the wireless local loop frequency, indicated that the non-ionising radiation from this wireless local loop transmitter was below the ICNIRP 1998 limits for general public exposure to non-ionising radiation.

All the measurements recorded by NETC at the selected sites of Esat Business were within the ICNIRP Guidelines: 1998 limits for general public exposure to non-ionising radiation.

3.4.4 Broadcasters

3.4.4.1 Radio Telefis Eireann (RTE)

3.4.4.1.1 Results of Audits of Compliance

NETC carried out an audit at Radio Telefis Eireann, Donnybrook, Dublin 4, on 4 July 2001. RTE broadcast television and radio on a national basis and use microwave point-to-point links in support of these broadcast activities.

The company representatives were Ms. Deirdre Callanan, Health and Safety Officer and Ms Emer Sheahan, Broadcast Engineer, Network Group.

The assurance that the company is meeting the ICNIRP guideline limits for general public exposure is based on the production and implementation by the company, of the following documentation:

- HS0200.3 "Procedures for monitoring RTE network transmission sites for ongoing compliance with General Public guidelines on Non-ionising radiation", dated 10 February 2001.
- HS0300.3 "Procedures for ensuring compliance with General Public guidelines on Non-ionising radiation for new RTE transmission sites", dated 10 February 2001.

An audit of the requirements of these documents, which included written procedures to ensure compliance with licence conditions, and an audit of the associated records, indicated the following:

- That the maximum transmitter power and antenna configuration per installation was specified.
- That calculations, from RTE high power sites, showing the power density value at various distances from the antenna, were documented.
- That an inventory of sites was maintained.
- That calculations for all microwave point-to-point links showing the power density value at various distances from the antenna, were documented.

- That emission test reports for specific sites, as required by RTE documents HS0200 and HS0300, were on file and adequate. These include the medium wave transmitters at Athlone and Tullamore.

- That an internal audit, to satisfy the company that ICNIRP emission limits are being fully complied with, was carried out and the results were available.

As a consequence of this audit no non-compliances were raised.

As a result of the audit NETC concluded that Radio Telefis Eireann has the procedures and arrangements in place and is operating in compliance with the general public exposure limits of the ICNIRP Guidelines: 1998.

3.4.4.1.2 Results of Site Measurements

The summary results of measured non-ionising radiation emitted from a number of Radio Telefis Eireann's transmitters are as follows:

Site Location	Frequency Range	Total Power Density Value Recorded – mW/cm^2	Times Below ICNIRP General Public Guideline Limit
Donnybrook, Dublin4	Microwave Point to Point Frequencies for RTE	Below minimum sensitivity of equipment	Below minimum sensitivity of equipment
	30 MHz – 18 GHz	3.3×10^{-5}	21,000

Site Location	Electric Field (E) (Volts per metre)	Times Below ICNIRP Electric Field (E) Limit	Magnetic Field (H) (Amperes per metre)	Times Below ICNIRP Magnetic Field (H) Limit
Collinswood, Beaumount, Dublin 9	8.0	9.6	<0.05	>11.4

Note: For the frequency range of the Beaumount medium wave transmitter i.e. 1,278 kHz, the ICNIRP limit is expressed in terms of Electric Field and Magnetic Field strengths, and not Power Density. Therefore both Electric Field and Magnetic Field measurements were performed at this site, as shown in the results table above. The values shown are the highest levels that were measured on this site in areas accessible to the general public. The ICNIRP Electric Field limit for this site is 77 Volts per metre. The ICNIRP Magnetic Field limit for this site is 0.57 Amperes per metre.

All the measurements recorded by NETC at the selected sites of Radio Telefis Eireann were within the ICNIRP Guidelines: 1998 limits for general public exposure to non-ionising radiation.

3.4.5 TV Deflector Licence Operators

3.4.5.1 Southcoast Community Television Ltd.

3.4.5.1.1 Results of Audits of Compliance

NETC carried out an audit at Southcoast Community Television Ltd., Enterprise House, Ballinrea Road, Carrigaline, Co. Cork on the 9 August 2001. Southcoast has a license for the provision of an analogue terrestrial retransmission of television programmes, using the UHF band.

The company representatives were Mr. Liam Hurley, Executive Director and Mr. Edward O'Gorman, technical consultant to the company.

The assurance that the company is meeting the ICNIRP Guideline limits for general public exposure is contained in the company's compliance document "Policy and Procedures for the Prevention of a Non-ionising Radiation Hazard at Southcoast Community Television Transmitter Sites

An audit of the requirements of this document, which included written procedures to ensure compliance with licence conditions, and an audit of the associated records, indicated the following:

- That the maximum transmitter power for each installation was specified, and that regular checks were specified to ensure that this power output was not exceeded.
- That measurements were made, using a calibrated broadband probe, at all transmission sites operated by the company. All these measurements indicated compliance with the ICNIRP Guideline limits: 1998.
- That an inventory of sites was maintained.

As a consequence of this audit no non-compliances were raised.

As a result of the audit NETC concluded that Southcoast Community Television Ltd. has the procedures and arrangements in place and is operating in compliance with the general public exposure limits of the ICNIRP Guidelines: 1998.

3.4.5.1.2 Results of Site Measurements

The summary results of measured non-ionising radiation emitted from a Southcoast Community Television Ltd. transmitter are as follows:

The summary results of measured non-ionising radiation emitted from a Southcoast Community TV transmitter are as follows:

Site Location	Frequency Range	Total Power Density Value Recorded – mW/cm^2	Times Below ICNIRP General Public Guideline Limit
Rosscarbery Road, Clonakilty, Co. Cork	TV Deflector Frequencies for Southcoast Community TV	3.8×10^{-7}	1,100,000
	30 MHz – 18 GHz	8.8×10^{-5}	3,900

All the measurements recorded by NETC at the selected site of Southcoast Community Television Ltd. were within the ICNIRP Guidelines: 1998 limits for general public exposure to non-ionising radiation.

3.4.5.2 Mayo Community Television Ltd.

3.4.5.2.1 Results of Audits of Compliance

NETC carried out an audit of Mayo Community Television Ltd., on the 28 August 2001. The company has a license for the provision of an analogue terrestrial retransmission of television programmes, using the UHF band.

The company representatives were Mr. Padraig Cunnane - Mayo Community Television Ltd, Mr. Donal Moran and Ms. Ann Hora, both of Television Systems Limited. Television Systems Limited provides technical consultancy to Mayo Community Television Ltd.

The assurance that the company is meeting the ICNIRP guideline limits for general public exposure is based on:

- The specification of the maximum transmitter power per installation.

- That an inventory of sites was maintained.

As a consequence of this audit two non-compliances were raised and presented to the company representative at the closing meeting. The non-compliances related to the lack of any issued documentation relating to the company's compliance regime or internal audit, and due to the fact that the site listing was incomplete.

A follow-up audit was conducted, at Television Systems Limited, Knox Street, Ballyhaunis, Co. Mayo, on the 28th September 2001. This audit, conducted by John Howley, consisted of a review of the corrective actions taken and a review of records generated by the company. Subsequent to this follow-up audit the company has issued a compliance document entitled "Procedures of Mayo Community Television Ltd. for Compliance with Limits for Non-Ionising Radiation". This document, dated September 2001, and the updated site listing issued concurrently, discharges the non-compliances detected during the audit process.

As a result of the audit NETC concluded that Mayo Community Television Ltd. has the procedures and arrangements in place and is operating in compliance with the general public exposure limits of the ICNIRP Guidelines: 1998.

3.4.5.2.2 Results of Site Measurements

The summary results of measured non-ionising radiation emitted from a Mayo Community Television transmitter are as follows:

Site Location	Frequency Range	Total Power Density Value Recorded – mW/cm^2	Times Below ICNIRP General Public Guideline Limit
Newport, Co. Mayo	TV Deflector Frequencies for Mayo Community TV	6.4×10^{-9}	40,000,000
	30 MHz – 18 GHz	3.7×10^{-7}	810,000

All the measurements recorded by NETC at the selected site of Mayo Community Television Ltd. were within the ICNIRP Guidelines: 1998 limits for general public exposure to non-ionising radiation.

3.4.5.3 Mr. Thomas Nallen

3.4.5.3.1 Results of Audits of Compliance

NETC carried out an audit of Thomas Nallen Community Television Services. The company has a license for the provision of an analogue terrestrial retransmission of television programmes, using the UHF band.

Mr John Howley, of NETC, conducted the audit. The audit consisted of telephone discussions between Mr. Howley and Mr. Nallen and a meeting between Mr. Howley and representatives of Television Systems Limited, Knox Street, Ballyhaunis, Co. Mayo. Television Systems Limited provides broadcast technical consultancy to Thomas Nallen Community Television Services.

The initial contacts resulted in the disclosure by Mr. Nallen that no documented procedures existed and that there was no internal audit results or procedures. As a consequence of this disclosure three non-compliances were raised and forwarded to Mr. Nallen. The non-compliances related to the lack of any issued documentation relating to the company's compliance regime or internal audit, and due to the fact that the site listing was incomplete. Mr Nallen acknowledged the audit non-compliances, signed the forms and returned the signed copies to NETC.

A meeting was held, at Television Systems Limited, Knox Street, Ballyhaunis, Co. Mayo, on the 28th September 2001. This meeting was attended by John Howley, Mr. Donal Moran (Television Systems Limited) and Ms. Ann Hora (Television Systems Limited). The meeting consisted of a clarification, by Mr. Howley, of the corrective actions required to discharge the non-compliances.

Subsequent to this meeting a compliance document, entitled "Procedures of Thomas Nallen Community Television Services for Compliance with Limits for Non-Ionising Radiation", was issued. This document, dated October 2001, and the updated site listing issued concurrently, discharges the non-compliances detected during the audit process.

As a result of the audit NETC concluded that Thomas Nallen Community Television Ltd. has the procedures and arrangements in place and is operating in compliance with the general public exposure limits of the ICNIRP Guidelines: 1998.

3.4.5.3.2 Results of Site Measurements

The summary results of measured non-ionising radiation emitted from a transmitter operated by Mr. Thomas Nallen are as follows:

Site Location	Frequency Range	Total Power Density Value Recorded – mW/cm^2	Times Below ICNIRP General Public Guideline Limit
Dooncarton, Co. Mayo	TV Deflector Frequencies for Thomas Nallen	3.6×10^{-7}	920,000
	30 MHz – 18 GHz	1.1×10^{-5}	47,000

All the measurements recorded by NETC at the selected site of Mayo Community Television Ltd. were within the ICNIRP Guidelines: 1998 limits for general public exposure to non-ionising radiation.

4 ODTR Conclusions

4.1 CONCLUSION

On the basis of the auditor's work, Enterprise Ireland has concluded that companies audited have procedures and arrangements in place to ensure compliance with the general public exposure limits specified in the ICNIRP guidelines and are in compliance with these guidelines. In addition written Statements of Compliance endorsed by senior management from each relevant company were received.

The measurements recorded by Enterprise Ireland at all of the 30 selected sites were within the ICNIRP 1998 limits for general public exposure to non-ionising radiation.

These sites included:

- 14 shared or multiple user sites
- 20 sites in population centres
- 21 mobile telephony sites occupied by Esat Digifone, Eircell and Meteor (including shared sites)
- 2 MMDS sites operated by Chorus
- 1 microwave link site
- 2 Fixed Wireless Access sites operated by Esat Business
- 2 TV and radio transmitter sites occupied by RTE
- 3 TV deflector sites operated by TV deflector licensees

4.2 FURTHER AUDITS OF COMPLIANCE

The Director intends to arrange for further audits to be carried out as necessary in order to continue to be satisfied that operators of radio installations are in compliance with their licence obligations with regard to general public exposure limits for non-ionising radiation.

5 Annex A

5.1 Brief Technical Description of Non-ionising Radiation

Electromagnetic waves are waves containing energy in the form of electric and magnetic fields that travel through the air at the speed of light (i.e. 300 million metres per second). This is equivalent to travelling around the world seven times in one second.

An important characteristic of an electromagnetic wave is its frequency. An electromagnetic wave has peaks and troughs, similar to the waves created when pebbles are tossed into a pond of water. The frequency of the signal is the number of peaks, or troughs, that pass a fixed point in one second. Frequency is measured in units of Hertz. A thousand hertz (1 kHz) is a kilohertz, while a million hertz (1 MHz) is a megahertz and a thousand million hertz (1 GHz) is a gigahertz.

The electromagnetic spectrum contains all the electromagnetic waves of different frequencies. The lowest frequencies in the electromagnetic spectrun1 are radio waves, which are, used for communication and entertainment purposes. As the frequency of the waves increase we encounter infrared waves, which we sense as heat, followed by visible light from the sun. Above visible light are ultra-violet waves, which causes sunburn, followed by X-rays and Gamma rays.

Electromagnetic radiation can be divided into two types, namely non-ionising and ionising radiation. The amount of energy in an electromagnetic wave depends on the frequency of the wave. High frequency waves carry more energy than low frequency waves.

All matter, including humans, is made up of atoms, which in turn consist of tiny electrons spinning around a nucleus. Ionisation occurs where electromagnetic waves with sufficient energy are able to disrupt atoms and molecules. This process occurs at frequencies above approximately 2420 million MHz, which corresponds, to the region of the electromagnetic spectrum above ultra violet light.

Non-ionising radiation is electromagnetic radiation at frequencies below 2420 million MHz. The ODTR only licences the use of frequencies in the non-ionising section of the electromagnetic