



An Coimisiún um  
**Rialáil Cumarsáide**  
Commission for  
**Communications Regulation**

# Satellite Earth Station Licensing Guidelines

**Guidance Document**

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**An Coimisiún um Rialáil Cumarsáide**  
**Commission for Communications Regulation**

1 Lárcheantar na nDugaí, Sráid na nGildeanna, BÁC 1, Éire, D01 E4X0.  
One Dockland Central, Guild Street, Dublin 1, Ireland, D01 E4X0.  
Teil | Tel +353 1 804 9600 Suíomh | Web [www.comreg.ie](http://www.comreg.ie)

# Content

Section	Page
1 Introduction.....	4
2 Licence Information.....	5
2.2 Licence types.....	5
2.3 Operation details (Transmit and /or Receive).....	5
2.4 Licence exemptions.....	6
2.5 Licence duration and renewal.....	6
2.6 Amendments to a licence.....	7
2.7 Cancellation of a licence.....	7
2.8 Lease or transfer of a licence.....	7
2.9 Licence fees.....	7
3 Frequency spectrum bands.....	12
3.1 Shared SES frequency bands.....	16
3.2 Exclusive SES frequency bands.....	17
3.3 Technical requirements.....	17
3.4 National and international coordination.....	19
3.5 Coordination procedures.....	19
3.6 SES operation within or near an aerodrome.....	20
3.7 Radio equipment compliance and requirements.....	21
3.8 FOI, AIE, and Data Protection.....	22
4 The application process.....	23
4.1 On-line application process.....	23
4.2 Evaluation of the application.....	23
4.3 Payment of licence fees.....	23

# Appendix

Section	Page
Appendix 1: Non-geostationary satellite earth station coordination process .....	24
Appendix 2: Details of relevant articles of the ITU Radio Regulations .....	27

# 1 Introduction

- 1.1 The Commission for Communications Regulation (“ComReg”) is the statutory body responsible for the regulation of the electronic communications (telecommunications, radiocommunication and broadcasting networks), postal and premium rate sectors in Ireland in accordance with European Union (“EU”) and Irish law. ComReg also manages Ireland’s radio frequency spectrum (“radio spectrum” or “spectrum”) and national numbering resource.
- 1.2 Under the Wireless Telegraphy Act 1926<sup>1</sup>, as amended<sup>2</sup> (“the 1926 Act”), all apparatus for wireless telegraphy (“apparatus”) requires a licence, unless that apparatus has been specifically exempted from licensing under Irish legislation by means of an exemption order.
- 1.3 Satellite Earth Station licences are governed by the S.I. No. 96 of 2024 Wireless Telegraphy (Satellite Earth Station Licence) Regulations 2024<sup>3</sup> (the “Regulations”).
- 1.4 This document sets out ComReg’s revised guidelines for applicants for Guidelines for Satellite Earth Station (“SES”) licences, replacing ComReg Document 00/64R3.
- 1.5 Among other things, these guidelines provide information on the:
  - (a) licence types;
  - (b) frequency bands;
  - (c) technical requirements; and
  - (d) licence application process.
- 1.6 Applicants must read these guidelines carefully prior to applying for a SES licence. Queries regarding these guidelines or the licensing process can be directed to ComReg’s radio spectrum licensing team by e-mail at [licensing@comreg.ie](mailto:licensing@comreg.ie).

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<sup>1</sup> <https://www.irishstatutebook.ie/eli/1926/act/45/enacted/en/print.html>

<sup>2</sup> [https://www.irishstatutebook.ie/eli/isbc/1926\\_45.html#effects](https://www.irishstatutebook.ie/eli/isbc/1926_45.html#effects)

<sup>3</sup> <https://www.irishstatutebook.ie/eli/2024/si/96/made/en/pdf>

## 2 Licence Information

- 2.1 A SES licence granted under the Regulations permits the licensee to keep and operate radio apparatus and all licensees must familiarise themselves with same. It should be noted that ComReg reserves the right not to grant a licence.
- 2.2 It is the responsibility of the licensee to ensure compliance with the licence conditions, and to ensure that their licence details as submitted to ComReg remain valid and up to date.
- 2.3 A licence allows the licensee to install and operate a SES within a specified frequency band(s) with specific bandwidth at identified sites. Licensees should be aware that ComReg grants licences to other users with the same bands, provided that there is minimal interference potential.

### 2.2 Licence types

- 2.4 Two categories of SES licences are covered by these Guidelines:
- (a) Fixed Earth Stations (FES)<sup>4</sup>; and
  - (b) Transportable Earth Stations (TES)<sup>5</sup>.

### 2.3 Operation details (Transmit and /or Receive)

- 2.5 FES licensees can be licensed for:
- (a) transmit (referred to as uplink or Earth-to-space (“E-s”)) operation; and / or
  - (b) receive (referred to as downlink or space-to-Earth (“s-E”)) operation
- within a 500 metre radius of a specific geographic point.
- 2.6 Receive-only (s-E) FES licences are generally only issued for Earth exploration-satellite services<sup>6</sup>, meteorological-satellite services<sup>7</sup>, and space research services<sup>8</sup> which are receiving data only, for example such as meteorological data for weather forecasting purposes. Receive-only SES normally operate on a secondary licence exempt basis however, the nature of some services is such that operators may

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<sup>4</sup> FES are earth stations used at fixed locations and which are non-transportable.

<sup>5</sup> TES are earth stations used to transmit live or recently recorded footage from different locations. TES are transportable and are commonly referred to as Satellite News Gathering stations.

<sup>6</sup> A radiocommunication service between earth stations and one or more space stations, which may include links between space stations, in which information relating to the characteristics of the Earth and its natural phenomena, including data relating to the state of the environment, is obtained from active sensors or passive sensors on Earth satellites.

<sup>7</sup> An earth exploration-satellite service for meteorological purposes.

<sup>8</sup> A radiocommunication service in which spacecraft or other objects in space are used for scientific or technological research purposes.

request that the station is protected from harmful interference. Applications for receive-only FES licences will be considered on a case-by-case basis.

## 2.4 Licence exemptions

- 2.7 Certain satellite terminals are exempt from licensing, please see the following for further information:
- (a) S.I. No 226 of 2020 - Wireless Telegraphy Act 1926 (Section 3) (Exemption of Terminals for Satellite Services) Order 2020;<sup>9</sup>
  - (b) ComReg 20/47, as amended - Permitted Licence Exemptions for Terminals for Satellite Services;<sup>10</sup> and
  - (c) General Radio Receivers (excluding Television Sets). For more information see [S.I. 197 of 2005](#) and [S.I. 292 of 2005](#).

## 2.5 Licence duration and renewal

- 2.8 The duration of the licence is 12 months. A licence may be renewed provided the renewal fee is paid in advance of the expiry of the licence, and subject to any renewal requirements being met.
- 2.9 In considering a renewal request, ComReg will have regard to whether, inter alia:
- the SES is being operated in accordance with the conditions of the licence and relevant requirements.
  - there are changes being considered or implemented to the relevant frequency bands available in Ireland and/or their conditions. These changes may be due to national or international considerations.
- 2.10 As a consequence of any such changes, licensees may be required to modify or cease their operations to comply with the revised frequency bands and/or conditions. ComReg will endeavour to provide as much notice as possible to licensees if any such changes are required.
- 2.11 Where a fee has not been paid in advance of the renewal of a licence, that licence automatically expires on its expiry date. Expired licences cannot be re-instated, and a new application is required in all cases and a new licence may be granted, subject to the licence coordination process.

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<sup>9</sup> <https://www.comreg.ie/publication-download/s-i-no-226-of-2020-wireless-telegraphy-act-1926-section-3-exemption-of-terminals-for-satellite-services-order-2020>

<sup>10</sup> <https://www.comreg.ie/industry/radio-spectrum/licence-exemptions/list-of-licence-exemptions/>

## 2.5.2 Temporary licence duration

- 2.12 The maximum duration of a temporary SES licence is eleven (11) months and cannot be renewed.
- 2.13 If a SES licence is granted for a period of less than one month, for the purposes of fee calculation only, the licence shall be considered as a licence granted for a period of one month.

## 2.6 Amendments to a licence

- 2.14 A licence amendment occurs when the details on the licence need to be updated, for example, when the technical characteristics of the link need to be changed to facilitate an upgrade of equipment etc.
- 2.15 Any proposed amendments to a SES licence must be approved by ComReg in advance. Licensees must also notify ComReg of any changes to licence contact details (for example, change of address) as soon as they occur.
- 2.16 A change in the site co-ordinates of the SES licence is not an amendment. In such cases an application for a new licence must be submitted.
- 2.17 Where amended technical characteristics of a licence are approved, ComReg will grant an amended licence to the licensee, subject to any fees that may arise.

## 2.7 Cancellation of a licence

- 2.18 A licensee may submit a written request to ComReg for a licence to be withdrawn.
- 2.19 If a licence is suspended or withdrawn, the licensee may be entitled to a refund on a pro rata monthly basis for the remaining period of the licence of the relevant licence fee. Refunds will be in the form of a credit to a licensee's account, which will be processed on a quarterly basis.

## 2.8 Lease or transfer of a licence

- 2.20 A licensee may request that a SES licence be leased or transferred to another undertaking. This request must be made in writing to [licensing@comreg.ie](mailto:licensing@comreg.ie) and is subject to the relevant radio spectrum licence leasing/transfer framework and the approval of ComReg.

## 2.9 Licence fees

- 2.21 The following annual Interim Fees for Satellite Earth Station licences **apply until 31 July 2024**.

## **Interim Fees**

- 2.22 Where the licence concerned relates to a Satellite Earth Station having an Equivalent Isotropically Radiated Power (e.i.r.p.) greater than 50 dBW, for use in one or both of the frequency bands 12.5-12.75 GHz and 14.0-14.25 GHz, or in another frequency band determined from time to time by the Commission to be a frequency band for which the fee structure set out in this paragraph should apply, operating to a Space Station, the Licensee shall pay the annual Licence Fee set out below and in accordance with Regulation 9 of these Regulations for the Satellite Earth Station on the grant of the licence:
- (a) The amount payable in relation to each licence shall be:
- i. €100 where the Licensee has 10, or less than 10, other licences for Satellite Earth Stations, and,
  - ii. €25 for each additional Satellite Earth Station above that specified in paragraph 2.23(a)(i).
- 2.23 Where the licence concerned relates to a Satellite Earth Station for use in any frequency bands other than those specified in paragraph 2.23 above operating to a Space Station, the Licensee shall pay a licence Fee in accordance with Regulation 9 of the Regulations.
- (a) In relation to a licence for a Satellite Earth Station for use in the frequency bands below 10 GHz:
- i. where Equivalent Isotropic Radiated Power (“e.i.r.p.”) less than 50 dBW, the fees in Table 1 apply:

**Table 1: Licence Fees for a Satellite Earth Station for use in any frequency band below 10 GHz, where e.i.r.p.) is less than 50 dBW**

<b>Bandwidth Used</b>	<b>Licence Fee Payable (€)</b>
Less than 500 kHz	1,000
500 kHz to < 2 MHz	1,250
2 MHz to < 11 MHz	1,500
11 MHz to < 40 MHz	1,750
40 MHz to 80 MHz	2,000
Above 80 MHz	2,000 + (BW - 80) x 25



- ii. where the e.i.r.p.) is between 50 and 75 dBW the fee is calculated by increasing the fee for the appropriate Bandwidth which would otherwise be payable by virtue of paragraph 2.24(a)(i), by €250.
  - iii. where the e.i.r.p.) is greater than 75 dBW the fee is calculated by increasing the fee for the appropriate Bandwidth, which would otherwise be payable by virtue of 2.24(a)(i), by €500.
- (b) In relation to a licence for a Satellite Earth Station for use in the frequency band 10-15 GHz, excluding the bands identified in paragraph 2.23, the fee which would otherwise be payable by virtue of sub-paragraphs 2.24(a)(i), (ii) and (iii) shall be reduced by €500;
  - (c) In relation to a licence for a Satellite Earth Station for use in the frequency band 15-20 GHz, the fee which would otherwise be payable by virtue of sub-paragraphs 2.24(a)(i), (ii), and (iii) shall be reduced by €875;
  - (d) In relation to a licence for a Satellite Earth Station for use in the frequency band 20-30 GHz, the fee which would otherwise be payable by virtue of sub-paragraphs 2.24(a)(i), (ii) and (iii) shall be reduced by €900; and
  - (e) In relation to a licence for a Satellite Earth Station for use in the frequency bands above 30 GHz, the fee which would otherwise be payable by virtue of sub-paragraphs 2.24(a)(i), (ii) and (iii), shall be reduced by €950.

2.24 Notwithstanding the above, in the case where a Satellite Earth Station is licensed for use as a receiving Satellite Earth Station, or a receive only Satellite Earth Station, the fee payable shall be the amount specified in paragraphs 2.24(a)(i), (ii) and (iii) as applied to the bands specified in paragraphs 2.24(a), (b), (c), (d) and (e).

2.25 Where the licence concerned relates to a Satellite Earth Station operating to a single Space Station which is licensed for a portion of a year, up to eleven months, then the Licence Fees to be paid shall be calculated as follows:

$$A \times (B / 12) = C$$

2.26 Where:

- A is the relevant annual licence Fee set out in paragraph 2.23 or paragraph 2.24;
- B is the number of whole months for which the licence is granted (if a licence is granted for a period of less than one month then, for the purpose of these calculations only, the licence shall be considered as a licence granted for a period of one month); and
- C is the appropriate licence Fee to be paid.

### **Licence Fees from the 1 August 2024**

2.27 **From the 1 August 2024**, the annual fee payable for a Satellite Earth Station licence (Licence Fee) is equal to the fee for that Satellite Earth Station licences in the base year of 2023 (the “base fee”), indexed to the annual rate of inflation since

2023 using the Consumer Price Index.

2.28 The base fee for a SES licence is calculated as follows:

$$A = \text{€}100 + 150 \times (\text{BW})^{0.75}$$

2.29 Where:

- A is the base fee for an annual SES licence;
- €100 is the marginal cost to the Commission of issuing a licence;
- 150 is the parameter level needed to recover administrative costs given a concavity of 0.75;
- BW is the total bandwidth (MHz) in use at a particular site by a licensee. This can be either Transmit and Receive, or, Transmit, or, Receive only where protection is sought on the receive; and
- 0.75 is the concavity parameter that adjusts total bandwidth.

2.30 The Consumer Price Index (“CPI”) adjustment, is set out in the following formula as follows:

$$C = \frac{\text{CPI}_t}{\text{CPI}_{2023}} \times 100$$

2.31 Where:

- $\text{CPI}_t$  represents the 12-month Consumer Price Index figures published by the Central Statistics Office, for year t, the year immediately preceding the indexation; and
- $\text{CPI}_{2023}$  represents the 12-month Consumer Price Index figures published by the Central Statistics Office for 2023. The first indexation shall take place on the 1 August 2025 and shall occur annually thereafter on that same date.

2.32 The annual fee indexed to the Consumer Price Index is equal to:

$$D = A \times C$$

2.33 Where:

- A is the base fee for an annual SES licence; and
- C is the CPI adjustment for the relevant period.

### **Temporary Licence Fees from the 1 August 2024**

2.34 For both Interim and Licence Fees, where a licence is required for a period less than 12 months, Licence Fees are applied pro-rata using the number of months for which the licence is granted as follows:

$$F = D \times \left(\frac{E}{12}\right)$$

2.35 Where:

- D is the annual fee indexed to the Consumer Price Index;
- E is the number of whole months for which the SES licence is granted; and
- F is the appropriate fee to be paid.

2.36 If a licence is granted for a period of less than one month, then, for the purpose of these calculations only, the licence shall be considered as a licence granted for a period of one month.

## 3 Frequency spectrum bands

- 3.1 The International Telecommunication Union Radio Regulations (“ITU RR”) assigns wireless services usage to frequency bands on an international basis. The Radio Frequency Plan for Ireland<sup>11</sup> (“RFPI”) outlines Ireland’s frequency plan and is updated from time-to-time by ComReg. For each frequency band, the Frequency Plan sets out the types of radio services that are permitted for operation and those radio services currently in use.
- 3.2 For ease of reference, the primary frequency bands applicable to the licensing of SES are set out in tables 2 and 3.
- 3.3 Due to the nature of TES applications and that they normally require a quick turnaround; ComReg recommends that applicants apply for TES operation in the bands which do not have other primary sharing services.
- 3.4 From time to time, ComReg may be required to make changes to the frequency bands and/or their technical conditions. Such changes may arise for several reasons, including:
- changes in spectrum allocations in accordance with the requirements of international treaties or regionally negotiated agreements;
  - changes necessitated by EU legislation;
  - changes to meet national requirements; and
  - changes in the interest of efficient use of spectrum.
- 3.5 Arising from any such changes, licensees may be required to modify or cease their SES operations to comply with the revised frequency bands and technical conditions. ComReg will endeavour to provide as much notice as possible to licensees if any such changes are required.

**Table 2: Frequency bands which are available for SES (E-s) transmit licensing**

Frequency (GHz)	Service allocation	Other National Primary and Secondary Users
0.401 – 0.403	Earth Exploration-Satellite (Earth-to-space)  Meteorological-Satellite (Earth-to-	Meteorological Aids (Primary) (401 – 403 MHz)

<sup>11</sup>

Frequency (GHz)	Service allocation	Other National Primary and Secondary Users
	space)	
2.025 – 2.110	Space Operation (Earth-to-space) Earth Exploration-Satellite (Earth-to-space) Space Research (Earth-to-space)	Fixed links (Primary) (2 GHz (2025 - 2110 MHz))
5.15 – 5.25	Fixed-Satellite (Earth-to-space)	Aeronautical Radionavigation (Primary)
5.725 – 5.85	Fixed-Satellite (Earth-to-space)	Radiolocation (Primary), Amateur (secondary), short range devices (“SRDs”) (secondary), FWA (5.725 – 5.875 GHz) (secondary)
5.85 – 5.925	Fixed-Satellite (Earth-to-space)	Radiolocation (Primary), Amateur (secondary), SRDs (secondary), FWA (5.725 – 5.875 GHz) (secondary)
5.925 – 6.7	Fixed-Satellite (Earth-to-space)	Fixed links (Primary) (L6 GHz (5.925 – 6.425) GHz and U6 GHz (6.425 – 7.125 GHz)), SRDs (secondary)
6.7 – 7.075	Fixed-Satellite (Earth-to-space)	Fixed links (U6 GHz (6.425 – 7.125 GHz)) (Primary)
7.9 – 8.4	Fixed-Satellite (Earth-to-space)	Fixed links (Primary) (L8 GHz (7.725 – 8.275 GHz) and U8 GHz (8.275 – 8.5 GHz)), SRDs (secondary)
10.7 – 11.7	Fixed-Satellite (Earth-to-space)	Fixed links (primary) (11 GHz (10.7 – 11.7 GHz)  Use of the band 10.7-11.7 GHz by the fixed-satellite service (E-s) is limited to feeder links for the broadcasting-satellite service
12.5 – 12.75	Fixed-Satellite (Earth-to-space)	Exclusive Satellite Band

Frequency (GHz)	Service allocation	Other National Primary and Secondary Users
12.75 – 13.25	Fixed-Satellite (Earth-to-space)	Fixed links (Primary) (13 GHz (12.75 – 13.25 GHz))
13.75 – 14.0	Fixed-Satellite (Earth-to-space)	Radiolocation (Primary), SRDs (Secondary)
14.0 – 14.25	Fixed-Satellite (Earth-to-space)	Exclusive Satellite Band
14.25 – 14.5	Fixed-Satellite (Earth-to-space)	Programme Marking and Special Events (PMSE) (Secondary)
17.3 – 18.1	Fixed-Satellite (Earth-to-space)	Fixed links (Primary) (18 GHz (17.7 – 19.7 GHz))  Note limited to feeder links for BSS
27.5 – 29.5	Fixed-Satellite (Earth-to-space)	Fixed links (Primary) (28 GHz (27.9405 – 28.445 / 28.9485 – 29.4525 GHz))
29.5 – 30.0	Fixed-Satellite (Earth-to-space)	
42.5 – 43.5	Fixed-Satellite (Earth-to-space)	Fixed links (Primary) (42 GHz (40.5 – 43.5 GHz))
47.2 – 50.2	Fixed-Satellite (Earth-to-space)	
50.4 – 52.4	Fixed-Satellite (Earth-to-space)	

**Table 3: Frequency bands which are available for SES (s-E) receive licensing**

Frequency (GHz)	Service allocation	Other National Primary and Secondary Users
0.401 – 0.402	Space Operation (space-to-Earth)	Meteorological Aids (Primary) (401 – 403 MHz)

Frequency (GHz)	Service allocation	Other National Primary and Secondary Users
2.20 – 2.29	Space Operation (space-to-Earth) Earth Exploration-Satellite (space-to-Earth) Space Research (space-to-Earth)	Fixed links (Primary) (2 GHz (2200 – 2290 MHz))
3.8 – 4.2	Fixed-Satellite (space-to-Earth)	Fixed terrestrial for ECS (3.6 – 3.8 GHz), Mobile terrestrial for ECS (3.6 – 3.8 GHz)
4.5 – 4.8	Fixed-Satellite (space-to-Earth)	
6.7 – 7.075	Fixed-Satellite (space-to-Earth)	Fixed links (Primary) (U6 GHz (6.425 – 7.125 GHz))
7.25 – 7.3	Fixed-Satellite (space-to-Earth)	Fixed links (Primary) (L7 GHz (7.125 – 7.425 GHz)), SRDs (Secondary)
7.3 – 7.45	Fixed-Satellite (space-to-Earth)	Fixed links (Primary) (L7 GHz (7.125 – 7.425 GHz))
7.45– 7.55	Fixed-Satellite (space-to-Earth) Meteorological-Satellite (space-to-Earth)	Fixed links (Primary) (U7 GHz (7.425 – 7.725 GHz)), SRDs (Secondary)
7.55– 7.75	Fixed-Satellite (space-to-Earth)	Fixed links (Primary) (U7 GHz (7.425 – 7.725 GHz) and L8 GHz (7.725 – 8.275 GHz)), SRDs (Secondary)
10.7 – 11.7	Fixed-Satellite (space-to-Earth)	Fixed links (Primary) (11 GHz (10.7 – 11.7 GHz))
11.7 – 12.5	Broadcasting-Satellite	PMSE
12.5 – 12.75	Fixed-Satellite (space-to-Earth)	
17.3 – 17.7	Fixed-Satellite (space-to-Earth)	Feeder link bands for BSS

Frequency (GHz)	Service allocation	Other National Primary and Secondary Users
17.7 – 19.7	Fixed-Satellite (space-to-Earth)	Fixed links (Primary) (18 GHz (17.7 – 19.7 GHz))
19.7 – 20.2	Fixed-Satellite (space-to-Earth)	
37.5 – 42.5	Fixed-Satellite (space-to-Earth)	Fixed links (Primary) (38 GHz (37.5 – 39.5 GHz) and 42 GHz (40.5 – 43.5 GHz))
48.2 – 48.54	Fixed-Satellite (space-to-Earth)	
49.44 – 50.2	Fixed-Satellite (space-to-Earth)	

### 3.1 Shared SES frequency bands

3.6 SES frequency bands are shared with other wireless services and the nature of this sharing depends upon the status (Primary or Secondary) of the other wireless service, as outlined in the RFPI. Two possible sharing scenarios can occur:

- (a) **Scenario 1:** Both SES and the other wireless service are Primary allocations. For example, some frequency bands are shared between SES and fixed point-to-point radio links.

Under this scenario the priority of both services is equal. Applications are therefore processed on a first-come-first served basis. Where two or more services occupy the same frequency band, a successful national and / or international coordination process will be required before a licence can be processed.

- (b) **Scenario 2:** SES is a Primary allocation while the other wireless service is a Secondary allocation. For example, some frequency bands are shared between SES and Short Range Devices.

Under this scenario the priority of the SES service is greater than that of the other wireless service. Accordingly, the Secondary service operates on a non-protected non-interference basis thereby accommodating the primary service.



## 3.2 Exclusive SES frequency bands

- 3.7 Exclusive SES frequency bands are frequency bands which are not shared with other wireless services. The exclusive SES frequency bands are:
- (a) 12.5 – 12.75 GHz; and
  - (b) 14.0 – 14.25 GHz.

## 3.3 Technical requirements

- 3.8 In the case of SES, the relevant ITU RR<sup>12</sup> sets out the technical requirements to enable coexistence with other co-frequency and adjacent band radio systems. The aim of those requirements is to ensure interference-free operations of radiocommunication systems. The main sources of those requirements are:
- (a) Article 5 which provides a list of frequency bands allocated to satellite services together with footnotes associated with specific frequency bands describing technical and operational conditions. This includes the relevant satellite services that may utilise the band(s), associated coordination requirements and technical requirements for Earth stations (e.g. power limits, minimum antenna diameter, e.i.r.p.) density limits, power flux density limits produced by Earth stations at a given distance/height).
  - (b) Article 21 which addresses terrestrial and space services sharing frequency bands above 1 GHz and describes power limits for Earth stations (in the form of e.i.r.p.) as a function of the angle of elevation of the horizon or off-axis angle) and minimum angle of elevation. Power flux density limits are also specified for space stations as a function of arrival above the horizontal plane on the surface of the Earth.
  - (c) Article 22 which addresses space services and defines equivalent power flux density limits to protect GSO Earth station and satellite receivers from the aggregate emissions of NGSO systems, together with reference antenna patterns. E.i.r.p.) limits (as a function of off-axis angle) are also defined for Earth stations operating in GSO (geostationary orbit) FSS (fixed satellite services) networks in Ku- and Ka-band frequencies.
- 3.9 Appendix 2 sets out relevant provisions from the ITU RR which apply to SES, applicants and licensees are referred to the ITU RR for the complete list of provisions.
- 3.10 In the case of SES transmit operation (i.e. Earth-to-space) the following requirements, amongst other things, from the ITU RR apply to SES operating in Ireland:

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<sup>12</sup> <https://www.itu.int/pub/R-REG-RR>

- (a) There is no restriction on e.i.r.p. levels for Earth station elevation angles greater than 5 degrees (ITU RR No. 21.9).
- (b) For Earth stations with elevation angles less than 5 degrees and frequencies listed in No. 21.12, Table 21-3, and shared with fixed or mobile services the e.i.r.p.) limits for the two frequency ranges 1 to 15 GHz and above 15 GHz are provided in ITU RR No. 21.8.
- (c) The e.i.r.p. limits provided in ITU RR No. 21.8 may be exceeded by not more than 10 dB subject to agreement (ITU RR No. 21.11).
- (d) In the case of 13.75 – 14 GHz, ITU RR No. 21.13A provides the off-axis e.i.r.p. for GSO FSS Earth station antennas smaller than 4.5 metre diameter.
- (e) Earth station antennas shall not be employed for transmission at elevation angles of less than 3° except when agreed to by administrations concerned and those whose services may be affected. (ITU RR No. 21.14)
- (f) Table 22-2 of the ITU RR provides the Equivalent Power Flux Density (“EPFD”) uplink limits in the geostationary-satellite orbit by emissions from all the Earth stations in a non-geostationary-satellite system in the fixed-satellite service in the listed frequency bands (ITU RR No. 22.5D).
- (g) There are e.i.r.p. limits provided for off-axis of the main lobe for GSO Earth stations in the bands 12.75 – 13.25, 13.75 – 14 and 14 – 14.5 GHz in Nos. 22.26 – 22.29, 22.31 and 22.37.
- (h) There are e.i.r.p. limits provided for off-axis of the main lobe for GSO Earth stations in 29.5 – 30 GHz in ITU RR Nos. 22.32, 22.35, 22.36, 22.38 and 22.39

3.11 In the case of SES receive operation (i.e. space to Earth) the following apply:

- (a) In the case of receive Earth stations (s – E) ITU RR No. 21.14 says, “In case of reception by an Earth station, the above value [3°] shall be used for coordination purposes if the operating angle of elevation is less than that value.”
- (b) The power flux-density at the Earth’s surface produced by emissions from a space station, including emissions from a reflecting satellite, for all conditions and for all methods of modulation, shall not exceed the limit given in Table 21-4 of the ITU RR that apply to the FSS. This applies to bands shared with fixed or mobile service (ITU RR No. 21.16).
- (c) Tables 22-1A to 22-1E of the ITU RR provide the EPFD↓ limits at any point on the Earth’s surface radiated by non GSO satellite systems in the FSS (ITU RR No. 22.5C) in the listed frequency bands.

- (d) There are also requirements for specific bands, such as 13.75 – 14 GHz provided in the footnotes of Article 5 of the ITU RR(frequency allocations).

### 3.4 National and international coordination

- 3.12 When a SES frequency band is shared with another primary wireless service, national and / or international coordination is required with existing services in that band before a licence can be issued.
- 3.13 Coordination is the process by which the requirements of various users of radio spectrum are balanced against the available spectrum resources and the probability of interference between the various users is reduced to acceptable levels.
- 3.14 Coordination between SES and other terrestrial stations applies principally to the site of the SES. However, variations in the antenna radiation patterns, emitted power, receiver sensitivity, assigned frequency or bandwidth will have an effect on the coordination distances and the type of coordination required.
- 3.15 Generally, coordination, involving interference checks between different services on a national level, is sufficient for most applications. However, in some cases, international coordination may be required, particularly where there is a possibility of interference to/from a wireless service of another administration.
- 3.16 For example, the 4/6 GHz SES frequency band generally requires both national and international coordination due to the large coordination areas.
- 3.17 In relation to international coordination, ComReg cannot licence SES transmitters which may cause interference above the internationally agreed level to receivers outside the country. Additionally, operators of receivers located in Ireland are required to accept interference levels if within internationally agreed limits. Potential applicants should also be aware that the process to complete international coordination can take at least 6 months.

### 3.5 Coordination procedures

- 3.18 If national or international coordination is necessary ComReg may request the following from applicants in order to minimise interference to/from other wireless services:
- (a) a physical site survey showing the horizon elevation angle from the centre of the proposed antenna;
  - (b) enhanced radio and antenna equipment to improve spectral efficiency; and / or

- (c) site shielding - being a natural or manufactured obstruction positioned between the SES, potentially interfering stations and/or stations potentially being interfered with.

- 3.19 Appendix 1 sets out the public notification process for SES licence applications which operate with Non-Geostationary Orbit (“NGSO”) networks. The notification process provides interested parties an opportunity to consider the technical parameters of a proposed deployment. Where an incumbent licensee considers that a proposed deployment would cause harmful interference to an existing SES, then it must submit detailed evidence that coexistence would not be feasible as it would cause harmful interference. ComReg will consider any submissions received to inform its decision regarding the grant of an SES licence.
- 3.20 NGSO SES licence applicants must set out how their NGSO network would coexistence with other NGSO networks and provide details on any additional measures which could be implemented by the applicant to ensure coexistence with existing and future systems.

## 3.6 SES operation within or near an aerodrome

- 3.21 The Licensee must notify the AirNav Ireland<sup>13</sup> and the relevant Airport Authority to obtain the required permission of any potential operation of SES apparatus within an aerodrome or from any location within 7 km of the perimeter fence of an aerodrome<sup>14</sup>.

### Co-ordination with aircraft

- 3.22 ECC Report 272<sup>15</sup> provides the maximum e.i.r.p.) levels from Earth Stations in the vicinity of aircraft in the 4-6, 12-18 and 18-40 GHz bands to ensure compliance with aircraft HIRF (High Intensity Radiated Field) protection criteria. No restrictions on operations in the proximity of or within airfields (airports and helipads) are required for Earth stations complying with the e.i.r.p. levels specified in Table 12 in ECC Report 272, part of which is replicated below in table 4:

**Table 4: Maximum e.i.r.p.) levels from Earth Stations in the vicinity of aircraft in the 4-6, 12-18 and 18-40 GHz bands**

Earth station deployment type	Maximum e.i.r.p. levels (dBW)		
	4 – 6 GHz	12 – 18 GHz	18 – 40 GHz
Earth stations in a fixed location within airport premises	67	68.4	66.4

<sup>13</sup> <https://www.airnav.ie/contact>

<sup>14</sup> <https://www.iaa.ie/commercial-aviation/aerodromes-6>

<sup>15</sup> ECC Report 272 – Earth Stations operating in the frequency bands 4-8 GHz, 12-18 GHz and 18-40 GHz in the vicinity of aircraft – published 26 January 2018 <https://docdb.cept.org/download/1315>

Earth station deployment type	Maximum e.i.r.p. levels (dBW)		
Fixed Earth stations or mobile Earth stations on land within a wedge-shaped area originating at the departure and arrival end of the runway and extending for 3 nautical miles over which aircraft would normally track <sup>16</sup>	73	74.5	72.4
Fixed Earth stations or land mobile Earth stations operating with NGSO satellites located outside the wedge-shaped area extending for 3 nautical miles from the runway of an airfield over which aircraft would normally track <sup>16</sup>	79	80.5	78.4
Fixed Earth stations or land mobile Earth stations operating with GSO satellites located outside the wedge-shaped area extending for 3 nautical miles from the runway of an airfield over which aircraft would normally track <sup>16</sup>	80.7 – 93 <sup>17</sup>	82.2 – 94.5 <sup>17</sup>	80.2 – 92.4 <sup>17</sup>

## 3.7 Radio equipment compliance and requirements

- 3.23 The Radio Equipment (RE) Directive<sup>18</sup> ensures a single market for radio equipment by setting essential requirements for safety and health, electromagnetic compatibility, and the efficient use of the radio spectrum. It applies to all products using the radio frequency spectrum. The RE Directive was transposed into Irish Law as S.I. No. 248/2017 - European Union (Radio Equipment) Regulations 2017.<sup>19</sup>
- 3.24 All radio and telecommunications terminal equipment must comply with the essential requirements and other relevant provisions of S.I. No. 248/2017 before

<sup>16</sup> the width of the wedge shaped area originating at the departure and arrival end of the runway and extending for 3 nm from the runway over which aircraft would normally track depends on the airfield and is determined by the airport authority.

<sup>17</sup> eirp values are dependent on Earth station latitude

<sup>18</sup> Directive 2014/53/EU, [https://ec.europa.eu/growth/sectors/electrical-engineering/red-directive\\_en](https://ec.europa.eu/growth/sectors/electrical-engineering/red-directive_en)

<sup>19</sup> <http://www.irishstatutebook.ie/eli/2017/si/248/made/en/print>

being placed on the market or put into service in Ireland.

## 3.8 FOI, AIE, and Data Protection<sup>20</sup>

### Freedom of information (“FOI”)

3.25 The Freedom of Information Act 2014<sup>21</sup> (FOI Act) establishes several important legal rights for those seeking access to official information.

3.26 Statutory rights under the FOI Act:

- A legal right for each person to access information held by public bodies.
- A legal right for each person to have official information relating to him/herself amended where it is incomplete, incorrect, or misleading.
- A legal right to obtain reasons for decisions affecting oneself.

3.27 The FOI Act is designed to allow public access to information held by the Commission which is not routinely available through other sources. Access to information under FOI is subject to certain exemptions and involves specific procedures and time limit.

### Access to Information on the Environment (“AIE”)

3.28 Subject to certain exceptions, information relating to the environment held by, or for, ComReg must be made available on request to any person.

3.29 The European Communities (Access to Information on the Environment) Regulations 2007<sup>22</sup>, as amended, provide a definition of environmental information, and sets out how requests for information may be submitted to public authorities.

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<sup>20</sup> <https://www.comreg.ie/about/foi-aie-info/>

<sup>21</sup> <https://www.irishstatutebook.ie/eli/2014/act/30/enacted/en/html>

<sup>22</sup> <https://www.irishstatutebook.ie/eli/2007/si/133/made/en/print>

## 4 The application process

### 4.1 On-line application process

- 4.1 To apply for a SES licence, applicants must login to ComReg's online facility [www.elicensing.comreg.ie](http://www.elicensing.comreg.ie). Applicants must be a ComReg account holder; if not, you can register for a ComReg account at [www.elicensing.comreg.ie](http://www.elicensing.comreg.ie).

### 4.2 Evaluation of the application

- 4.2 Applications are generally processed on a first-come, first-served basis. Each application is evaluated based on the following criteria:

- (a) efficient use of the spectrum;
- (b) minimum radio and antenna equipment requirements;
- (c) successful coordination between Administrations and existing users;
- (d) compliance with international obligations; and
- (e) compliance with other licensing regimes regulated by ComReg.

- 4.3 ComReg may request additional information to evaluate a licence application. For example, Applicants for a SES licence may be required to demonstrate that co-existence is possible with existing licensed SES and other licensed services, e.g. fixed terrestrial links. Applicants should identify the stations falling within the coordination contours by using the ITU-R space network software and inform ComReg of any potential issues associated with the detailed coordination process.

### 4.3 Payment of licence fees

- 4.4 A licence cannot be issued until all fees have been received and fees must be submitted as part of the application via the applicant's account on <https://www.elicensing.comreg.ie/>.

# Appendix 1: Non-geostationary satellite earth station coordination process

- A 1.1 Non-Geostationary Orbit (“NGSO”) satellite systems are inherently more complex than traditional geostationary systems as they utilise constellations comprised of hundreds of satellites in multiple low Earth orbital planes. These satellite systems are in motion so they must be tracked by steerable SES antennas. This contrasts with geostationary systems where the antenna points to a single satellite in the Clarke belt<sup>23</sup>. With steerable SES antennas operating at lower elevations the interference environment around NGSO SESs is more complex.
- A 1.2 Recognising that the potential for harmful interference is greater for NGSO SESs, the ITU has defined Equivalent Power Flux Density (“EPFD”) limits in the Radio Regulations to protect GSO networks from NGSO systems. There are also limits on GSO networks in Article 22 and Resolution 169 to protect NGSO systems. The antenna radiation pattern envelope must meet the minimum performance specified by ITU-R Recommendation ITU-R S.465, or ITU-R.S.580. The component of effective isotropic radiated power directed towards the horizon and the minimum elevation<sup>24</sup> angle above the horizontal must comply with ITU Regulations and not exceed those limits specified by Radio Regulations 21.8 – 21.15.
- A 1.3 While coordination is a requirement under the ITU Radio Regulations these regulations only address coordination between different countries and do not consider the specific locations of SESs within an individual state. Therefore, due the possibility of overlapping portions of the spectrum being allocated to multiple operators, ITU coordination alone may not always be sufficient to guarantee harmonious coexistence of multiple SESs within the state. It may be necessary to have significant physical separation (tens of kilometres) between SESs to minimize interference. Therefore, inter operator coordination is beneficial in mitigating interference issues and ensuring the efficient use of the radio spectrum.
- A 1.4 To assure co-existence with licensees, applicants for SES licences (new licences and amendments to licences) to operate with a NGSO system must demonstrate how coexistence is possible between their proposed non-geostationary SES and:

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<sup>23</sup> The Clarke Belt is term used to describe a Geostationary Orbit. A Geostationary Orbit is a Geosynchronous Orbit which is located at a latitude of zero degrees, directly above the Earth’s Equator.

<sup>24</sup> ITU Radio Regulation 21.14 stipulates that Earth station antennas shall not be employed for transmission at elevation angles of less than 3 degrees measured from the horizontal plane to the direction of maximum radiation.



- a) existing non-geostationary satellite gateways that are already licensed;
- b) non-geostationary satellite systems for which an application has been made and which has been published for comment on ComReg's website; and
- c) other co-frequency SESs registered with the ITU.

A 1.5 ComReg's notification process enables interested parties to submit any views they have on a proposed SES regarding, for example, potential harmful interference or the potential impact on future SES deployments. The notification process provides transparency to all interested parties and allows ComReg to consider views regarding SES deployments operating with NGSO systems<sup>25</sup>. The notification process does not conflict with nor attempt to replace the ITU procedures.

A 1.6 The following steps in the notification process are as follows:

**Step 1** Prior to submitting an application, applicants should seek to have an agreement with regards to coexistence with relevant Licensees. The agreement can be either an ITU coordination agreement and/or a local coordination agreement whereby the relevant parties agree to work together to mitigate any potential harmful interference and to existing and future SES deployments in Ireland.

If no such agreement exists, the applicant should set out in detail, in their application, how the proposed SES would coexist with existing and future SES deployments. The applicant needs to set out in detail what measures can be put in place, by either the applicant and/or existing/future Licensees, to achieve coexistence, and provide an assessment of the potential impact on network availability and throughput for existing or future SES deployments. The information provided by the applicant would be subject to the provisions of ComReg's guidelines on the treatment of confidential information as set out in Document 05/24<sup>26</sup>.

ComReg will review the application and assess whether applicant has provided a detailed plan with sufficient information for how coexistence can be achieved.

**Step 2** ComReg will review the application and assess whether the applicant has provided a detailed plan with sufficient information for how coexistence can be achieved and may seek further information or seek clarity on specific points from the applicant.

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<sup>25</sup> Document 24/04 sets out that ComReg is fully committed to effective implementation of its three consultation principles to promote transparent and comprehensive participation in the policy development process. This means that ComReg recognises that there may be a wide range of stakeholders on any particular issue, not just those with a direct pecuniary or other interest. See ComReg Document 24/04 – Consultation Procedure Guidelines – published 11 January 2024

<sup>26</sup> [ComReg Document 05/24](#), "Guidelines on the treatment of confidential information", published 22 March 2005, available at [www.comreg.ie](http://www.comreg.ie)

**Step 3** ComReg will publish a notice setting out the relevant information of the proposed SES and the applicant's proposals regarding coexistence with existing and future services. Interested parties will be invited to provide any views they may have on the proposed SES. Where an interested party is of the view that an SES licence should not be granted, they will be required to provide evidence as to why the coexistence measures provided by the applicant will not succeed in limiting the impact to existing or future licensees. This shall include setting out why, in their view, the proposed coexistence measures are insufficient or unreasonable.

A licensee needs to provide sufficient evidence of harmful interference issues from any proposed new SES or use of a frequency band beyond a certain distance (20km) of their site. ComReg intends to reserve the right to address any disputes on a case-by-case basis, for example considering any perceived abuse of the system or lack of coordination efforts on the part of an incumbent Licensee.

**Step 4** ComReg will then carefully consider any submissions before making a decision regarding the granting of an SES licence. Where required, ComReg may seek clarifications or additional information from the applicant on foot of any submissions received.

## Appendix 2: Details of relevant articles of the ITU Radio Regulations

A 2.1 The following are the main relevant articles of the ITU's Radio Regulations ([Radio Regulations \(itu.int\)](#)) relevant to the deployment and use of satellite earth stations.

A 2.2 Article 5. The following details some of the main applicable footnotes noted in ITU's Radio Regulations. For others please refer to Article 5 in Radio Regulations, Volume 1:

- 5.441. The use of the bands 4 500-4 800 MHz (space-to-Earth), 6 725-7 025 MHz (Earth-to-space) by the fixed satellite service shall be in accordance with the provisions of Appendix 30B. The use of the bands 10.7-10.95 GHz (space-to-Earth), 11.2-11.45 GHz (space-to-Earth) and 12.75-13.25 GHz (Earth-to-space) by geostationary-satellite systems in the fixed-satellite service shall be in accordance with the provisions of Appendix 30B. The use of the bands 10.7-10.95 GHz (space-to-Earth), 11.2-11.45 GHz (space-to-Earth) and 12.75-13.25 GHz (Earth-to-space) by a non-geostationary-satellite system in the fixed-satellite service is subject to application of the provisions of No. 9.12 for coordination with other non-geostationary-satellite systems in the fixed-satellite service. Non-geostationary-satellite systems in the fixed-satellite service shall not claim protection from geostationary-satellite networks in the fixed-satellite service operating in accordance with the Radio Regulations, irrespective of the dates of receipt by the Bureau of the complete coordination or notification information, as appropriate, for the non-geostationary-satellite systems in the fixed satellite service and of the complete coordination or notification information, as appropriate, for the geostationary-satellite networks, and No. 5.43A does not apply. Non-geostationary-satellite systems in the fixed-satellite service in the above bands shall be operated in such a way that any unacceptable interference that may occur during their operation shall be rapidly eliminated.
- 5.447A. The allocation to the fixed-satellite service (Earth-to-space) in the band 5 150-5 250 MHz is limited to feeder links of non-geostationary-satellite systems in the mobile-satellite service and is subject to coordination under No. 9.11A.
- 5.457A. In the frequency bands 5 925-6 425 MHz and 14-14.5 GHz, earth stations located on board vessels may communicate with space stations of the fixed-satellite service. Such use shall be in accordance with Resolution 902 (Rev.WRC-23). In the frequency band 5 925-6 425 MHz, earth stations located on board vessels and communicating with space

stations of the fixed-satellite service may employ transmit antennas with minimum diameter of 1.2 m and operate without prior agreement of any administration if located at least 330 km away from the low-water mark as officially recognized by the coastal State. All other provisions of Resolution 902 (Rev.WRC-23) shall apply. (WRC-23)

- 5.458. In the band 6 425-7 075 MHz, passive microwave sensor measurements are carried out over the oceans. In the band 7 075-7 250 MHz, passive microwave sensor measurements are carried out. Administrations should bear in mind the needs of the Earth exploration-satellite (passive) and space research (passive) services in their future planning of the bands 6 425-7 075 MHz and 7 075-7 250 MHz.
- 5.458B. The space-to-Earth allocation to the fixed-satellite service in the band 6 700-7 075 MHz is limited to feeder links for non-geostationary satellite systems of the mobile-satellite service and is subject to coordination under No. 9.11A. The use of the band 6 700-7 075 MHz (space-to-Earth) by feeder links for non-geostationary satellite systems in the mobile-satellite service is not subject to No. 22.2.
- 5.461. Additional allocation: the frequency bands 7 250-7 375 MHz (space-to-Earth) and 7 900-8 025 MHz (Earth-to-space) are also allocated to the mobile-satellite service on a primary basis, subject to agreement obtained under No. 9.21, with the exception that No. 9.21 shall not apply to the geostationary-satellite networks in the mobile-satellite service for which complete coordination information is received by the Bureau as of 1 January 2025 with respect to non-geostationary-satellite systems for which complete coordination or notification information, according to the case, is received by the Bureau as of 1 January 2025. Non-geostationary-satellite systems for which complete coordination or notification information, according to the case, is received by the Bureau as of 1 January 2025 shall not cause unacceptable interference to and shall not claim protection from geostationary-satellite networks in the mobile-satellite service operating in accordance with these Regulations. No. 5.43A does not apply. (WRC-23).
- 5.461AC In the frequency band 7 375-7 750 MHz, non-geostationary-satellite systems operating in the fixed-satellite service for which complete coordination or notification information, according to the case, is received by the Bureau as of 1 January 2025 shall not cause unacceptable interference to and shall not claim protection from geostationary-satellite networks in the maritime mobile-satellite service operating in accordance with these Regulations. No. 5.43A does not apply. (WRC-23)

- 5. 484. In Region 1, the use of the band 10.7-11.7 GHz by the fixed-satellite service (Earth-to-space) is limited to feeder links for the broadcasting-satellite service
- 5.484A. The use of the frequency bands 10.95-11.2 GHz (space-to-Earth), 11.45-11.7 GHz (space-to-Earth), 11.7-12.2 GHz (space-to-Earth) in Region 2, 12.2-12.75 GHz (space-to-Earth) in Region 3, 12.5-12.75 GHz (space-to-Earth) in Region 1, 13.75-14.5 GHz (Earth-to-space), 17.3-17.7 GHz (space-to-Earth) in Region 2, 17.8-18.6 GHz (space-to-Earth), 19.7-20.2 GHz (space-to-Earth), 27.5-28.6 GHz (Earth-to-space), 29.5-30 GHz (Earth-to-space) by a non-geostationary-satellite system in the fixed-satellite service is subject to application of the provisions of No. 9.12 for coordination with other non-geostationary-satellite systems in the fixed-satellite service. Non-geostationary-satellite systems in the fixed-satellite service shall not claim protection from geostationary-satellite networks in the fixed-satellite service operating in accordance with the Radio Regulations, irrespective of the dates of receipt by the Bureau of the complete coordination or notification information, as appropriate, for the non-geostationary-satellite systems in the fixed-satellite service and of the complete coordination or notification information, as appropriate, for the geostationary-satellite networks, and No. 5.43A does not apply. Non-geostationary-satellite systems in the fixed-satellite service in the above bands shall be operated in such a way that any unacceptable interference that may occur during their operation shall be rapidly eliminated. In Region 2, No. 22.2 shall continue to apply in the frequency band 17.3-17.7 GHz. (WRC-23).
- 5.487A. Additional allocation: in Region 1, the band 11.7-12.5 GHz, in Region 2, the band 12.2-12.7 GHz and, in Region 3, the band 11.7-12.2 GHz, are also allocated to the fixed-satellite service (space-to-Earth) on a primary basis, limited to non-geostationary systems and subject to application of the provisions of No. 9.12 for coordination with other non-geostationary-satellite systems in the fixed-satellite service. Non-geostationary-satellite systems in the fixed-satellite service shall not claim protection from geostationary-satellite networks in the broadcasting-satellite service operating in accordance with the Radio Regulations, irrespective of the dates of receipt by the Bureau of the complete coordination or notification information, as appropriate, for the non-geostationary-satellite systems in the fixed-satellite service and of the complete coordination or notification information, as appropriate, for the geostationary-satellite networks, and No. 5.43A does not apply. Non-geostationary-satellite systems in the fixed-satellite service in the above bands shall be operated in such a way that any unacceptable interference

that may occur during their operation shall be rapidly eliminated. (WRC-03)

- 5.492. Assignments to stations of the broadcasting-satellite service which are in conformity with the appropriate regional Plan or included in the Regions 1 and 3 List in Appendix 30 may also be used for transmissions in the fixed satellite service (space-to-Earth), provided that such transmissions do not cause more interference, or require more protection from interference, than the broadcasting-satellite service transmissions operating in conformity with the Plan or the List, as appropriate. (WRC-2000).
- 5.502. In the band 13.75-14 GHz, an earth station of a geostationary fixed-satellite service network shall have a minimum antenna diameter of 1.2 m and an earth station of a non-geostationary fixed-satellite service system shall have a minimum antenna diameter of 4.5 m. In addition, the e.i.r.p., averaged over one second, radiated by a station in the radiolocation or radionavigation services shall not exceed 59 dBW for elevation angles above 2° and 65 dBW at lower angles. Before an administration brings into use an earth station in a geostationary-satellite network in the fixed-satellite service in this band with an antenna diameter smaller than 4.5 m, it shall ensure that the power flux-density produced by this earth station does not exceed:
  - $-115 \text{ dB(W/(m}^2 \cdot 10 \text{ MHz))}$  for more than 1% of the time produced at 36 m above sea level at the low water mark, as officially recognized by the coastal State;
  - $-115 \text{ dB(W/(m}^2 \cdot 10 \text{ MHz))}$  for more than 1% of the time produced 3 m above ground at the border of the territory of an administration deploying or planning to deploy land mobile radars in this band, unless prior agreement has been obtained.
  - For earth stations within the fixed-satellite service having an antenna diameter greater than or equal to 4.5 m, the e.i.r.p. of any emission should be at least 68 dBW and should not exceed 85 dBW. (WRC-03)
- 5.503. In the band 13.75-14 GHz, geostationary space stations in the space research service for which information for advance publication has been received by the Bureau prior to 31 January 1992 shall operate on an equal basis with stations in the fixed-satellite service; after that date, new geostationary space stations in the space research service will operate on a secondary basis. Until those geostationary space stations in the space research service for which information for advance publication has been

received by the Bureau prior to 31 January 1992 cease to operate in this band:

- in the band 13.77-13.78 GHz, the e.i.r.p. density of emissions from any earth station in the fixed satellite service operating with a space station in geostationary-satellite orbit shall not exceed:
  - i)  $4.7D + 28 \text{ dB(W/40 kHz)}$ , where  $D$  is the fixed-satellite service earth station antenna diameter (m) for antenna diameters equal to or greater than 1.2 m and less than 4.5 m;
  - ii)  $49.2 + 20 \log(D/4.5) \text{ dB(W/40 kHz)}$ , where  $D$  is the fixed-satellite service earth station antenna diameter (m) for antenna diameters equal to or greater than 4.5 m and less than 31.9 m;
  - iii)  $66.2 \text{ dB(W/40 kHz)}$  for any fixed-satellite service earth station for antenna diameters (m) equal to or greater than 31.9 m;
  - iv)  $56.2 \text{ dB(W/4 kHz)}$  for narrow-band (less than 40 kHz of necessary bandwidth) fixed-satellite service earth station emissions from any fixed-satellite service earth station having an antenna diameter of 4.5 m or greater; –
- The e.i.r.p. density of emissions from any earth station in the fixed-satellite service operating with a space station in non-geostationary-satellite orbit shall not exceed 51 dBW in the 6 MHz band from 13.772 to 13.778 GHz.

Automatic power control may be used to increase the e.i.r.p. density in these frequency ranges to compensate for rain attenuation, to the extent that the power flux-density at the fixed-satellite service space station does not exceed the value resulting from use by an earth station of an e.i.r.p. meeting the above limits in clear-sky conditions. (WRC-03).

- 5.515A. In addition to the need to comply with the coordination criteria in Annex 4 to Appendix 30A, under assumed free-space propagation conditions, the power flux-density of an assignment in the fixed-satellite service (space to-Earth) of a geostationary-satellite network in the frequency band 17.3-17.7 GHz in Region 2 shall not exceed the value of  $-98 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$  at points in the geostationary-satellite orbit with geocentric orbital separation angles between  $152.6^\circ$  and  $162.6^\circ$ . (WRC-23).
- 5.515B. In the frequency band 17.3-17.7 GHz, the use of the fixed-satellite service (space-to-Earth) by geostationary-satellite space stations in Region 2 shall not cause harmful interference to space station receivers nor claim protection from the broadcasting-satellite service feeder-link

earth stations operating under Appendix 30A in all three Regions, nor put any limitations or restrictions on the locations of the broadcasting-satellite service feeder-link earth stations anywhere within the service area of the feeder link. The notifying administration for the fixed-satellite service(space-to-Earth), when submitting Appendix 4 information elements, shall provide a firm, objective, actionable, measurable and enforceable commitment that, in the event of harmful interference being reported to space station receivers in Appendix 30A, it shall take immediate action to eliminate the interference or reduce it to an acceptable level. (WRC-23).

- 5.516. Use of the band 17.3-18.1 GHz by geostationary-satellite systems in the fixed-satellite service (Earth to-space) is limited to feeder links for the broadcasting-satellite service. The use of the bands 17.3-18.1 GHz (Earth-to-space) in Regions 1 and 3 by non-geostationary-satellite systems in the fixed-satellite service is subject to application of the provisions of No. 9.12 for coordination with other non-geostationary-satellite systems in the fixed-satellite service. Non-geostationary-satellite systems in the fixed-satellite service shall not claim protection from geostationary-satellite networks in the fixed-satellite service operating in accordance with the Radio Regulations, irrespective of the dates of receipt by the Bureau of the complete coordination or notification information, as appropriate, for the non-geostationary-satellite systems in the fixed satellite service and of the complete coordination or notification information, as appropriate, for the geostationary-satellite networks, and No. 5.43A does not apply. Non-geostationary-satellite systems in the fixed-satellite service in the above bands shall be operated in such a way that any unacceptable interference that may occur during their operation shall be rapidly eliminated. (WRC-2000)
- 5.516A. In the band 17.3-17.7 GHz, earth stations of the fixed-satellite service (space-to-Earth) in Region 1 shall not claim protection from the broadcasting-satellite service feeder-link earth stations operating under Appendix 30A, nor put any limitations or restrictions on the locations of the broadcasting-satellite service feeder-link earth stations anywhere within the service area of the feeder link. (WRC-03)
- 5.516B. The following bands are identified for use by high-density applications in the fixed-satellite service:
  - 17.3-17.7 GHz (space-to-Earth) in Region 1,
  - 19.7-20.2 GHz (space-to-Earth) in all Regions,
  - 39.5-40 GHz (space-to-Earth) in Region 1,



- 40-40.5 GHz (space-to-Earth) in all Regions,
- 47.5-47.9 GHz (space-to-Earth) in Region 1,
- 48.2-48.54 GHz (space-to-Earth) in Region 1,
- 49.44-50.2 GHz (space-to-Earth) in Region 1, and
- 27.5-27.82 GHz (Earth-to-space) in Region 1,
- 28.45-28.94 GHz (Earth-to-space) in all Regions,
- 29.46-30 GHz (Earth-to-space) in all Regions.

This identification does not preclude the use of these frequency bands by other fixed-satellite service applications or by other services to which these frequency bands are allocated on a co-primary basis and does not establish priority in these Radio Regulations among users of the frequency bands. Administrations should take this into account when considering regulatory provisions in relation to these frequency bands. See Resolution 143 (Rev.WRC-19). (WRC-19)

- 5.521A For use of the frequency bands 18.1-18.6 GHz, 18.8-20.2 GHz and 27.5-30 GHz, or parts thereof, by space stations in the inter-satellite service, Resolution 679 (WRC-23) shall apply. Such use is limited to space research, space operation and/or Earth exploration-satellite applications, and also transmissions of data originating from industrial and medical activities in space. When using these frequencies, administrations shall ensure that this inter-satellite service is used only for the aforementioned purposes and is not subject to coordination under No. 9.11A. For use of the frequency bands 18.1-18.6 GHz, 18.8-20.2 GHz, 27.5-29.1 GHz and 29.5-30 GHz by space stations, the allocation is limited to inter-satellite links between non-geostationary satellites or between non-geostationary satellites and geostationary satellites. For use of the frequency band 29.1-29.5 GHz by space stations, the allocation is limited to inter-satellite links between non-geostationary satellites and geostationary satellites. No. 4.10 does not apply. (WRC-23)
- 5.522B . The use of the band 18.6-18.8 GHz by the fixed-satellite service is limited to geostationary systems and systems with an orbit of apogee greater than 20 000 km.
- 5.526. In the bands 19.7-20.2 GHz and 29.5-30 GHz in Region 2, and in the bands 20.1-20.2 GHz and 29.9- 30 GHz in Regions 1 and 3, networks which are both in the fixed-satellite service and in the mobile-satellite service may include links between earth stations at specified or

unspecified points or while in motion, through one or more satellites for point-to-point and point-to-multipoint communications.

- 5.535A. The use of the band 29.1-29.5 GHz (Earth-to-space) by the fixed-satellite service is limited to geostationary satellite systems and feeder links to non-geostationary-satellite systems in the mobile-satellite service. Such use is subject to the application of the provisions of No. 9.11A, but not subject to the provisions of No. 22.2, except as indicated in Nos. 5.523C and 5.523E where such use is not subject to the provisions of No. 9.11A and shall continue to be subject to Articles 9 (except No. 9.11A) and 11 procedures, and to the provisions of No. 22.2. (WRC-97)
- 5.538. Additional allocation: the bands 27.500-27.501 GHz and 29.999-30.000 GHz are also allocated to the fixed-satellite service (space-to-Earth) on a primary basis for the beacon transmissions intended for up-link power control. Such space-to-Earth transmissions shall not exceed an equivalent isotropically radiated power (e.i.r.p.) of 10 dBW in the direction of adjacent satellites on the geostationary-satellite orbit. (WRC-07)
- 5.539. The band 27.5-30 GHz may be used by the fixed-satellite service (Earth-to-space) for the provision of feeder links for the broadcasting-satellite service.
- 5.540. Additional allocation: the band 27.501-29.999 GHz is also allocated to the fixed-satellite service (space-to-Earth) on a secondary basis for beacon transmissions intended for up-link power control.
- 5.541A. Feeder links of non-geostationary networks in the mobile-satellite service and geostationary networks in the fixed-satellite service operating in the band 29.1-29.5 GHz (Earth-to-space) shall employ uplink adaptive power control or other methods of fade compensation, such that the earth station transmissions shall be conducted at the power level required to meet the desired link performance while reducing the level of mutual interference between both networks. These methods shall apply to networks for which Appendix 4 coordination information is considered as having been received by the Bureau after 17 May 1996 and until they are changed by a future competent world radiocommunication conference. Administrations submitting Appendix 4 information for coordination before this date are encouraged to utilize these techniques to the extent practicable. (WRC-2000)
- 5.547. The frequency bands 31.8-33.4 GHz, 37-40 GHz, 40.5-43.5 GHz, 51.4-52.6 GHz, 55.78-59 GHz and 64-66 GHz are available for high-density applications in the fixed service. Administrations should take this into account when considering regulatory provisions in relation to these

bands. Because of the potential deployment of high-density applications in the fixed-satellite service in the frequency bands 39.5-40 GHz and 40.5-42 GHz (see No. 5.516B), administrations should further take into account potential constraints to high-density applications in the fixed service, as appropriate. (WRC-23)

- 5.550C. The use of the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2- 50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) by a non-geostationary-satellite system in the fixed satellite service is subject to the application of the provisions of No. 9.12 for coordination with other non-geostationary satellite systems in the fixed-satellite service but not with non-geostationary-satellite systems in other services. Resolution 770 (WRC-19) shall also apply, and No. 22.2 shall continue to apply. (WRC-19).
- 5.550CA Non-geostationary-satellite systems in the fixed-satellite service operating with an apogee altitude above 407 km and below 2 000 km in the frequency band 37.5-38 GHz shall not exceed an unwanted emission e.i.r.p. density of  $-21$  dB(W/100 MHz) per space station for angles greater than  $65.0^\circ$  from nadir relative to the space station in the fixed-satellite service in the frequency band 36-37 GHz in order to protect the Earth exploration-satellite service (passive) operating in the latter frequency band. (WRC-23).
- 5.550E. The use of the frequency bands 39.5-40 GHz and 40-40.5 GHz by non-geostationary-satellite systems in the mobile-satellite service (space-to-Earth) and by non-geostationary-satellite systems in the fixed-satellite service (space-to-Earth) is subject to the application of the provisions of No. 9.12 for coordination with other non-geostationary satellite systems in the fixed-satellite and mobile-satellite services but not with non-geostationary-satellite systems in other services. No. 22.2 shall continue to apply for non-geostationary-satellite-systems.
- 5.552. The allocation of the spectrum for the fixed-satellite service in the bands 42.5-43.5 GHz and 47.2-50.2 GHz for Earth-to-space transmission is greater than that in the band 37.5-39.5 GHz for space-to-Earth transmission in order to accommodate feeder links to broadcasting satellites. Administrations are urged to take all practicable steps to reserve the band 47.2-49.2 GHz for feeder links for the broadcasting-satellite service operating in the band 40.5-42.5 GHz.
- 5.554A. The use of the bands 47.5-47.9 GHz, 48.2-48.54 GHz and 49.44-50.2 GHz by the fixed-satellite service (space-to-Earth) is limited to geostationary satellites. (WRC-03)

- 5.555B. The power flux-density in the band 48.94-49.04 GHz produced by any geostationary space station in the fixed-satellite service (space-to-Earth) operating in the bands 48.2-48.54 GHz and 49.44-50.2 GHz shall not exceed  $-151.8$  dB(W/m<sup>2</sup>) in any 500 kHz band at the site of any radio astronomy station. (WRC-03)
- 5.555C. The use of the frequency band 51.4-52.4 GHz by the fixed-satellite service (Earth-to-space) is limited to geostationary-satellite networks. The earth stations shall be limited to gateway earth stations with a minimum antenna diameter of 2.4 metres. (WRC-19).

A 2.3 Article 21. The following provide the relevant excerpts from Article 21:

- No. 21.8 § 4 1) The equivalent isotropically radiated power (e.i.r.p.) transmitted in any direction towards the horizon by an earth station shall not exceed the following limits except as provided in No. 21.10 or 21.11:
  - a) in frequency bands between 1 GHz and 15 GHz  $+40$  dBW in any 4 kHz band for  $\theta \leq 0^\circ$   $+40 + 3\theta$  dBW in any 4 kHz band for  $0^\circ < \theta \leq 5^\circ$ ; and
  - b) in frequency bands above 15 GHz  $+64$  dBW in any 1 MHz band for  $\theta \leq 0^\circ$   $+64 + 3\theta$  dBW in any 1 MHz band for  $0^\circ < \theta \leq 5^\circ$ , where  $\theta$  is the angle of elevation of the horizon viewed from the centre of radiation of the antenna of the earth station and measured in degrees as positive above the horizontal plane and negative below it.
- No. 21.9 2) For angles of elevation of the horizon greater than  $5^\circ$  there shall be no restriction as to the equivalent isotropically radiated power (e.i.r.p.) transmitted by an earth station towards the horizon.
- No. 21.11 4) The limits given in Nos. 21.8 and 21.10, as applicable, may be exceeded by not more than 10 dB. However, when the resulting coordination area extends into the territory of another country, such increase shall be subject to agreement by the administration of that country.
- No. 21.12 5) The limits given in No. 21.8 apply, where applicable, to the services and frequency bands indicated in Table 21-3 for transmission by earth stations where the frequency bands are shared with equal rights with the fixed or mobile service.
- No. 21.13A 7) In the band 13.75-14 GHz, the level of off-axis e.i.r.p. emitted by an earth station of a geostationary fixed-satellite service network with an antenna diameter smaller than 4.5 m shall not exceed the following values:

Angle off-axis (degrees)	Maximum e.i.r.p. in any 1 MHz band (dBW)
$2 \leq \varphi \leq 7$	$43 - 25 \log \varphi$
$7 < \varphi \leq 9.2$	22
$9.2 < \varphi \leq 48$	$46 - 25 \log \varphi$
$\varphi > 48$	4

- No. 21.14 § 5 1) Earth station antennas shall not be employed for transmission at elevation angles of less than  $3^\circ$  measured from the horizontal plane to the direction of maximum radiation, except when agreed to by administrations concerned and those whose services may be affected. In case of reception by an earth station, the above value shall be used for coordination purposes if the operating angle of elevation is less than that value.
- No. 21.16 § 6 1) The power flux-density at the Earth's surface produced by emissions from a space station, including emissions from a reflecting satellite, for all conditions and for all methods of modulation, shall not exceed the limit given in Table 21-4. The limit relates to the power flux-density which would be obtained under assumed free-space propagation conditions and applies to emissions by a space station of the service indicated where the frequency bands are shared with equal rights with the fixed or mobile service, unless otherwise stated.

A 2.4 Article 22. The following provide the relevant excerpts from Article 22:

Section II – Control of interference to geostationary-satellite systems. Includes articles that define EPFD (down) limits to protect GSO ES receivers from NGSO satellite interference, so they define protection levels for ES receivers.

- No. 22.25C § 6 1) The equivalent power flux-density<sup>27</sup>, EPFD<sub>↓</sub>, at any point on the Earth's surface visible from the geostationary-satellite orbit, produced by emissions from all the space stations of a non-geostationary-satellite system in the fixed-satellite service in the frequency bands listed in Tables 22-1A to 22-1E, including emissions from a reflecting satellite, for all conditions and for all methods of modulation, shall not exceed the limits given in Tables 22-1A to 22-1E for the given percentages of time.

<sup>27</sup> 22.5C.1 The equivalent power flux-density is defined as the sum of the power flux-densities produced at a geostationary-satellite system receive station on the Earth's surface or in the geostationary orbit, as appropriate, by all the transmit stations within a non-geostationary-satellite system, taking into account the off-axis discrimination of a reference receiving antenna assumed to be pointing in its nominal direction

These limits relate to the equivalent power flux-density which would be obtained under free-space propagation conditions, into a reference antenna and in the reference bandwidth specified in Tables 22-1A to 22-1E, for all pointing directions towards the geostationary-satellite orbit. (WRC-03)

- No. 22.25D 3) The equivalent power flux-density<sup>28</sup>, EPFD<sub>↑</sub>, produced at any point in the geostationary-satellite orbit by emissions from all the earth stations in a non-geostationary-satellite system in the fixed-satellite service in the frequency bands listed in Table 22-2, for all conditions and for all methods of modulation, shall not exceed the limits given in Table 22-2 for the specified percentages of time. These limits relate to the equivalent power flux-density which would be obtained under free-space propagation conditions, into a reference antenna and in the reference bandwidth specified in Table 22-2, for all pointing directions towards the Earth’s surface visible from any given location in the geostationary-satellite orbit. (WRC-2000)

Section VI – Off-axis power limits on earth stations of a geostationary-satellite network in the fixed-satellite service.

- No. 22.26 § 9 The level of equivalent isotropically radiated power (e.i.r.p.) emitted by an earth station of a geostationary-satellite network shall not exceed the following values for any off-axis angle  $\Phi$  which is 3° or more off the main-lobe axis of an earth station antenna:

Off-axis angle	Maximum e.i.r.p.)
$3^\circ \leq \Phi \leq 7^\circ$	42 – 25 log $\Phi$ dB (W/40 kHz)
$7^\circ < \Phi \leq 9.2^\circ$	21 dB (W/40 kHz)
$9.2^\circ < \Phi \leq 48^\circ$	45 – 25 log $\Phi$ dB (W/40 kHz)
$48^\circ < \Phi \leq 180^\circ$	3 dB (W/40 kHz)

- No. 22.27 For frequency-modulated television emissions with energy dispersal, the limits in No. 22.26 above may be exceeded by up to 3 dB, provided that the off-axis total e.i.r.p. of the transmitted frequency-modulated television carrier does not exceed the following values:

Off-axis angle	Maximum e.i.r.p.)
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<sup>28</sup> 22.5D.1 See No. 22.5C.1. (WRC-2000)

$3^\circ \leq \Phi \leq 7^\circ$	$56 - 25 \log \Phi$ dBW
$7^\circ < \Phi \leq 9.2^\circ$	35 dBW
$9.2^\circ < \Phi \leq 48^\circ$	$59 - 25 \log \Phi$ dBW
$48^\circ < \Phi \leq 180^\circ$	17 dBW

- No. 22.28 Frequency-modulated television carriers which operate without energy dispersal should be modulated at all times with programme material or appropriate test patterns. In this case, the off-axis total e.i.r.p. of the emitted frequency-modulated television carrier shall not exceed the following values:

Off-axis angle	Maximum e.i.r.p.)
$3^\circ \leq \Phi \leq 7^\circ$	$56 - 25 \log \Phi$ dBW
$7^\circ < \Phi \leq 9.2^\circ$	35 dBW
$9.2^\circ < \Phi \leq 48^\circ$	$59 - 25 \log \Phi$ dBW
$48^\circ < \Phi \leq 180^\circ$	17 dBW

- No. 22.29 The e.i.r.p. limits given in Nos. 22.26, 22.27 and 22.28 are applicable in the following frequency bands allocated to the fixed-satellite service (Earth-to-space):

12.75-13.25 GHz

13.75-14 GHz

14-14.5 GHz. (WRC-97)

- No. 22.32 § 10 The level of equivalent isotropically radiated power (e.i.r.p.) density emitted by an earth station in a geostationary-satellite network in the 29.5-30 GHz frequency band shall not exceed the following values for any off-axis angle  $\Phi$  which is  $3^\circ$  or more off the main-lobe axis of an earth station antenna:

Off-axis angle	Maximum e.i.r.p.)
$3^\circ \leq \Phi \leq 7^\circ$	$28 - 25 \log \Phi$ dB (W/40 kHz)

$7^\circ < \Phi \leq 9.2^\circ$	7 dB (W/40 kHz)
$9.2^\circ < \Phi \leq 48^\circ$	$31 - 25 \log \Phi$ dB (W/40 kHz)
$48^\circ < \Phi \leq 180^\circ$	-1 dB (W/40 kHz)

- No. 22.35 For geostationary-satellite systems in which the earth stations are expected to transmit simultaneously in the same 40 kHz band, e.g. for geostationary-satellite systems employing code-division multiple access, the maximum e.i.r.p. values given in No. 22.32 should be decreased by  $10 \log(N)$  dB, where N is the number of earth stations which are in the receive satellite beam of the satellite with which these earth stations are communicating and which are expected to transmit simultaneously on the same frequency. (WRC-2000)
- No. 22.36 Earth stations operating in the frequency band 29.5-30 GHz should be designed in such a manner that 90% of their peak off-axis e.i.r.p. density levels do not exceed the values given in No. 22.32. Further study is needed to determine the off-axis angular range over which these exceedances would be permitted, taking into account the interference level into adjacent satellites. The statistical processing of the off-axis e.i.r.p. density peaks should be carried out using the method given in the most recent version of Recommendation ITU-R S.732. (WRC-07)
- No. 22.37 The limits given in Nos. 22.26 to 22.28 and 22.32 apply under clear-sky conditions. During rain-fade conditions, the limits may be exceeded by earth stations when using uplink power control. (WRC-2000)
- No. 22.38 Earth stations in the fixed-satellite service operating in the 29.5-30 GHz band, which have lower elevation angles to the geostationary-satellite orbit, will require higher e.i.r.p. levels relative to the same terminals at higher elevation angles to achieve the same power flux-densities at the geostationary-satellite orbit, due to the combined effect of increased distance and atmospheric absorption. Earth stations with low elevation angles may exceed the levels given in No. 22.32 by the following amounts:

Elevation angle to geostationary-satellite orbit, $\epsilon$	Increase in e.i.r.p. density (dB)
$\epsilon \leq 5^\circ$	2.5
$5^\circ < \epsilon \leq 30$	$0.1 (25 - \epsilon) + 0.5$



- No. 22.39 The values in No. 22.32 applicable to the off-axis angle range from  $48^\circ$  to  $180^\circ$  are intended to account for spillover effects. (WRC-2000).