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Radiocommunications Assignment and Licensing Instruction

**COORDINATION
OF APPARATUS LICENSED SERVICES WITHIN
THE AUSTRALIAN RADIO QUIET ZONE
WESTERN AUSTRALIA**

RADIOCOMMUNICATIONS ASSIGNMENT AND LICENSING INSTRUCTIONS

DISCLAIMER

The Australian Communications and Media Authority (ACMA) advises that these instructions reflect the current policies of the ACMA.

Prospective applicants for licences should take all necessary steps to ensure that they have access to appropriate technical and other specialist advice independently of the ACMA concerning their applications, the operation of radiocommunications equipment and services, and any other matters relevant to the operation of transmitters and services under the licences in question.

The policies of the ACMA and the laws of the Commonwealth may change from time to time, and prospective licensees should ensure that they have informed themselves of the current policies of the ACMA and of any relevant legislation (including subordinate instruments). Prospective applicants for licences should not rely on statements made in these instructions about the policies that may be followed by other government authorities or entities, nor about the effect of legislation. These instructions are not a substitute for independent advice (legal or otherwise) tailored to the circumstances of individual applicants.

Radiocommunications Assignment and Licensing Instructions are subject to periodic review and are amended as the ACMA considers necessary. To keep abreast of developments, it is important that users ensure that they are in possession of the latest edition.

No liability is or will be accepted by the Minister or Department for Broadband, Communications and the Digital Economy, the ACMA, the Commonwealth of Australia, or its officers, servants or agents for any loss suffered, whether arising directly or indirectly, due to reliance on the accuracy or contents of these instructions.

Suggestions for improvements to Radiocommunications Assignment and Licensing Instructions may be addressed to The Manager, Spectrum Engineering, ACMA at PO Box 78, Belconnen, ACT, 2616. It would be appreciated if notification to the ACMA of any inaccuracy or ambiguity found be made without delay in order that the matter may be investigated and appropriate action taken.

Amendment History

Date	Comments
September 2007	Initial version covering 100 MHz to 25.25 GHz
December 2014	Incorporated changes to align with RQZ Band Plan and introduce 50 km radius criteria among other changes (see IFC 32/2013 consultation).

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COORDINATION OF APPARATUS-LICENSED SERVICES WITHIN THE AUSTRALIAN RADIO QUIET ZONE WESTERN AUSTRALIA (ARQZWA)

1.0 Introduction/Background

1.1 Background

The radio astronomy service uses extremely sensitive radio receiving systems to detect very weak signals of cosmic origin at much lower power levels than are generally used in other radiocommunications services. It is highly susceptible to interference from emissions by other radiocommunications services. To minimise such interference, radio astronomy antennas and receivers are usually located in geographically remote locations and ideally within radio quiet zones.

1.2 Radio Quiet Zones

Generally, a radio quiet zone is a geographic area within which signal levels from radiocommunications transmitters are controlled in some way to minimise the strength of electromagnetic energy within the area.

Radio quiet zones exist in other parts of the world. For example, the United States of America established the National Radio Quiet Zone (NRQZ) in 1958, to minimise possible harmful interference to the National Radio Astronomy Observatory (NRAO) in Green Bank, West Virginia, and the radio receiving facilities for the United States Navy in Sugar Grove, West Virginia. Rectangular in shape, the NRQZ has an area of approximately 33 000 square kilometres.

Another example is the radio quiet zone around the Arecibo Observatory in Puerto Rico. Licensees in the area must make “reasonable efforts” to protect the Observatory from interference.

1.3 The ARQZWA

The radio quiet zone addressed by this Radiocommunications Assignment and Licensing Instruction (RALI) is the Australian Radio Quiet Zone Western Australia (ARQZWA) and comprises locations described in section 3.0. It provides interference protection for radio astronomy within a region in the Mid West of Western Australia. A site at its centre is being used for the purposes of radio astronomy and is the central core of the Australian component of the geographically distributed Square Kilometre Array (SKA) telescope¹. It is geographically isolated, provides an exceptionally radio-quiet environment and exhibits good ionospheric and tropospheric conditions for radio astronomy.

¹ See <http://www.ska.gov.au> and <http://www.skatelescope.org>

2.0 PURPOSE and SCOPE

2.1 PURPOSE

This RALI is intended to provide a framework for the interference protection of radioastronomy activities sited within 50 km of the centre of the ARQZWA.

The provisions of this RALI need to be considered in conjunction with the *Radiocommunications (Mid-West Radio Quiet Zone) Frequency Band Plan 2011* (RQZ Band Plan).

In particular, this RALI specifies:

- criteria and associated processes for coordination of prospective apparatus licensed radiocommunications transmitters within the ARQZWA with radioastronomy receivers sited within 50 km of the centre of the ARQZWA
- that the consultation required for coordination of prospective apparatus licensed radiocommunications transmitters within the ARQZWA with radioastronomy receivers should, in the first instance, be based on the interference threshold limits and interference determination and minimisation methods described in this RALI.

The geographic area as addressed by this RALI is referred to as the Australian Radio Quiet Zone (Western Australia) – (ARQZWA). It comprises the zones of the RQZ Band Plan and frequency dependent zones extending from 150km to 260km from the centre point of the ARQZWA.

Prospective frequency assignments for transmitters within the ARQZWA need to be analysed to determine whether the use of a planned transmitter at a location would produce signal levels above prescribed receiver thresholds. If the analysis finds that potential signals are above the prescribed thresholds then the prospective licensee must undertake measures such as those described in this RALI (see section 4.5) including those that would reduce the signal level to below the thresholds. For example, transmitter antennas may be modified, alternative transmitter locations may be used to take advantage of terrain shielding or transmitter EIRP may be reduced.

2.2 Scope

A potential frequency assignment falls within the scope of this RALI if -

- the assignment is for an apparatus-licensed transmitter of a coordinated terrestrial service station or earth station; and
- its frequency and geographical location is within the ARQZWA

This RALI does *not* apply to:

- frequency assignments to radiocommunications systems that operate in an itinerant²

² It is intended that these services are characterised by operation while in motion or on a transitory basis and at unspecified locations. It does not include operation that is other than such short-term use, or involves the establishment of radiocommunications facilities at a particular location.

fashion, i.e. systems that have an area wide licence (e.g. Australia-wide or airborne itinerant) and that may operate within the ARQZWA from time to time,

- existing transmitters authorised by apparatus licences,
- unless otherwise annotated in licences, transmitters whose use is authorised by spectrum or class licences within the band 70 MHz to 25.25 GHz,
- frequency assignments of space licences.

3.0 Zones

The ARQZWA comprises both of the following components and characteristics:

1. The *Radiocommunications (Mid-West Radio Quiet Zone) Frequency Band Plan 2011* (RQZ Band Plan) applies to two zones comprising the frequency range 70 MHz to 25.25 GHz and geographical areas specified by the following radii around the geographical coordinates of Latitude 26.704167 South and Longitude 116.658889 East (GDA94 datum):
 - RQZ (inner) – the zone within a radius of 70 kilometres;
 - RQZ (outer) – the zone comprising an annulus of inner radius 70 kilometres and outer radius 150 kilometres.

The RQZ Band Plan provides that a radiocommunications transmitter in the RQZ (inner) zone is taken to be a secondary service in relation to radio astronomy services.

The RQZ Band Plan provides that a potential applicant for a radiocommunications transmitter in its zones must consult with the MRO Entity before the licence application is considered by the ACMA. The purpose of the consultation is to ensure that radio astronomy receivers are protected from harmful interference while maximising the opportunities for other spectrum users to use the spectrum.

2. Zones around the ARQZWA centre described by the radii listed in Table 1 of the Annex to this RALI.

4.0 Procedures

The following outlines procedures and criteria for the coordination of prospective apparatus licensed transmitters with the radioastronomy service in the ARQZWA. It is based on providing interference protection to the radio astronomy service while recognising that parties and the MRO entity may establish co-existence agreements in relation to the operation of transmitters.

Such agreements are relevant considerations for the ACMA when deciding whether to issue an apparatus licence.

The ACMA is aware of the existence of various policy documents agreed between the Commonwealth of Australia and the State of Western Australia regarding Radio Quiet Zone consultation procedures between industry and the MRO entity. These are also relevant

considerations.

In cases where the interference from the proposed transmitter would exceed the threshold levels specified in this RALI the prospective licensee must undertake interference mitigation measures and consult with the MRO entity for the purpose of reaching agreement on resolution of interference protection. Such agreement should be achieved within a timeframe agreed between the prospective licensee and the MRO entity. Documents confirming and describing any agreement, including the impact on radioastronomy of any potential interference, shall accompany frequency assignment applications.

If no agreement can be made then the ACMA will, in deciding whether to issue an apparatus licence, have regard to all matters that it considers relevant and taking into account the requirements of all stakeholders. Documents describing the reasons why agreement was not reached must be forwarded to the Manager, Spectrum Engineering Section, ACMA³.

Contact details for the MRO entity are:

Email: atnf-spectrum@csiro.au

4.1 Interference protection criteria

The first three columns of Table 1 of the Annex describe thresholds and distances that would provide interference protection for the centre of the ARQZWA for typically deployed radiocommunications transmitters.

These thresholds are consistent with internationally agreed requirements for radio astronomy services and derived from criteria specified by the International Telecommunication Union (ITU). In particular, received levels at or below the Threshold levels in the third column of Table 1 would provide adequate protection for radio astronomy receivers at the ARQZWA centre for the corresponding frequency range.

The coordination radii specified in Table 1 are those distances beyond which the ACMA estimates, for typically deployed radiocommunications transmitters (of services to which the bands are allocated in the *Australian Radiofrequency Spectrum Plan*), interference levels would satisfy the protection criteria specified in the third column of Table 1. For frequency bands above 694 MHz, there are Coordination Radii less than the 150 kilometre limit of the RQZ Band Plan. For these cases, while there would otherwise be a requirement to consult with the MRO entity, the ACMA advises that, in consideration of 8(4) of the RQZ Band Plan, consultation with the MRO entity is not required where proposed locations are at distances greater than the Coordination Radii listed in Table 1.

The fourth column of Table 1 of the Annex defines thresholds that would, together with the protection provided to the central point, provide interference protection for array stations outside the centre of the ARQZWA but within 50 km of the centre. The coordination radii of Table 1 apply also to these thresholds; that is, stations within the radii must be assessed against the requirements of the fourth column as well as the third column.

³ Manager, Spectrum Engineering Section, ACMA, PO Box 78 Belconnen ACT 2616.

4.2 Procedures Within the ARQZWA

The RQZ Band Plan requires that applicants proposing assignments within the RQZ consult with the MRO entity and identifies that radiocommunications services located within the RQZ (inner) zone are taken to be secondary services in relation to radio astronomy services.

In addition, within the RQZ (inner) zone, practical distance separations of potential radiocommunications from both the ARQZWA centre and associated array stations are such that unacceptable levels of interference would be caused to radio astronomy. This means that it is unlikely that transmitters could be licensed in this zone. Therefore, while similar interference criteria would apply regardless of the location of the proposed assignment, considering that it is unlikely that radiocommunications assignments in the RQZ (inner) zone would be able to be approved, the following procedures apply only to prospective radiocommunications located outside of the RQZ (inner) zone and within the relevant Coordination Radius included in this RALI (Table 1 of the Annex).

For transmitters covered by the Scope of this RALI (section 2), an assessment of the interference potential, as described in Section 4.4, must be performed.

In addition to the aforementioned requirement included in the RQZ Band Plan for applicants to consult with the MRO entity, if the assessment identifies that the interference signal levels will exceed the Threshold levels specified in column 3 and 4 of Table 1 then:

- unless otherwise decided by the ACMA, an applicant for apparatus licences for those services must consult with the MRO entity and reduce interference levels before applying for licences;
- unless otherwise decided by the ACMA, an applicant intending to vary apparatus licences for services must consult with the MRO entity about the variation to those services before applying to vary those licences;
- reasonable measures (examples provided below) shall be taken by the applicant to reduce the expected signal levels to below the Thresholds. In cases where the potential signal levels (as calculated by the methods prescribed in this RALI) cannot be reduced below the Thresholds, the application may still be considered by the ACMA. If a mutually satisfactory technical agreement has been reached with the MRO entity, this will be a relevant factor for the ACMA in its decision making;

The ACMA will have regard to advice and technical information, including the impact on radioastronomy of any potential interference, resulting from consultation between licence applicants and the MRO entity in deciding whether to issue apparatus licences for radiocommunications services and in relation to any conditions that may be applied to licences.

Note that below 694 MHz the ARQZWA includes locations outside of the RQZ Band Plan zones. Considering the interference potential associated with those locations, and consistent with the procedures of the previous version of this RALI, interference assessments, as outlined above, continue to be required.

Also note that the interference protection criteria of Table 1 addresses the SKA Phase 1 array station deployment within 50 kilometres of the ARQZWA centre. It is intended that radio astronomy capability will be expanded beyond this initial stage and that consequential interference protection for future deployment beyond 50 kilometres will be considered in the future, most likely through a later version of this RALI.

4.3 Procedures Outside the Coordination Radius

If the proposed frequency assignment is in accordance with the parameters of ACMA radiocommunications service models⁴ and is beyond the relevant Coordination Radius of Table 1, then the ACMA would accept that interference protection requirements for the ARQZWA have been satisfied and that consultation with the MRO entity is not required.

Coordination requirements for proposed frequency assignments at locations inside of any supplementary RQZ required for the SKA Phase 2 are yet to be developed.

4.4 Assessment

Methods for the assessment of interference are described in the Annex. The necessary potential interference assessments concern estimated levels of interference from prospective radiocommunications to the centre of the ARQZWA and to the area within 50 km of the centre. The latter is intended to support establishment of array stations at any location within this area and considers the propagation of interference from transmitters located outside of the RQZ (inner) zone into this area.

4.5 Mitigation and Other Measures

Measures such as power reduction, site relocation, advantageous use of antenna directivity and pattern notches are available to reduce the signal in the direction of radio astronomy receivers. Antennas may be designed or modified to reduce interference to radioastronomy. Selection of frequencies already in use within or adjacent the ARQZWA would potentially minimise any additional impact of interference to the radio astronomy service.

It may also be feasible for prospective radiocommunications users to use alternative communications carriage mechanisms, such as optical fibre.

Operational agreements may also be negotiated between the MRO entity and the applicant. For example, a licensee that requires only occasional use of a system may negotiate a procedure whereby the MRO entity is informed in advance of any use of the system.

4.6 Licence applications and documentation

Documents confirming and describing any mutually agreed technical solution shall accompany applications for apparatus licences for radiocommunications services.

The ACMA will decide whether, and under what conditions, to issue apparatus licences based on information provided with applications. In this respect, section 100(4) of the *Radiocommunications Act 1992* requires that, in deciding whether to issue apparatus licences,

⁴ The ACMA models in this case are those specified in RALIs. The majority are in RALIs LM 8 and FX 3.

the ACMA must have regard to all matters that it considers relevant, including the impact on radioastronomy of any potential interference. Relevant matters include confirmation and description of mutually agreed technical solutions between applicants and the MRO entity or, where agreement cannot be reached, the basis of the disagreement, measures taken to resolve the disagreement and any matters that are agreed.

4.7 Licence Renewal procedure

Licences granted under a licence agreement between the MRO and a third party will be considered for renewal consistent with the obligations under the *Radiocommunications Act 1992* and the ACMA's apparatus licence renewal policy⁵. Any agreements reached will not be required to be renegotiated at the time of licence renewal, unless stated in the agreement or if the licence agreement has a limited time period.

In addition, any future changes to RALI MS 32 will not count as a reason for the ACMA to depart from the standard renewal practice (as outlined under 'special cases' in the ACMA's apparatus licence renewal policy), nor will they result in a requirement to renew existing licence agreements between a third party and the MRO.

For licences to be renewed as described above, the parameters of transmitters operating under existing apparatus licences shall not be modified in a way such that their potential to cause interference would increase.

5.0 Exceptions

Exceptions to the requirements of this RALI for prospective assignments require case-by-case consideration by the Manager, Spectrum Engineering Section⁶.

A request for exemption from the requirements of this RALI would need to be accompanied by evidence of MRO entity support.

6.0 RALI Authorisation

[signed – 19/12/2014]

Mark Arkell

Manager
Spectrum Engineering Section
Spectrum Planning and Engineering Branch
Australian Communications and Media Authority

⁵ *Policy on apparatus licence tenure, ACMA 2011*,
http://www.acma.gov.au/webwr/_assets/main/lib312068/apparatus_licence_tenure_policy.doc

⁶ *Manager, Spectrum Engineering Section, ACMA, PO Box 78 Belconnen ACT 2616.*

Glossary

ARQZWA	Australian Radio Quiet Zone (Western Australia)
EIRP	Equivalent Isotropically Radiated Power
MRO	Murchison Radioastronomy Observatory
MRO entity	the entity responsible for operating the MRO
NRQZ	National Radio Quiet Zone - United States of America
RALI	Radiocommunications Assignment and Licensing Instruction
RQZ Band Plan	<i>Radiocommunications (Mid-West Radio Quiet Zone) Frequency Band Plan 2011</i>
SKA	Square Kilometre Array
Supplementary RQZ	a radio quiet zone as described in the RQZ Band Plan

ANNEX

Interference assessment methods

Centre threshold assessment

For interference to the ARQZWA centre, assessment is based on the following method of determining the signal level from the proposed transmitter:

$$\text{Tx PSD}_{(\text{dBm/Hz})} - \text{PPL} - 3.9 \leq \text{Threshold at ARQZWA centre}$$

Where:

$\text{Tx PSD}_{(\text{dBm/Hz})}$ = Transmitter power spectral density (dBm/Hz)⁷

PPL = Propagation Path Loss (dB)

Threshold at ARQZWA centre (dBm/Hz): as given in third column of Table 1.

Transmitter power spectral density ($\text{Tx PSD}_{(\text{dBm/Hz})}$) in the direction of the centre of the ARQZWA is determined by:

$$\text{Tx PSD}_{(\text{dBm/Hz})} = \text{Tx}_{(\text{dBm})} - 10\log(\text{BW}_{(\text{Hz})}) + \text{G}_{(\text{dBi})}$$

Where:

$\text{BW}_{(\text{Hz})}$ = Channel bandwidth (Hz)

$\text{G}_{(\text{dBi})}$ = Antenna Gain (dBi) towards the centre of the ARQZWA

$\text{Tx}_{(\text{dBm})}$ = Transmitter Power (dBm) into the antenna (peak for pulsed transmitters)

Propagation Path Loss is determined as follows (a “K factor” of 4/3 is assumed⁸):

- For cases where the path is unobstructed:

$$\text{PPL} = \text{Free Space Loss} + 10 \text{ dB}$$

- For cases where the path is obstructed, PPL is determined by use of the method described in section 4.5 (Method for a general terrestrial path) of Recommendation ITU-R P.526-12. Other methods for determining the propagation path loss may also be used with agreement of the MRO entity.
- A 9 second digital elevation model (such as the *GEODATA 9 Second Digital Elevation Model (DEM-9S)*, available from www.ga.gov.au) or better should be used. An antenna height of 15 metres (for frequencies greater than or equal to 300 MHz) or 1 metre (for frequencies below 300 MHz) shall be assumed for radio astronomy facilities within the ARQZWA.

⁷ A relatively uniform emission level is assumed. For less uniform emissions (e.g. analogue television signal) refer to the MRO entity for advice.

⁸ The ratio of the effective Earth radius to the actual Earth radius.

Area threshold assessment

Assessment of potential interference to array stations beyond the ARQZWA centre involves calculation of interference power levels within 50 kilometres of the centre and comparison with the “Maximum allowable power level within 50 kilometres” criteria in Table 1. The following method should be used:

$$T_{X(dBm)} + G_{(dBi)} - PPL - 3.9 \leq \text{Maximum allowable power level}$$

Where:

$T_{X(dBm)}$ = Transmitter Power (dBm) into the antenna (peak for pulsed transmitters)

$G_{(dBi)}$ = Antenna Gain (dBi) towards the point under evaluation

PPL = Propagation Path Loss (dB)

Maximum allowable power level (dBm): as given in the last column of Table 1.

The same propagation loss methods, as described above, may be used in this calculation if assessors have the capability to calculate propagation loss between the transmitter and points distributed over the area within 50 km of the ARQZWA centre. Other propagation prediction methods may be used if agreed by the MRO entity.

Alternatively, an initial estimate may be obtained by calculation of the received level at the *nearest point* on the boundary of the area within 50 km of the ARQZWA centre using the Smooth Earth propagation model with appropriate adjustment factors as given below. This model is described in section 3 (Diffraction over a spherical Earth) of Recommendation ITU-R P.526-12.

If the Smooth Earth propagation model is used, then the propagation path loss is given by

$$PPL = L_{smooth} - 30 \text{ dB} \quad \text{for } f \leq 300 \text{ MHz}$$

$$PPL = L_{smooth} - 10 \text{ dB} \quad \text{for } f > 300 \text{ MHz}$$

Note that assessment at the boundary of the area within 50 km of the ARQZWA centre may be used as an indicator of potential compatibility. More rigorous assessment to validate compatibility would need to be undertaken as part of the MRO consultation process.

If the calculated value at any point within 50 km of the ARQZWA centre exceeds the relevant Threshold value then mitigation measures of section 4.5, or other relevant measures, are necessary.

Coordination zone parameters

Frequency Range (MHz)⁹	Coordination Radius (km)	Threshold at ARQZWA centre (dBm/Hz)	Maximum allowable power level within 50 kilometres (dBm)
70-100	260	-211	-90
100-230	260	-214	-90
230-400	180	-222	-95
400-520	165	-224	-95
520-694	190	-224	-95
694-1000	145	-228	-95
1000-2300	140	-230	-95
2300-6000	120	-232	-95
6000-10000	100	-232	-95
10000-25250	100	-236	-95

Table 1: Coordination Zone Parameters (centre latitude 26.704167 South and longitude 116.658889 East (GDA94 datum)).

⁹ Lower limit exclusive, upper limit inclusive.