



# SLOVENSKI STANDARD PSIST ETR 053:1998

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**Radijska oprema in sistemi (RES) - Radijski inženiring na kraju samem za radijsko opremo in sisteme za mobilne storitve**

Radio Equipment and Systems (RES); Radio site engineering for radio equipment and systems in the mobile service

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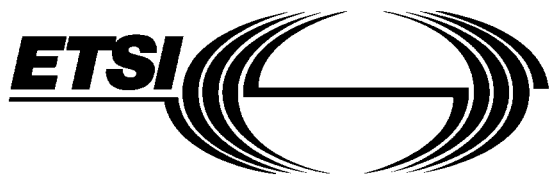
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## Foreword

This ETSI Technical Report (ETR) has been prepared by the Radio Equipment and Systems (RES) Technical Committee of the European Telecommunications Standards Institute (ETSI).

ETRs are informative documents resulting from ETSI studies which are not appropriate for European Telecommunication Standard (ETS) or Interim European Telecommunication Standard (I-ETS) status.

An ETR may be used to publish material which is either of an informative nature, relating to the use or application of ETSs or I-ETSs, or which is immature and not yet suitable for formal adoption as an ETS or I-ETS.

## Introduction

The growth of radio services has resulted in an increase in the number of radio sites required and in the number of users sharing their facilities.

The radio frequency spectrum is a finite natural resource for which there are many competing demands, therefore radio systems must be designed so that individual systems are very efficient and operate with minimum interference to other systems.

The aesthetic impact of radio structures provides an increasing constraint on the development of further radio sites. It is essential, therefore, to obtain the support of the community with regard to environmental issues. Consequently it is necessary to demonstrate that the optimum use will be made of the proposed installation.

In granting building permission for a radio structure, local authorities expect radio system users to operate the maximum number of systems from existing structures before giving consideration to an application for another structure in the same area.

The use of radio or repeater stations is subject to the radio license conditions of the relevant regulatory authority. The inclusion of any type of radio station in the ETR does not mean its use will be permitted by the responsible administration.

Whilst this ETR has been prepared to assist radio system designers to obtain optimum use of radio sites and the radio spectrum, it is also intended for the guidance of those site operators and maintenance organizations who do not have ready access to radio systems engineers.

This document also addresses radio engineering installations which may cause potential problems with regard to interaction and interference.

Accordingly the document sets out methods and design solutions which are achievable without extensive resources.

Radio equipment for the mobile and fixed services is built to standards which are directed to ensure the efficient use of the radio spectrum. One set of parameters control bandwidth and the level of out of band radiation, which will cause interference to other users, and will specify the receiver sensitivity and limits to the levels of spurious emission from receivers. Another set of parameters define conditions which make a system less susceptible to interference by others; they include receiver selectivity, dynamic range and blocking characteristics. Good installation design ensures that as far as possible the performance of a complete installation preserves the professional characteristics of the components, laying down the intended field strength in the designated area, avoiding the radiation of spurious emissions and preserving the sensitivity of receivers.

The objectives are as follows:

- a) to obtain the coverage required from the chosen site in a precise and well defined manner;
- b) to minimize spectrum pollution to other users on adjacent sites;
- c) to minimize interference to other co-sited users;

- d) to operate the system with the effective radiated power (erp) and optimum spectral efficiency compatible with providing the required service;
- e) to minimize the effects of lightning.

To fulfill the requirements of all relevant legislation and recommendations, the above criteria should be met for the whole of the working life of the installation and should allow for future expansion. The quality of service is largely dependent on the planning of the system and considerable guidance on the topic is given in annex A.

The layout of this ETR follows the logical approach that would be adopted in the provision of a new radio site, from the selection of a suitable geographic location to the installation and maintenance of radiocommunications equipment. It must be stressed that the order in which these subjects are discussed is not in order of importance. It is therefore essential to read the ETR in its entirety after which it may be used as a reference document.

Preventive maintenance and repairs will be required to ensure that the installation continues to meet the performance criteria described; good engineering design will allow these activities to be carried out safely and with minimum loss of service.

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## 1 Scope

This ETSI Technical Report (ETR) provides guidance for engineers concerned with the design, specification, installation, operation and maintenance of radio systems. It is particularly directed towards systems working in the Very High Frequency (VHF) and Ultra High Frequency (UHF) bands but encompassing a measurement range between 9 kHz and 4 GHz in respect of compatibility where co-sited operation of many different users' equipment has become common. It does not specifically cover the technology associated with microwave systems.

This ETR examines the objectives of good design and the effects of common deficiencies. It provides recommendations designed to ensure that users avoid interactions which result in mutual interference, spectrum contamination, or danger to personnel or equipment. References and annexes are provided for further reading by engineers who are new to the field or are encountering the problems which are described for the first time.

This ETR also includes information relating to the safety precautions required when dealing with non-ionising radiation.

The contents of this ETR have been arranged to identify the source of the problems found on radio sites and recommendations are made for the control of these problems.

## 2 References

For the purposes of this ETR, the following references apply:

- [1] CCIR Report 358-5: "Protection ratios and minimum field strengths required in the mobile services".
- [2] CCIR Report 739-1: "Interference due to intermodulation products in the land mobile service between 25 MHz and 1 000 MHz".
- [3] CCIR Report 1019: "Sources of unwanted signals in multiple base station sites in the land mobile service".  
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- [4] CCIR Report 258-4: "Man made radio noise".
- [5] ETS 300 086 (1991): "Radio Equipment and Systems (RES); Land mobile group Technical characteristics and test conditions for radio equipment with an internal or external RF connector intended primarily for analogue speech".
- [6] ETS 300 113: "Radio Equipment and Systems (RES); Land mobile service; Technical characteristics and test conditions for radio equipment intended for the transmission of data (and speech) and having an antenna connector".
- [7] ETS 300 296: "Radio Equipment and Systems (RES); Land mobile service Technical characteristics and test conditions for radio equipment using integral antennas intended primarily for analogue speech".
- [8] ETS 300 390: "Radio Equipment and Systems (RES); Land mobile service; Technical characteristics and test conditions for radio equipment intended for the transmission of data (and speech) and using an integral antenna".
- [9] I-ETS 300 220: "Radio Equipment and Systems (RES); Short range devices Technical characteristics and test methods for radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW".
- [10] ENV 50166-2: "Human exposure to electromagnetic fields - High frequency (10 kHz to 300 GHz)".

- [11] I-ETS 300 230: "Radio Equipment and Systems (RES); Land mobile service Binary Interchange of Information and Signalling (BIIS) at 1 200 bit/s (BIIS 1 200)".

### 3 Definitions, symbols and abbreviations

#### 3.1 Definitions

For the purposes of this ETR, the following definitions apply:

**communal site:** A location at which there is more than one fixed transmitter. There are two types of communal site; one having separate equipment and antennas but housed in a common equipment room, and the other having an engineered system employing common antenna working where the isolation between equipment's is determined by the filter system.

At all communal sites equipment installed on the site must meet the limits as specified in the relevant standards.

**finial:** Metal spike or similar device mounted on the topmost part of a structure - usually for lightning protection in the context of this document.

**single fixed station:** A radio station where only one Radio Frequency (RF) carrier can be radiated at any one time; the fixed station equipment is only required to meet the limit specified for intermodulation attenuation. All other limits in the relevant standard should be met.

**multiple fixed station:** When two sites are in close proximity the decision governing when they should be classed as a single site or two sites shall be decided by the RF isolation between them. The limiting minimum figure shall be 60 dB but this figure should ideally exceed 70 dB at all frequencies of operation. In any case any signal received from a neighbouring site should not exceed - 20 dBm and ideally - 30 dBm.

**downlink:** A radio path for the transmission of signals from one Base Station (BS) to Mobile Stations (MS).

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**uplink:** A radio communication path for the transmission of signals from Mobile Stations (MS) to one Base Station (BS).

**spurious emissions:** Emissions at frequencies other than those of the carrier and sidebands associated with normal modulation.

#### 3.2 Symbols

For the purposes of this ETR, the following symbols apply:

ac	alternating current
C/I	Carrier to Interference ratio
C/N	Carrier to Noise ratio
dB	decibel
dBc	decibel relative to carrier
dBd	decibel relative to a half wave dipole
dB <sub>i</sub>	decibel relative to an isotropic radiator
dBm	decibel relative to one mW
dc	direct current
GHz	Gigahertz
Hz	Hertz
Intermod	Intermodulation
kHz	kilohertz
km	kilometre
kW	kilowatt
MHz	Megahertz
m	metre
mm	millimetre

mW	milliWatt
RX	Receiver
TX	Transmitter
V	Volt
W	Watt

### 3.3 Abbreviations

For the purposes of this ETR, the following abbreviations apply:

ABS	Acrylonitrile Butadiene Styrene
AF	Audio Frequency
AMPS	Advanced Mobile Phone System
AUC	Authentication Centre
BIIS	Binary Interchange of Information and Signalling
BPSK	BiPolar Shift Keying
BSC	Base Station Controller
BT	Bandwidth Time product
BTS	Base Transceiver Station
CBS	Common Base Station
DCS	Digital Communications System
DTMF	Dual Tone Multi Frequency
DQPSK	Differential Quadrature Phase Shift Keying
EIR	Equipment Identity Register
ELCB	Earth Leakage Circuit Breaker
EMC	ElectroMagnetic Compatibility
e.m.f.	electro-motive force
EPIRB	Emergency Position Indication Radio Beacon
ERMES	European Radio Message System
erp	effective radiated power
ETACS	Extended Total Access Communications System
FDMA	Frequency Division Multiple Access
FM	Frequency Modulation
FSK	Frequency Shift Keying
GFSK	Gaussian Frequency Shift Keying
GMSK	Gaussian Minimum Shift Keying
GSM	Global System for Mobile communications
HF	High Frequency
HLR	Home Location Register
IF	Intermediate Frequency
ISDN	Integrated Services Digital Network
LMS	Land Mobile Service
MF	Medium Frequency
MSC	Mobile services Switching Centre
MSK	Minimum Shift Keying
MTBF	Mean Time Between Failure
NAD	Noise Amplitude Distribution
NMT	Nordic Mobile Telephone system
NRJ	Non-Reciprocal Junction
PA	Power Amplifier
PAMR	Public Access Mobile Radio
PDO	Packet Data Optimized
PIB	PolyIsoButylene
PMR	Private Mobile Radio
POCSAG	Post Office Code Standardization Advisory Group
PSK	Phase Shift Keying
PSTN	Public Switched Telephone Network
PVC	PolyVinylChloride
RCCB	Residual Current Circuit Breaker
RCD	Residual Current Device
RF	Radio Frequency
RL	Return Loss