



Office of the Director of  
**Telecommunications  
Regulation**

# **Compliance with emission limits for non-ionising radiation**

***First Audit Report 1998***

**Document No. ODTR 98/23**  
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## **Foreword by the Director**

There has been a big increase in the use of radio for individual, industrial and commercial purposes in Ireland in recent years. These uses include radio and television broadcasting, telecommunications services including mobile telephony, satellite services, radio navigation systems and equipment used in industry, medicine and commerce. This trend is expected to continue. In particular, wireless based systems will be vital for delivering advanced telecommunications services to areas outside the main centres of population.

All of these technologies have made our lives richer and easier. Mobile phones have greatly enhanced the ability of individuals to keep in touch with each other and have facilitated the dispatch of emergency medical and Garda assistance to the public in both urban and rural environments. Radio navigation systems are essential to ensure safety for air and sea travel, while radio and television broadcasting provide both information and entertainment to the public.

The rapid growth in the use of radio based services has required the construction of masts in urban and rural areas across the country. Shortly after the office was established in July 1997, it was decided to include a provision in relevant licences to ensure compliance with the international guidelines for general public exposure to electromagnetic fields.

Early this year, I arranged for an audit of major licensed operators to be carried out by Forbairt. The audit focused on compliance with the general public exposure limits specified in the guidelines published by the International Radiation Protection Association (IRPA). In particular, 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 IRPA guidelines. The audit also included radio emission measurements at 30 sites throughout the country.

The audit was conducted to the most stringent standards in accordance with the international standard ISO 10011-1. Operators dealt with the documentary issues which were noted and for all but one operator, the complimentary field tests showed emissions well below the IRPA Guidelines. For RTE, emissions were above the guidelines at two sites at places close-up to the transmitters to which the public could gain access (but as they were on RTE property would not ordinarily do so). RTE has now restricted entry to these sites.

On the basis of Forbairt's work, I have concluded that all the companies audited now 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.

I hope this report on the audit will serve to inform and reassure the public on 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*

## Foreword by the Director

## Executive Summary

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## Executive Summary

The increase in the number of radiocommunications masts throughout the country in recent years has raised concerns amongst the public that the radio emissions from these masts may be a hazard to health.

As the licensing authority for radiocommunications, the Office of the Director of Telecommunications Regulation (ODTR) reviewed the situation in relation to non-ionising radiation emissions shortly after its establishment in July 1997. Taking account of the public concerns, it was decided to include a provision in relevant licences to ensure compliance with the international guidelines for general public exposure to non-ionising radiation.

The frequencies used for radiocommunications are in the non-ionising part of the electromagnetic spectrum below 2420 million Mega Hertz (MHz). Electromagnetic waves at frequencies above 2420 million MHz are referred to as ionising radiation and this includes X-rays and Gamma rays. The ODTR does not licence the use of frequencies in the ionising part of the spectrum.

At the beginning of this year, the Director of Telecommunications Regulation wrote to major operators of licensed radio installations and advised them that she would be carrying out an audit of the procedures in place to ensure compliance with the internationally accepted guidelines issued by the International Radiation Protection Association (IRPA). Following a competitive tender process, the National Electronic Technology Centre (NETC) in Forbairt was contracted to carry out the audit.

Audits were carried out in the following companies:

- Cablelink Limited
- Cable Management Ireland Limited
- Eircell Limited
- Esat Digifone Limited
- Princes Holdings Limited
- Radio Telefís Éireann
- Suir Nore Relays Limited
- Telecom Éireann

The ODTR has concluded that, on the basis of Forbairt's work, all the companies audited have procedures and arrangements in place to ensure compliance with the general public exposure limits specified in the IRPA guidelines, 1988. The ODTR also concludes that these companies are taking a responsible approach to ensuring compliance, and has received written Statements of Compliance endorsed by senior management from each company. It has also been noted that significant efforts have been made by the companies to improve internal compliance procedures since this audit was initiated by the ODTR in December, 1997.

The audits included measurements of emission levels at 30 sites throughout the country chosen by Forbairt. For each site, the ODTR requires that the measured levels of non-ionising radiation emissions should not exceed the IRPA 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 IRPA limits are exceeded, adequate measures such as fencing and notices must be in place to prevent the public from gaining access.

At 28 of the 30 selected sites, the measurements recorded by Forbairt were all within the IRPA 1988 limits for general public exposure to non-ionising radiation.

At 2 medium wave radio transmitter sites operated by RTE (Tullamore and Athlone), Forbairt measured emission levels in areas close-up to the transmitters to which the public had access which were in excess of the IRPA 1988 limits. At both sites, the critical issue was the lack of adequate notices and fencing to prevent the public from gaining access to the areas where the IRPA 1988 limits were exceeded.

Following discussions between the ODTR and RTE, remedial actions were undertaken to identify and secure the areas close-up to the transmitters where the public exposure levels are exceeded. An inspection was carried out by Forbairt on behalf of the ODTR at both Tullamore and Athlone. In addition, actions were initiated by RTE to engage contractors to provide suitable permanent fencing around the restricted areas. The ODTR will continue to monitor the position at Tullamore and Athlone to ensure that suitable permanent fencing and notices have been erected.

The Director intends to carry out further audits 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. These audits will also serve to reassure the public in this regard.

**SECTION I**  
**INTRODUCTION AND BACKGROUND TO AUDIT**



## **1.1 INTRODUCTION**

### **1.1.1 Introduction**

This report presents the results of the first audit of compliance on non-ionising radiation (NIR) from the radio masts of the major licensed radio operators in Ireland. The audit examined the procedures put in place by the radio operators to ensure compliance with the general public exposure limits of the International Radiation Protection Association (IRPA) Guidelines 1988<sup>1</sup>. The audit also included measurements at 30 sites throughout the country. The audit was carried out by Forbairt 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 IRPA 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 IRPA limits are 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. Section I 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 Forbairt's appointment to carry out the audit.

Section II is Forbairt'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 Forbairt on the extent of procedures and arrangements in place and on measurements recorded to ensure compliance with the general public exposure limits of the IRPA Guidelines 1988.

Each of the operators audited was requested to furnish a Compliance Statement signed by either the Chief Executive or the Company Secretary. Section III contains these statements outlining each company's commitment to comply with the IRPA Guidelines and how each intend to carry out this commitment.

Section IV contains the conclusions of this Office.

### **1.1.2 Viewing the Full Audit Report**

A copy of Forbairt's full audit report with the site measurements is available for inspection at this Office during normal working hours. Requests to view the full report should be made to Mr. Stephen Blake (tel. no. 01-804 9600; fax no. 01 804 9680).

## **1.2 BACKGROUND**

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<sup>1</sup> During the audit, ICNIRP published an update to the guidelines (see section 1.2.3)

### **1.2.1 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.

As a licensing authority, the ODTR reviewed the situation in relation to non-ionising radiation shortly after its establishment, in July 1997. In view of concerns about possible dangers to health, it was decided to include a provision in relevant licences, which already existed in the mobile phone licences, to ensure compliance with the international guidelines for exposure to electromagnetic fields. These international guidelines cover the permissible public exposure limits to electromagnetic fields in the frequency band 100 kHz to 300 GHz. The radio based services which the ODTR licence are within the frequency range of the guidelines.

In order to ensure that the maximum permissible emissions to which the public are exposed do not exceed the levels in the IRPA guidelines, it was decided at the end of 1997 to undertake a comprehensive audit of the procedures put in place by the major licensed operators. The audit included measurements at 30 sites throughout the country.

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

- Telecom Eireann's microwave point to point links and their microwave Rurtel system, which is used for providing radio telephony access mainly in the west of Ireland.
- RTE's radio and television broadcasting transmitters.
- MMDS systems operated by Cable Management Ireland, Princes Holdings, Cablelink and Suir Nore Relays.
- Eircell and Esat Digifone's mobile telephony base stations.

### **1.2.2 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 B.

The ODTR only licences radio services in the non-ionising radiation part of the spectrum.

### **1.2.3 Standards for emissions limits for non-ionising radiation**

The International Radiation Protection Association (IRPA), in co-operation with the World Health Organisation (WHO) published their guidelines for NIR in 1988. The guidelines covered both public and occupational exposure limits for the frequency range 100 kHz to 300 GHz.

Its successor, the International Commission for Non-Ionising Radiation Protection (ICNIRP), in 1996 issued a position paper on the health and safety aspects of NIR. This reviewed both thermal and athermal effects and its conclusion was to endorse the 1988 guidelines.

Last April<sup>2</sup>, when the audit was in progress, ICNIRP published an update to their guidelines on NIR. The exposure limits in the updated guidelines for the radio systems covered by this audit remain unchanged, except in one instance. There was an increase in the maximum permissible exposure level to magnetic fields in the frequency range 100 kHz to 10 MHz.

A summary of the maximum public exposure levels in the IRPA Guidelines for the radio systems in this audit are shown in section 2.2.2.2.

### **1.2.4 Appointment and independence of Forbairt**

Following a competitive tender process, the National Electronic Technology Centre (NETC) in Forbairt 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 Safety and Environmental Test Section of NETC.

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

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<sup>2</sup> Vol. 74, No. 4, April 1998 in Health Physics

## **SECTION II**

### **FORBAIRT'S REPORT ON AUDIT OF COMPLIANCE**

## **2.1 INTRODUCTION**

As part of its general obligations to ensure compliance with radio licensing conditions, the Office of the Director of Telecommunication Regulation has initiated an ongoing programme to monitor the procedures in place by the major licensed operators, in order to ensure compliance with the prescribed general public exposure limits for non-ionising radiation. These limits are contained in the IRPA Guidelines published in 1988.

The National Electronics Technology Centre (NETC) of Forbairt were contracted by the Office of the Director of Telecommunication Regulation to be responsible for the 1998 programme, which was to consist of the following :

- An audit of the procedures and arrangements in place, by the major licensed operators, to ensure compliance with the general public exposure limits of the IRPA Guidelines of 1988.
- Detailed measurements of the actual non-ionising radiation emitted from a number of selected transmitters of each of the major licensed operators, at various locations around Ireland.

This report contains the major results of both the audit and measurement programme carried out by NETC, Forbairt.

## **2.2 SCOPE AND METHODOLOGY OF AUDIT AND SITE MEASUREMENTS**

### **2.2.1 Audit 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 the company was meeting the general public exposure limit requirements of its licence conditions with respect to non-ionising radiation and that the documentation, in respect of this scope, was available and adequate.

In January of this year the ODTR wrote to each of the major licensed 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 (see Annex C);

- Any emission test reports for specific sites;
- The most recent internal audit to satisfy the company that IRPA emission limits are being fully complied with.

An audit programme was drawn up in advance of each 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 assure that the IRPA 1988 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.

It should be noted that non-compliances raised during the audit meetings refer to the documentation of their compliance regimes and not to actual NIR emissions from their radio installations.

## **2.2.2 Site Measurements**

### **2.2.2.1 Overview**

The site measurements of non-ionising radiation were planned and carried out by the Safety and Environmental Test Section of NETC. At the request of the ODTR, site measurements were performed at five sites prior to the commencement of the audit.

Subsequent to 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 :

- Every attempt was made to ensure that 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 40,000 MHz and narrowband equipment over the frequency range of 30 MHz to 14,000 MHz.

- Measurements were made according to documented test procedures by fully trained engineers.
- All measurement data and associated test records have been maintained and filed.

#### **2.2.2.2 Site Measurements Specification and Limits**

The IRPA document “Guidelines on Limits of Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 100 kHz to 300 GHz” was published by the International Non-Ionising Radiation Committee of the International Radiation Protection Association (IRPA) in 1988. The Guidelines contain both occupational and general public exposure limits to non-ionising radiation over the frequency bandwidth 0.1 MHz to 300,000 MHz.

The IRPA states in this document that the limits are based on available scientific data, and that no consideration was given to economic impact or other non-scientific priorities. They further state that, from presently available knowledge, the limits should provide a safe, healthy working or living environment from exposure to non-ionising radiation under all normal conditions.

The appropriate restrictions on exposure recommended by the IRPA are as follows:

- Exposure should not exceed the levels of unperturbed ( i.e. body absent situation) root mean squared (rms) electric and magnetic field strength for members of the general public at frequencies below and up to 10 MHz.
- The average Specific Absorption Rate (SAR) in the body over any six minute period should not exceed 0.08 Watts per kilogram for members of the general public at frequencies above 10 MHz.
- Field strength should be limited to avoid the hazard of radiofrequency shock and burns, caused by touching ungrounded metal objects that have been charged by the field or from contact of a charged body with a grounded metal object. The limiting touch current value is 50 milliamps.

As the Specific Absorption Rate (SAR) is not measurable for a living person and, as a consequence, cannot be used for practical work, the IRPA Guidelines contain derived limits in terms of the unperturbed root mean square values for the electric and magnetic field strengths and for the equivalent plane wave power flux density.

The appropriate restrictions on general public exposure recommended by the IRPA are shown in the following table, together with the relevant radio application type :

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 <sup>2</sup> )	Radio Service
0.1 - 1	87	$0.23/f^{1/2}$	-	MW radio broadcasting
>1 - 10	$87/f^{1/2}$	$0.23/f^{1/2}$	-	
>10 - 400	27.5	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, MMDS and Rurtel

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

The IRPA guidelines require that in instances of simultaneous exposure to multiple sources, the sum of the exposure levels should be considered. In these cases the power density at each frequency should be expressed as a fraction of the limit at that frequency and the sum of these should not exceed unity.

### 2.2.2.3 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 monitor calculates and displays the total power density over a frequency bandwidth of 0.1 MHz to 40,000 MHz. This frequency bandwidth covers long-wave, medium-wave and FM radio broadcasts, VHF & UHF television, the cellular mobile telephone services, MMDS and Rurtel transmissions and microwave point to point links up to 40,000 MHz.

Narrowband emissions were measured over the frequency range from 30 MHz up to 14,000 MHz, depending on the particular transmitter frequencies in use at a particular site. This enables the power level from each transmitter to be determined. This frequency range includes FM radio broadcasts, VHF & UHF



television, the cellular mobile telephone system, MMDS and Ruritel transmissions and microwave point to point links.

#### **2.2.2.4 Measurement Techniques**

Broadband measurements were made at each location to determine the position of maximum field strength. The maximum reading was noted and subsequently narrowband measurements were taken at that position. 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. While narrowband scans were being carried out, broadband measurements were made at the measurement site.

Narrowband measurements were initially taken over a wide 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 the 930 MHz to 960 MHz band, for the cellular telephone frequencies.

Narrowband measurements were made using measurement antennas and a spectrum analyser or measuring receiver and it was ensured that the maximum field strength and the ground reflected components were measured. The measurement height was approximately 1 metre. The temperature and Relative Humidity at each location was recorded. It was also noted whether the ground conditions were wet or dry.

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.

## 2.3 RESULTS OF AUDITS OF COMPLIANCE AND SITE MEASUREMENTS

### 2.3.1 MMDS Licensees

#### 2.3.1.1 Princes Holdings Ltd

##### A. *Results of Audit of Compliance*

NETC carried out an audit at Princes Holdings Limited, Corporate House, Mungret Street, Limerick, on 7 May 1998. Princes Holding Ltd. is the holding company for the following companies who have licences for the provision of Multi-point Microwave Distribution System (MMDS) television service:

Cork Communications Ltd.	Cells 25, 26 28 and 29
Independent Wireless & Cable Ltd.	Cells 7, 8, 9, 12, 17, 22 and 23.
Horizon T.V. Distribution Ltd.	Cells 10, 11, 14, 15, 18, 19, and 24.

The company representatives were Mr John Horan, Director of Network Technology and Mr John P. Moran, MDS Engineer.

The assurance that the company is meeting the IRPA Guideline limits for general public exposure is based on :

- The specification of the maximum transmitter power per installation and the checking, on a regular basis, that the power output is not exceeded.
- Extensive measurement data showing compliance with the IRPA Guideline limits, made by third party testing agencies, on several of Princes Holdings Limited's installations, including the installations radiating the highest power. One site has been audited 13 times since 1993.
- The production of an inventory of sites.
- The preparation of a compliance document "Emission Limits for Non-Ionising Radiation", which was presented in draft form at the audit meeting.

As a consequence of the audit three non-compliances were raised and presented to the company representatives at the closing meeting. The non-compliances related to the lack of issued documentation relating to the company's compliance regime.

Subsequent to the audit, the company issued its compliance document "Emission Limits for Non-Ionising Radiation". The document is dated 5 June 1998 and it discharges the non-compliances detected in the audit of 7 May 1998.

As a result of the audit, and the subsequent actions of the company, NETC concluded that Princes Holdings Limited have the procedures and arrangements

in place to ensure compliance with the general public exposure limits of the IRPA Guidelines of 1988.

**B. Results of Site Measurements**

The summary results of measured non-ionising radiation emitted from a number of Princes Holdings Limited’s transmitters were as follows :

<b>Site Location</b>	<b>Total Power Density Value Recorded - MMDS Frequency Range mW/cm<sup>2</sup></b>	<b>Times Below IRPA Limit - MMDS Frequency Range</b>	<b>Total Power Density Value Recorded in 30 - 2,900 MHz Frequency Range mW/cm<sup>2</sup></b>	<b>Times Below IRPA Limit in 30 - 2,900 MHz Frequency Range</b>
Oriel, Co. Louth <b>(Primary Site)</b>	$1.0 \times 10^{-6}$	950,000	$2.5 \times 10^{-4}$	770
Mullingar, Co. Westmeath <b>(Secondary Site)</b>	$4.3 \times 10^{-7}$	2,400,000	$8.2 \times 10^{-7}$	720,000
Blessington, Co. Wicklow <b>(Beambender)</b>	$4.8 \times 10^{-8}$	21,000,000	-	-

All the measurements recorded by Forbairt at the selected sites of Princes Holdings Limited were within the IRPA 1988 limits for general public exposure to non-ionising radiation.

### **2.3.1.2 Cablelink**

#### ***A. Results of Audit of Compliance***

NETC carried out an audit at Cablelink, 10 Pembroke Place, Ballsbridge, Dublin 4, on 12 May 1998. Cablelink has licences for MMDS television service in Cells 4, 5, 13, 16 and 27.

The company representatives were Mr. Joe Jennings, Technical Systems Manager and Mr Mike Carter, Development Engineer.

The assurance that the company is meeting the IRPA Guideline limits for general public exposure is based on :

- The specification of the maximum transmitter power per installation.
- The production of an inventory of sites.
- Detailed calculations, for each transmission site, showing the power density value at 10 metres in front of the main beam and the power density at a point from the transmitting antenna where the main beam reaches a point 2 metres above flat ground. This data had been verified by actual measurements at certain sites, but no records were available of these measurements.
- The preparation of a compliance document "Procedures for Measuring Electromagnetic Emissions at MMDS Transmitter Sites", which was presented in draft form at the audit meeting.

As a consequence of this audit two non-compliances were raised and presented to the company representatives at the closing meeting. The non-compliances related to the lack of issued documentation relating to the company's compliance regime.

Subsequent to the audit, the company has re-drafted and issued their compliance document, now titled "Procedures Ensuring Compliance with Emission Limits for Non-Ionising Radiation at MMDS Transmitter Sites". The document discharges the non-compliances detected in the audit of 12 May 1998.

As a result of the audit, and the subsequent actions of the company, NETC concluded that Cablelink have the procedures and arrangements in place to ensure compliance with the general public exposure limits of the IRPA Guidelines of 1988.

#### ***B. Results of Site Measurements***

The summary results of measured non-ionising radiation emitted from a number of Cablelink's transmitters were as follows :

Site Location	Total Power Density Value Recorded - MMDS Frequency Range mW/cm <sup>2</sup>	Times Below IRPA Limit - MMDS Frequency Range	Total Power Density Value Recorded in 30 - 2,900 MHz Frequency Range mW/cm <sup>2</sup>	Times Below IRPA Limit in 30 - 2,900 MHz Frequency Range
Naul, Co. Dublin <b>(Primary Site)</b>	$2.1 \times 10^{-5}$	48,000	-	-
Loughrea, Co. Galway <b>(Beambender)</b>	$1.5 \times 10^{-4}$	6,600	$1.5 \times 10^{-4}$	6,600
Salthill, Galway <b>(Primary Site)</b>	$1.9 \times 10^{-6}$	520,000	$5.8 \times 10^{-6}$	34,000

All the measurements recorded by Forbairt at the selected sites of Cablelink were within the IRPA 1988 limits for general public exposure to non-ionising radiation.

### 2.3.1.3 Cable Management Ireland Limited

#### A. Results of Audit of Compliance

NETC carried out an audit at Cable Management Ireland Limited, 70 Capel Street, Dublin 1, on 6 May 1998. The company has licences for MMDS television service in Cells 1, 2, 3 and 6.

The company representatives were Mr. Michael O'Connor, Business Development Manager and Mr. John Dennehy, Operations and Development Manager.

The assurance that the company is meeting the IRPA Guideline limits for general public exposure is based on :

- The specification of the maximum transmitter power per installation and the requirement that there must be documented approval of any changes of power output levels.
- The production of an inventory of sites.
- Measurement data showing compliance with the IRPA Guideline limits, made by third party testing agencies, on several of Cable Management Ireland Limited's installations, including the installations radiating the highest power.
- The preparation of a compliance document "MMDS Safety Maintenance Procedure", Issue A, which was presented in draft form at the audit meeting.

As a consequence of this audit four non-compliances were raised and presented to the company representatives at the closing meeting. The non-compliances related to the lack of issued documentation relating to the company's compliance regime.

Subsequent to the audit, the company has re-drafted and issued their compliance document "MMDS Safety Maintenance Procedure", Issue C. The document discharges the non-compliances detected in the audit of 6 May 1998.

As a result of the audit, and the subsequent actions of the company, NETC concluded that Cable Management Ireland Limited have the procedures and arrangements in place to ensure compliance with the general public exposure limits of the IRPA Guidelines of 1988.

### ***B. Results of Site Measurements***

The summary results of measured non-ionising radiation emitted from a Cable Management Ireland Limited's transmitters were as follows :

<b>Site Location</b>	<b>Total Power Density Value Recorded - MMDS Frequency Range mW/cm<sup>2</sup></b>	<b>Times Below IRPA Limit - MMDS Frequency Range</b>	<b>Total Power Density Value Recorded in 30 - 2,900 MHz Frequency Range mW/cm<sup>2</sup></b>	<b>Times Below IRPA Limit in 30 - 2,900 MHz Frequency Range</b>
Coolaney, Co. Sligo <b>(Primary Site)</b>	2.1 x 10 <sup>-7</sup>	4,700,000	1.1 x 10 <sup>-6</sup>	470,000

The measurements recorded by Forbairt at a selected site of Cable Management Ireland Limited were within the IRPA 1988 limits for general public exposure to non-ionising radiation.

### **2.3.1.4 Suir Nore Relays Limited**

#### ***A. Results of Audit of Compliance***

NETC carried out an audit at Suir Nore Relays Limited, 50/51 Upper John Street, Kilkenny, on 8 May 1998. The company has licences for MMDS television service in Cells 20 and 21.

The company representative was Mr. Tim Quinn, Technical Manager.

The assurance that the company is meeting the IRPA Guideline limits for general public exposure is based on :

- The specification of the maximum transmitter power per installation and the checking, on a regular basis, that the power output is not exceeded.
- The production of an inventory of sites.
- Measurement data showing compliance with the IRPA Guideline limits, made by third party testing agencies, on several of Suir Nore Relays Limited's installations, including the installations radiating the highest powers.

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 lack of any issued documentation relating to the company's compliance regime.

Subsequent to this audit, the company issued a compliance document " Non-Ionising Radiation Compliance Procedure". The document is dated June 1998 and it discharges the non-compliances detected in the audit of 8 May 1998.

As a result of these actions, NETC concluded that Suir Nore Relays Limited has the procedures and arrangements in place to ensure compliance with the general public exposure limits of the IRPA Guidelines of 1988.

### ***B. Results of Site Measurements***

The summary results of measured non-ionising radiation emitted from a Suir Nore Relay's transmitters were as follows :

<b>Site Location</b>	<b>Total Power Density Value Recorded - MMDS Frequency Range mW/cm<sup>2</sup></b>	<b>Times Below IRPA Limit - MMDS Frequency Range</b>	<b>Total Power Density Value Recorded in 30 - 2,900 MHz Frequency Range mW/cm<sup>2</sup></b>	<b>Times Below IRPA Limit in 30 - 2,900 MHz Frequency Range</b>
Johnstown, Co. Kilkenny <b>(Primary Site)</b>	4.3 x 10 <sup>-5</sup>	23,000	5.6 x 10 <sup>-5</sup>	14,000

The measurements recorded by Forbairt at a selected site of Suir Nore Relays Limited were within the IRPA 1988 limits for general public exposure to non-ionising radiation.

## **2.3.2 Cellular Telephony Licensees**

### **2.3.2.1 Eircell**

### ***A. Results of Audit of Compliance***

NETC carried out an audit at Eircell, Unit 8, Richview Park, Clonskeagh, Dublin 14 on 5 May 1998. Eircell operate a combined analogue (TACS) and digital (GSM) national cellular telephone system and use microwave point to point links to provide communication between cellular telephone base stations and other points in the network.

The company representative was Mr. Val Duffy, Engineer - Radio Planning.

The assurance that the company is meeting the IRPA Guideline limits for general public exposure is based on :

- Assessment data, made by third party agencies, on Eircell's Cellular Telephone Transmitter Base Stations, which show compliance with the IRPA Guideline limits.
- Extensive measurement data showing compliance with the IRPA Guideline limits, made by third party testing agencies, on several of Eircell's installations.
- Production of an inventory of sites.
- The preparation of a compliance document "Non-Ionising Electromagnetic Radiation Levels - Theoretical Calculations and Measurement Procedures ", which was presented in draft form at the audit meeting. This document includes updates to Eircell's transmission network, such as the use of microcells, and indicates compliance to the IRPA Guideline limits.

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 issued documentation relating to the company's compliance regime.

Subsequent to this audit the company issued their compliance document. This document discharges the non-compliances detected in the audit of 5 May 1998.

As a result of these actions NETC concluded that Eircell has the procedures and arrangements in place to ensure compliance with the general public exposure limits of the IRPA Guidelines of 1988.

### ***B. Results of Site Measurements***

The summary results of measured non-ionising radiation emitted from a number of Eircell's transmitters were as follows. The calculations for total power



density makes the worst case assumption that all the analogue phone channels are transmitting simultaneously.

<b>Site Location</b>	<b>Total Power Density Value Recorded - Mobile Telephony Frequency Range mW/cm<sup>2</sup></b>	<b>Times Below IRPA Limit - Mobile Telephony Frequency Band</b>	<b>Total Power Density Value Recorded in 30 - 2,000 MHz Frequency Range mW/cm<sup>2</sup></b>	<b>Times Below IRPA Limit in 30 - 2,000 MHz Frequency Band</b>
Ashbourne, Co. Meath	$1.1 \times 10^{-5}$	44,000	$1.1 \times 10^{-5}$	44,000
Lucan, Co. Dublin	$2.0 \times 10^{-5}$	24,000	$2.0 \times 10^{-5}$	24,000
Templehill, Cork - away from a metal hoarding	$1.9 \times 10^{-3}$	240	$1.9 \times 10^{-3}$	240
Templehill, Cork - close to the metal hoarding	$4.5 \times 10^{-3}$	110	$4.5 \times 10^{-3}$	110
Shantalla, Galway City	$1.8 \times 10^{-4}$	2,600	$1.8 \times 10^{-4}$	2,600
Mahon, Cork	$2.5 \times 10^{-2}$	19	$2.5 \times 10^{-2}$	19
Phibsboro, Dublin	$2.0 \times 10^{-4}$	2,400	$2.0 \times 10^{-4}$	2,400

All the measurements recorded by Forbairt at the selected sites of Eircell were within the IRPA 1988 limits for general public exposure to non-ionising radiation.

### **2.3.2.2 Esat Digifone**

#### ***A. Results of Audit of Compliance***

NETC carried out an audit at Esat Digifone, Digifone House, 76 Lower Baggot Street, Dublin 2 on 30 April 1998. Esat Digifone operate a national GSM network 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 Mr. Declan Drummond, Acquisitions Manager and Mr. Des Coburn, Microwave Network Transmission Design.

The assurance that the company is meeting the IRPA Guideline limits for general public exposure is based on :

- The specification of the maximum possible transmitted power for an Esat Digifone Base Transmission Station (BTS).
- The production of an inventory of sites.
- Assessment and actual measurement data, showing compliance with the IRPA Guideline limits, made by third party agencies, on Esat Digifone's Base Transmission Stations (BTS).
- Calculations for all microwave point to point links, showing compliance with the IRPA Guideline limits, giving the power density value at various distances from the antenna.

As a consequence of this audit two non-compliances were raised and presented to Mr. Drummond at the closing meeting. The non-compliances related to documenting the company's internal audit procedure and calibration of a broadband measurement instrument.

Subsequent to this audit the company has corrected the non-compliances and, as a consequence of this, NETC concluded that Esat Digifone has the procedures and arrangements in place to ensure compliance with the general public exposure limits of the IRPA Guidelines of 1988.

#### ***B. Results of Site Measurements***

The summary results of measured non-ionising radiation emitted from a number of Esat Digifone's mobile telephony transmitters were as follows :

Site Location	Total Power Density Value Recorded - Mobile Telephony Frequency Range mW/cm <sup>2</sup>	Times Below IRPA Limit - Mobile Telephony Frequency Band	Total Power Density Value Recorded in 30 - 2,000 MHz Frequency Range mW/cm <sup>2</sup>	Times Below IRPA Limit in 30 - 2,000 MHz Frequency Band
Collins Barracks, Cork City	$7.8 \times 10^{-7}$	610,000	$1.7 \times 10^{-5}$	18,000
Dunboyne, Co. Meath	$5.5 \times 10^{-5}$	8,700	$5.5 \times 10^{-5}$	8,700
Kilrush, Co. Clare	$1.6 \times 10^{-6}$	290,000	$1.6 \times 10^{-6}$	290,000
Leixlip, Co. Kildare	$1.5 \times 10^{-6}$	330,000	$1.5 \times 10^{-6}$	330,000
Monasterevin, Co. Kildare	$2.3 \times 10^{-6}$	210,000	$2.3 \times 10^{-6}$	210,000
Riverstown, Co. Sligo	$8.7 \times 10^{-7}$	560,000	$9.6 \times 10^{-7}$	450,000
Dunshaughlin, Co. Meath	$8.9 \times 10^{-6}$	54,000	$1.8 \times 10^{-5}$	16,000
Ballymun, Dublin	$2.9 \times 10^{-7}$	1,700,000	$3.2 \times 10^{-7}$	1,300,000
Granard, Co. Longford	$5.0 \times 10^{-5}$	9,600	$1.5 \times 10^{-4}$	3,300

All the measurements recorded by Forbairt at the selected sites of Esat Digifone were within the IRPA 1988 limits for general public exposure to non-ionising radiation.

### 2.3.3 Telecom Eireann

#### A. Results of Audit of Compliance

NETC carried out an audit at Telecom Eireann, on 29 April 1998. The audit took place at the company's offices in Wainsford Road, Terenure, Dublin 6 and St. Stephen's Green West, Dublin 2. Telecom Eireann operate a large number of microwave point to point links throughout the country to carry its telecommunications traffic, and also operate Rurtel, a multi access radio system providing telephony service to remote areas, mainly in the west of Ireland.

The company representatives were Mr Brian McGuinness, Health and Safety Manager; Mr Paul Hamilton and Mr. Oliver Foley, Manager - Cable, Satellite and Radio Division.

The assurance that the company is meeting the IRPA Guideline limits for general public exposure is based on :

- The specification of the maximum transmitter power per installation. Both the microwave point to point links and Rurtel have a low power, of the order of 1 Watt, radiated from the antenna.
- Sample calculations showing the power density values at distances in front of the main beam, supplemented by actual measurements at various sites.
- The production of an inventory of sites.
- The preparation of a compliance document "Protection of staff members, contractors and the public from the effects of Non-Ionising Electromagnetic Fields", which was issued in March 1998.

No non-compliances were raised as a consequence of this audit.

NETC concluded that the company has the procedures and arrangements in place to ensure compliance with the general public exposure limits of the IRPA Guidelines of 1988.

### ***B. Results of Site Measurements***

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

<b>Site Location</b>	<b>Total Power Density Value Recorded - Microwave Frequency Range mW/cm<sup>2</sup></b>	<b>Times Below IRPA Limit - Microwave Frequency Range</b>	<b>Total Power Density Value Recorded in 30 - 14,000 MHz Frequency Range mW/cm<sup>2</sup></b>	<b>Times Below IRPA Limit in 30 - 14,000 MHz Frequency Range</b>
Capard, Co. Laois <b>(Rurtel)</b>	$2.0 \times 10^{-9}$	500,000,000	$5.0 \times 10^{-5}$	5,000
Castlebar, Co. Mayo <b>(Rurtel)</b>	$1.7 \times 10^{-9}$	590,000,000	$1.8 \times 10^{-4}$	1,200
Coolmine, Co. Dublin <b>(Microwave Links)</b>	$9.4 \times 10^{-8}$	11,000,000	$7.5 \times 10^{-5}$	6,300

All the measurements recorded by Forbairt at the selected sites of Telecom Eireann were within the IRPA 1988 limits for general public exposure to non-ionising radiation.

### 2.3.4 Radio Telefis Eireann

#### *A. Results of Audit of Compliance*

NETC carried out an audit at Radio Telefis Eireann, Donnybrook, Dublin 4, on 14 May 1998. RTE broadcast radio and television, and use microwave point to point links in support of these broadcast activities.

The company representatives were Mr Malachy Donohoe, Manager - Network Capital Projects and Transmission Services and Mr Seamus O'Leary, Broadcast Engineer - Network.

The assurance that the company is meeting the IRPA Guideline limits for general public exposure is based on :

- The specification of the maximum transmitter power per installation.
- Sample calculations, from RTE high power sites, showing the power density value at various distances from the antenna. These calculations did not address all the company's transmission systems, such as the medium wave transmitters.
- The production of an inventory of sites.
- Calculations for all microwave point to point links showing the power density values at various distances from the antenna.
- The preparation of a compliance document "RTE Radio Frequency Compliance Policy", which was presented in draft form at the audit meeting.

As a consequence of this audit, three non-compliances were documented and presented to the company representatives at the closing meeting. The non-compliances related to the lack of issued documentation relating to the company's compliance regime.

Subsequent to the audit the company has re-drafted and issued their compliance document, now titled "Document on Procedures in RTE for Compliance with Non-Ionising Radiation Standards".

As a result of the audit, and the subsequent actions of the company, NETC concluded that RTE have the procedures and arrangements in place to ensure compliance with the general public exposure limits of the IRPA Guidelines of 1988, with the proviso that the issues raised in respect to the medium wave transmitter sites are resolved, as is indicated in their compliance document.

#### *B. Results of Site Measurements*

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

<b>Site Location</b>	<b>Total Power Density Value for RTE Transmitters mW/cm<sup>2</sup></b>	<b>Times Below IRPA Limit – Broadcasting Frequency Bands</b>	<b>Total Power Density Value Recorded in 30 - 2,000 MHz Frequency Range mW/cm<sup>2</sup></b>	<b>Times Below IRPA Limit in 30 - 2,000 MHz Frequency Range</b>
Mt. Leinster, Co. Wexford	5.0 x 10 <sup>-3</sup>	40	5.8 x 10 <sup>-3</sup>	34
Three Rock Mountain, Co. Dublin	-	-	6.5 x 10 <sup>-4</sup>	310

For the frequency range of the Athlone and Tullamore medium wave transmitters, the IRPA exposure limit is expressed in terms of electric field and magnetic field and not as power density. Therefore, both electric field and magnetic field measurements were performed at these sites, as shown in the results table below.

<b>Site Location</b>	<b>Electric Field (Volts per metre)</b>	<b>IRPA Electric Field Limit (Volts per metre)</b>	<b>Magnetic Field (H) (Amperes per metre)</b>	<b>IRPA Magnetic Field (H) Limit (Amperes per metre)</b>
Athlone	120 V/m	87 V/m	0.28 A/m	0.29 A/m
Tullamore	530 V/m	87 V/m	0.76 A/m	0.31 A/m

At the Athlone site, one measurement of 120 V/m for the electric field was recorded, which exceeds the IRPA limit of 87 V/m. This was beside the main building, beneath where high voltage cables leave the building to supply the mast. All measurements recorded for magnetic field were within the IRPA limit of 0.29 A/m for Athlone.

At the Tullamore site, measurements up to 530 V/m for the electric field were recorded, which exceed the IRPA limit of 87 V/m. These were at locations within approximately ten metres of the mast. In addition, measurements up to 0.76 A/m for the magnetic field were recorded, which exceed the IRPA limit of 0.31 A/m for Tullamore. These were at the same locations within ten metres of the mast.

The new ICNIRP limits, which were published after this assessment commenced, indicates that a higher limit, of 1.29 A/m, is appropriate for magnetic field measurements for the Tullamore frequency. On the basis of this new ICNIRP limit, the measurements obtained at the Tullamore site were within the new ICNIRP limit.

The measurements recorded by Forbairt at the Mount Leinster and Three Rock sites of RTE were within the IRPA 1988 limits for general public exposure to non-ionising radiation. However, at Tullamore and Athlone, Forbairt measured emission levels in areas to which the public had access which were in excess of the IRPA 1988 limits.

**SECTION III**  
**COMPLIANCE STATEMENTS**



### 3.1 COMPLIANCE STATEMENTS

This section includes copies of Compliance Statements received from each of the companies audited. Each statement outlines the company's commitment to comply with the IRPA Guidelines and how they intend to carry out this commitment.



princes.jpg



cablink.jpg



cmi.jpg



suirnore.jpg



eircell.jpg



digifone.jpg



te.jpg



rte.jpg

**SECTION IV**  
**ODTR RESPONSE AND CONCLUSIONS**

#### 4.1 ODTR Response to Forbairt's Report

In response to Forbairt's findings at both Athlone and Tullamore, the ODTR initiated the following actions. Firstly it assessed the critical issue as a lack of adequate fencing and notices to prevent the public from gaining access to the areas close-up to the transmitters where the IRPA 1988 limits are exceeded.

Following discussions between the ODTR and RTE on 17th June, the following remedial actions were undertaken.

1. Extensive site measurements were carried out by RTE to identify the areas where the public exposure levels are exceeded in order to establish where new fencing must be provided.
2. The restricted areas close-up to the transmitters, where public access must be prevented, were secured by RTE using existing fencing and/or rope. In addition, warning notices were posted.
3. An inspection was carried out by Forbairt on behalf of the ODTR at both Tullamore and Athlone to confirm that the emission levels outside the restricted areas did not exceed the IRPA limits.
4. Arrangements were initiated by RTE to engage contractors to provide suitable permanent fencing around the restricted areas.

In addition, RTE have undertaken to carry out further analysis on their medium wave transmitters in order to improve their compliance documentation.

The ODTR will continue to monitor the position at Tullamore and Athlone to ensure that suitable permanent fencing and notices have been erected.

## **4.2 ODTR Conclusions**

The ODTR concludes that, on the basis of Forbairt's work, all the companies audited have procedures and arrangements in place to ensure compliance with the general public exposure limits specified in the IRPA guidelines, 1988. The ODTR also concludes that these companies are taking a responsible approach to ensuring compliance, and has received written Statements of Compliance endorsed by senior management from each company. It has also been noted that significant efforts have been made by the companies to improve internal compliance procedures since this audit was initiated by the ODTR in December, 1997.

The measurements recorded by Forbairt at 28 of the 30 selected sites were all within the IRPA 1988 limits for general public exposure to non-ionising radiation. These sites included:

- 15 mobile telephony sites operated by Esat Digifone and Eircell
- 8 MMDS sites operated by Princes Holdings, Cablelink, CMI and Suir Nore
- 1 microwave link site operated by Telecom Eireann
- 2 Rurtel sites operated by Telecom Eireann
- 2 TV and radio transmitter sites operated by RTE

At 2 RTE medium wave radio transmitter sites (Tullamore and Athlone), Forbairt measured emission levels in areas to which the public had access which were in excess of the IRPA 1988 limits. At both sites, the issue was the lack of adequate notices and fencing to prevent the public from gaining access.

Following discussions between the ODTR and RTE, remedial actions were undertaken to identify and secure the areas close-up to the transmitters where the public exposure levels are exceeded. In addition, actions were initiated by RTE to engage contractors to provide suitable permanent fencing around the restricted areas. The ODTR will continue to monitor the position at Tullamore and Athlone to ensure that suitable permanent fencing and notices have been erected.

## **4.3 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. These audits will also serve to reassure the public in this regard.

## **Annex A      Glossary of Terms**

Hertz	Unit of frequency (e.g. one million Hertz = 1 MHz)
ICNIRP	International Commission for Non-Ionising Radiation Protection
IRPA	International Radiation Protection Association
MMDS	Microwave Multipoint Distribution System
NETC	National Electronic Technology Centre in Forbairt
NIR	Non-Ionising Radiation
ODTR	Office of the Director of Telecommunications Regulation
SAR	Specific Absorption Rate
RTE	Radio Telefis Eireann
UHF	Ultra High Frequency
VHF	Very High Frequency
WHO	World Health Organisation

## **Annex B      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 spectrum are radio waves which are used for communication and entertainment purposes. As the frequency of the waves increase we encounter infra-red 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 spectrum.

## ANNEX C Inventory of Sites Format

Site Name	Location (NGR)	Radio Installation Type	Multiple Mast/Tower Site (Yes/No)	Mast/Tower Sharing (Yes/No)	Estimated Maximum Power Density (mW/cm <sup>2</sup> )	Test Conducted at Site (Yes/No)	Test Reference

**Site Name** The site names shall be in alphabetical order.

**Radio Installation Type** The type of radio installation shall be specified, the following are some of the more common examples:  
 GSM BTS MW Radio VHF Radio  
 Point to Point Link TACS BTS VHF TV  
 Rurtel BTS LW Radio GSM + TACS BTS  
 UHF TV MMDS

**Multiple Mast/Tower Site** The licensee should state whether there are other antenna masts/towers on the same site.

**Mast/Tower Sharing** The licensee should state whether his radio installation is sharing the antenna mast or tower with other radio users. If sharing is in operation, please state the other radio user(s) on the mast/tower, if known.

**Estimated Power Density** The licensee should estimate the maximum power density level in mW/cm<sup>2</sup> that the general public will be exposed to outside the protected area.

**Conducted Tests** The licensee should state whether tests were carried out at the site.

**Test Reference** If tests were carried out at the site, the licensee should provide test references.