

## Safe Work Practices on Radio Frequency Transmitting Apparatus

### Summary:

This document supports the Power System Safety Rules and its requirements assembled under 'Radio Frequency Transmitting Apparatus' Category 8.

It covers safe work practices on Radio Frequency Transmitting Apparatus to maximise the safety of staff where it is possible for radio frequency electromagnetic radiation exposure levels to occur.

This standard applies to all persons working on Radio Transmitting Apparatus.

Revision No: 3	TRIM No:D2012/08921	Date: 28/02/2017
Business function: Manage Health & Safety	Document type: Work Instruction	
Process owner: Manager Health Safety and Environment		
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When referring to TransGrid's policies, frameworks, procedures or work instructions, please use the latest version on the Wire

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## 1. Overview

### 1.1. Purpose

This document supports the Power System Safety Rules and its requirements assembled under 'Radio Frequency Transmitting Apparatus' Category 8.

### 1.2. Policy Base

Document
Power System Safety Rules

### 1.3. Reference Documents

Document
Australian Communications and Media Authority Human Exposure to Radiofrequency Electromagnetic Radiation Information for licensees of radio communications transmitters OCTOBER 2005
Australian Radiationprotection and Nuclear Safety Authority(ARPANSA) Radiation Protection Standard RPS No3 2002 - Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz
Electric & Magnetic Fields & Radio Frequency Electromagnetic Fields - Policy
Operating Process for Access to LV & MECH Apparatus
Access for Work on LV & MECH Apparatus
Safe Work Practices on LV & MECH Apparatus

### 1.4. Scope

This standard covers safe work practices on Radio Frequency Transmitting Apparatus to maximise the safety of staff where it is possible for radio frequency electromagnetic radiation exposure levels to occur.

### 1.5. Accountability

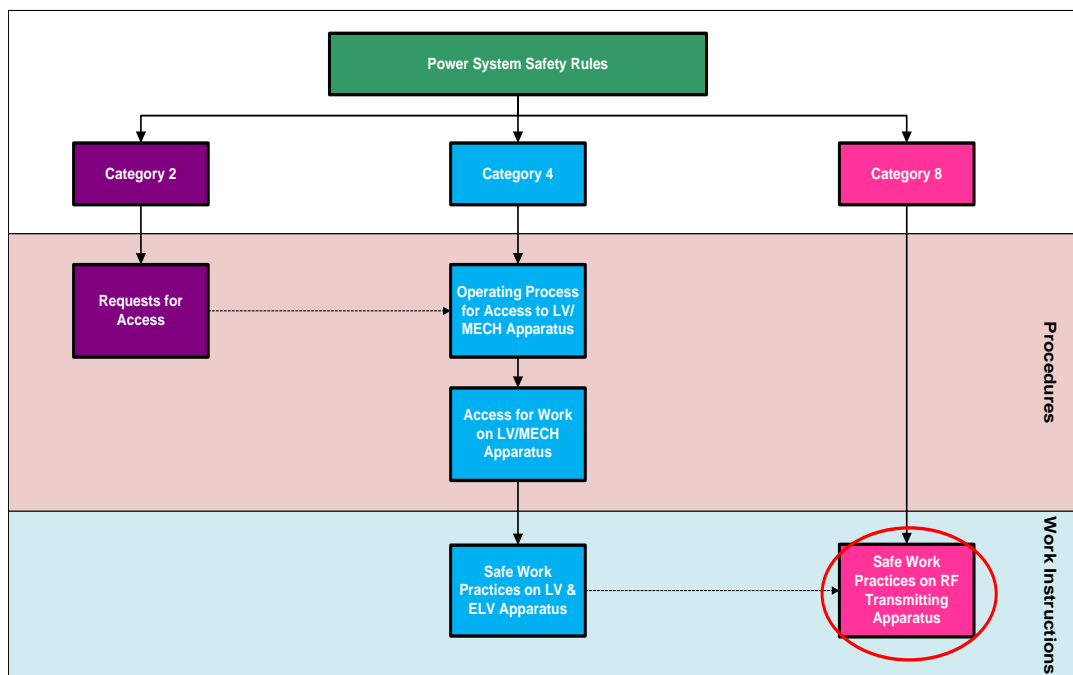
Responsible person	Responsibility
Manager Health Safety and Environment	Maintenance and ownership of this standard
Manager Training	Implementation of training packages associated with this standard
Authorised persons	Comply with this standard

## 1.6. Definitions

<i>ACEBR</i>	Australian Centre for Electromagnetic Bioeffects Research
<i>EME</i>	Electro Magnetic Energy
<i>EMR</i>	Electro Magnetic Radiation
<i>RFNSA</i>	Radiofrequency National Site Archive
<i>RF</i>	Radio Frequency
<i>RTFA</i>	Radio Frequency Transmitting Apparatus
<i>WHS</i>	Work Health Safety

## 1.7. Document Location

Block diagram showing location of document in relation to others.



## 2. Introduction

This standard was developed to assist staff in selecting the correct safe work practices to be used when performing work on or near Radio Frequency Transmitting Apparatus (RFTA). Work may only commence on or near *RFTA* following the implementation of safeguards applicable to the work being undertaken.

The safe work practices contained within this document assist in the protection of staff when working on or near *RFTA*. It sets out hazardous situations, the controls (safeguards) to be implemented and describes the safe work practices which must be observed.

These safe work practices are to be used in conjunction with TransGrid's Work Health Safety (WHS) Risk Management Process. The process may identify that additional controls are required for particular tasks and situations.

## 3. Radio Frequency Electromagnetic Radiation

All *RFTA* generate Radio Frequency (RF) Electromagnetic Radiation (*EMR*) as part of normal operation. The *RF EMR* can be described as waves of electric and magnetic energy emanating from a source in an outwards direction moving through the air. The source is usually the antennae associated with the *RFTA*. *RF EMR* is also found as part of everyday life, emitted by natural sources like the Sun, the Earth and the ionosphere.

*RF EMR* is also emitted by artificial sources such as electrical and electronic equipment, mobile phone base stations, broadcast towers and radar facilities. Sources of *RF EMR* can be either unintentional eg radiated into space from slots, gaps or structures such as leakage from the door of a microwave oven or intentional eg radiated from a telecommunications antenna.

## 4. Radio Frequency Electromagnetic Radiation Hazard

*Injury may result due to heating of biological tissue from exposure to Radio Frequency Radiation greater than the ARPANSA RPS3 Occupational Limits.*

Radio Frequency *EMR* exposure Limits are based on established health effects. There are different physical quantities used to specify the exposure limits depending on the frequency of the RF source. For RF sources typically encountered on TransGrid sites, the appropriate exposure limits are based on the Whole Body Specific Absorption Rate (SAR). Whole Body SAR is the amount of RF energy the body absorbs and is measured in W/kg (Watts per Kilogram). Due to thermal inertia of tissue, a six minute averaging time is appropriate for time averaged SAR assessments. For occupational workers a 10 fold safety factor has been incorporated into SAR values from the levels of the first known biological effect on the body.

Whole Body SAR = Total Power Absorbed in the Body / Total Mass of the Body

<b>Classification</b>	<b>Work Environment</b>	<b>SAR</b>
<i>Occupational (RF Worker)</i>	<i>Restricted Access Zone (Yellow Zone)</i>	<i>0.4W/kg</i>
<i>General Public</i>	<i>General Access (White Zone)</i>	<i>0.08W/kg</i>

The ARPANSA RPS3 Standard - Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz states that the exposure limits for 'occupational' and 'general public' groups are distinguished by their potential level of exposure and are defined by the degree of control and the level of training they have, as distinct from whether or not an exposure is likely to occur in the workplace. Occupational exposure is permitted only after thorough risk analysis has been performed and the appropriate risk management and control regimes are in force. In many cases, members of the general public are unaware of their exposure to

RF fields. These considerations underlie the application of more stringent exposure restrictions for the general public than for the occupationally exposed population.

## 5. Occupational Exposure Control Principles

The following are the TransGrid *RF EMR* hazard control principles;

1. **The Primary Control Principle is to Minimise *RF EMR* exposure and restrict access to *RF EMR* hazard areas.** Where access is required to *RF EMR* hazard areas appropriate arrangements must be made to switch off equipment causing elevated radiation levels.
2. Access zones have been determined for all Radio Frequency Transmitting Antennae and are classified as:
  - Exclusion Zone – Red
  - Exclusion Zone – Yellow (RF Worker)
  - General Access Zone – White

Access zones are described and recorded for each *RFTA* in the site Electro Magnetic Energy (EME) Guide.

3. No person is to enter the Exclusion Zone - Red associated with an active Radio Frequency Transmitting Antenna.
4. Only Radio Frequency Workers may enter Exclusion Zone – Yellow (RF Worker) when a Radio Frequency Transmitting Antenna is active. Allowable exposure levels must not be exceeded.
5. Not break the path between the Radio Frequency Transmitter and the Antenna associated with active Radio Frequency Transmitting Apparatus, unless it is a design condition of the apparatus or required for testing.
6. Access restriction and *RF EMR* signage must be implemented, to warn of the hazards and control access to Radio Frequency Transmitting Apparatus.

## 6. Safe Work Practices for Work on Radio Frequency Transmitting Apparatus

### 6.1. General

- (a) Work on all *RFTA* must be in accordance with this procedure and carried out by a person authorised Category 8 in the Power System Safety Rules or an instructed person.
- (b) All personnel who access a tower, pole or structure supporting Radio Frequency Transmitting Antennae must consult the *EME* Guide to determine any relevant Exclusion Zones.
- (c) The currency of the *EME* Guide can be verified at “[www.RFNSA.com.au](http://www.RFNSA.com.au)”
- (d) If the *EME* Guide is incomplete, not updated or not available use interim safe working procedures and contact your supervisor.
- (e) If safety cannot be maintained discontinue work and contact your supervisor.
- (f) Only TransGrid authorised Radio Frequency Workers may isolate in-service TransGrid *RFTA*.

### 6.2. Work on an Radio Frequency Transmitting Apparatus Required to be Isolated

#### 6.2.1. Prior to Commencing Work

- (a) Consult the *EME* Guide to determine the Exclusion Zones.
- (b) Make inactive and isolate identified *RFTA* before accessing structure.



### 6.2.2. Requirements for Request For Access

- (a) For all work on *RFTA* which requires the *RFTA* in the charge of a controller isolated a Request for Access shall be submitted in accordance with section 2 of the Power System Safety Rules with the required *RFTA* described and with 'Verbal' specified in 'Access Required' column.
- (b) *RFTA* in the charge of a controller includes *RFTA* that supports services required for protection intertrips and supervisory control and monitoring equipment of any description (LCSS, SCADA, EMS etc).
- (c) *RFTA* that is not in the charge of a controller is that apparatus which is not included in the preceding paragraph (b) and includes apparatus such as that required for telephony trunks, VHF/UHF radio and Telecommunications Customers.

### 6.2.3. Isolation/Restoration and Access – *RFTA* in charge of a controller

- (a) The Radio Frequency Worker contacts the controller to advise of the planned removal from service of the *RFTA* as described on the Request for Access.
- (b) The controller will issue the Radio Frequency Worker with a verbal clearance to commence work.
- (c) The Radio Frequency Worker then isolates the *RFTA* and attaches 'Do Not Operate' tag(s) if **no** testing is required during work or attaches 'Warning' Tag(s) if testing **is** required during work.
- (d) Prior to accessing the tower, pole or structure the Radio Frequency Worker must consult the *EME* Guide to determine any relevant Exclusion Zone - Red and Exclusion Zone – Yellow (RF Worker) and confirm the correct *RFTA* is now isolated.
- (e) If, during work, the *RFTA* is required to be made active for testing purposes the Radio Frequency Worker must ensure that all connections have been properly re-instated and that all persons are clear of the Radio Frequency Transmitting Antenna and relevant access zones and that any plant, tools and materials have been, removed unless they are required for testing.
- (f) On completion of work the Radio Frequency Worker is to remove the 'Do Not Operate' or 'Warning' Tag(s) and restore to service the isolated *RFTA*.
- (g) After restoration is complete the Radio Frequency Worker is to advise the controller that work is completed and that the *RFTA* has been returned to service.

### 6.2.4. Isolation/Restoration and Access – *RFTA* not in charge of a controller

- (a) The Radio Frequency Worker isolates the *RFTA* and attaches 'Do Not Operate' tag(s) if no testing is required during work or attaches 'Warning' Tag(s) if testing is required during work.
- (b) Prior to accessing the tower, pole or structure the Radio Frequency Worker must consult the *EME* Guide to determine any relevant Exclusion Zone - Red and Exclusion Zone – Yellow (RF Worker) and confirm the correct *RFTA* is now isolated.
- (c) If, during work, the *RFTA* is required to be made active for testing purposes the Radio Frequency Worker must ensure that all connections have been properly re-instated and that all persons are clear of the Radio Frequency Transmitting Antenna and relevant access zones and that any plant, tools and materials have been removed unless required for the testing.
- (d) On completion of work, the Radio Frequency Worker is to remove the 'Do Not Operate' or 'Warning' Tag(s) and restore to service the isolated *RFTA*.

## 6.3. Work on Active or Inactive *RFTA*

### 6.3.1. Work on Active or Inactive Antenna

Where work requires access to an active or inactive Radio Frequency Transmitting Antenna the Radio Frequency Worker must:

- a) Consult the *EME* Guide to determine the Exclusion Zone - Red and Exclusion Zone – Yellow (RF Worker);
- b) Identify the Radio Frequency Transmitting Antenna;



- c) Take suitable precautions such as having an observer in place and/or wearing a personal RF detector/monitor when entering Exclusion Zone – Yellow (RF Worker); and
- d) Use safe work methods relevant to the work.

### 6.3.2. Work on Active or Inactive Coax, Waveguide, Filter or Coupler

Authorised staff must use safe work methods relevant to the work.

## 7. RFTA Hazards

The following table lists hazards that could be encountered when working on *RFTA* and the controls to be implemented.

Situation	Hazard	Control
Accessing Towers/Poles	<ul style="list-style-type: none"> <li>• Radio Frequency</li> <li>• Personnel Injury</li> <li>• Fall from Height</li> </ul>	<ul style="list-style-type: none"> <li>• Consult <i>EME</i> Guide</li> <li>• Avoid entering prohibited or restricted access zones</li> <li>• Use Personal Monitor/Detector if required</li> <li>• Use hierarchy of control when selecting access method (EWP before PPE harness)</li> <li>• Use correct working at heights and access techniques</li> <li>• Working at heights training</li> </ul>
Work on a Radio Frequency Transmitting Antenna	<ul style="list-style-type: none"> <li>• Exposure to RF radiation</li> <li>• Burns</li> </ul>	<ul style="list-style-type: none"> <li>• Isolate Radio Frequency Transmitting Antenna</li> <li>• Identifying isolated Radio Frequency Transmitting Antenna</li> <li>• Identifying any active Radio Frequency Transmitting Antennae</li> </ul>
Repairing/changing out a dehydrator or wave guide.	<ul style="list-style-type: none"> <li>• Compressed Gases(air)</li> <li>• Injuries due to release of compressed gas</li> </ul>	<ul style="list-style-type: none"> <li>• Isolate equipment before work</li> <li>• Controlled release of pressure</li> <li>• Use PPE (eye protection)</li> </ul>
Electrical storage batteries	<ul style="list-style-type: none"> <li>• Electric shock</li> <li>• Manual handling injuries</li> <li>• Electrolyte burns</li> </ul>	<ul style="list-style-type: none"> <li>• Electrical isolation and testing</li> <li>• Mechanical aids, multiple persons</li> <li>• PPE, gloves, face mask</li> <li>• Eye wash available</li> <li>• Ventilation</li> </ul>

## 8. Radio Frequency Worker

### 8.1. General

Radio Frequency Workers are those staff:

- approved by “Manager Maintenance Programs” to be a TransGrid Radio Frequency Worker
- are authorised under the PSSR for applying ‘Do Not Operate’ and ‘Warning Tags’
- who have been trained and are familiar with;
  - (a) The responsibilities and accountabilities for *RF EMR* safety,
  - (b) Safe work practices and the appropriate controls to manage the potential *RF EMR* hazard,
  - (c) *RF EMR* hazard area signage and access restriction methods and,
  - (d) The *RF EMR* hazard information contained in the *EME* Guide and its application.

### 8.2. Responsibilities of a TransGrid Radio Frequency Worker

All TransGrid Radio Frequency Workers must:

- (a) Read and implement the requirements of entry point warning signs to *RF EMR* areas,
- (b) Be approved to make inactive and isolate TransGrid operational Radio Transmitting Apparatus
- (c) Follow the requirements of this procedure and any relevant work procedures,
- (d) Brief contractors and instructed persons prior to accessing a tower or pole containing *RFTA* of all *RF* hazards associated with any work,
- (e) Not enter the Exclusion Zone – Red when equipment is operational;
- (f) Not break the path between the Radio Frequency Transmitter and the Antenna associated with active *RFTA*, unless it is a design condition of the apparatus or required for testing;
- (g) Not exceed allowable exposure levels when working in Exclusion Zone – Yellow (RF Worker),
- (h) Notify their supervisor if they become pregnant, or have/receive metallic implants or medical devices during the time they are engaged in *RF EMR* work and,
- (i) Notify their supervisor in the event of suspected over-exposure.

### 8.3. Radio Frequency Workers in Other Organisations

Other organisations working on their own *RFTA* will do so under their own rules. A minimum training requirement for workers from other organisations accessing Transgrid's antenna support structures should be the successful completion of an *ACEBR* Accredited *RF* Safety Awareness Course.

Staff from other organisations should not isolate or make inactive operational TransGrid *RFTA* unless special arrangements have been made.

## 9. Records

The administration files of workers who are Authorised Category 8 and occupationally exposed to *RF* fields must be identified and maintained so that retrospective health enquiries can be made. Such files must be retained for the full duration of, and after termination of employment as required by law.

## 10. Access Management

### 10.1. Access Restriction

Access restriction is installed where the General Public exposure limits are exceeded. Access restriction can be installed:

- At ground level (<2m), Secure Barrier 2m high palisade or cyclone wire fence.
- On a structure, Secure Barrier 2m high fence around structure;
  - Locked ladder cage; or
  - Locked pole door
- On a Rooftop (<2m), Secure Barrier
  - Locked rooftop door;
  - Locked rooftop ladder; or
  - Barrier around hazard area

### 10.2. RF Signage

Signage is to be installed to identify the presence of RF *EMR* exceeding the General Public exposure limits, signs will be installed at access boundaries in the following positions:

“**NO ENTRY**” installed on the site/compound access gate

“**RF Hazard Area**” installed on the site/compound access gate and at base of pole/tower/structure

“**Site Information**” installed near the pole/tower/structure or attached to the outside of the building

**Concrete poles, wooden poles and steel towers must not be drilled or have their structural integrity altered when affixing signs. The preferred attachment method is to use stainless steel strapping.**

Typical signs used at TransGrid sites:



**Access Restriction Signage**



**RF Hazard Signage**



**Site Information Signage**

### 10.3. Access Zones

Access zones are divided into three areas for an Active Radio Transmitting Antenna:

- General Access Zone - White **White Zone** Access possible at any time;
- Exclusion Zone – Yellow (RF Worker) **Yellow Zone** Access limited to RF Workers;
- Exclusion Zone – Red **Red Zone** No access when active.

The access zones are specified in the *EME* Guide and must be consulted prior to access.

No person is to enter the Exclusion Zone – Red associated with an active Radio Frequency Transmitting Antenna.

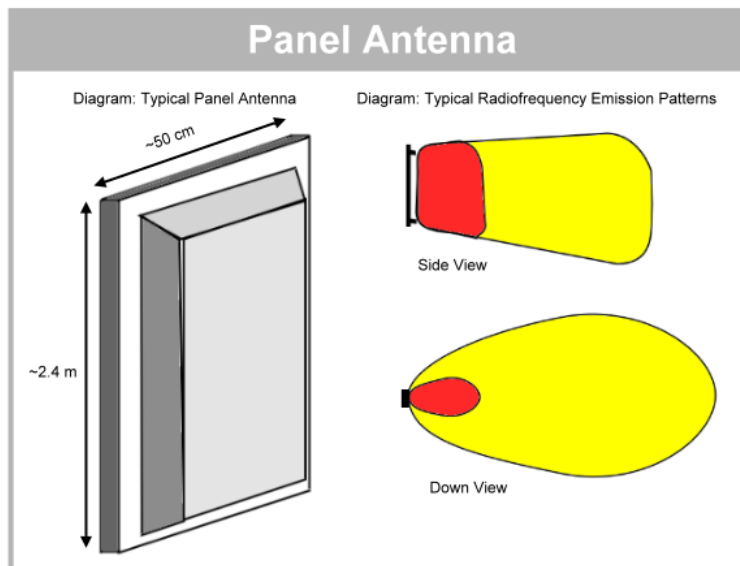
Only Radio Frequency Workers may enter an Exclusion Zone – Yellow (RF Worker) when a Radio Frequency Transmitting Antenna is active. The exposure level within the Exclusion Zone is not to exceed Radio Frequency Worker maximum allowable absorption levels.

In the event the *EME* Guide does not identify an antenna with defined zones then the area in front of a parabolic antenna, or within 2m surrounding other antennas is to be considered an Exclusion Zone – Red and a Personal RF monitor must be used to confirm that the area to be accessed is below the occupational limits. The TransGrid site manager must also be contacted to arrange for the *EME* Guide to be updated.

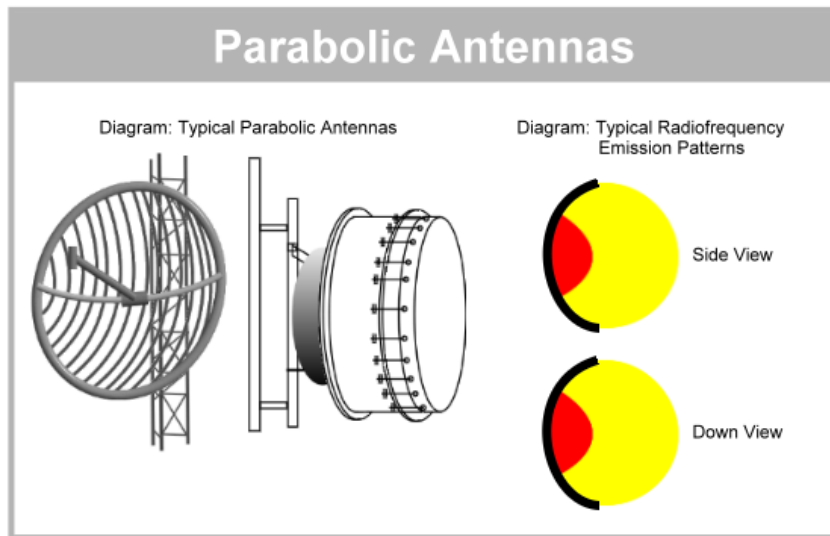
### 10.4. Radio Pattern and Access Zone Drawings

#### 10.4.1. Radiation Emission Patterns from Telecommunications Equipment

Antennas that transmit information emit *RF EMR* (including microwave radiation). Each antenna has a specific emission pattern. The typical emission patterns for panel and parabolic antennas are shown below.

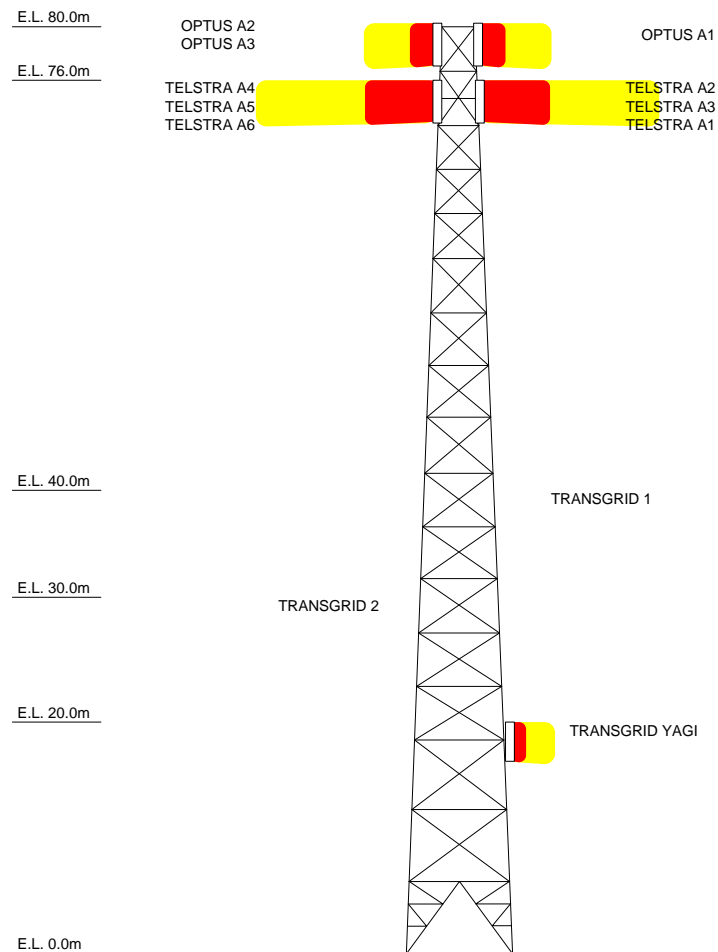


For panel antennas the zone of high field is highly directional, extending forwards from the front of the antenna, almost parallel to the ground. Where these antennas are mounted on high buildings or towers, *RF EMR* levels at ground level and in regions normally accessible to the public are many times below hazard levels

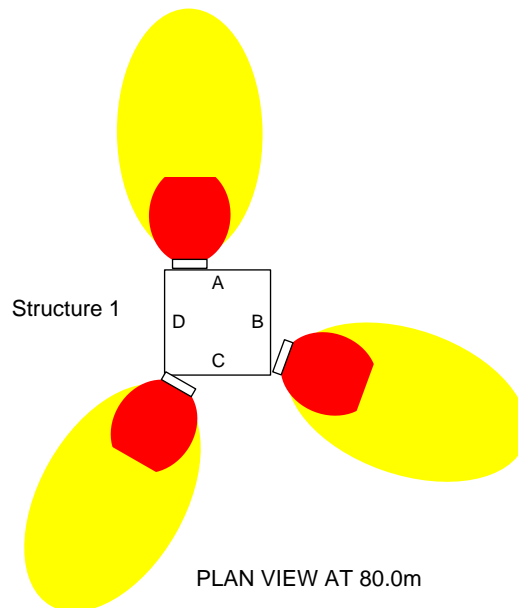


Parabolic antennas send or receive microwave radiation. The area where hazardous amounts of radiation exist is generally limited to within the radius of the dish.

#### 10.4.2. Typical Elevation View



### 10.4.3. Typical Plan View



### 10.5. EME Guide (blue)

The *EME* Guide manages RF hazards at transmitting sites. The guide is coded ‘Blue’ to indicate a full assessment of all radio sources has been undertaken.

*RF* sources not identified in the *EME* Guide should be reported to the Site Manager or Team Leader.

The *EME* Guide may be located:

- as a hardcopy within the radio building
- as a hardcopy on the outside of the building in an all-weather enclosure
- or available electronically from [www. RFNSA.com.au](http://www.RFNSA.com.au)

The *EME* Guide should contain the following information:

- Site *RF EMR* Certificate
- Measurement, Evaluation and Calculation Reports
- Radiation Hazard Drawings
- *RF EMR* Access Zones
- Details of *RF EMR* Hazard Access Area Restrictions and Signage
- Equipment, feeder and antenna list

It should be noted that a hardcopy *EME* guide located at site may not be the most current version, the *RFNSA* website should be checked to verify currency.

### 10.6. Limited EME Guide (yellow)

In certain circumstances a limited *EME* Guide is produced where it has not been possible to fully assess or verify all radio transmitting sources at site. Limited *EME* guides are coded “Yellow”. Allowances need to be made during the risk assessment and access planning stages to account for the limitations of the *RF* information.

## 10.7. Site Management Information

An all-weather sign should be affixed to the building describing site management requirements including:

- Site and after hours contact numbers
- RF NSA site number, site address, *RFNSA* website access details
- Process for suspected RF over exposure

## 10.8. Suspected Over Exposure Management

If a TransGrid employee or contractor suspects that he/she has been overexposed to *RF* the following process must be followed:

1. In the unlikely event that injuries occur seek medical attention
2. Immediately inform your Team Supervisor or Manager
3. Document the specific location(s) accessed on the structure
4. Document the status of all *RF* sources in the access area including Equipment Reference ID
5. Document the time and duration of the suspected exposure
6. Notify your respective Health and Safety section as soon as practicable. (No later than 24 hours)

## 11. Personal *RF* EMR Monitor

### 11.1. General Usage

Only Radman personal *RF* monitors will be used to assess *RF* levels.

- If wearing the Radman on the body as a warning device. It is important to note that measurements can be influenced by the body. The yellow *RF* absorber cap is designed to minimise the body's influence on measurements, therefore always wear the Radman with the absorber cap mounted on top and the clip facing outwards (away from the body).
- If the Radman is handheld, it can be used as a measurement device for initial qualification. Affix the yellow absorber cap on the bottom of the unit, so that you can read "E field" and "H field" text on the Radman sensors.
- The Radman should not be used closer than 100mm to any object;
- The Radman will flash a LED every 10 seconds as a self-test;
- Use a handle or "selfie stick" at frequencies below 120MHz;
- Only when the 100% LED flashes continuously is that area classed as a RED NO-GO area.

### 11.2. Warnings

- The safety of persons within electromagnetic fields must not be based purely on the indicated values from this device (Not to be used without other controls);
- Never hold or place the unit inside field generating equipment or machines. Damage may occur resulting in erroneous operation;
- The unit has a limited frequency range;
- Secondary reflectors may result in local amplification of field strength. E.g. metal fences, poles, towers, guys, etc; and
- Measured values may be underestimated if a body is placed between the radiation source and the detector.



### 11.3. Operation, Inspection and Calibration

- The operation of an *RF* Monitor will be in accordance with manufacturer's instructions.
- The ARPANSA Standard requires that test equipment must be calibrated at intervals as required, in accordance with AS/NZS 2772.2. Section 5. Local procedures will be followed to ensure that instruments are properly tested, calibrated and records are maintained.
- Users of *RF* monitors should also receive appropriate training in the correct use of the Radman to avoid potential false alarms and misinterpretation of results. Correct Radman operation is a topic in any ACEBR approved RF Safety Awareness course.

## 12. Change history

Revision no	Approved by	Amendment
1	Lionel Smyth, EGM/Network Services & Operations	6.6 and 6.8.2 updated to remove ambiguity in access zone definitions
2	Lionel Smyth, EGM/Network Services & Operations	3 improve clarity in description of RF <i>EMR</i> 5 minor editorial changes 6.2 amended to reflect changes to PSSR Rev5.1 for Cat 8
3	Ken McCall Manager Health Safety and Environment	Updated to content following HSE Audit 2016 4 Updated with current industry definitions and expanded text for clarity 5 Removed reference to Attachment A and Site Management Book 6.2.1 Removed reference to Site management Book 8.3 Added reference to training requirements to ACEBR standard 10.3 Added directions on what to do in event EME guide does not identify all antennae 10.5 Expanded content of EME Guide, describing the different types and their content 10.6 Added new section on yellow EME guide 10.7 New section on site management 10.8 Expanded content on steps to take when suspected RF exposure occurs 11 Reworked section on Personal RF Monitors 11.3 Added training requirements for RF monitor usage

### **13. Implementation**

This procedure is to be implemented in conjunction with the implementation of TransGrid's Power System Safety Rules.

For staff previously deemed competent the primary delivery method will be face to face refresher training delivered at team meetings or online learning.

For staff without prior competency, training will be delivered by face to face training in the classroom environment.

Subsequent refresher training may be delivered by face to face delivery, team meetings and email.

### **14. Monitoring and Review**

The Manager Health Safety and Environment is responsible for the ongoing monitoring and review of the documents associated with the Power System Safety Rules. This can include but is not limited to:

- (a) Requesting regular feedback on the effectiveness of procedures and work instructions. Appropriate feedback tools include focus groups and online assessments;
- (b) Where a change has occurred in our processes; and
- (c) Recommendations arising from incidents.