

Australian/New Zealand Standard™

## **Siting and operation of radiocommunications facilities**

### **Part 1: General guidelines for fixed, mobile and broadcasting facilities including fixed location satellite earth stations independent of the operating frequency**



## **AS/NZS 5070.1:2008**

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee RC-006, Radiocommunications Equipment—General. It was approved on behalf of the Council of Standards Australia on 26 February 2008 and on behalf of the Council of Standards New Zealand on 7 March 2008.  
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The following are represented on Committee RC-006:

AirServices Australia  
Australian Communications and Media Authority  
Australian Electrical and Electronic Manufacturers Association  
Australian Information Industry Association  
Civil Aviation Safety Authority  
Electromagnetic Technical Evaluation Committee (New Zealand)  
Free TV Australia  
Ministry of Economic Development (New Zealand)  
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## Siting and operation of radiocommunications facilities

### Part 1: General guidelines for fixed, mobile and broadcasting facilities including fixed location satellite earth stations independent of the operating frequency

Originated as AS 3516.1—1988 and part of AS 3516.3—1991.  
Jointly revised and redesignated as AS/NZS 5070.1:2008.

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## PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee RC-006, Radiocommunications Equipment—General, to supersede AS 3516.1—1988, *Siting of radiocommunications facilities*, Part 1: *LF, MF and HF transmitting and HF receiving facilities* and also to incorporate information of a general nature from other parts of the AS 3516 series.

The AS 3516 series will remain available superseded.

The objective of this Standard is to recommend good practice for, and to set out desirable outcomes in the planning, locating, constructing, commissioning, operating and decommissioning of radiocommunications sites. It addresses particularly the sharing of radiocommunications sites and the management of sites to achieve compliance with electromagnetic radiation human exposure limits set by other standards.

This Standard is the first part of a revised set of Standards on the subject of siting and operation of radiocommunications facilities. It deals with items of a general nature common to the siting, installation and operation of radiocommunications facilities independent of application and operating frequency. Committee RC-006 decided to reorganize the subject matter to extract the material common to all parts of the AS 3516 series into this common part so as to avoid repetition and achieve greater consistency.

In developing this part the concept of a Site Technical Manager that was used in AS 3516.2—1988 was discarded as it has been found in practice that this can produce conflicts with contractual arrangements binding on owners and operators of radiocommunication facilities.

At the time this Standard was written there is only one other member of the set, namely:

AS/NZS 5070.2, *Siting of radiocommunications facilities*, Part 2, *Guidelines for siting of radiocommunications facilities: VHF, UHF and SHF*. Other standards may be added to the set in future if the need arises.

Extracts from the material that was in AS 3516.1—1988, *Siting of radiocommunications facilities*, Part 1: *LF, MF and HF Transmitting and HF Receiving facilities*, now appear in this Standard at Appendix J.

Extracts from the material that was in AS 3516.3—1988, *Siting of radiocommunications facilities*, Part 3: *Fixed location satellite earth stations*, now appear in this standard at Appendix K.

Poorly planned, constructed and maintained sites can result in interference problems for users of those sites, particularly as the number of services at such sites increases. Hence, it is in the interest of site users to pay regard to the recommendations of this Standard. The Standard addresses a wide range of factors considered to influence the location of radiocommunications facilities. It also takes into account interaction with other radiocommunications sources, the effect of interference caused to radiocommunications and broadcast reception in the vicinity. It also considers the impact that such facilities might have on the environment and the community.

The Standard is intended to provide information to responsible authorities, site owners, facilities planners, site planners, site personnel, other organizations and members of the public on the effects that existing or planned developments could be expected to have on the operation of such facilities. It is intended to assist relevant authorities and concerned parties when considering the impact that such facilities might have on the community.

The term ‘informative’ has been used in this Standard to define the application of the appendix to which it applies. An ‘informative’ appendix is only for information and guidance.

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## STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

### Australian/New Zealand Standard

### Siting and operation of radiocommunications facilities

Part 1: General guidelines for fixed, mobile and broadcasting facilities including fixed location satellite earth stations independent of the operating frequency

## SECTION 1 SCOPE AND GENERAL

### 1.1 SCOPE

This Standard provides guidance of a general nature for the siting, installation and operation of radiocommunications facilities independent of the operating frequency.

It is intended to assist those responsible for the planning, construction, installation, operation, maintenance and decommissioning of radiocommunications and broadcasting services. It provides information and guidance for organizations and the public, from the viewpoint of the impact on the general public and operational staff, on the siting of radiocommunications and broadcasting facilities. It also provides information on the effects that existing or planned developments in the vicinity of those facilities could be expected to have on the operations of such facilities.

NOTE: Regulatory, planning and environmental authorities and bodies are listed in Appendices A and B. Appendices C and D list organizations involved in the radiocommunications/broadcasting industry. These lists may not be exhaustive. Users of this Standard should consult appropriate directories including the World Wide Web (Australian Government entry point address: <http://www.nla.gov.au/oz/gov/>) for up-to-date listings.

In Australia, telecommunications carriers who intend to install, or who are installing or operating fixed radiocommunications infrastructure used to supply a carriage service, may be required to comply with the Australian Communications Industry Forum (ACIF) Code C564:2002.

### 1.2 APPLICATION

This Standard is intended to apply to original work and subsequent alterations and additions. It is not intended to apply, retrospectively, to existing approved sites, although it contains guidance on how to make improvements or help alleviate problems that could have arisen.

This Standard applies to facilities used for radiocommunications purposes such as:

- (a) Cellular phone base stations.
- (b) Two-way radio base stations.
- (c) Broadcasting stations used for television, FM radio, AM radio and similar services
- (d) Microwave point-to-point stations.
- (e) Microwave point-to-multipoint stations.
- (f) Satellite earth stations.
- (g) Radiolocation stations.

This Standard does not apply to amateur radio, mobile, handheld or domestic radio equipment.

### 1.3 REFERENCED AND RELATED DOCUMENTS

#### 1.3.1 Referenced documents

The following documents are referred to in this Standard:

|                |                                                                                                                   |
|----------------|-------------------------------------------------------------------------------------------------------------------|
| <b>AS</b>      |                                                                                                                   |
| 1170           | Structural design actions                                                                                         |
| 1170.4         | Part 4: Earthquake actions in Australia                                                                           |
| 2209           | Timber—Poles for overhead lines                                                                                   |
| 2772           | Radiofrequency radiation                                                                                          |
| 2772.2         | Part 2: Principles and methods of measurement—300 kHz to 100 GHz                                                  |
| 3600           | Concrete structures                                                                                               |
| 3995           | Design of steel lattice towers and masts                                                                          |
| 4100           | Steel structures                                                                                                  |
| <b>AS/ACIF</b> |                                                                                                                   |
| S009           | Installation requirements for customer cabling (Wiring Rules)                                                     |
| <b>AS/NZS</b>  |                                                                                                                   |
| 1170           | Structural design actions                                                                                         |
| 1170.1         | Part 1: Permanent, imposed and other actions                                                                      |
| 1170.2         | Part 2: Wind actions                                                                                              |
| 1768           | Lightning protection                                                                                              |
| 1801           | Occupational protective helmets                                                                                   |
| 1891           | Industrial fall-arrest systems and devices                                                                        |
| 1891.1         | Part 1: Harnesses and ancillary equipment                                                                         |
| 2210           | Occupational protective footwear                                                                                  |
| 2381           | Electrical equipment for explosive gas atmospheres—Selection, installation and maintenance                        |
| 2381.1         | Part 1: General requirements                                                                                      |
| 3000           | Electrical installations (known as the Australian/New Zealand Wiring Rules)                                       |
| 3009           | Electrical installations—Emergency power supplies in hospitals                                                    |
| 4065           | Concrete utility service poles                                                                                    |
| 4745           | Code of practice for handling combustible dusts                                                                   |
| 60079          | Electrical apparatus for explosive gas atmospheres                                                                |
| 60079.10       | Part 10: Classification of hazardous areas (IEC 60079-10:2002, MOD)                                               |
| 61241          | Electrical apparatus for use in presence of combustible dust                                                      |
| 61241.10       | Part 10: Classification of areas where combustible dusts are or may be present                                    |
| <b>BS</b>      |                                                                                                                   |
| 6656           | Assessment of inadvertent ignition of flammable atmospheres by radio-frequency radiation. Guide                   |
| 6657           | Assessment of inadvertent initiation of bridge wire electro-explosive devices by radio-frequency radiation. Guide |

ACIF C564: 2002 Deployment of radiocommunications infrastructure

ACMA interference handbook and (NZ equivalent by MED: Public Information Brochure 9A (PIB 9A))

ARPANSA RPS3: Maximum Exposure Levels to Radio Frequency fields 3 kHz to 300 GHz

ACMA Radiocommunications (Electromagnetic Radiation—Human Exposure) Standard 2003

ACMA RALI LM8, Frequency assignment requirements for the land mobile service

### **1.3.2 Related documents**

Attention is drawn to the following related documents:

ABA (Australian Broadcasting Authority)

Technical Planning Guidelines Radiocommunications Act 1992

IE Aust Environmental Principles For Engineers

Some examples of engineering practice which may be found useful are as follows:

MPT 1331 Code of Practice For Radio Site Engineering

Motorola Standards and Guidelines for Communication Sites R56 Part No 68P81089E50-A

## **1.4 DEFINITION**

For the purpose of this Standard, the definition below applies.

### **1.4.1 Electromagnetic radiation (EMR)**

The radiofrequency portion of the electromagnetic spectrum. Energy transmissions over the entire spectrum and includes commonly experienced emissions such as visible light, TV transmission and AM and FM radio signals. A number of other terms are commonly used for the whole spectrum which include EME (electromagnetic energy), and EMF (electromagnetic fields) which are often used interchangeably with EMR.

NOTE: It is anticipated that in many cases this Standard will be applied in conjunction with the ACIF Code C564 'Deployment of Radiocommunications Infrastructure' and so to avoid confusion, this definition has been adopted from the ACIF code.

## S E C T I O N 2 M A N A G E M E N T

### 2.1 GENERAL

The establishment and use of a radiocommunications site generally moves through the following phases:

- (a) Planning and design (see Section 3).
- (b) Construction and installation (see Section 4).
- (c) Commissioning (see Section 5).
- (d) Operation and maintenance (see Section 6).
- (e) Decommissioning (see Section 7).

This Standard follows the approach of identifying critical elements of each of these phases, that should be addressed to achieve the desired outcomes. In some cases this is supported by reference to informative appendices.

### 2.2 RESPONSIBILITY

As the establishment and use of the site moves through the phases listed above, responsibility for adherence with this Standard may concern owners, designers, project managers as well as operators of the site.

## SECTION 3 PLANNING AND DESIGN

### 3.1 GENERAL

The siting of a transmitting station requires careful consideration and planning to ensure compliance with all relevant standards and the facility approval processes.

It is important to determine the facility approval process to ensure the relevant authorities and procedures are identified. The planning and design aspects of the transmitting site may be influenced by the formal approval process.

### 3.2 COMMUNITY CONSULTATION

The type and extent of community consultation will depend on the type of facility proposed its location and the requirements of local government in the area. Most radio communications facilities require formal planning approval via the local government planning regime. Some exemptions apply to additions to existing radio communications facilities.

NOTE: In Australia Telecommunications Carriers have particular obligations in this respect as detailed in ACIF C564.

In the planning and design of radiocommunications infrastructure the primary objectives of community consultation are to—

- (a) inform interested and affected parties of the proposed project;
- (b) provide adequate time for affected parties to consider and engage in meaningful dialogue on the project;
- (c) maximize the level of accurate and accessible information about the project to affected communities;
- (d) identify and attempt to resolve potential issues early in the planning process; and
- (e) obtain mutually acceptable outcomes on individual projects.

It is recommended that an appropriate community consultation plan be developed and implemented for all new sites or significant changes to existing sites.

NOTE: Appendix I provides information on community consultation plans

### 3.3 SITE SELECTION CRITERIA

#### 3.3.1 General

The selection of a suitable site for radiocommunications or broadcasting should take into account the prime objective of establishing a communication link between locations, or achieving the target area coverage of the transmitted signal.

#### 3.3.2 Important considerations

Important considerations in the selection of the site include—

- (a) environmental, visual and social impact including compliance with relevant Codes;
- (b) safety, compliance with relevant OHS standards;
- (c) electromagnetic emissions;
- (d) compliance with relevant EMR regulations;
- (e) electromagnetic interference and electromagnetic compatibility;
- (f) availability of capacity at existing sites (site sharing);

- (g) availability of power and other utilities;
- (h) ease of access;
- (i) electrical noise and interference;
- (j) proximity to airports or airfields (see Clause 3.3.3);
- (k) likely urban development; and
- (l) economic viability.

Typically a number of candidate sites will be evaluated against the above considerations.

NOTE: Appendix J provides information of particular concern regarding the siting of LF, MF and HF facilities.

### 3.3.3 Proximity to aerodromes

The proximity to aerodromes should to be considered, as the following may affect site selection:

- (a) Towers and masts which represent a physical hazard to aircraft.
- (b) Interference to aircraft electronic systems from transmitters.
- (c) Interference to ground based electronic systems used for air traffic management from transmitters.
- (d) Interference to receivers on and off aerodromes from aircraft transmitters.

These issues, together with the Australian requirements and appropriate contacts for information, are addressed in Appendix E.

### 3.3.4 Proximity to radio astronomy and sensitive sites

The proximity to radio astronomy sites should be considered, as they may be highly susceptible to interference by unwanted emissions from nearby or even distant spectrum bands.

A summary of major Australian radio astronomy sites and related information is given in Appendix F.

Radio science laboratories and research laboratories often carry out extremely sensitive radio measurements. Operation of radio transmitters close to such sites may seriously impede these research activities. Consideration should be given to early consultation and coordination with such facilities.

### 3.3.5 Proximity to flammable liquids and Gas facilities and combustible dust facilities.

AS/NZS 2381.1 provides useful guidelines and further references to BS 6656 and BS 6657 for assessment of such risks.

In all cases where such risks may be identified it is necessary for assessment to involve the relevant plant operators as ignition risks relate not only to EMR strength and frequency but the design and operations of the at risk plant.

Information on potential hazardous areas can be found in AS/NZS 60079.10, AS/NZS 61241.10 and AS/NZS 4745.

### 3.4 SITE DESIGN EMR ASSESSMENT

An EMR assessment should be performed for all new site proposals and site equipment changes to ensure compliance with the relevant EMR standards which—

- (a) in the case of mathematical modelling (usually in situations where antennas are sufficiently clear of reflective objects), takes into account all transmitters necessary to assess the cumulative EMR levels;

NOTE: This may involve the assessment of radio services from adjacent sites

- (b) identifies the EMR hazard areas; and
- (c) incorporates a safe work procedure.

NOTE: Examples of documentation and procedures used to manage EMR site safety are provided in Appendix H.

### 3.5 ANTENNA MOUNTING DESIGN GUIDELINES—MINIMIZATION OF ACCESSIBLE AREAS CONTAINING EMR HAZARDS

Where possible, antennas should be mounted to eliminate EMR hazards from accessible areas on structures, for example, ladders, platforms and rooftops.

It is recommended that:

- (a) Antennas are mounted so that EMR hazard areas do not significantly intrude into the accessible space within a tower or structure.
- (b) Except for directional antennas, rooftop mounted antennas generally should be mounted so that EMR hazard areas are higher than 2 m above any accessible area including areas that are accessible in adjacent buildings or structures.
- (c) Where EMR hazard areas are accessible, and cannot be eliminated through design, they are to be managed through signage and other controls.

## SECTION 4 CONSTRUCTION AND INSTALLATION

### 4.1 GENERAL

This Section applies to original work on a site and all subsequent alterations and additions thereof.

### 4.2 PROJECT MANAGEMENT PROCESS

Depending on the size and complexity of the facility being constructed, various levels of project management will be required. Consideration should be given to—

- (a) site safety;
- (b) structures;
- (c) provision of utilities;
- (d) installation of electronic equipment; and
- (e) earthing.

### 4.3 SITE SAFETY

#### 4.3.1 Strategic safety plan

Site safety during construction requires the preparation of a strategic safety plan.

#### 4.3.2 Safety risks

The safety plan should identify the safety risks of the project which should be assessed and abated.

#### 4.3.3 Safety plan provisions

The safety plan should make provision for the following:

- (a) The implementation of a site induction program to ensure that—
  - (i) all visitors and contractors are fully informed of the safety risks and procedures; and
  - (ii) the maintenance of a site induction log.
- (b) A site safety notice to be prominently displayed and to include—
  - (i) the name of the safety representatives;
  - (ii) a nominated first aid officer;
  - (iii) required safety equipment;
  - (iv) electromagnetic exposure hazard warning;
  - (v) emergency contact telephone numbers and procedures;
  - (vi) a fire protection containment and evacuation procedure; and
  - (vii) first aid kit locations.
- (c) The provision of suitable fire extinguishers on site and instructions for their correct use.

## 4.4 STRUCTURES

### 4.4.1 Regulatory requirements

In the construction of towers and buildings consideration should be given to any relevant—

- (a) legislation;
- (b) building codes;
- (c) codes of practice; and
- (d) Australian Standards.

### 4.4.2 Engineering provisions

In the constructions of towers and antenna support structures it should be ensured that—

- (a) a system for establishing their orientation relative to true north is established; and
- (b) an installation procedure is provided; and
- (c) an engineering review procedure for any variations is established.

### 4.4.3 Safe working on towers

In carrying out work on towers and support structures the following should be ensured—

- (a) work is carried out only by suitably qualified personnel.
- (b) rigging work is conducted only by persons holding relevant statutory certificates for the work being undertaken and properly equipped as follows:
  - (i) Safety helmets—AS/NZS 1801.
  - (ii) Safety boots—AS/NZS 2210.
  - (iii) Body harness—AS/NZS 1891.1.
  - (iv) Fall-arrest system—AS/NZS 1891.
- (c) suitable precautions are taken when working in adverse weather conditions such as high winds, rain and snow; and
- (d) work is not carried out during electrical storm activity or if heavy icing has occurred.

### 4.4.4 Relevant Australian standards

In the design and assessment of towers and masts it should be ensured that consideration is given to Australian Standards, including but not confined to:

- (a) AS/NZS 1170.1; for dead and live loads and load combinations.
- (b) AS/NZS 1170.2; for wind loads.
- (c) AS 2209; for timber poles.
- (d) AS 3995; for design of steel lattice towers and masts.
- (e) AS/NZS 4065; for concrete poles.
- (f) AS 3600; for concrete structures.
- (g) AS 4100; for steel structures.

NOTE: The timber and concrete poles referred to in AS 2209 and AS/NZS 4065 may also be suitable for communications applications (e.g. mounting of antennas).

#### 4.4.5 Work practices

Good working practice should be followed in the construction of towers and buildings. Where relevant, the following should be ensured:

- (a) Cutting or drilling items with protective coating is not permitted.
- (b) A painting schedule is prepared detailing the exact processes to be used and their timing.
- (c) All antennas, mounting steelwork, feeders and ancillary equipment are securely clamped to protect feeders and other semi-flexible items from damage by vibration.
- (d) Manufacturers' recommended feeder clamp spacings are observed, particularly on exposed areas and transition points, between the tower and antennas, gantries, and similar.
- (e) Feeders are not laid on gantries without clamping.
- (f) Cables are run to take advantage of structural members, where practical, in order to afford protection from falling objects and ice.
- (g) Where cables and antennas are exposed to the danger of falling ice, suitable ice breakers are fitted for protection.
- (h) Particular care is taken in the fitting of cable terminating connectors and earth kits to ensure that feeders remain sealed and are protected against water ingress.
- (i) Non-setting pastes, or self-amalgamating or telco-adhesive tapes, as appropriate, are used in accordance with manufacturers' instructions.
- (j) Particular attention is paid to orientation of cables and connectors to facilitate shedding of surface water.

#### 4.4.6 Site security

In the construction and installation phase site security should be assured by measures such as—

- (a) construction of appropriate fencing prior to major structural works to restrict access to the construction work at all times;
- (b) erection of appropriate warning signs to warn of hazards on the site;
- (c) fitting of anti-climbing devices to structures, to prevent access by unauthorized persons; and
- (d) provision of suitable security alarms, patrols or permanent security staff to enforce site security.

### 4.5 PROVISION OF UTILITIES

#### 4.5.1 Electrical supplies

In providing electrical supplies for the operation of the facilities the following should be ensured:

- (a) Where power is supplied by the local electricity supply authority work conforms to AS/NZS 3000 and with any requirements specific to the local supply authority.
- (b) Work on standby generating plant conforms to AS/NZS 3000 and with local supply authority regulations.
- (c) Care is taken during installation to ensure exhausts are separated from air inlets.
- (d) Anti-vibration mounts are considered for mounting generator sets to reduce noise and vibration levels.

- (e) Installation staff are familiar with emergency plant shutdown, and with the methods provided for fuel and battery isolation.

#### **4.5.2 Water supplies**

In providing water supplies to the site consideration should be given to the supply of adequate water supplies for—

- (a) the treatment of electrolyte burns and dilution of electrolyte spills;
- (b) sanitation; and
- (c) general use.

#### **4.5.3 Communications to the site**

Immediate and reliable outside communication should be available at all times. Where a fixed phone is not installed, cellular telephones, radio telephones or some other form of external communication should be available to persons visiting the site.

#### **4.5.4 Sewerage and drainage**

In providing sewerage and drainage to the site consideration should be given to the following:

- (a) Specifications drawn up in the design phase.
- (b) Local council regulations for the installation of sewerage and drainage systems.
- (c) Provision for regular inspection during the construction and operation of the site.

### **4.6 INSTALLATION OF ELECTRONIC EQUIPMENT AND CABLING**

#### **4.6.1 Electronic equipment considerations**

With the objective of enhancing the long term reliability of radiocommunications on the site, good engineering practice in the installation of electronic equipment should be adhered to. For each item of electronic equipment consideration should be given to—

- (a) ventilation;
- (b) access to any plugs or connections;
- (c) service access;
- (d) ease of adjustment;
- (e) removal from service;
- (f) room for any swing-open panels or doors;
- (g) building environment, vibration, humidity and temperature;
- (h) backup power supply; and
- (i) separation from batteries.

#### **4.6.2 Cabling requirements**

Telecommunications cabling on the site should—

- (a) comply with customer cabling Wiring Rules/AS/ACIF S009; and
- (b) be installed by a registered cabler.

### 4.6.3 Electronic equipment labelling

Electronic equipment on the site should be labelled—

- (a) in accordance with any relevant ACMA determination;
- (b) to indicate its type, owner, spectrum access number, frequency and service company and carrying the words 'Do not remove'.

NOTE: The purpose of such labels is to facilitate the identification of the transmitter and its operating parameters (e.g. frequency), and to provide the name of a contact person. This is particularly useful in relation to interference investigations.

### 4.6.4 Documentation for maintenance purposes

The following documentation should be compiled at the time of installation detailing:

- (a) The physical facilities on the site.
- (b) The layout and interconnection of equipment.
- (c) Details of all items of electronic equipment including licensees and emission where necessary.

This documentation should be made accessible to operations and maintenance staff.

## 4.7 EARTHING

### 4.7.1 Earthing installation practice

With the objective of ensuring the long term reliability of the radiocommunications performance and lightning protection of the site good practice in the installation of the earthing system should be followed. It should be ensured that:

- (a) The design specifications are followed.

NOTE: Careful attention to detail is important in the installation of the site earthing system. Good earthing will improve lightning protection and reduce the likelihood of intermodulation problems due to poor bonding connections. Arrangements will vary considerably from very simple sites to complicated sites with multiple buildings, antenna support structures and associated plant, and may involve integration with existing systems.

- (b) Earth resistance is kept to a minimum and should typically measure less than 10  $\Omega$ .

NOTE: The measured value will depend on soil and rock conditions and moisture content, which may vary considerably.

- (c) The earthing system is made equipotential where possible across the whole site.

NOTE: When the site earth potential is different from the earth potential at the remote end of the power or communication cables, dangerous currents can be generated in earth conductors.

- (d) When the site earth potential is different from the earth potential at the remote end of the power or communication cables, consideration is given to the use of isolation transformers, with appropriate high voltage isolation ratings, or the use of optical fibre cables.

### 4.7.2 Electrical power earthing

The requirements of telecommunications authorities and power distribution authorities should be consulted to ensure their earthing requirements are met.

### 4.7.3 Equipment earthing

All equipment within the site should be bonded to the site earthing system.

#### 4.7.4 Lightning protection devices

Design specifications relating to lightning protection should be followed. In applying these specifications attention should be given to—

- (a) lightning air terminations;
- (b) earth rings;
- (c) sacrificial earth lugs and electrodes;
- (d) copper tape; and
- (e) surge suppressors and arresters.

NOTE: Careful installation of these devices will ensure the best protection is afforded.

#### 4.7.5 Lightning protection installation practice

With the objective of achieving good lightning protection efficiency, particular attention should be used during installation to ensure that—

- (a) the use of dissimilar metals in contact is avoided;
- (b) sacrificial earth lugs are clearly marked;
- (c) sacrificial earth lugs are made easily accessible for periodical inspection and replacement, if necessary;
- (d) non-reactive paste or tapes are used where protection of bonding connections is required;
- (e) all antenna feeders are bonded to the tower at the upper and lower ends (see AS/NZS 1768).